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Assessment of Effectiveness of Geologic Isolation Systems

REFERENCE SITE INITIAL ASSESSMENT FOR A SALT DOME REPOSITORY

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June 1982

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PREFACE

The Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program presents in this report a methodology demonstration applied as an initial assessment of a reference site for a salt dome nuclear waste repository. The information in this document is designed to support the Preliminary Information Report (PIR) being assembled by the Office of Nuclear Waste Isolation (ONWI).

This report presents an exercise of the AEGIS methodology, as applied to a hypothetical repository located in a reference salt dome site; it is not an actual site assessment. The salt dome referred to in this documentation has been excluded from consideration as a repository for nuclear waste.

ACKNOWLEDGMENTS

This research was supported by the Waste Isolation Safety Assessment Program (WISAP) conducted by Pacific Northwest Laboratory (PNL). The program was sponsored by the Office of Nuclear Waste Isolation (ONWI), which is managed by Battelle Memorial Institute under contract DE-AC06-76RLO 1830 with the Department of Energy. On 1 October 1979, WISAP became the Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program and the Waste/Rock Interaction Technology (WRIT) Program. This report is issued by AEGIS.

The following are the lead authors (and their contributions) of this report: M. A. Harwell and A. Brandstetter, coordination and integration; G. L. Benson, scenario analyses and external coordination; J. R. Raymond, consequence analysis; D. J. Bradley, leach rate data; R. J. Serne, sorption data; J. K. Soldat, dose analyses. The other authors are listed alphabetically: C. R. Cole, transport modeling; W. J. Deutsch, solubility limits; S. K. Gupta, near-dome simulations; C. C. Harwell, human intrusion and report coordination; B. A. Napier, dose calculations; A. E. Reisenauer regional hydrologic simulations; L. S. Prater, scenario development and report coordination; C. S. Simmons, radionuclide transport modeling; D. L. Strenge, dose calculations; J. F. Washburn, transport modeling; and J. T. Zellmer, scenario methodology.

In addition to the authors, contributions from other AEGIS and WRIT staff at PNL were made by the following individuals: L. L. Ames, C. O. Harvey, D. D. Hostetler, F. E. Kaszeta, Y. B. Katayama, J. W. Lindberg, W. J. Martin, R. W. Nelson, C. A. Newbill, G. M. Petrie, W. M. Phillips, J. F. Relyea, D. J. Silviera, J. A. Stottlemyre, R. P. Turcotte, R. W. Wallace, C. D. Washburne, K. M. Wilson, and J. T. Zuck. Contributions from the Los Alamos Scientific Laboratory (LASL) staff were headed by B. R. Erdal.

The AEGIS staff wish to acknowledge the invaluable support provided by the Water and Land Resources Department Word Processing staff, especially D. A. Berg and B. E. Roberts.

This effort could not have been completed without the cooperation and assistance of the Law Engineering Testing Company, the NUS Corporation, and the Texas Bureau of Economic Geology. Finally, we wish to acknowledge the external reviewers who provided valuable feedback based on the working document of this report. Many of their comments and suggestions have been incorporated into this revised report and into the ongoing technology development of the AEGIS and WRIT programs.

Revisions two, three and four of the working draft of PNL-2955 were completed with M.A. Harwell retained as an AEGIS consultant under contract B-93866-A-U. Completion dates for the working draft revisions were as follows:

Working Draft:
31 August 1979
Revision 1: December 1979
Revision 2: January 1981
Revision 3: August 1981
Revision 4: March 1982

EXECUTIVE SUMMARY

As a methodology demonstration for the Office of Nuclear Waste Isolation (ONWI), the Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program conducted an initial reference site analysis of the long-term effectiveness of a salt dome repository. The Hainesville Salt Dome in Texas was chosen to be representative of the Gulf Coast interior salt domes; however, the Hainesville Site has been eliminated as a possible nuclear waste repository site. The data used for this exercise are not adequate for an actual assessment, nor have all the parametric analyses been made that would adequately characterize the response of the geosystem surrounding the repository. Additionally, because this was the first exercise of the complete AEGIS and WASTE Rock Interaction Technology (WRIT) methodology, this report provides the initial opportunity for the methodology, specifically applied to a site, to be reviewed by the community outside the AEGIS.

The scenario evaluation, as a part of the methodology demonstration, involved consideration of a large variety of potentially disruptive phenomena, which alone or in concert could lead to a breach in a salt dome repository and to a subsequent transport of the radionuclides to the environment. Without waste- and repository-induced effects, no plausible natural geologic events or processes which would compromise the repository integrity could be envisioned over the one-million-year time frame after closure. Near-field (waste- and repository-induced) effects were excluded from consideration in this analysis, but they can be added in future analyses when that methodology development is more complete.

The potential for consequential human intrusion into salt domes within a million-year time frame led to the consideration of a solution mining intrusion scenario. The AEGIS staff developed a specific human intrusion scenario at 100 years and 1000 years post-closure, which is one of a whole suite of possible scenarios. This scenario resulted in the delivery of radionuclide-contaminated brine to the surface, where a portion was diverted to culinary salt for direct ingestion by the existing population. Consequence analyses indicated calculated human doses that would be highly deleterious. Additional

analyses indicated that doses well above background would occur from such a scenario, even if it occurred a million years into the future. The way to preclude such an intrusion is for continued control over the repository site, either through direct institutional control or through the effective passive transfer of information.

A secondary aspect of the specific human intrusion scenario involved a breach through the side of the salt dome, through which radionuclides migrated via the ground-water system to the accessible environment. This provided a demonstration of the geotransport methodology that AEGIS can use in actual site evaluations, as well as the WRIT program's capabilities with respect to defining the source term and retardation rates of the radionuclides in the repository.

This reference site analysis was initially published as a Working Document in December 1979. That version was distributed for a formal peer review by individuals and organizations not involved in its development. The present report represents a revision, based in part on the responses received from the external reviewers. Summaries of the comments from the reviewers and responses to these comments by the AEGIS staff are presented.

The exercise of the AEGIS methodology was successful in demonstrating the methodology, and thus, in providing a basis for substantive peer review, in terms of further development of the AEGIS site-applications capability and in terms of providing insight into the potential for consequential human intrusion into a salt dome repository.

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CHAPTER 1

OVERVIEW

The Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) is developing and applying the methodology for assessing the post-closure safety of deep geologic nuclear waste repositories. During FY-1979 the predecessor to AEGIS, the Waste Isolation Safety Assessment Program (WISAP), was divided into four tasks, two associated with data development and two directed toward simulation of the repository hydrologic and geologic system. These tasks were designed to interact concurrently, so that a systematic methodology/data system would emerge (Figure 1.1). Beginning 1 October 1979, WISAP was divided into the AEGIS and Waste/Rock Interaction Technology (WRIT) programs. AEGIS is essentially a continuation of Tasks 1 and 3 of WISAP (Figure 1.1), and WRIT is essentially a continuation of Tasks 2 and 4 of WISAP.

Since its inception, WISAP worked toward the development of methodology for assessing the far-field aspect of the repository/geologic system. WISAP did not develop the methodology to include the repository- and waste-induced effects on the system nor to inspect the processes internal to the confines of the repository. These aspects are being considered in other DOE programs and will ultimately be integrated with the AEGIS methodology. Further, WISAP originated as a methodology development effort, with site applications scheduled for subsequent years. In practice, WISAP began the transition to a site-applications orientation at the end of FY-1978. This initial effort involved the exercise of the geotransport models based on site data and scenarios that were provided to WISAP and that were associated with the Paradox Basin (Raymond et al. 1980).

During FY-1979 AEGIS performed one site-applied exercise of the total AEGIS and WRIT methodology. That exercise is the subject of this AEGIS report, representing the first time the full AEGIS and WRIT expertise has been focused on a single problem. This was the initial effort by DOE to indicate what it believes is necessary for a preliminary site license application, and was

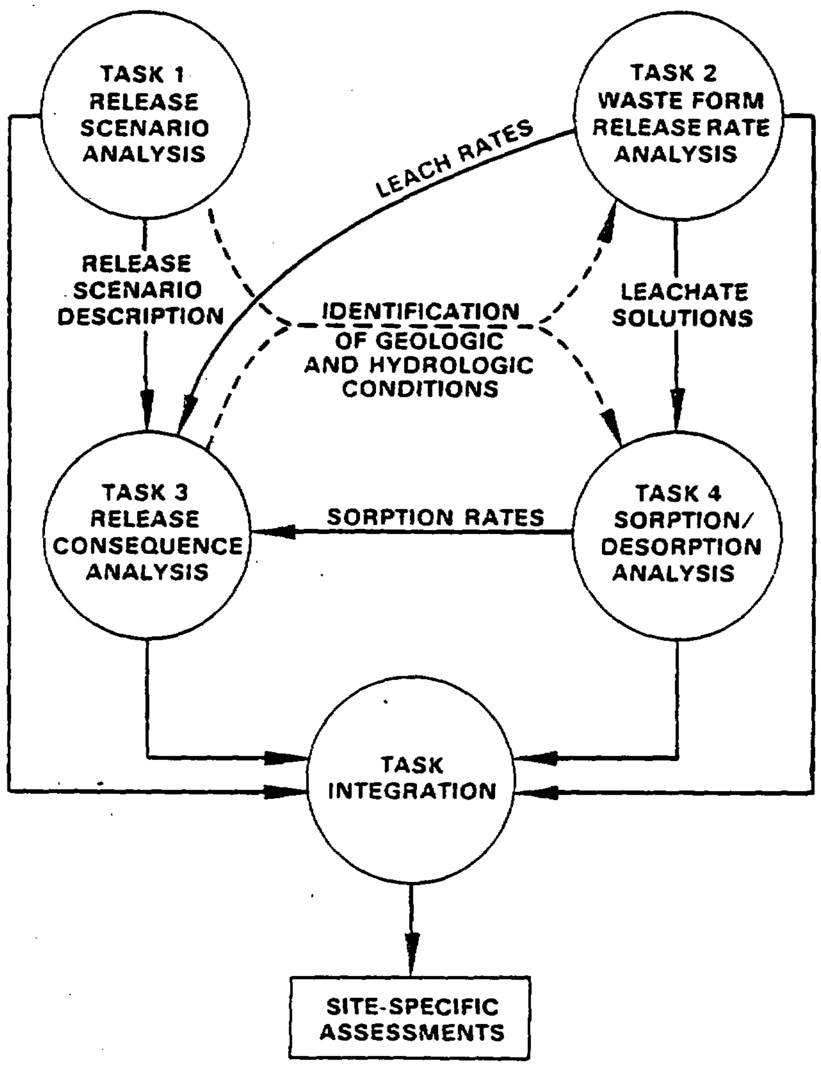


FIGURE 1.1. WISAP* Task Interrelationships

* Note: The left half of this diagram now is in the AEGIS program, and the right half is in the WRIT program.

collated by ONWI into the Preliminary Information Report (PIR). The PIR was designed to be analogous to a Preliminary Safety Analysis Report (PSAR) for a repository to be built in an Interior Gulf Coast salt dome. The site chosen for this PIR analysis, however, would not be considered for an actual potential nuclear waste repository, largely because of past human activities that have affected the integrity of the salt dome.

One of the important concerns of a PSAR or PIR is the post-closure safety of the repository. AEGIS efforts, then, were to exercise its methodology and simultaneously provide the base for the post-closure safety chapter of the PIR being prepared by other ONWI contractors.

This methodology exercise has been performed within the context of certain key assumptions, including:

- The presence of engineered barriers was not considered in order to provide a baseline for subsequent evaluations of the effectivness of engineered barriers.
- Waste- and repository-induced effects were not explicitly considered in this study, as these were outside the scope of the programs at the time of the analyses.
- In the development of the human intrusion scenario, assumptions concerning the effect of future human activities were based on the currently available draft EPA standards on nuclear waste management. Institutional controls were not assumed to be effective beyond 100 years post-closure, and no reliance was placed on active or passive controls preventing intrusion after that time.
- In quantifying the solution mining operation, only the physical limits of the system itself were relied upon; no specific level of technology nor specific technique of mining was assumed (except that a minimum level of mining capability was implicit). In addition, no specific monitoring of the brine for radioactivity was assumed.

More detailed discussion of the assumptions used is included throughout the text of Volume 1 of this report, and a compiled list of assumptions is provided in Chapter 3.

Again, this was an exercise of the AEGIS and WRIT methodology and an evaluation of a hypothetical repository in a reference salt dome, not an actual site assessment. The data used for this exercise are not adequate for an actual site assessment, nor have all the parametric analyses been made that would adequately characterize the response of the geologic system surrounding the repository. As this was the first exercise of the complete AEGIS and WRIT methodology, this report provided the initial opportunity for the AEGIS methodology, specifically applied to a site, to be reviewed by the community outside of AEGIS and WRIT. This review has resulted in some changes in this document and has provided significant guidance for future AEGIS and WRIT activities. Representative comments and AEGIS responses to the reviewers' comments are presented in Chapter 12. Continued review will assist in improving the methodology. Finally, this exercise was a substantial learning experience for the AEGIS team.

SALT DOME REFERENCE SITE

This reference site initial assessment is based upon the Hainesville Salt Dome, which is not being considered for a nuclear waste repository. This salt dome is located in the central part of Wood County in East Texas (Figure 1.2), with the regional surface sloping generally from northwest to southeast. The Hainesville Salt Dome is one of 26 salt domes in the East Texas Salt Dome basin. Within 200 miles of Hainesville are four cities with a population of over 100,000: Dallas, Fort Worth, Shreveport, and Waco.

Geology

The sediments of the East Texas Salt Dome basin record a series of marine transgressions and regressions, superimposed on a progradational depositional basin. The basin contains a very thick formation of Louann salt, and most of the local structures in the basin are probably related to movements of salt from the Louann.

The Hainesville Salt Dome is the northernmost shallow piercement salt dome in the basin. Its site area consists of approximately 542 square miles of rolling hill topography. Within this area the data used to characterize the salt dome include 11 wells penetrating the salt, one seismic reflection line, a basin gravity survey, and a number of wells in the vicinity of the salt dome.

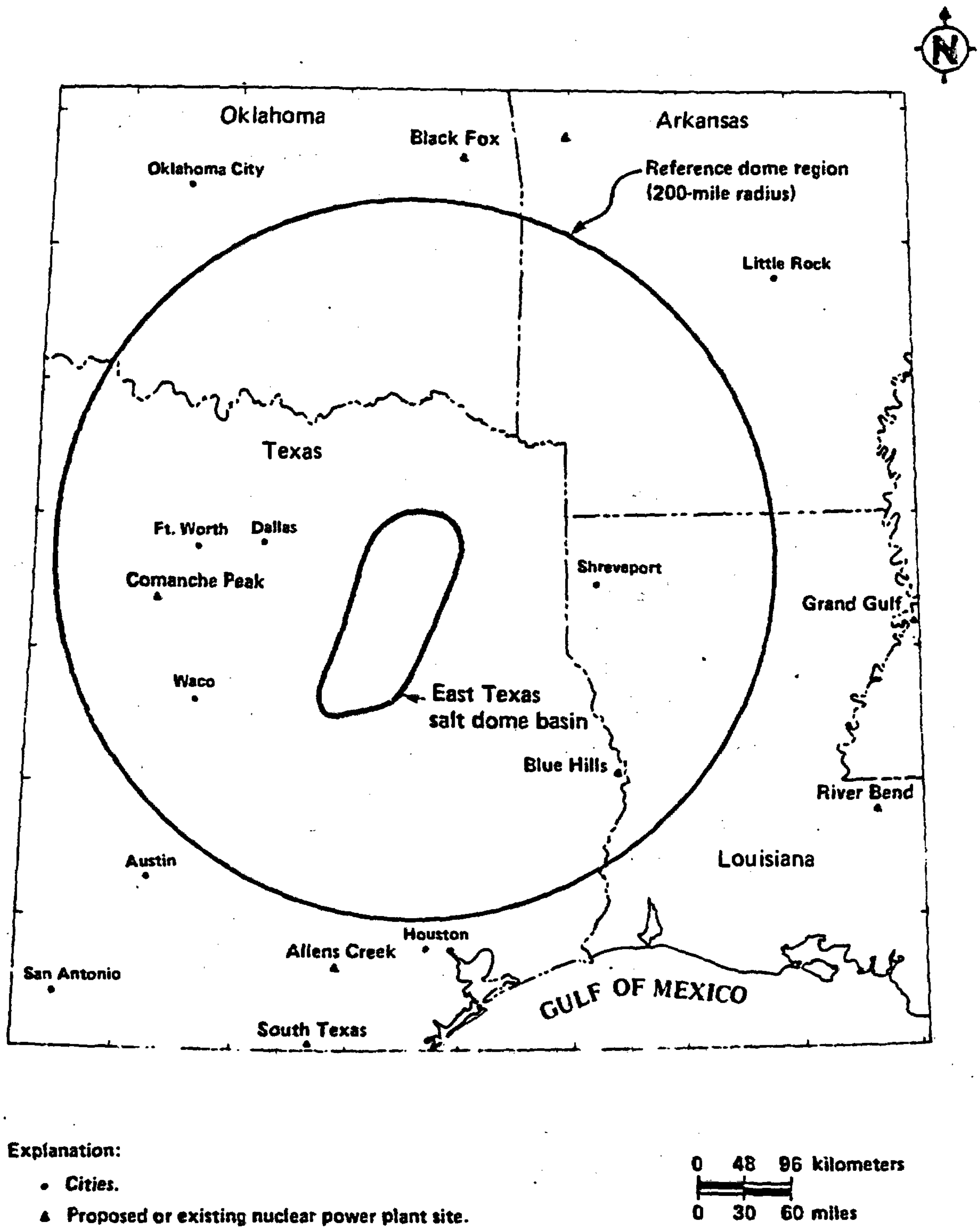


FIGURE 1.2. Regional Location Map

Source: Law Engineering Testing Company 1979b

The salt dome pierces 16,000 ft of strata, ranging from Late Jurassic to Early Tertiary in age (Figure 1.3). Caprock is believed to cover the top of the salt dome, with thickness ranging from 50 ft to more than 250 ft. This caprock is composed of a top zone of disseminated pyrite in carbonate, a middle zone of gray shaley carbonate, and a lower zone of clear, very dense anhydrite. The salt dome itself is made of halite, with some evidence of shale inclusions on the periphery of the salt dome. At the repository depth, the salt dome is assumed to be approximately 2100 acres in cross-sectional area. Of this area, the repository would occupy about 1370 acres surrounded by an 800 ft buffer zone (Figure 1.4).

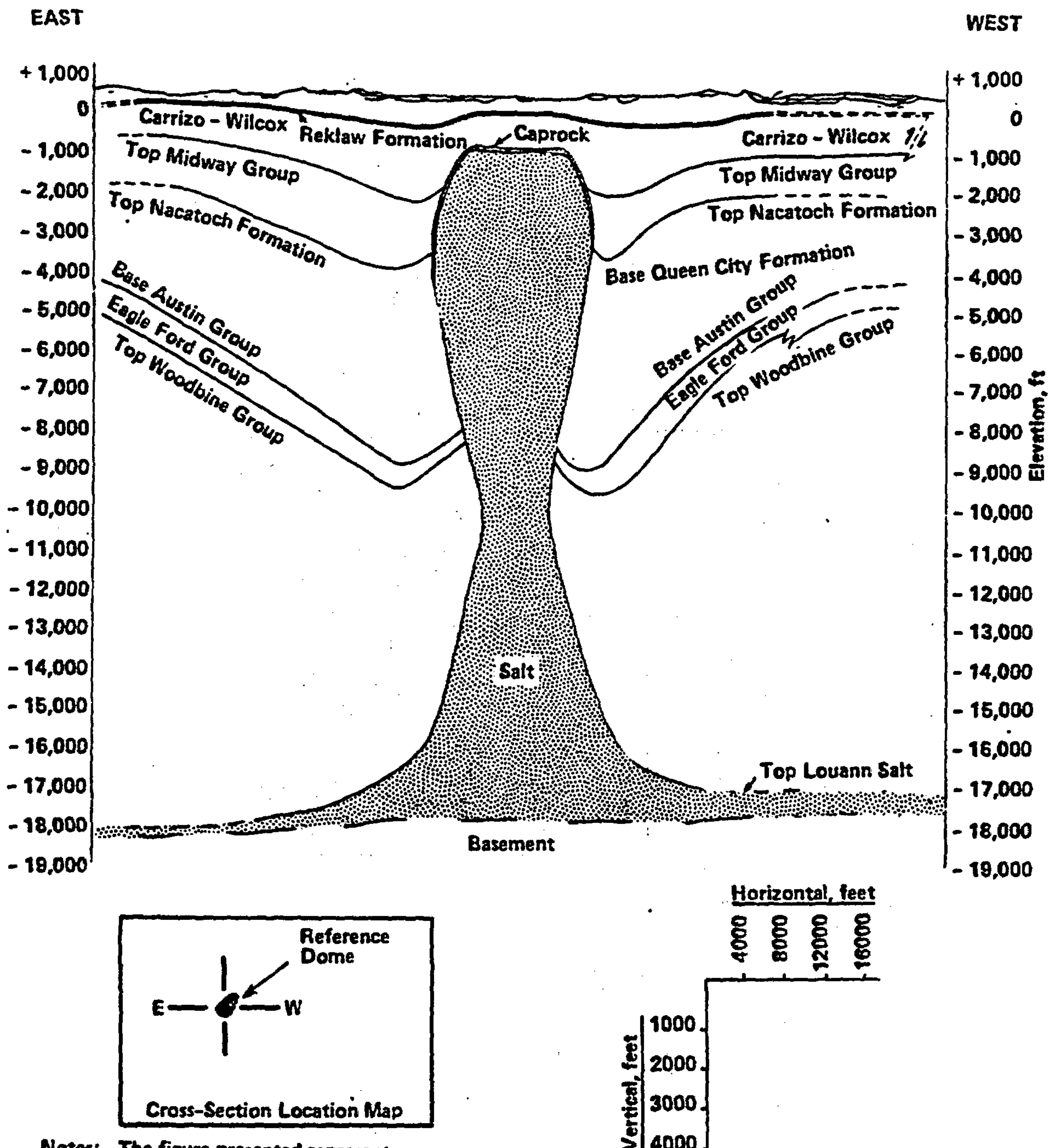
Subsurface Hydrology

The hydrologic system in the vicinity of the salt dome consists of the following:

Geologic Unit	
Sparta Formation	aquifer
Weches Formation	aquitard/aquiclude
Queen City Formation	aquifer
Recklaw Formation	aquitard/aquiclude
Carrizo Formation	aquifer
Wilcox Group	aquifer
Midway Group	aquiclude

The Midway extends well below the repository level, and all aquifers below the Midway are quite saline. Thus, lower aquifer systems are not considered important in this preliminary safety analysis, since they are not likely to be tapped for human usage and they are not likely to come in contact with the repository waste.

The Sparta and Queen City Formations were taken to be a single unit. Similarly, the Carrizo and Wilcox were treated as a single unit because the Weches is an incomplete barrier between them. The Wilcox-Carrizo aquifer is the most important aquifer in the study area for human utilization. Most of



Notes: The figure presented represents an interpretation of subsurface conditions based on presently available data. Some variation from these conditions must be expected
Depths measured in feet.
To convert feet to meters, multiply by 0.3048.

FIGURE 1.3. Site Cross-Section East-West

Source: Law Engineering Testing Company 1979b

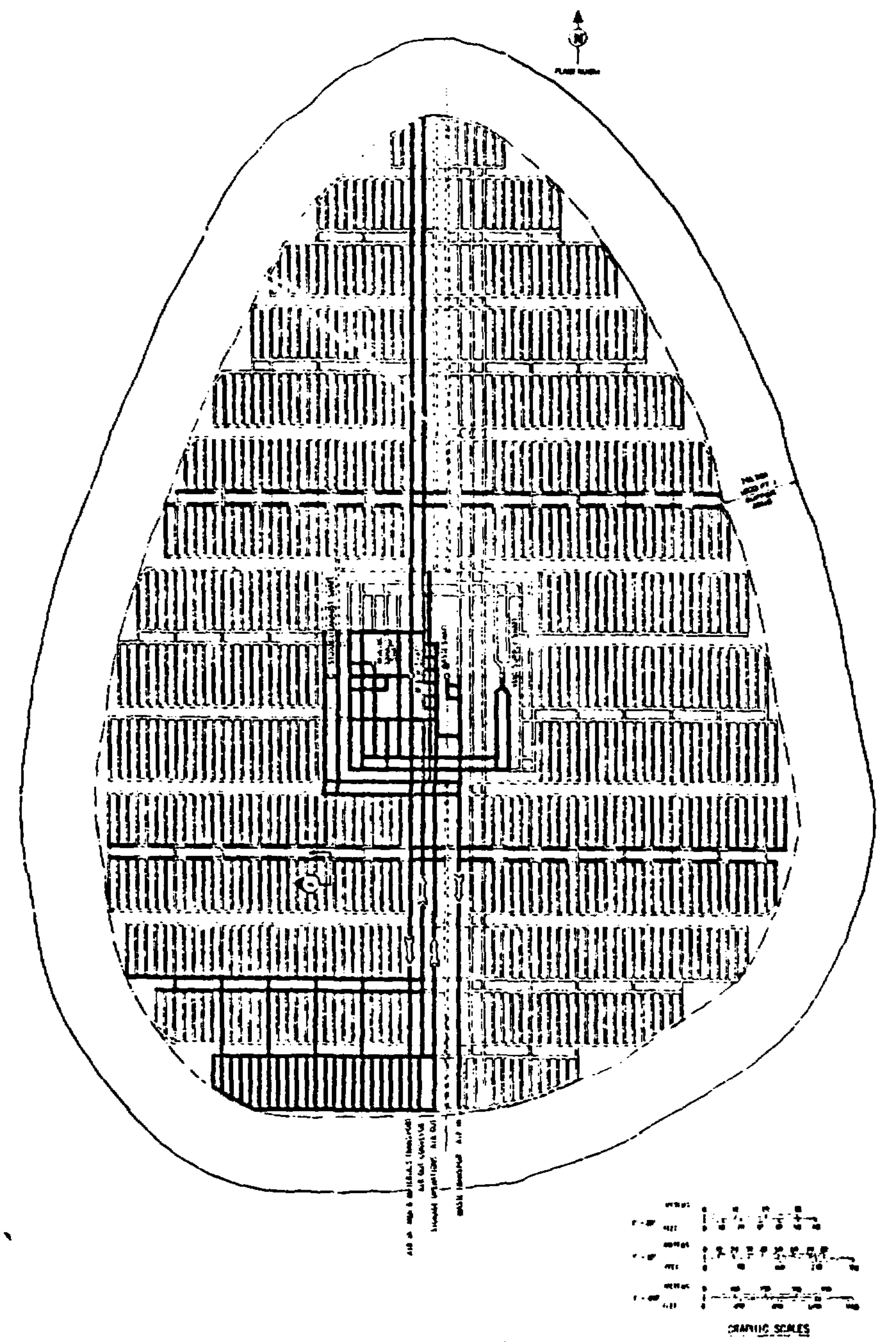


FIGURE 1-4. Areal Reporesentation of the Hypothetical Nuclear Waste Repository Located in the Hainesville Salt Dome

the larger municipalities and industries in the region obtain their water from this aquifer. Importantly, this aquifer surrounds the salt dome at repository depth.

The Wilcox-Carrizo is very thick, and thus has a moderate transmissivity despite a relatively low hydraulic conductivity of its sands. Pumping tests conducted in the aquifer in Wood County from eight wells indicated the following characteristics:

Transmissivity	600-19,000 gpd/ft
Well discharge rates	50-500 gpm
Specific capacities	0.8-9.7 gpm/ft of drawdown
Hydraulic conductivity	4-700 gpd/ft^2 (50 gpd/ft^2 average)
Storage Coefficient	0.00007-0.00027 (unitless)

Using these site geologic and hydrologic characteristics, including considerably more information provided by the site Geologic Project Manager (GPM), Law Engineering Testing Company (LETCO), AEGIS conducted a preliminary reference site assessment of a repository situated within the Hainesville Salt Dome. Briefly, the procedures involved the examination of potentially disruptive geological and human-induced phenomena, selection of release scenarios, simulation of the near-dome hydrologic system, simulation of the regional hydrologic system, simulation of the transport of released radioisotopes to aquifer discharge points, and calculations of dose burdens based on one portion of a release scenario.

RELEASE SCENARIO DEVELOPMENT

The release scenarios were developed by a team of AEGIS staff and consultants addressing the three categories of release scenarios:

- Type 1 Scenario - resulting from a natural, continuous sequence of geological processes ultimately disrupting the repository
- Type 2 Scenario - resulting from catastrophic impact of a discrete event such as meteorite impact
- Type 3 Scenario - resulting from human-induced phenomena.

The scenario team used the logic structure of the scenario analysis model now under development by AEGIS as the basic framework for consideration of Types 1 and 2 scenarios. This model is not yet fully operational and has been developed based on the characteristics of a basalt host medium (see Appendix A). However, the approach built into the model was followed: specifically, AEGIS staff systematically examined geological phenomena that potentially could disrupt a repository. These phenomena were selected or rejected by the scenario team as being capable of resulting in a breach in the reference salt dome repository.

Type 1 and 2 Scenarios

This systematic consideration of the potential Type 1 and 2 phenomena for the Hainesville Salt Dome indicated there are no plausible mechanisms for a Type 1 or 2 breach within the million-year time frame under AEGIS consideration. Therefore, for that time frame, no natural geologic breach scenario is considered by the AEGIS scenario team to be credible for the reference site. However, this conclusion is based on an analysis that did not consider repository construction- nor waste-induced effects. A separate analysis would have to be performed to determine if those effects could lead to plausible Type 1 or Type 2 breach scenarios. Additional and more detailed geologic investigations would be required to substantiate this conclusion.

Natural dissolutioning of the salt dome by the ground water flowing past the dome was considered to be a plausible breach mechanism in the few-to-many million year time frame. Thus, to provide an exercise of a natural geologic scenario causing a breach, and a subsequent exercise of the consequence analyses, and to provide a conservative bound on the geologic system, AEGIS selected a natural dissolutioning scenario occurring at a time 1×10^6 years post-closure as one that would require further consideration. As of the date of this report though, consequence analyses on this natural geologic scenario have not been performed.

The scenario actually selected for of the consequence analysis, dissolutioning caused by solution mining activities, was considered by the scenario team to be the most plausible breaching scenario to occur within the given million-year time frame, as discussed below. The scenario actually analyzed exposes the repository contents to the same hydrologic system involved in natural dissolutioning. The consequences of any natural dissolutioning scenario are expected to be of less magnitude than the consequences of the solution mining scenario because of radioactive decay of the repository inventory by the later time of the natural dissolutioning.

Type 3 Scenario

A comprehensive assessment of the safety of a waste repository must include some analysis of how humans might cause a future interaction between remaining radioactive materials and the human environment. The consequences of deliberate or inadvertent human intrusion, in terms of radionuclides released, could far outweigh the consequences of release through gradual ground-water contamination. For this reason, consideration of how future human activities might affect the repository integrity must be incorporated, into potential release scenario analyses.

At the time of this assessment a structured methodology for dealing with potential human-induced repository breaches had not been developed; however, it seems unlikely that the probabilities for such events could be quantified as events in the geologic process currently are. The history of human activities is extremely brief in comparison with geologic history. While the probability of occurrence of geologic activities can be quantified based on long-term histories of those activities, human activities cannot be similarly treated. Geologic processes are often dated in many millions of years; hominid predecessors, Australopithecus and Homo habilis, however, have existed only within the past few million years. The appearance of modern humans is dated from about fifty thousand years ago, while the existence of agricultural systems and the recording by humans of history can be traced for only ten thousand years or less. Any analysis that would attempt to categorize past human activities and project those categorizations into the future must currently be qualitative in nature and highly uncertain in its predictions.

An analysis of future human-induced activities that might compromise the integrity of a repository sited in a salt dome can be structured to discuss a range of potentialities. The methodology involves an examination of the range of known past human activities that might, if repeated, breach the repository. Separate analyses can be made of those activities that would breach the repository intentionally and those that would result in an inadvertent breach. Finally, any analysis of human-induced phenomena is highly time-dependent in character, as related to the presence and quality of institutional controls and passive information transfer.

There exist at least three phases of institutional control based on predictive reliability:

- short term (less than 50 years after closure of repository) - Reasonable predictions can be made about stability, goals, and operation of human institutions, as well as degree of uncertainty.
- intermediate term (100-200 years after closure of repository) - Predictions are based largely on extrapolation or projection of present trends; there is a limited degree of confidence, which decreases with time.
- long term (more than 100-200 years after closure of the repository) - Uncertainties dominate.

Draft Environmental Protection Agency (EPA) regulations on disposal of high-level radioactive waste, available at the time of scenario development, stated that controls for the repository that are based on institutional functions cannot be relied upon for longer than 100 years after closure. AEGIS neither endorses nor rejects the tenets of these EPA draft standards; however, for purposes of this analysis, loss of institutional control, regardless of cause, is presumed at 100 years after repository closure. One of the purposes of control of the repository site is the transfer of information about the nature of the repository and the dangers inherent in the release of the radioactive materials it contains. Implicit in the loss of physical control of the site is the possibility that the effective intergenerational transfer of information would be lost, or that only a partial transfer would be made. Current EPA draft regulations require supplemental controls to be designed using the most permanent markers and records practicable to communicate the nature and hazard of the material and its location. In spite of these precautions, the possibility remains that information transfer might not effectively survive, intact and intelligible, for any period significantly longer than that presumed for institutional control to the degree necessary for reliance in protecting the environment from the radioactive waste.

Based upon these considerations the AEGIS team considered the possibilities of deliberate intrusion of a repository. Probable knowledge of the nature of the repository contents can be inferred from the society's technological capability and desire to intrude deliberately into the repository. This scenario was discarded for further consequence analysis on the basis that a future society intruding into a repository, while fully knowing the nature of the repository, assumes upon itself the inherent risk burden of such activity. Draft federal regulations support this decision.

Inadvertent Intrusion

Inadvertent human intrusion is defined to include those activities of a future society carried out without adequate knowledge of the presence or nature of the repository. The hazard of such inadvertent intrusion exists after a loss of institutional control over the repository site. One of the primary reasons for geologic disposal is to keep the waste and humans separated. Implicit in this is a judgment that it is incumbent on the present society to minimize the risk of future inadvertent intrusion; hence, consideration of inadvertent human intrusion was deemed essential to a post-closure safety analysis. Draft federal regulations support this decision, suggesting that for an actual site analysis involved in the licensing process a human intrusion analysis would be required.

The physical features that make a salt dome attractive as a repository for nuclear waste isolation also make it attractive for current, and, presumably, future alternative uses. Salt domes are large, accessible concentrations of a relatively pure mineral that has biological and cultural value to humans. Other mineral deposits are frequently associated with salt domes. Also, salt domes are a valuable resource for the geologic stability of cavities created within them for storage of such materials as compressed air, petroleum, and natural gas. The rate of such utilization has been increasing for several years, and current rates of salt dome utilization indicate that all Interior Gulf Coast salt domes will be significantly exploited in the next few centuries (Griswold 1980).

AEGIS scenario staff looked at potential uses of salt domes and at potential means of such utilization. Key to this part of the scenario development is the nature of solution mining. This technique was found to have a long historical record and to require a relatively unsophisticated technology, to be an efficient means of removal of the contents of the salt dome without the physical presence of humans within the geomedia, and to be a commonly used practice in many salt domes in the Interior Gulf Coast, as in other areas. These factors led to the conclusion that a remote-controlled, solution mining intrusion into a salt dome containing a repository, subsequent to loss of institutional control is a quite plausible Type 3 scenario.

Type 3 Scenario Used in the Reference Site Analysis

Based upon this conclusion, the AEGIS staff designed a Type 3 scenario in the level of detail needed to perform consequence analyses. The specifics of the scenario analyzed are not of primary importance; AEGIS is not predicting that this particular sequence of events will occur. Rather, AEGIS is using the scenario as representative of the processes involved in human-intrusion scenarios of which there are a large number of potential specific scenarios.

The specific human-intrusion scenario of this analysis involves the solution mining of the salt dome for the purpose of producing salt. The initial intrusion was assumed to immediately follow the loss of institutional control, i.e., 100 years. However, to illustrate the effect of that timing on the consequences, an identical scenario was analyzed, initiating 1000 years after closure. In addition, analyses of the consequences of human intrusion over the very long term are presented in this revised report. The solution mine was assumed to remain operational until it breached the side of the salt dome, opening a pathway from the surface or Queen City-Sparta aquifer, through the salt dome, to an exit into the Wilcox-Carrizo aquifer.

In this scenario there are two pathways to the surface for contaminated water: 1) by leaching of radionuclides into the brine that is pumped to the surface during the operational phase of the mine, and 2) by subsequent leaching of contaminated brine into the Wilcox-Carrizo aquifer and geotransport to the aquifer discharge sites. Pathway 1 is generic to salt domes, whereas pathway 2 must be analyzed in a site-specific assessment. The latter pathway has three phases: 1) leaching into the aquifer system based on an intact conduit as input from the surface water system, 2) leaching into the aquifer system after partial collapse of the geosystem above the cavity, and 3) leaching into the aquifer after total dissolution of the salt dome and concomitant collapse of the overlying strata. Because of the time contraints and the exercise nature of this consequence analysis, this three-phase scenario was simplified into two phases by assuming the collapse does not occur until the salt dome dissolves down to the level of the repository. Note that the rate for such salt dome dissolutioning subsequent to a breach through the interior does not correspond to the rate of natural dissolutioning over the top and caprock of the salt dome. Specifically, total salt dome dissolutioning down to the level of the repository after the human intrusion was calculated to occur as soon as 15,000 years after breach, in contrast to the millions of years required for the natural scenario.

The scenario analysis provided the base case, solution mining scenario, with initiation at 100 and 1000 years after closure. In addition, a regional scenario was developed, showing the possible effects on the geotransport system of changes that could occur before the breach (e.g., climatic changes and elimination of a current, major water withdrawal by human activities). Some of these aspects were included, or may be addressed in future simulations, as variations on the base case scenario.

QUANTIFICATION OF SCENARIO CONDITIONS

Translation of the scenarios into the initial conditions of the consequence models proved to be a more difficult exercise than had been anticipated. Specific questions that had to be addressed included:

- estimation of the cavity size, shape, water turnover times, and flow rates at the exit into the aquifer

- estimation of the distribution coefficient (Kd values) associated with retardation of the radionuclides by the geomedia
- estimation of the solubility limits imposed on the transport system
- estimation of the salt dome dissolutioning rate and subsequent collapse
- estimation of the near-dome hydrologic system before and subsequent to collapse of the salt dome
- estimation of the effects on the regional hydrologic system of eliminating the current human activities affecting the Wilcox-Carrizo aquifer.

SOURCE TERM

Briefly, these estimates were made as described below. Leach rates were measured by the WRIT program using the International Atomic Energy Agency (IAEA) standardized procedure for spent fuel that had been pushed out of its cladding. Data taken after 467 days of leaching showed that essentially congruent dissolutioning of the spent fuel occurs at the rate of uranium leaching. This rate is a function of surface area; therefore, particle size distribution was measured by WRIT on pushed-out spent fuel by sieving a sample in the hot cell. The particle size distribution and leach rates were included in an AEGIS leaching computer model. This model includes compensation for temperature effects, based on an Arrhenius function, and for decreasing surface area as each particle dissolves. Results from this simulation indicated the entire repository contents could be dissolved in a few tens of years; however, results showed the potential for the solubility limits to be exceeded.

To address this possibility, the near-dome hydrology had to be simulated by AEGIS using the three-dimensional finite element model to provide an estimate of the water flow rates through the repository. Initial simulations gave rates for the first phase of the geotransport of a few hundred gallons per minute. To assess the sensitivity of the results to the size of the aperture at the side of the salt dome opening into the Wilcox-Carrizo aquifer, sensitivity analyses were performed using various sizes of openings. Results showed that a very large increase in the aperture size only increased the flow rates by 10-20%. Hence, it was concluded that the flow rates through the repository are primarily limited by the physical nature of the receiving aquifer. As such, the flow rates are not sensitive to the particular opening site assumed.

Using the estimates of the flow rates during phase one of the geotransport simulation, it was calculated that the uranium would have to be in solution orders of magnitude above the best estimates of solubility limits for the ground-water system to deliver the quantity of material in the time predicted by the leaching model. Therefore, the source term of uranium is limited by a solubility ceiling, not by leach rates from the spent fuel.

The WRIT leach data had shown congruent dissolutioning of the radioisotopes in the spent fuel at the rate of uranium leaching. This seems reasonable, in that most of the radionuclides are bound within the uranium oxide matrix that constitutes the bulk of the spent fuel. Thus, the source term of the non-uranium isotopes was taken to be proportional to the fractional release of uranium. Because of this, each individual isotope does not necessarily reach its own solubility limit.

Further AEGIS calculations showed that the solution mining operational phase also becomes solubility limited within a short period after initiation of the intrusion. According to these calculations the solubility limitation at the flow rates assumed for the solution mining operation is reached with only a small fraction of the repository being exposed. This leads to the conclusion that after this small fraction is exposed, any further increase in the exposure of the repository will have no effect on the quantity of radioisotopes delivered to the surface. In fact, a solution mining event with only 1/50 of the exposed fraction of the scenario used here would produce the same dose results.

SORPTION DATA

The data (other than source term and site characteristics) needed for geotransport calculations are associated with the retardation of radioisotopes by the geomedia through which the ground-water passes. WRIT obtained from the Geologic Program Manager (GPM) some outcrop samples of the aquifers associated with the Hainesville area for determination of the distribution coefficients (Kd values). Inspection of these samples suggested that excessive weathering and the presence of organics might make their measured sorptive properties not representative of the actual geomedia. Kd measurements were performed on these by WRIT, and many values seemed unrepresentative (nonconservatively high). Based on WRIT's mineral characterization of these samples, all were found to be essentially quartz, with secondary minor inclusions. Therefore, to provide a representative, conservative assessment, Kd values on quartz in brine and bicarbonate waters were selected from the WRIT generic data bank for use in this analysis. As such, the Kd values used may differ significantly from the values for actual geomedia. If this were an actual site analysis accompanying a site license application, Kd values would have been measured on actual uncontaminated core samples from the various formations involved. Thus, the results from the geotransport part of this reference site analysis may not be representative of actual geotransport; however, these geotransport analyses do demonstrate the types of analyses that would be performed by WRIT and AEGIS.

CONSEQUENCE ANALYSES

Using these scenarios and data, the consequence analyses were performed by AEGIS, including the operational phase of the solution mining scenario and the geotransport phase subsequent to the breach of the salt dome. Because of the inherent limitations of dose calculations (related to the time scale of demographic and societal changes that affect dose values), AEGIS initially limited dose-to-human calculations to the time period then specified in the EPA draft standards for health effects, 1000 years. (It should be noted that more recent EPA draft standards do not have this 1000-year criterion.) Thus, dose calculations were initially presented for the operational phase of the solution mining at times 100 and 1000 years after closure. In this revised report, doses are calculated for solution mining over the very long term. No dose calculations were performed for radioisotopes entering the biosphere after geotransport, because such transport took, at a minimum, about 15,000 years after the breach occurs.

For this analysis, the calculated doses are summarized in Tables 1.1 through 1.5. For the geotransport analyses, simulations were run for a base case and several variations. Output was obtained for each radionuclide for each scenario variation and is presented in Appendices G and H. A summary of the quantity released via geotransport to the surface is listed in Table 1.6.

TABLE 1.1. Radiation Doses Calculated for Solution Mining Scenario (Uranium Solubility Limited, 50-year Ingestion--Base Case)

A. 70-Year Population Dose,* man-rem

Decay Time	Organ of Reference: Total Body	Bone	Lung	Thyroid
100 Years	1.6×10^{11}	6.5×10^{11}	2.8×10^{9}	4.7×10^{6}
1000 Years	1.3×10^{9}	3.0×10^{10}	3.7×10^{4}	4.7×10^{6}
B. 70-Year Individual Dose Commitments, rem				
100 Years	1.1×10^{4}	4.4×10^{4}	1.8×10^{2}	3.2×10^{-1}
1000 Years	8.4×10^{1}	2.0×10^{3}	2.5×10^{-3}	3.1×10^{-1}

* Based on affected population of 15 million.

TABLE 1.2. Radiation Doses Calculated for Solution Mining Scenario (Uranium Solubility Limited, 1-year Ingestion)

A. 70-Year Population Dose, man-rem

Decay Time	Organ of Reference: Total Body	Bone	Lung	Thyroid
100 Years	3.3×10^{9}	1.4×10^{10}	5.5×10^{7}	9.5×10^{4}
1000 Years	3.5×10^{7}	8.6×10^{8}	7.5×10^{2}	9.4×10^{4}
B. 70-Year Individual Dose, rem				
100 Years	2.2×10^{2}	9.6×10^{2}	3.7	6.3×10^{-3}
1000 Years	2.3	5.7×10^{1}	5.0×10^{-5}	6.3×10^{-3}

TABLE 1.3. Radiation Doses Calculated for Solution Mining Scenario (Uranium Solubility Limited, 10-year Ingestion)

A. 70-Year Population Dose, man-rem

Decay Time	Organ of Reference: Total Body	Bone	Lung	Thyroid
100 Years	3.3×10^{10}	1.4×10^{11}	5.5×10^{8}	9.5×10^{5}
1000 Years	3.3×10^{8}	8.2×10^{9}	7.5×10^{3}	9.4×10^{5}

B. 70-Year Individual Dose Commitments, rem

Decay Time	Total Body	Bone	Lung	Thyroid
100 Years	2.2×10^{3}	9.5×10^{3}	3.7×10^{1}	6.3×10^{-2}
1000 Years	2.2×10^{1}	5.5×10^{2}	5.0×10^{-4}	6.3×10^{-2}

TABLE 1.4. Radiation Doses Calculated for Solution Mining Scenario (Uranium Solubility Limited, 25-year Ingestion)

A. 70-Year Population Dose, man-rem

Decay Time	Organ of Reference: Total Body	Bone	Lung	Thyroid
100 Years	8.3×10^{10}	3.5×10^{11}	1.4×10^{9}	2.4×10^{6}
1000 Years	7.7×10^{8}	1.9×10^{10}	1.9×10^{4}	2.4×10^{6}

B. 70-Year Individual Dose Commitments, rem

Decay Time	Total Body	Bone	Lung	Thyroid
100 Years	5.5×10^{3}	2.3×10^{4}	9.2×10^{1}	1.6×10^{-1}
1000 Years	5.1×10^{1}	1.2×10^{3}	1.2×10^{-3}	1.6×10^{-1}

For this revised report, the total-body doses have been compared to the total-body doses received from natural background radiation. These comparisons have been made for times of human intrusion long after closure. These results are presented in Table 1.7.

Conclusions

A primary goal of this work, the exercising of the AEGIS methodology, was a success both in terms of demonstrating the methodology and thereby providing

TABLE 1.5. Ingested Curies of Isotopes Delivered to Surface, 50 Years of Consumption of Table Salt

Isotope	Time: 100 Years	1000 Years	10,000 Years	30,000 Years
H3	62	0	0	0
C14	32	29	9.8	0.9
Cl36	0.3	0.3	0.2	0.2
Fe55	2.1×10^{-7}	0	0	0
Co60	0.3	0	0	0
Ni59	72	72	66	56
Ni63	4.9×10^{3}	5.6	0	0
Se79	8.9	8.5	7.7	6.2
Kr85	310	0	0	0
Sr90	1.4×10^{5}	3.1×10^{-5}	0	0
Y90	1.4×10^{5}	3.1×10^{-5}	0	0
Zr93	69	69	68	67
Nb93m	58	58	58	57
Nb94	22	21	16	7.8
Mo93	0.5	0.4	4.9×10^{-2}	4.8×10^{-4}
Tc99	280	280	270	250
Pd107	2.4	2.4	2.4	2.4
Sn121m	2.7	1.1×10^{-5}	0	0
Sb125	3.4×10^{-6}	0	0	0
Te125m	8.2×10^{-7}	0	0	0
Sn126	16	16	15	13
Sb126	2.3	2.3	2.1	1.8
Sb126m	16	16	15	13
I129	0.7	0.7	0.7	0.7
Cs135	8.2	8.2	8.2	8.1
Cs137	2.2×10^{5}	2.2×10^{-4}	0	0
Ba137	2.1×10^{5}	2.1×10^{-4}	0	0
Pm147	9.7×10^{-6}	0	0	0
Sm151	3.8×10^{3}	4.6	0	0
Eu154	68	0	0	0
Eu155	5.3×10^{-2}	0	0	0
Subtotal	7.2×10^{5}	6.0×10^{2}	5.4×10^{2}	4.8×10^{2}

TABLE 1.5. (contd)

Isotope	Time: 100 Years	1000 Years	10,000 Years	30,000 Years
Pb210	3.0×10^{-4}	6.1×10^{-2}	2.6	9.1
Pb214	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Bi210	3.0×10^{-4}	6.1×10^{-2}	2.6	9.1
Bi214	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Po210	3.0×10^{-4}	6.1×10^{-2}	2.6	9.1
Po214	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Po218	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Rn222	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Ra226	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Th230	2.6×10^{-2}	0.3	3.3	9.0
Th234	7.1	7.1	7.1	7.1
Pa233	8.7	21	25	25
Pa234m	7.1	7.1	7.1	7.1
U234	33	41	40	38
U236	5.3	5.6	7.3	8.3
U238	7.1	7.1	7.1	7.1
Np237	8.7	21	25	25
Np239	330	310	140	22
Pu238	2.2×10^{4}	1.0×10^{4}	4.0×10^{3}	510
Pu239	6.8×10^{3}	6.6×10^{3}	5.2×10^{3}	3.0×10^{3}
Pu240	1.1×10^{4}	1.0×10^{4}	4.0×10^{3}	510
Pu241	2.3×10^{4}	0.4	0.2	3.5×10^{-2}
Pu242	48	38	37	36
Am241	8.1×10^{4}	1.9×10^{4}	0.2	9.5×10^{-3}
Am243	330	310	140	22
Cm242	51	0.8	0	0
Cm244	660	0	0	0
Subtotal	1.5×10^{5}	3.6×10^{4}	9.7×10^{3}	3.8×10^{3}
TOTAL OF ALL ISOTOPES CONSUMED	8.7×10^{5}	3.7×10^{4}	1.0×10^{4}	4.3×10^{3}

TABLE 1.6. Cumulative Radiocontaminant Discharge after Geotransport Curies for the Four Release Scenarios

Cumulative Discharge (curies)

Nuclide	Simulation Number (1)	(2a)	(2b)	(3)	(4)
^{14}C	5.21E3**	8.90E1	1.52E2	2.50E4	8.88E1
^{79}Se	0	0	0	0	0
^{99}Tc	5.43E5	2.46E5	3.88E5	4.32E5	2.46E5
^{129}I	2.28E3	1.14E3	1.14E3	2.28E3	1.10E3
^{135}Cs	2.49E4	7.74E3	7.71E3	1.66E4	7.68E3
^{240}Pu	0	0	0	0	0
^{236}U	2.90E4	1.44E4	1.44E4	2.91E4	1.44E4
^{232}Th	1.13E-1	4.73E-2	4.84E-2	4.84E-2	3.87E-1
^{241}Am	0	0	0	1.07E6	0
^{237}Np	8.05E4	3.53E4	3.50E4	8.67E4	4.0E4
^{233}U	7.31E4	4.90E4	5.12E4	1.52E4	2.84E4
^{229}Th	4.47E3	2.08E3	1.95E3	7.49E2	1.17E3
^{242}Pu	0	0	0	0	0
^{238}U	2.45E4	1.22E4	1.22E4	2.45E4	1.22E4
^{234}U	9.64E4	2.83E4	3.06E4	1.31E5	3.39E4
^{230}Th	4.33E3	1.24E3	1.37E3	3.59E3	1.07E3
^{226}Ra	9.48E3	2.55E3	3.19E3	8.30E3	1.73E3
^{243}Am	8.75E4	3.08E3	4.55E3	3.29E5	3.08E3
^{239}Pu	2.26E2	8.36	6.81	3.89E2	9.27
^{235}U	8.16E2	4.12E2	6.00E5	7.82E2	5.50E5
^{231}Pa	2.75E1	7.48	1.26E1	2.96E1	5.93

(1) Base Case. East Texas oil field discharge.
(2a) Base Case. Sabine River discharge.*
(2b) Base Case. Big Cypress Bayou discharge.*
(3) Base Case. Well pumping case.
(4) Base Case. Sabine River discharge. Lower bound Kd.
* Represents half of released inventory.
** Computer notation for 5.21×10^3.

TABLE 1.7. Relative Total Body Dose Burdens Compared to Natural Radiation Background

Time of Intrusion (yr after closure)	Multipliers Above Background* (50 yr ingestion) (individual doses)
100	1,571.4
1,000	12.0
10,000	6.7
50,000	27.1
100,000	41.4
500,000	37.1
1,000,000	20.0

* Background here is taken to be 100 mrem/yr, or approximately 7 rem/70 yr lifetime. Actual background varies from this depending on the location of the individual.

a basis for substantive peer review and in terms of further developing the capability for site assessment. In the process of performing this, the evaluations led to some preliminary conclusions concerning the salt dome reference site repository. These conclusions are subject to the limitations of the data used:

- Human intrusion, involving solution mining and a subsequent breach, potentially could deliver a substantial quantity of the nuclear waste inventory to the accessible environment, based on plausible scenarios.
- Engineered barriers that are totally effective in providing containment could alleviate the operational-phase consequences of a solution mining intrusion, if the intrusion occurred during the life of the barrier. For example, if the intrusion occurred at 100 yr after closure and if all barriers lasted more than 150 yr no radioisotopes would be delivered to the surface during the mining operations. Geotransport of the radioisotopes, however, could still occur after the engineered barriers were no longer effective, because

a pathway to the accessible environment might exist. It is outside the scope of this work to determine if engineered barriers could be developed that would be totally effective throughout the physically disruptive breach scenario.

- Engineered barriers that are totally effective for 1000 yr would have very little impact on the consequences of geotransport of the radionuclides to the surface, compared with having no barriers at all. (This is based on geotransport simulations initiated at 100 yr and 1000 yr after closure, the latter being analogous to an earlier intrusion which had no release until 1000 yr because of the engineered barrier.) This lack of effect results from the long geotransport time to the surface (about 15,000 yr) for this reference site, and thus, this conclusion may not be true for other salt dome sites. It is outside the scope of AEGIS to determine if engineered barriers could be designed to be totally effective for 1000 yr.
- The insensitivity of the geotransport consequences to initiation at 100 yr versus 1000 yr after closure indicates that geotransport to the surface is not strongly sensitive to the timing of the loss of institutional control, for this salt dome site.
- Calculations based on the limitations imposed by the ground-water system for this reference site indicate that solubility limits are the determinants of the source term, where spent fuel is the waste form. If those solubility limits did not apply, the consequences from solution mining could be more severe.
- Because of this solubility-limited situation, the dose calculations are remarkably insensitive to many of the quantifying parameters that would have been expected to be critical. For instance, the size of the solution mined cavity that intercepts the nuclear waste repository could be reduced by a factor of 50 without reducing the individual or population doses. The size of the solution mining operation itself (in terms of brine production) could be reduced by

a factor of 50 without reducing the doses to individuals. Importantly, the size of the solution mining operation could be reduced by a factor of 30, while increasing the fraction of brine going to culinary salt to the more realistic factor of 90%, without changing the doses to individuals or to the general population.

- The calculated occupational doses to operators of a solution mining operation are not sufficiently acute to cause termination of the solution mining operations. Thus, solution mining provides a remote-controlled means of delivering radionuclides to contact with the accessible environment. This contrasts with in-situ conventional mining (room and pillar), where the deleterious thermal and radiation effects would force the termination of mining activities in the repository.
- The long-term dose calculations indicate that the potential for adverse consequences from a human intrusion event involving solution mining exists beyond the one million year time frame. This conclusion is contrary to the view that the hazards of a nuclear waste repository are no greater than the hazards of a comparable natural ore body after 10,000 yr. The difference is that the latter may be true for geotransport consequences, but not for the direct consequences of human intrusion into an edible host medium.
- The geology of the salt dome provides no barrier to the human intrusion scenario; indeed, salt domes are very localized, attractive resources, enhancing the likelihood of eventual human intrusion. The sole barriers then would have to be effective intergenerational transfer of information and/or almost totally effective engineered barriers that provided a substantial reduction in the source term for an exceedingly long period of time.

Again it should be emphasized that the AEGIS efforts for this reference site analysis were an exercise of the AEGIS methodology. The intent was not to conduct an actual site evaluation to the depth that would be appropriate for a site qualification or licensing. Rather, what is presented here is an example of the utilization of AEGIS methodology for site evaluations, based on a hypothetical repository located in a reference salt dome. It is expected that the methodology will have progressed and the data will be adequate by the time of an actual site selection and licensing to reduce the uncertainties and to provide a sound assessment of the long-term post-closure safety of nuclear waste repositories. Nevertheless, these reference site analyses do provide a strong indication of the generic potential for human intrusion into a nuclear waste repository located in a salt dome.

CHAPTER 2

OVERVIEW OF THE AEGIS AND WRIT PROGRAMS

Associated with commercial nuclear power production in the United States is the generation of hazardous radioactive wastes. The Department of Energy (DOE), through the National Waste Terminal Storage (NWTS) Program, is seeking to develop nuclear waste isolation systems in geologic formations with the objective of precluding contact of waste radionuclides with the biosphere in concentrations that are sufficient to cause deleterious impact on humans or their environments. Comprehensive analyses of specific isolation systems are needed to assess the expectations of meeting that objective. The Waste Isolation Safety Assessment Program (WISAP) was established at the Pacific Northwest Laboratory (PNL), operated by Battelle Memorial Institute, for developing the capability of making those post-closure analyses. In FY-80, WISAP was divided into the AEGIS and WRIT programs.

Among the analyses required for isolation system evaluation is the detailed assessment of the post-closure performance of nuclear waste repositories in geologic formations. This post-closure assessment is essential because it is concerned with aspects of the nuclear power program which previously have not been addressed and that have potential long-term consequences. Specifically, the nature of the isolation systems and the time-scales necessary for isolation dictate the development, demonstration, and application of novel assessment capabilities. The assessment methodology needs to be thorough, flexible, objective, and scientifically defensible. Further, the data used must be accurate, documented, reproducible, and based on sound scientific principles.

The objectives of AEGIS and WRIT are to: 1) develop the capabilities needed to assess the post-closure safety of geologic repositories, 2) obtain scientifically defensible generic and site-specific data necessary for safety assessments, 3) provide, as needed, studies to further support these data and analyses, 4) demonstrate the assessment capabilities by performing analyses of reference sites, 5) apply the assessment methodology to assist the National Waste Terminal Storage Program in site selection, and 6) perform repository site analyses responsive to the time schedule and to the level of sophistication required to meet the licensing needs of the National Waste Terminal Storage Program.

Post-closure safety assessments will be required with differing levels of detail as the repository site selection, qualification, and licensing processes develop. Thus, the safety assessment program will continue to evolve to match the requirements for technical detail and sophistication of the assessment input for the various site qualification and licensing stages. A post-closure safety assessment program must advance the state of the art for generic assessment capabilities while providing the credible assessments required to evaluate specific geologic isolation systems.

There are two basic components of repository post-closure safety assessments:

- identification and analyses of breach scenarios and the pattern of events and processes causing each breach
- identification and analyses of the environmental consequences of radionuclide transport and interactions subsequent to a repository breach.

The scope of AEGIS at the time of this analysis was limited to long-term, post-closure analyses. It excluded the consideration of waste-induced and repository-induced processes that may affect the repository integrity, and it excluded the consideration of nuclear waste isolation alternatives other than geologic isolation repositories. The near-field/near-term aspects of geologic repositories are being considered by the Office of Nuclear Waste Isolation (ONWI)/DOE under separate programs. They are being integrated with the AEGIS methodology for the actual site-specific repository safety analyses.

The Waste Isolation Safety Assessment Program was divided into a management task and four technical tasks (Figure 1.1). These tasks were designed to be integrated to produce the needed assessment methodology and site analyses, as described below. The current AEGIS program involves the left half of this diagram, and the current WRIT program involves the right half.

RELEASE SCENARIO ANALYSIS (AEGIS)

AEGIS Release Scenario Analysis uses geoscientist teams and mathematical models to identify and provide bounds to the events and processes that could potentially affect the repository integrity. This includes the analysis of the interactions and consequences of phenomena that could result in a loss of containment by the repository. Based on the particular nature of a release sequence of phenomena, the condition of the geology surrounding the repository at the time of the breach will be determined as initial conditions for the consequence analysis.

The purpose of the determination of nuclear waste repository release scenarios is to evaluate geologic events and processes, human-induced events and processes, and the impact of these on the integrity of the repository. Events such as earthquakes, faulting, and human intrusion, and processes such as erosion, uplift, and diapirism, could, alone or in concert, significantly alter the geology surrounding the repository and lead to a loss of repository integrity. The output from scenario analyses will establish the conditions of the geology and hydrology surrounding the repository at the time of an identified breach, providing the major geologic boundary conditions for input into the consequence analysis models.

Development of the release scenario analytical capability is performed in a two-stage approach. An _ad hoc_ team of geoscientists is generating release scenarios for reference sites as inputs to reference site analysis. Concurrently, release scenario models are being developed so that in subsequent years the models can be used to assist the scenario team in the generation of release scenarios. These two approaches are intimately interrelated so that the information and data developed from the effort of the geoscientists are being used to aid in the conceptualization of the differing geologic parameters incorporated in the developing models. Conversely, the expert team efforts are using the intermediate stages of the models being developed to aid in focusing the scenario generation.

The generic phase of scenario methodology development has provided the baseline from which actual release scenarios for reference site initial analyses are being generated. The development and testing of the generic computer program during the initial phase of scenario analysis formed the basis for the development of geology-specific, second generation models. Thus, while sophisticated scenario models are not currently available for site applications, prerequisite steps have been completed that will simultaneously allow *ad hoc* team use of AEGIS technology for site scenario analyses and continuation of release scenario model development.

RELEASE CONSEQUENCE ANALYSIS (AEGIS)

AEGIS Release Consequence Analysis is using ground-water and radionuclide migration models to simulate the pathways and transit times of each radionuclide to the accessible environment. For radionuclides reaching the accessible environment, radiological dose models are used to compute exposures to humans and their environment. The release consequence analyses include:

- simulations of water movement through the geosphere from the areas near the repository
- simulations of the transport of radionuclides through the geosphere, driven by the water flow
- providing source terms for the radiological dose models
- predicting anticipated radiological dose levels for humans and their environment based on the geosphere simulations.

It is assumed that the movement of radionuclides through the geosphere would be primarily by water transport. Thus, the geosphere transport aspect of this task has two components: 1) the identification, through simulation, of the potential ground-water pathways and transit times, and 2) the juxtaposition of the actual radionuclide movement onto this hydrologic regime, taking into consideration factors affecting chain decay and transport. Added onto the output of these geosphere models are radiological dose models, so that three model sets are involved in this task. Figure 2.1 is a schematic flow diagram for the release consequence analysis. Additionally, within each

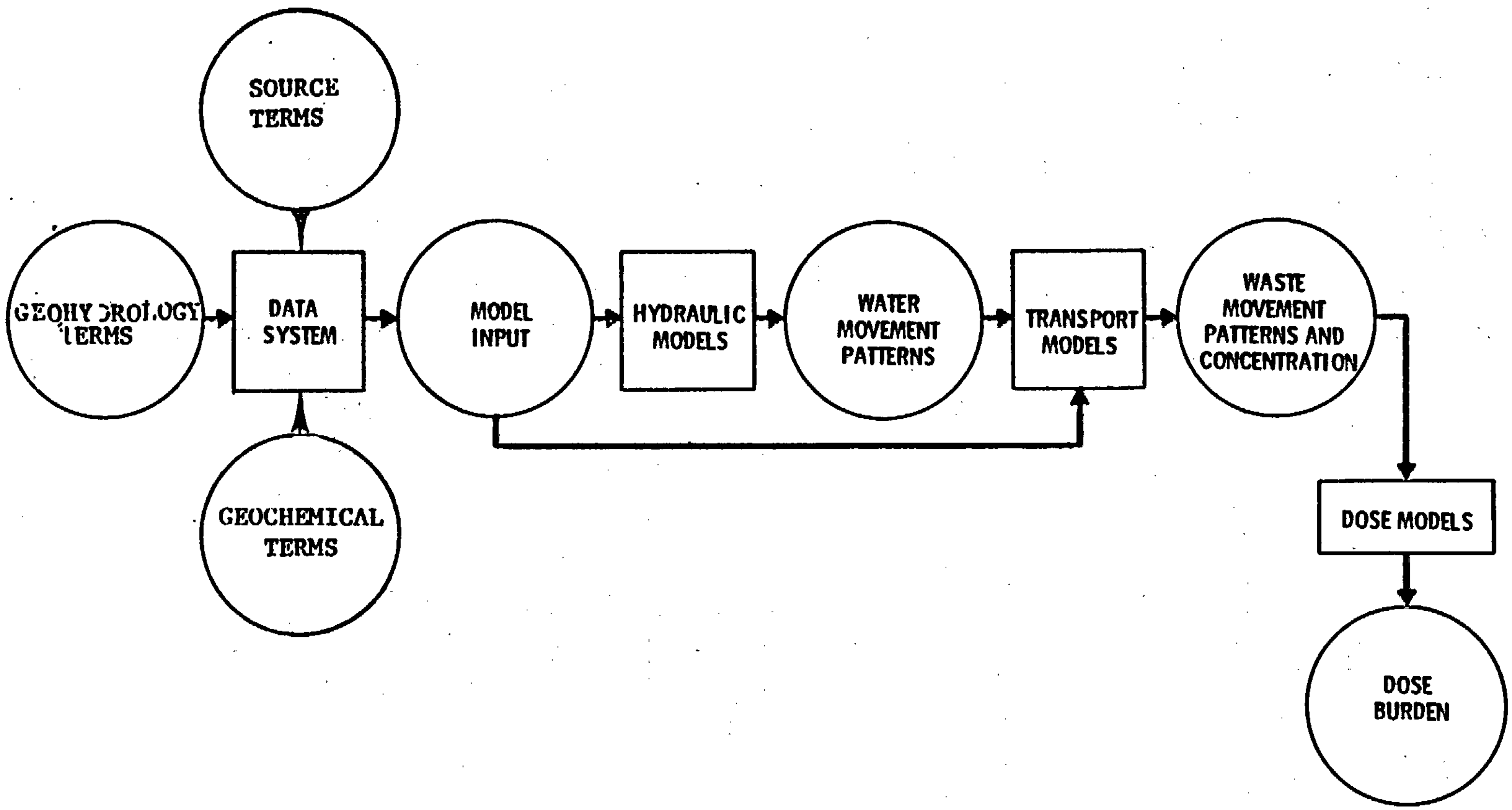


FIGURE 2.1. Consequence Analysis Schematic Diagram

model grouping are models of differing levels of complexity, so that the degree of model sophistication can be attuned to the adequacy of the data base for each particular analysis and to the purpose of the analysis (e.g., preliminary planning, site selection, licensing of specific site). Thus, AEGIS currently provides a flexible capability for consequence analysis.

A major objective of this task is to use these existing models to perform reference site initial analyses to enhance the model development effort. The objectives are to increase the efficiency, defensibility, and credibility of the models so that later, more complete site-specific analyses can be performed to the depth required for the licensing process.

AEGIS efforts have brought release consequence analysis to the point where actual site-specific analyses can now be made. Specifically, the data base system has been established on a flexible data retrieval system. Generic data have been compiled for test case model runs and verification. Site-specific data for reference sites have been added to the system. The hydrologic, radionuclide-transport, and dose models selected for AEGIS use have been implemented; sensitivity analyses have been performed; and test cases have been run for verification.

Waste Form Release Rate Analysis (WRIT)

WRIT Waste Form Release Rate Analysis staff are investigating the leaching rates and processes of radionuclide release from nuclear waste forms, providing essential source terms for radionuclide movement. These rates are of major importance to breach consequences, because slower leach rates add time delays before the hydrologic transport of the radionuclide inventory. Such delays can be important factors in isolation, especially for radionuclides of rapid or intermediate decay rates. Leach rates are dependent on the characteristics of the waste forms and the extant physico-chemical conditions within the repository at the time of breach. The functions of the leaching studies are to:

- simulate actual repository physico-chemical conditions during the leach rate measurement
- perform leaching measurements on the anticipated waste forms, geomedia, and ground waters of specific sites for use by consequence analyses

- provide actual leachate solutions for sorption measurements
- investigate the fundamental physico-chemical phenomena governing waste form leaching under repository conditions for the development of a model for prediction of long-term waste form behavior
- develop mathematical relationships of waste leaching for incorporation into the AEGIS radionuclide transport models.

At the present time the waste forms being investigated by WRIT include spent fuel, high level waste (HLW) glass, and, for transuranics (TRU), concrete, bitumen, urea-formaldehyde, and polymers.

The activities necessary for the acquisition of data include: 1) preparation and characterization of waste form samples, 2) measurement of leach rates of selected radionuclides using leaching solutions and physical parameters that span the range anticipated for waste repositories, 3) development of a data base from leach measurements, 4) mechanistic modeling studies for ultimate use in consequence analyses, and 5) preparation of leachate from actual waste forms for use in sorption studies.

Sorption/Desorption Analysis (WRIT)

WRIT Sorption/Desorption Analysis staff are investigating radionuclide sorption processes. If radionuclides are actually released into a transporting ground water, they may be sorbed by the geomedia that they contact. Irreversible sorption would act to remove the radionuclide from the ground water. Reversible sorption would act in a manner similar to waste form leaching, by providing time delays to the migration of radionuclides. Geomedia of sufficient sorptive capability could provide isolation of the waste from the accessible environment by extending transit times to very long periods. As with leaching, sorption/desorption by geomedia is dependent on the specific radionuclide involved and the physico-chemical characteristics of the geomedia and transporting solutions. Sorption analysis includes:

- investigating the fundamental phenomena governing sorption/desorption of radionuclides by geomedia

- providing measured values of sorption distributions for specific nuclides and media
- developing predictive equations for sorption distribution extrapolations for non-measured situations.

INTRODUCTION TO REFERENCE SITE ANALYSIS

The Preliminary Information Report (PIR) was the initial effort by ONWI designed to exercise the methodologies under development for performing safety assessments for waste repository licensing. ONWI's PIR was to be in the format of an eventual Preliminary Safety Analysis Report (PSAR), which would be one of the documents submitted with an actual repository license application to the Nuclear Regulatory Commission. The AEGIS reference site analysis was designed to assess the safety of a reference repository site considered by ONWI in the PIR as part of AEGIS's methodology exercise. The site assessed is based on the Hainesville Salt Dome, an Interior Gulf Coast salt dome, which is not being considered for a potential nuclear waste repository site, largely because of past human activities on this salt dome.

During FY-1979, AEGIS performed for the PIR the first site-applied exercise of the total AEGIS and WRIT methodology operative to date. The AEGIS efforts in the exercise of its methodology were performed to provide the bases for the post-closure safety chapter, Chapter 7 of the final PIR; however, the preparation of the PIR is being done by other ONWI contractors.

Briefly, the procedures AEGIS followed for this exercise included the examination of potentially disruptive geological and human-induced phenomena, selection of plausible release scenarios, simulation of the near-dome hydrologic system, simulation of the regional hydrologic system, simulation of the transport of released radioisotopes directly to the surface or to aquifer discharge points, and calculations of doses based on portions of a release scenario.

This report represents an exercise of AEGIS and WRIT methodology for a hypothetical repository located in a reference salt dome, not an actual site assessment. The data used for this exercise are not adequate for an actual assessment, nor have all the parametric analyses been made that would adequately characterize the response of the geosystem surrounding the repository. Additionally, because this was the first exercise of the complete AEGIS and WRIT methodology, this report provides the initial opportunity for the AEGIS methodology, specifically applied to a site, to be reviewed by the community outside of AEGIS. This review to date has resulted in some changes in this document and has provided significant guidance for future AEGIS and WRIT activities. Further review will assist in improving the methodology. Finally, this exercise was a substantial learning experience for the AEGIS team.

The analyses performed for this exercise are described in the subsequent chapters of Volume 1. Chapter 1 provides an overview of this report. Chapter 3 gives a thorough listing of the assumptions used in the analyses. Chapter 4 discusses the aspects of potential disruptive phenomena that need to be considered in developing release scenarios for the Hainesville Salt Dome site. Chapter 5 follows with a description of the scenarios developed, emphasizing the scenarios analyzed as being representative of release mechanisms. The near-dome simulations done to help quantify the scenarios are discussed in Chapter 6, and the actual simulations of the geotransport of released radioisotopes are presented in Chapters 7 (hydrology) and 8 (transport). Dose calculations were performed only on the operational phase of a human intrusion scenario; these are presented in Chapter 9. Chapters 10 and 11 discuss the WRIT methodology and the values actually chosen for quantification of the source term of the radioisotope leaching into the ground water and the subsequent retardation of those isotopes by the geological media. Chapter 12 presents a thorough set of comments received from the external review of the working document and responses to those comment by AEGIS.

Appendices presented in Volume 2 describe the scenario methodology under development that would be used for an actual site assessment, summary documentations of the AEGIS hydrological, transport, and dose models used, the input data and conceptual models used for the simulations, the graphical and computer listing of results from the geotransport of released nuclides, the detailed output from the dose calculations, a description of the site characteristics, and detailed inventories and dose calculations for the long-term.

CHAPTER 3

ASSUMPTIONS IN AEGIS SALT DOME REFERENCE SITE ANALYSIS

Included in this chapter is a list of the assumptions involved in the post-closure safety analyses of this report. These assumptions are grouped into categories and have been annotated to indicate whether they are considered by the AEGIS staff to be conservative, nonconservative, or reasonable. Conservative is here defined as an assumption that would increase the severity of consequences. In general, the approach taken was to select the bounding type of scenario for analysis. Specifically, the class of scenarios involving human intrusion into a salt dome repository via solution mining for the purpose of producing culinary salt was selected to be the conservative bound to the larger range of possible human intrusion scenarios. Within that class of scenarios the scenario analyzed was not the most conservative bounding one possible, as it involved both conservative and nonconversative assumptions. The reasonable values and assumptions used that were not conservative were used whenever the data or sound logic indicated they were appropriate. Thus, in our judgement, the scenario analyzed represents a conservatively realistic example of the conservatively bounding class of scenarios resulting in releases to the accessible environment.

Upon review of these assumptions, it was concluded by the AEGIS staff that the geotransport aspects of the consequence analyses are site-specific, involve some very conservative assumptions, and represent consequences worse than reasonably would be expected. The potential for human intrusion via solution mining, on the other hand, is generic to salt domes. This form of intrusion represents a plausible and potentially highly consequential scenario. The specific analyses of this scenario include both conservative and nonconservative assumptions and values. Thus the operational phase consequences of this scenario do not represent the worst possible situation for solution mining. At present, it appears to AEGIS staff that this is conservatively representative of the consequences of a human intrusion via solution mining into a repository contained within a salt dome. Further parametric runs would be necessary to define better the bounds of consequences from such a mechanism of breach. However, the scenario class is felt to be plausible and the consequences to be a reasonable quantification of such an intrusion.

There are a few key assumptions from which this analysis follows. First, AEGIS did not consider the potential containment afforded by engineered barriers to provide a basis for subsequent barrier performance evaluation. The analyses in this report should provide a basis for considering the engineering design of a repository with respect to mitigating the consequences. Other key assumptions relate to the plausibility and timing of loss of institutional controls, the question of whether passive information transfer can be relied upon for any or a fixed amount of time, and the question of whether active monitoring of radioisotopes in the salt brine or of health effects could lead to a discovery of the source of contamination and to a cessation of mining operations. For the purposes of this report, AEGIS relied upon drafts of the proposed EPA standards, which were interpreted to mean that no reliance on institutional control can be placed beyond 100 years post-closure, that passive information transfer is required but is only a supplementary protection (not the single line of defense), and that if no reliance can be placed on institutional controls beyond 100 years, none should be placed on specific technical knowledge that could lead to active monitoring.

Such limitations on the reliance on human activities are properly the responsibility of the appropriate regulatory agencies and must involve societal decisions. AEGIS neither endorses nor rejects the tenets of the EPA draft standards; we do recognize the qualitative difference between reliance on human versus geologic characteristics.

ASSUMPTIONS IN AEGIS ANALYSES

Assumption	Class	Comments	Key Assumption
General			
1) Natural phenomena considered for 10^6 years	Conservative	Not important since no natural breach in 10^6 years	*
2) Natural phenomena consistent with past few 10^6 year record	Reasonable		
3) Natural dissolution scenario at time = 10^6 years	Conservative	After that long, results not sensitive to time; bounded by solution mining scenario	
4) Waste-induced effects not addressed	Nonconservative	Not strictly true, since had to consider some near-field aspects. Could significantly affect natural dissolutioning	*
5) Insufficient data to characterize geohydrology	May be conservative or nonconservative		
6) Disregard complexity of near-dome hydrology	May be conservative or nonconservative	Could significantly affect natural scenarios	*
7) Ignore human effects on natural dissolutioning rate	Nonconservative	Bounded by human intrusion scenario. Could significantly affect natural scenarios	*
8) Ignore repository-induced effects on geosystem (e.g., construction)	May be nonconservative	Bounded by human intrusion scenario	
9) Ignore synergisms and multiple occurrences of natural phenomena	May be nonconservative	Bounded by human intrusion scenario	
10) Several assumptions in how each natural phenomenon treated	Mixed	Unimportant to results since natural solution and solution mining are bounding scenarios	
11) No human mitigation of geotransport consequences subsequent to breach	Reasonable	Consistent with assumptions re human intrusion. Could significanlty affect dose results	*
Source Term			
12) Raw spent fuel	Conservative	Not as important as apparent; see Note 1	*

Note: The key assumptions in this analysis are indicated by an asterisk in the right column

Assumption	Class	Comments	Key Assumption
13) Solubility limited	Nonconservative	If the system were leach limited, all of the repository could be dissolved during the operational phase of solution mining; also, the geotransport source term would be reduced from 10^5 years to less than 10^2 years	*
14) Solubility limit of 6 ppm for U	Nonconservative	See Note 2. Could significantly affect dose results	*
15) Congruent dissolutioning	Nonconservative	See Note 3. Could significantly affect dose results	*
16) Gaseous effluent not considered	Nonconservative		
17) Particulates not considered	Nonconservative		
18) Inorganic system only	Nonconservative	See Note 4. Could significantly affect dose results	
19) WRIT Leach data based on IAEA testing	Reasonable	Best available data; see Note 5	
20) WRIT Leach data using HB Robinson II fuel	Reasonable	Best available; burnup 28,000 MWD/MTU; see Note 5	
21) Particle size based on WRIT sieve data	Reasonable	Best available; confirm GEIS data; photos show no effect from sample preparation; see Note 5	
22) Temperature effects for leaching: 10X increase 25°C to 125°C	Nonconservative	Best available data; Arrhenius relationship; 125°C estimate of temperature after contact with water; see Note 5	
Human Instrusion Scenario			
23) Institutional control lost at 100 years	Conservative	Based on draft EPA standards; provides lower bound	*
24) Institutional control lost at 1000 years	Nonconservative	Provides upper bound	*
25) Salt domes continue to be resource	Reasonable	See Note 6	*
26) Lower than present technology needed for solution mining	Reasonable	See Note 7	
27) Solution mining at repository level	Conservative but reasonable	See Note 8	

Assumption	Class	Comments	Key Assumption
28) Solution mining would intercept the repository	Reasonable	Repository occupies 2/3 of dome area at its depth (800-ft buffer zone at edge, but mining would try to avoid the edge)	*
29) Cavity formed for salt, not storage	Conservative - - - May be - - - nonconservative	Eating is most direct vector Relates to Note 4 and presence of organics to increase source terms	*
30) Preferential dissolution of repository volume	Conservative	See Note 9. Not critical since solubility limited	
31) Not preferential dissolution of interior of rooms	Nonconservative	See Note 10. Note critical since solubility limited	
32) 410,000 ppm salt in brine	Conservative - - - Nonconservative-	Exposure rate Relative amount of radioisotopes per unit weight of table salt	
33) Salt production 1×10^6 tons/yr salt	Nonconservative	GEIS: 2.4×10^6 Some current production several times higher	*
34) 50-year life of solution mining	Conservative	Same as GEIS	*
35) 50-year consumption of salt	Conservative	See Note 11	*
36) 1200 gpm rate of solution mining	Reasonable	Based on 10^6 tons per year production	
37) 3% of mined salt to culinary usage	Nonconservative	Recent information shows that for a salt dome being used for culinary salt production, almost all (80-90%) of the brine would go to culinary salt. This would linearly increase the dose	*
38) 1800 g/yr per person salt consumed	Nonconservative	New data show current U.S. usage is 5000-6000 g/yr per person; also, see comment for Assumption 37	*
39) 15×10^6 population affected	Conservative	Assumes all of salt in that population's diet comes from single source	
40) Isotopes also at 3% usage	??	Processing could eliminate or concentrate isotopes in table salt	*

Assumption	Class	Comments	Key Assumption
41) Usage of 97% of contaminated mined salt not considered	Nonconservative	Could be considered in future; could lead to other vectors to humans; also, see comment for Assumption 37	*
42) Dose limited to single lifetime (70 yrs)	Nonconservative	Ignores genetic effects, potential for recycling in ecological systems	
Geotransport			
43) 50-ft head maintained for 15K years before collapse	Very conservative	Dome collapse reduces source term by factor of ten. Could significantly affect source term for geotransport	*
44) Salinity not considered with respect to density and viscosity	Conservative		
45) Inadequate data on where surface discharge point would be	??	Better data not available	
46) Discharge to E. Texas Oil field	Very conservative	Requires human activity; bounded by Case 2	
47) Breach dome at end of 50 years mining	Conservative	Timing not very important to geotransport results, for breach delay up to 1000 years	
48) Breach downflow side of dome	Conservative		
49) Near-dome model based on regional hydrologic values	??	No near-dome information. Could significantly affect source term for geotransport	*
50) Maximum regional transmissivities used for near-dome model	??	No near-dome information	
51) Breach opening 1000 ft^2	??	Sensitivity studies showed not important variable between 1000 and 13,000 ft^2	
52) Channeling in aquifer ignored	??	Not homogeneous system; rather clay with sand lenses; could retard or increase ground-water flow velocities. Could significantly affect geotransport consequences	
53) After collapse, water twice height of canister is saturated with U	??		

Assumption	Class	Comments	Key Assumption
54) After collapse, above dome permeability doubles	Conservative		
55) Anhydrites (in salt left behind from solution mining) not affect source	Conservative	Only few cm would cover bottom of cavity at time of total repository exposure	
56) WRIT Kd values done on quartz with artificial ground water	Conservative	Available outcrop samples too weathered for reliable Kd values	
57) WRIT Kd values selected were lower of each pair of anoxic/aerobic	Conservative	No data to characterize water as aerobic or anoxic	
58) Well scenario done at 6 km	Conservative then nonconservative	See Note 12	
59) Well pump rate 400 gpm	Conservative		
60) No other change in hydrologic system in 10^5-10^6 year time frame	Nonconservative	Discharge points could have shorter travel paths	

NOTES TO ASSUMPTIONS

1. There are many important aspects involved with reaching the solubility limit rather than having a leach limited source term. A key factor is the surface area required to saturate the 1200 gpm of water involved in the solution mining operational phase. This amounts to about 1.5% of the surface area of the spent fuel in the repository. Because 1.2% of the repository could be exposed per year, after a little more than one year of operation an increase in the surface area exposed has no effect on the dose values. Thus, the conclusion that 62% of the repository would be exposed during the operational phase is unimportant. Stated another way, if only 1/50 of the effective surface area is available compared with what we calculated could be available, exactly the same dose values would result. Similarly, if a cladding or other barrier were assumed to be present, and if such a barrier reduced the effectively exposed surface area by a factor of 50, precisely the same dose values as raw spent fuel would result. When the dynamic nature of the solution mining scenario is considered, fracturing of the engineered barrier to expose effectively

1/50 of the surface is not an unreasonable event. Such dynamics include the potential effect of the floor being dissolved out from under the waste in other solution mining scenarios, allowing it to fall to the bottom of the cavity, and the effect of spalling from the top of the cavity. Spalling is a common problem in solution mining, where substantial chunks of rock salt fall to the bottom of the cavity, often damaging the solution mining apparatus.

2. The value of 6 ppm solubility limit for U was selected as representative of the values in the literature (ranging from 3 to 10 ppm). In addition, leach values were based on WRIT IAEA tests that are not static and, thus, not solubility limited. Actual analyses of the leachate from these IAEA tests using spent fuel are summarized below:

Solution	Range of U (ppm)	pH Range
WIPP Brine	0.4 - 4	4 - 7
NaCl (dilute)	0.3 - 17	4.5 - 5.0
$CaCl_2$	0.1 - 18	4.3 - 5.7
$NaHCO_3$	0.2 - 13	8.6 - 9.7
Deionized Water	0.3 - 27	3.9 - 5

Note that these numbers do not necessarily represent the maximum U that could go into solution; rather, they show examples actually found in non-static tests. The value of 6 ppm is seen to be average and not a conservative bound. The dose result would be essentially linear with the limit chosen. Thus, choosing the highest measured value would increase doses by nearly a factor of 5.

An additional source of information is cited in Davis and DeWiest (1966), where the concentration of U in actual ground water in the vicinity of U-rich sandstones is 18 ppm.

3. Congruent dissolutioning means that the non-uranium isotopes cannot go into solution any faster than uranium can. Because U represents the vast majority by weight of the waste form, each of the other isotopes is allowed to go into solution at considerably lower mass per time. This means the other isotopes are not solubility limited. This is, for

example, very important for highly soluble fission products such as Cs, which provide a substantial portion of early doses. If these were allowed to go into solution up to their own solubility limit, considerably higher doses would result.

4. We assumed no organics were present at the source or during geotransport. This could be nonconservative in that organics could reduce the sorption of the radioisotopes during geotransport. More importantly, organics could allow more radioisotopes to go into solution than the solubility limit of uranium would allow. Certain chelators could increase the source term by orders of magnitude. Potential sources of organics include: residue from repository construction phase, the oil cap around the waste, the use of an oil layer during the solution mining operation (frequently done today), the presence of organics from wastes other than spent fuel (e.g., low level, TRU), the use of the cavity for storage of organic compounds, and hydrocarbon pools adjacent to the salt dome. A particular problem with regard to low level waste would be the presence of decontamination agents (e.g., EDTA).

5. The spent fuel leach data were not used in the source term because since solubility limits were assumed. However, these data did provide the basis for estimating the bounds on solubility limit. When the solubility limit is reached; the assumption of congruent dissolutioning; how much water is necessary for the system not to be solubility limited. These bounds were so broad that it is highly unlikely that variation in the leach values would change the source term.

6. The continuing use of salt domes as resources is influenced by the multiplicity of uses associated with them (e.g., salt, hydrocarbon deposits, stable storage cavities). Salt has been a culinary and preservative resource throughout cultural evolution, and it has a biological basis, including a metabolic requirement for existence. Salt domes are sources of highly pure salt, are identifiable from the surface, and are not spatially homogeneous (i.e., the very nature of salt domes concentrates the resources at very localized sources). The current utilization of salt domes in the Gulf Coast indicates that all usable salt domes

(Griswold 1980) will be used in the next three centuries. The salt domes under consideration for nuclear waste storage are also under consideration for compressed air energy storage and for strategic petroleum reserves.

7. Solution mining is a means of remote-controlled removal of salt and has been used for several millenia. More recently, many of the salt domes in the Gulf Coast Interior Basin have been solution mined. This includes the solution mining and collapse of some domes in the early years of this century before general knowledge of nuclear phenomena. Thus, the historical record substantiates the fact that a technology level capable of dealing with nuclear waste is not a concomitant development with solution mining technologies.

8. The depth of placement of a cavity in a salt dome, whether for a nuclear waste repository or for other usages, is limited by the physical nature of the salt dome. It is necessary to maintain a sufficient overburden of the dome above a cavity to help preclude salt dome collapse; thus, a cavity optimally will not be at a depth much less than for the repository. Additionally, a cavity cannot as easily be maintained at greater depths, because the increased pressures result in faster creep rates; thus, a cavity will not optimally be at a much greater depth than for the repository. Many current solution mining operations occur at depths comparable to the repository.

9. The cavity formation was assumed to occur within the volume of 1370 acres x 20 feet, representing the height of the room times the spatial extent. This assumption seems reasonable in that the repository is to be backfilled to 80% with crushed salt. The creep may not make that volume homogeneous and more soluble than the intact host rock salt by the time (100 and 1000 years) of the intrusion. As discussed in Note 1, were this assumption relaxed so that 1.5% rather than 62% of the waste was exposed, the source term and results would not change.

10. Preferential dissolutioning of the backfilled material would dissolve the interior of the rooms, not the volume of intact host rock between rooms.

Thus, the entire 1370 acres need not be dissolved to dissolve all the previously open repository. This is inconsistent with Assumption 30, done deliberately to provide offsetting effects.

11. Implicit in this assumption is that the population does not become aware of contamination of salt by radioisotopes. As in Note 7, the society could do this mining without being cognizant of nuclear phenomena. Even if it knows about nuclear phenomena, the society may not monitor its salt for radiation. Currently, virtually no salt productions monitor their brine for radiation. To bound the question of length of salt consumption, doses were calculated for 1, 10, and 25 years of consumption. A possibility existed that the operational doses are high enough to provide short term health effects on the mine operators, thereby leading to termination of salt production. Such dose calculations have been made for this revised report. They show the occupational doses are not high enough to result in termination of the solution mine operations.

12. The saline plume during the first 15,000 years would not be potable, all the way to the discharge point. However, after the salt dome dissolves, the water may be potable even immediately above the waste. Recent draft regulations, however, would include even the nonpotable salt plume in the accessible environment and, thus, subject to numerical limits.

CHAPTER 4

COMPONENTS OF RELEASE SCENARIO ANALYSIS

The development of potential release scenarios is an integral component of any repository safety analysis. A release scenario describes in detail how a variety of natural geologic, human-induced, and waste-induced phenomena could alone or in concert cause a loss of isolation within the repository boundaries and host medium. A release scenario describes the state of the geologic and hydrologic system at the time of a breach. This information is used as input into the geohydrologic transport models, which simulate the movement of the radionuclides through the geohydrologic system to the accessible environment.

The scenarios developed for the salt dome reference site analysis assume both a multiple barrier system and no long-term human mitigation of the disruptive phenomena. The analysis also addresses the various disruptive phenomena over a one-million-year time frame and assumes a loss of institutional control after 100 yr (based on the EPA draft standards available at the time of scenario development and subsequently repeated in later EPA drafts). The near-field or waste-induced phenomena are outside the scope and are not systematically addressed within this analysis. However, to define the state of the geosystem at the time of a breach for the geohydrologic transport runs, several near-field considerations had to be addressed. The near-field assumptions are detailed in the release scenario descriptions in Chapter 5.

The multiple barrier concept is illustrated in Figure 4.1 and comprises several components. The waste form represents the spent fuel assemblies from Pressure Water Reactors (PWR) and from Boiling Water Reactors (BWR). The engineered barriers, for purposes of this discussion, represent the canisters surrounding the waste form, along with any overpack or engineered backfill placed around the canisters. The host repository medium is the Hainesville Salt Dome located in the East Texas Salt Dome Basin. Surrounding the repository and its host salt dome is the geosphere, which consists of the geological and hydrological systems of the following units: Queen City, Recklaw, Carrizo,

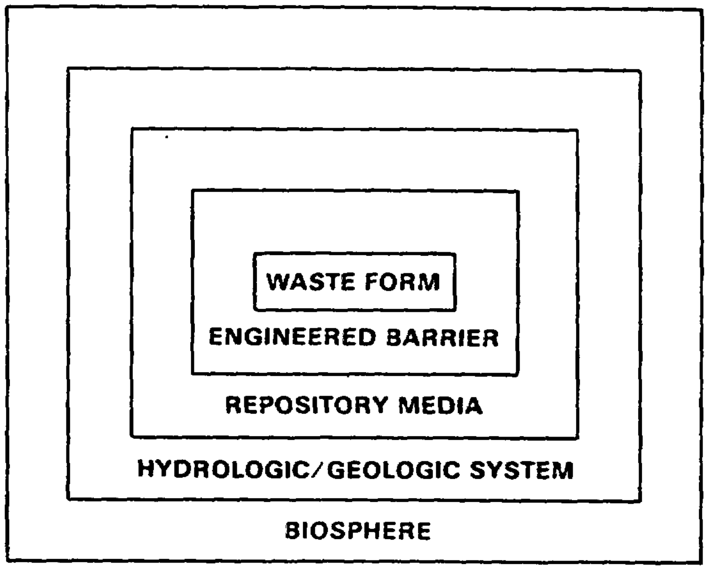


FIGURE 4.1. Schematic Representation of the Multiple Barrier System

Wilcox, and Midway Formations. For the purposes of this analysis, the biosphere is defined as that portion of the system starting at the earth's surface including surface hydrologic systems (i.e., rivers and streams). The accessible environment includes all parts of the biosphere plus those parts of the hydrogeologic system that are potential underground sources of drinking water.

There are three system states described in this safety assessment report: perturbation, breach, and failure. A perturbation is any change in the state of the geosystem as a result of some dynamic phenomenon, either natural or human-induced, acting upon the system. A perturbation of the system does not mean that there has been any loss of repository integrity. On the contrary, perturbations of the geosystem are assumed and expected to occur because of the dynamic nature of the geosystem.

A single perturbation or series of perturbations severe enough to cause a loss of containment within the confines of the repository boundaries constitutes a breach of the repository. A breach consists of a pathway for the movement of radionuclides and a transport medium (i.e., ground water) with sufficient potential to move them along the pathway. It is the description of the state of the geosystem at the time of the breach that is needed as input into the geohydrologic transport models for the consequence analysis.

These consequence analysis models simulate the movement of the radionuclides within the geohydrologic system until they ultimately leave the geosphere, enter the accessible environment, and potentially come in contact with human populations. This situation is considered to be a failure of the repository.

In short, a perturbation is any change in the geosystem; it may not alter the containment provided by the repository and host media. A breach is a single perturbation or combination of perturbations of sufficient severity to cause a loss of containment of the repository from the host medium; however, the geosphere may still isolate the waste from the accessible environment. An isolation failure is manifested when the radionuclides ultimately travel to reach the accessible environment.

When characterizing a breach of a repository and creating a release scenario, the pathway, transport media, time of occurrence and overall state of the geosystem at the time of the breach must be identified.

This analysis did not address the possible perturbation to the system induced by the original mining of the repository for the placement of the waste. Nor were the various waste-induced phenomena that could perturb the near-field environment of the repository considered. Inclusion of waste- or repository-induced effects could significantly alter the conclusions in this chapter concerning the incidence of natural breach scenarios. Further, the far-field analysis presented within this report assumed no engineered barriers, canisters, or waste forms other than the raw spent fuel assemblies.

The approach used to develop the release scenarios for use in this analysis was a modified Delphi/expert opinion approach. Currently under development by AEGIS is a more thorough and auditable scenario development methodology, which is scheduled to be ready for use in the actual repository licensing phase. Details on the release scenario methodology being developed are discussed in Appendix A.

The expert opinion approach for developing the release scenarios for this reference site analysis used the basic philosophy and methodology that are currently being developed by AEGIS. Because of the timing of developing the scenarios for this analysis, the full computer-assisted approach described in Appendix A was not sufficiently developed. However, several components of this AEGIS system were used in both qualitative and quantitative assessments of various phenomena. For example, parts of the climate and sea level submodels of the developing computerized methodology were used to describe the future states of these parameters.

In general, the scenarios were developed by the AEGIS staff and a team of consultants. The scenarios were then reviewed and revised by several organizations working on the overall PIR for ONWI and a consensus was achieved on a set of final scenarios. This process is described in detail in Chapter 5, Release Scenarios.

Because this was only a reference site analysis, no detailed site investigations were conducted. Rather, summary investigations were conducted by Law Engineering and Testing Company to gather available literature on the Hainesville Salt Dome. Additionally, information for other salt domes in the Gulf Coast of a similar nature were extrapolated to fit the Hainesville Salt Dome. A brief discription of the Hainesville Salt Dome and its surrounding geologic system is presented in the following section. A more detailed discussion is available in Appendix K. The scenarios developed for this analysis were based on limited geological site information and data and should not be construed to be totally complete and final. The scenarios and the approach should be considered as a representative case of a developing methodology.

When describing potential release scenarios it is important to focus on the mechanisms of the release. For this analysis the primary mechanisms addressed are: direct surface release of the radionuclides and long-term geohydrologic transport via communication between either the upper Queen City and the lower Wilcox aquifer, or direct communication through the salt dome between different portions of the Wilcox aquifer. While analyzing the potentially disruptive phenomena described in the following section, those credible phenomena that would influence and ultimately bound these release mechanisms were identified.

The scenarios for this analysis were developed using the following steps:

- identification of potentially disruptive phenomena
- description of phenomena interactions
- characterization of perturbations of the repository system
- characterization of potential breaches.

The remainder of this chapter deals with the first three scenario development steps listed above. Before formulating and postulating the scenarios for use in this safety assessment, a wide range of geologic and human-induced phenomena were identified and investigated in the context of perturbing the Hainesville Salt Dome. Most of the phenomena described were dismissed as either not having the potential to breach the repository or not being credible within the time frame considered and within the realm of the regional and local geologic setting. Some, however, did have the potential for disrupting a salt dome repository and were expanded, as described in Chapter 5, into release scenarios for input into the geotransport models for consequence analysis.

REFERENCE GEOLOGIC DESCRIPTION

This section contains a summary of the important geological and hydrological characteristics of the Hainesville Salt Dome and the surrounding region. The following discussion summarizes the local and regional geological information that is necessary for evaluating the suitability of siting an underground nuclear waste repository within a Gulf Coast salt dome. A more detailed presentation of this information is available in Appendix K. Because this is only a reference site analysis no actual field investigations were conducted at the site. This information was gathered from available literature, previous geologic investigations at the site, and information extrapolated from other similar salt dome locations. Unless otherwise noted, the geologic description of the Hainesville Salt Dome and its geologic environment is taken from a report prepared by the Law Engineering and Testing Company (1979b).

This reference site assessment is based on the Hainesville Salt Dome. This salt dome is located in the central part of Wood County in Northeast Texas (Figure 1.2), with the regional surface sloping generally from northwest to southeast. The Hainesville Salt Dome is one of 26 salt domes in the East Texas

Salt Dome basin. Within 200 miles of Hainesville are four cities with a population of over 100,000: Dallas, Fort Worth, Shreveport, and Waco.

Regional Geology

The East Texas Salt Dome Basin is part of the Gulf Coast geosyncline. This geosyncline was initiated in Late Triassic by a combination of block faulting and rifting in the continental crust. Subsequent sedimentation into the geosyncline resulted in the formation of what is now the Gulf Coastal Plain, an area of low relief that borders the Gulf of Mexico.

Depositional patterns in the northern Gulf Coastal Plain consist of periods of inundation, characterized mainly by deposition of limestone, alternating with periods of delta progradation and deposition of clastics. Stratographic units for this area have been correlated and are listed in Table 4.1.

Post-salt inundations began with the Smackover carbonates in the Jurassic and continued into the Cretaceous. A subsequent period of deltaic deposition culminated in the deposition of the Wilcox Group in Early Tertiary. Succeeding deposits were alternatively marine and non-marine. Late Cenozoic deposition consisted of terrace and valley-filling alluvial deposits in the interior salt basins. These deposits grade into marginal shoreline deposits and ultimately into marine sediments offshore. The sediments generally have a regional dip of about one degree to the south; however, posiments and negaments interrupt this pattern and form the predominant structural elements in the Gulf Coast basin.

During the Mesozoic, subsidence initiated the development of a boundary fault system above pre-existing basement faults. Subsidence on a geosynclinal scale began in the Lower Gulf Coast Basin during the Cenozoic. This period of subsidence initiated several new fault zones in the Gulf Coast Basin.

The development of salt domes has caused localized structural features. Movement of salt (to form salt ridges) within the Louann Formation began during the later part of the Jurassic Smackover deposition, and continued as additional sedimentation occurred. Diapirism was initiated in places where the salt was sufficiently thick. In the interior salt basin, diapirism climaxed during the Mesozoic, but diapirism in the coastal salt basin did not climax until the Late Tertiary.

TABLE 4.1. Stratigraphic Column East Texas Basin

Source: Law Engineering Testing Company 1979b.

Era	System	Series	Stage	Group	Formation	Unit
CENOZOIC ERA	QUATERNARY	RECENT				
		PLEISTOCENE				
	TERTIARY SYSTEM	EOCENE SERIES	LUTETIAN AUVERSIAN	CLAIBORNE GROUP	SPARTA FM.	
					WECHES FM.	
					QUEEN CITY FM.	
					REKLAW FM.	
					CARRIZO FM.	
			SPARNACIAN CUISIAN	WILCOX GROUP	UNDIFF. IN NORTHEAST TEXAS	
		PALEOCENE SERIES	DANIAN THANETIAN	MIDWAY GROUP	UPPER	WILLS POINT
					LOWER	KINCAID
MESOZOIC ERA	CRETACEOUS SYSTEM	GULF SERIES	MAASTRICHTIAN	NAVARRO GROUP	UPPER NAVARRO	
					NACATOCH SAND	
					LOWER NAVARRO	
			CAMPANIAN	TAYLOR GROUP	UPPER TAYLOR GP.	
					PECAN GAP CHALK	
					WOLFE CITY SD.	
					LOWER TAYLOR GP.	
				AUSTIN GROUP	GOBER CHALK	
			CONIACIAN SANTONIAN		MIDDLE AUSTIN	
					ECTOR CHALK FM.	
			TURONIAN STAGE	EAGLE FORD GROUP	EAGLE FORD FORMATION	U. SUBCLARKSVILLE SAND
						MIDDLE
						LOWER
			CENOMANIAN STAGE	WOODBINE GROUP	LEWISVILLE FM.	
					DEXTER FM.	
		COMANCHE SERIES		WASHITA GROUP	MANESS SHALE	
					BUDA LIMESTONE	
					GRAYSON SHALE	
			ALBIAN STAGE	WASHITA GROUP — GEORGETOWN	MAIN STREET LIMESTONE	
					WENO-PAW PAW LIMESTONE	
					DENTON SHALE	
					FORT WORTH LIMESTONE	
					DUCK CREEK LIMESTONE	
				FREDERICKSBURG GROUP	KIAMICHI SHALE	
					GOODLAND LS.-EDWARDS LS.	
MESOZOIC ERA	CRETACEOUS SYSTEM	COMANCHE SERIES	ALBIAN STAGE	TRINITY GROUP	PALUXY FM.	
				GLEN ROSE	UPPER GLEN ROSE FM.	
					MASSIVE ANNHYDRITE	
					LOWER GLEN ROSE FM.	RODESSA MEMBER
			APTIAN STAGE			JAMES LIMESTONE
			NEOCOMIAN STAGE			PINE ISLAND SHALE
						PETTET LIMESTONE TRANSITION ZONE
					TRAVIS PEAK FM.	
	JURASSIC SYSTEM	UPPER JURASSIC SERIES	TITHONIAN	COTTON VALLEY GROUP	SHULER FM.	
					BOSSIER FM.	
			KIMMERIDGIAN		COTTON VALLEY LS.	
					BUCKNER FM.	
			OX FORD		SMACKOVER LIMESTONE	
					NORPHLET FM.	
					LOUANN SALT	
					WERNER FM.	
					EAGLE MILLS FM.	
TRIASSIC AND/OR PERMIAN REDBEDS AND PALEOZOIC ROCKS QUACHITA FACIES						

Geology of the East Texas Salt Dome Basin

The East Texas Salt Dome Basin occupies the central portion of the East Texas embayment. The embayment is a coastal depression that occupies about 44,000 square miles of northeastern Texas. Embayment boundaries are defined by the Sabine uplift on the east and the Angelina-Caldwell flexure on the south. Sediments contained in the embayment range from Jurrasic to Mid-Tertiary and Quaternary in age. The East Texas embayment is thought to be controlled by negative down-faulted blocks on the southeast margin of the Ouachita foldbelt.

The limits of the East Texas Salt Dome Basin are rather arbitrarily defined, but the basin occupies about 10% of the East Texas embayment. Elevations within the salt dome basin range from 200 ft above sea level in the south to between 400 to 500 ft toward the Sabine uplift in the east and the Mexia-Talco fault zone in the west.

The basin is characterized by a marked thickening of Mesozoic and Cenozoic strata toward its center. The strata generally dip toward the Gulf at angles slightly steeper than the regional slope of the land surface. Tertiary strata form concentric outcrop patterns in the basin, being younger in the center and progressively older toward the borders.

The sediments of the East Texas Salt Dome Basin record a series of marine transgressions and regressions, superimposed on a progradational depositional basin. The basin contains a very thick formation of Louann salt, and most of the local structures in the basin are probably related to movements of salt from the Louann.

Geology of the Hainesville Salt Dome

The Hainesville Salt Dome is the northernmost shallow piercement salt dome in the basin. Its site area consists of approximately 542 square miles of rolling hill topography. Within this area the data used to characterize the salt dome include 11 wells penetrating the salt, one seismic reflection line, a basin gravity survey, and a number of wells in the vicinity of the salt dome.

The salt dome pierces 16,000 ft of strata, ranging from Late Jurassic to Early Tertiary in age. Caprock is believed to cover the top of the salt dome, with thickness ranging from 50 ft to more than 250 ft. This caprock is composed of a top zone of disseminated pyrite in carbonate, a middle zone of gray shaley limestone, and a lower zone of clear, very dense anhydriate. The salt dome itself is made of halite, with some evidence of shale inclusions on the periphery of the salt dome. At the repository depth, the salt dome is assumed to be approximately 2100 acres in cross section. Of this area, the repository would occupy about 1370 acres surrounded by an 800-ft buffer zone. An overhang exists from -10,000 ft MSL to near the salt dome top, with the largest diameter of the overhang occurring between -3000 ft to -5000 ft MSL. Below -10,000 ft MSL the salt dome develops a broad shoulder-like base down to -17,000 ft MSL, where the salt dome stock connects with the top of the Louann salt.

Subsurface mapping indicates a rim syncline adjacent to the salt dome. Some peripheral faulting at the boundaries of the site area is indicative of rim synclines in Late Lower Cretaceous to Early Upper Createaceous rocks. Subsurface mapping of the Woodbine and Austin Group indicates two peripheral, normal faults, which are related to rim syncline development during Lower Woodbine deposition. These faults have a displacement of 100-200 ft and are confined primarily to Upper Cretaceous rocks. Well data and published reports also show a fault offsetting Early Tertiary strata. This may be related to deeper Middle Cretaceous faulting (Dillard 1963). No central graben or radial faults have been mapped; however, they are assumed to be present under the recent sediments. A more complete discussion of local faulting is available in Appendix K.

Subsurface Hydrology

The hydrologic system in the vicinity of the salt dome consists of the following:

Geologic Unit	
Sparta Formation	aquifer
Weches Formation	aquitard/aquiclude
Queen City Formation	aquifer
Recklaw Formation	aquitard/aquiclude

Geologic Unit	
Carrizo Formation	aquifer
Wilcox Group	aquifer
Midway Group	aquiclude

The Midway extends well below the repository level and all aquifers below the Midway are quite saline. Thus, lower aquifer systems are not considered important in this preliminary safety analysis because they are not likely to be tapped for human usage and they are not likely to come in contact with the repository waste.

The Sparta and Queen City Formations were taken to be a single unit. Similarly, the Carrizo and Wilcox are treated as a single unit because the Weches is an incomplete barrier between them. The Wilcox-Carrizo aquifer is the most important aquifer in the study area. Most of the larger municipalities and industries in the region obtain their water from this aquifer. Further, this aquifer surrounds the salt dome at repository depth.

The Wilcox-Carrizo is very thick, so it has a moderate transmissivity despite a relatively low hydraulic conductivity of its sands. Pumping tests conducted in the aquifer in Wood County from eight wells indicated the following characteristics:

Transmissivity	600-19,000 gpd/ft
Well discharge rates	50-500 gpm
Specific capacities	0.8-9.7 gpm/ft of drawdown
Hydraulic conductivity	4-700 gpd/ft^2 (50 gpd/ft^2 average)
Storage Coefficient	0.00007-0.00027 (unitless)

GEOLOGIC DISRUPTIVE PHENOMENA

This section contains a summary of the geologic processes that alone or in concert could affect a salt dome repository.

Denudation and Stream Erosion

Denudation and stream erosion are both processes by which earth material is moved on the earth's surface. Denudation is considered over long time periods (>1000 years) and consists of the processes by which relief or elevation differences are reduced. Erosion consists of the processes by which earth material is loosened or dissolved and moved on the earth's surface. Stream erosion is that erosion performed by running water in streams or rivers and generally results in deepening the river or stream channels by downcutting.

Maximum rates of total erosion have been projected for the next 10^6 years for both denudation and river entrenchment (Mara 1980). Average values were also estimated. For the Gulf Coast region, denudation rates were given as 150 meters maximum and 50 meters average. These entrenchment values were given for the Mississippi River, both near its mouth and 200 km upstream (Mara 1980). The upstream values were chosen as more representative of the Gulf Coast Interior Salt Dome basins, and the possible rates were 40 meters maximum and 30 meters average. The values represent the river erosion occurring during each full glacial period. Also, it should be noted that a period of aggradation (deposition or building up of sediment) follows the erosion as the ice sheets melt and sea level rises. This period of aggradation replaces sediment removed during the preceding phase of erosion. Entrenchment values are probably lower for smaller rivers, and streams that drain smaller areas have less flow and carry less sediment. Denudation and stream erosion would not lead to a breach in the reference salt dome repository.

Sedimentation

Sedimentation, as a process in the Gulf Coast Interior Salt Dome region, is expected to occur primarily in the form of aggradation of river and stream beds. This sedimentation is a result of the ongoing process of land surface reduction by geomorphic agents, and of the transport of material to lower elevations. In a humid climate, such as the Gulf Coast now has, the most active geomorphic agent is running water. Therefore, most aggradation will occur in connection with rivers and streams. The Gulf Coast, in general, is an area of low relief, and it is unlikely that a large enough thickness of sedimentary material would accumulate to affect a salt dome repository at 600 meters or more in depth.

Considerable changes in sedimentation patterns are associated with episodes of continental glaciation (Mara 1980). Based on the known extent of past ice sheets, the Gulf Coast should be affected only indirectly by glacial phenomena, such as by changes in sea level and increased flow from meltwater in the major drainageways (e.g., the Mississippi River Valley).

A lowering of sea level and base level during major ice sheet growth would cause rivers and streams to deepen their channels and to remove material rather than deposit it. During the waning stages of glaciation, large volumes of water carrying large amounts of sediment would be available to the rivers that drain the area of melting ice. As the sea level gradually rises and river gradients are reduced, sediment would be deposited. However, the main effect for the central United States would probably be in the Mississippi River Valley. The Gulf Coast Interior Salt Dome region, with its general elevation of 100-plus meters above present sea level, should not be seriously affected by sedimentation associated with glaciation.

In summary, unless major or catastrophic changes occur in the geologic setting of the Interior Salt Dome area of the Gulf Coast, it is unlikely that a sufficient thickness of sedimentary material could accumulate to affect a salt dome repository.

Flooding

Flooding could possibly affect a salt dome repository, either by acting as a source of recharge water and increasing ground-water flow, or by attaining a sufficient depth of water for hydrostatic pressure effects to extend to repository depth. Both of these effects are considered unlikely to disrupt a repository at 600-plus meters in depth.

In general, surface floods are transient events. Their time duration is measured in days, at most, and then only along the major river systems. Smaller river systems without large, high elevation catchment areas for rain and snow, such as those in the Interior Salt Dome region of the Gulf Coast, would not be expected to generate larger or long-lasting floods. This lack of potential for large, long-lasting floods, plus the time lag associated with water infiltration and percolation, makes it unlikely that flooding would affect a salt dome repository after sealing. It is beyond the scope of this report to consider the effects of flooding before closure of a repository.

Climatic Fluctuations and Glaciation

The world climate varies considerably on a variety of time scales. Correlations have been found between past climatic changes and the periodicity of the earth's orbital parameters (at least to 0.4-0.6 million years before present). Solar activity has also been correlated with some past climatic effects. Even though it is not known how the various factors link together, or exactly how the climate system operates, observations from studies of the past one million years' (m.y.) climate can be used to estimate some of the possibilities for the next one million years. Human-caused climatic changes, as from increased CO_2 in the atmosphere or destruction of the ozone layer, are excluded from consideration here.

Some observations on record of the past one m.y. suggest that for only about 10% of the time was the climate as warm or warmer than at present. Also, the past record suggests that no interval of global climate with temperatures as warm or warmer than present lasted uninterruptedly for more than about 15,000 years. Past precipitation has been estimated indirectly from pollen studies, which indicate the type of vegetation that existed in the past. These studies have shown that during the cold stages of the Pleistocene, much of the U.S. was considerably wetter than at present.

Kukla (1978) has summarized potentially disruptive climatic processes for the next one million years. From the information contained in that study, it seems probable that future climatic changes will be toward a wetter, cooler climate. There is also sedimentary evidence of drier periods during parts of the Pleistocene. However, because drier conditions are not considered as likely to affect waste containment, a wetter climate is considered here.

Based on the climate record of the past one m.y., a cycle of continental glaciation can be expected to be completed about once in every 10^5 years. A glacial cycle consists of a glacial period (90-110 x 10^3 years) and an interglacial period (10-30 x 10^3 years) (Kukla 1978). For discussion purposes, only one glacial cycle is considered here. The change to a glacial period is believed to be the most significant and widespread climatic change, with respect to the integrity of a salt dome repository.

During a glacial period, the regional effects expected for the Gulf Coast Interior Salt Dome region would be:

- precipitation increase by less than a factor of 2
- temperature decrease of 3-4°C over the oceans (-10°C over land masses)
- sea level decrease of 100-150 meters.

Local effects would be the same as regional effects for precipitation and temperature, resulting in more rainfall and less evaporation-transpiration caused by lower temperatures. Sea level decrease would occur gradually, and the main local effect would be to lower the erosional base level and increase downcutting by rivers and streams. The increased erosion has been estimated to be 10-20 meters, with a maximum of 50 meters for the southeastern coastal U.S. (Kukla 1978).

These effects are not considered a threat to a salt dome repository at the proposed depth. An interglacial period would follow a glacial period, with warmer temperatures, less precipitation, and a rise in sea level causing aggradation or deposition. These processes would tend to replace some material removed by erosion. The fact that Gulf Coast salt domes have survived a number of glacial cycles during the past one million years is good empirical evidence that they have not been seriously affected.

There is no evidence of past glaciations having reached to the Gulf Coast, so the effects of an ice sheet lobe on the area (ice loading, scour, outwash flooding) are not considered in this report.

Diagenesis

Diagenesis is "all the chemical, physical, and biologic changes, modifications, or transformations undergone by a sediment after its initial deposition during and after its lithification, exclusive of surficial alteration (weathering) and metamorphism. It embraces those nondestructive or reconstructive processes (such a consolidation, compaction, cementation, reworking, authigenesis, replacement, solution, precipitation, crystallization, recrystallization, oxidation, reduction, leaching, hydration, dehydration, polymerization, adsorption, bacterial action and formation of concretions) that occur under conditions of pressure (up to 1 kb) and temperature (maximum range 100°C to 300°C) that are normal to the superficial or outer part of the Earth's crust, and may include changes occurring after lithification under the same conditions of temperature and pressure" (Gary, McAfee, and Wolf 1974). As used here, diagenesis also includes modifications experienced at the forming of the salt dome caprock, which is not a sediment.

Diagenetic processes are very active in and near the salt dome environment. Sediments above and adjacent to shallow salt domes (less than 1 km in depth) are generally drastically different from their surroundings as a result of two marked, diagenesis-promoting circumstances: unusual heat and unusual chemical concentration.

Salt domes often display locally elevated temperatures compared to surrounding sediments. These thermal anomalies are a result of the relatively high thermal conductivity of halite compared to Gulf Coastal sediments. Thermal conductivities of the sediments average 4×10^{-3} cal/cm^2-sec C, whereas rock salt averages 12.5×10^{-3} cal/cm^2-sec C (Law Engineering Testing Co. 1979a). Because salt is several times more efficient in transporting heat from depth than the sediments, salt domes act as heat conductors, elevating the temperature of the rock above and around the salt domes.

An important factor in salt dome diagenesis is the presence of flowing ground water. Diagenetic effects (and caprock) are most common near shallow salt domes because of the abundant supply of fresh ground water available. The effects are more obvious in the fast-moving shallow aquifer systems, because the approach to chemical equilibrium is more rapid. Ground-water velocities in near-surface aquifers may be on the order of 1 cm/day, as compared with 1 cm/year in aquifers occurring at greater depths (Etter 1978).

Chemical gradients required for diagenesis are commonly present in the salt dome environment, afforded by hydrocarbon compounds, brines, and trace constituents of the salt stock that are liberated by dissolution.

Hydrocarbon compounds are common constituents of the salt dome environment, and they play a complex and important role in near-dome diagenetic processes. Organic fluids, having a low viscosity as a result of the salt stock's high temperature, migrate along fracture systems and through tilted beds above and adjacent to the salt dome. Concentrations of methane and hydrogenous compounds serve as reducing agents, thereby promoting transformation of sulphates, such as anhydrite, to elemental sulphur, pyrite, or H_2S gas.

Brines, which may move upward from depth along the salt dome flank and via fracture systems, provide a source for the chemical constituents of some of the exotic minerals occasionally found in caprock. For example, celestite ($SrCO_4$) may be precipitated upon upward movement of ground water that has picked up large concentrations of Sr^{++} at depth.

Diagenetic processes such as those mentioned above can be expected to occur in the next one million years. However, the changes brought about by diagenesis are usually slow and relatively subtle and, hence, should not affect the integrity of a salt dome repository.

Salt Dissolution

Salt dissolutioning is perhaps the most obvious of potential disruptive processes for a salt dome nuclear waste repository. The fact that many of the Gulf Coast Interior salt domes have existed for tens of millions of years attests to the concept that massive dissolution by laterally or vertically moving ground waters is unlikely. However, this concept must be verified by detailed studies of salt dome dissolution mechanisms before a definitive safety assessment can be made. Dissolution may be initiated or even controlled by a variety of human-caused events or processes (e.g., solution mining) as well as by the natural action of ground water flowing over and around a salt dome. This discussion is limited to the description of the mechanisms and potential effects of salt dissolution occurring without the intervention of humans.

For rapid dissolution to occur, dome salt must be in direct contact with flowing ground water. Impervious barriers such as dense anhydrite caprock, clays, or marls must be absent. Ground-water flux at the zone of dissolutioning must be great enough to remove saturated brines and to supply incoming fresh or undersaturated ground waters. Clearly, the greater the ground-water flux of fresh or undersaturated water, the greater the potential for salt dissolution. The basic conditions for salt dissolution are potentially fulfilled wherever a salt dome intersects an aquifer system, or where structural features such as upturned beds and faults allow vertical ground-water movement along the salt-host interface. Accurate determination of the perturbing effect of dissolutioning upon a salt dome requires detailed knowledge of regional and near-dome hydrology, salt-sediment interface lithologies, and near-dome structure. That information is not available for this reference site assessment.

In the East Texas basin, only two aquifer systems appear capable of promoting active salt dome dissolutioning. These aquifers are the Woodbine Formation and the Carrizo-Wilcox Group.

The Woodbine consists of interbedded sandstones and clays with an average thickness of about 900 ft. Ground waters are saline, wth total dissolved solids attaining 100,000 ppm in the center of the basin. Average permeabilities are about 18 gpd/ft^2. Average porosities can reach 25%.

Typically, the Woodbine lies below the level of any nuclear waste repository. Average depths to the top of the Woodbine in Wood County range from -3700 ft to -4500 ft. However, faulting or folding associated with salt dome intrusion may have locally uplifted the Woodbine to repository depths. Definition of near-dome structure is, therefore, required to identify dissolution hazards posed by the Woodbine.

In some salt domes the Woodbine coincides with occurrence of salt dome overhangs. This situation has led to speculation that salt dissolution by Woodbine waters has produced the overhang configuration. However, regional studies of Cl/Mg ratios in Woodbine ground water suggest that such large-scale dissolution has not occurred. Most authorities relate salt dome overhangs to the mechanics of salt diapirism.

Woodbine waters rising along faults or upturned beds could also cause some salt dissolution. Saline springs present over some salt domes may be the result of such an occurrence. However, many other plausible explanations can be advanced for saline springs. For example, the salinity may be from salt dissolutioning via a fresh water aquifer, or may constitute a surface release of saline Woodbine waters without any active dissolutioning.

The Carrizo-Wilcox aquifer system is the most prolific fresh water horizon in Northeast Texas. Composed of complexly interfingering sands, clays, and lignite, the system has a thickness of several thousand feet. The aquifer is confined by the overlying Reklaw aquitard and often produces artesian well conditions in the center of the East Texas basin. Average permeabilities range from 50 to 184 gpd/ft^2. Regionally, the aquifer has a hydraulic gradient of about 3 ft/mile. Flow is typically downdip to the southeast, although salt dome structures may locally produce flow perturbations.

A number of East Texas salt domes appear to intersect the Carrizo-Wilcox at repository depths. Because of the aquifer's high permeability and low salinity, salt dissolution caused by this system can be viewed as the bounding case. Determination of the hazard posed by salt dissolutioning to a nuclear waste repository in a salt dome can thus be determined by defining the past and present dissolution rates caused by the Carrizo-Wilcox system. Probabilities for future dissolutioning may be estimated by determining the frequency of ongoing or past dissolutioning among Interior Gulf Coast salt domes possessing equivalent geological environments.

A variety of methods have been suggested for determining whether a salt dome has or is experiencing salt dissolutioning. They include: definition of faults, up-turned beds, sink holes, breccias and topographic features caused by solution collapse; calculation of dissolution rates based on caprock thicknesses; and mapping of saline plumes in the Carrizo-Wilcox aquifer. For repository safety assessments to have a technically sound basis, the assumptions and limitations of each method must be fully recognized.

A number of Interior Gulf Coast salt domes possess structural features suggestive of solution collapse caused by salt dissolutioning. In detail, the geology of each of these salt domes is quite distinct. All share some combination of faults, steeply inclined strata, sinkholes, breccias, and topographic features that are mechanically compatible with extension related to salt dissolution and attendant solution collapse. The Chestnut Salt Dome of northeast Louisiana exhibits perhaps the most compelling evidence of widespread solution collapse. At the Chestnut Salt Dome, the Eocene Cane River Formation has been rotated to nearly vertical, and fault thickened and thinned by a collapse affecting much of the top of the salt dome. Significantly, Pleistocene terrace deposits fill a portion of the graben, which is approximately one mile in width.

In contrast, the Vacherie Salt Dome of northeast Louisiana has only subtle structural features in unconsolidated Tertiary sediments that may be the result of only limited solution collapse. Because deformation associated with salt dome intrusion or growth may produce geometrically similar structures, further study is required to substantiate claims that Vacherie has undergone dissolutioning-induced collapse.

Other Interior Gulf Coast salt domes show topographic evidence of possible solution collapse. For example, a lake at the surface over the Palestine Salt dome of northeast Texas perhaps is indicative of widespread subsidence caused by solution collapse. Most salt domes possessing marked topographic expression are shallow (only several hundred feet below the surface) and may be exposed to dissolutioning by water table aquifers.

Although definition of the structural geology of any given salt dome may indicate whether widespread dissolution has occurred in the past, such a method is clearly an imprecise indicator of rates and probabilities for the next one million years. Structural features caused by salt dome growth may be confused with dissolution-induced deformation. Furthermore, because the age of deformed sediments are not known with great precision, it is not generally possible to place accurate limits on the timing and duration of a dissolution episode. Thus, discussion of dissolution mechanisms in a one million year time frame is typically not possible.

Caprock composed of stratified anhydrite, gypsum, and calcite is commonly present on salt domes. Caprock formation is most commonly attributed to large-scale dissolution of salt and attendant concentration of relatively insoluble impurities (sulphates and carbonates). Based upon the observation that dome salt is very pure (98.6% halite is a widely quoted figure), rates of salt dome dissolution can be calculated if the time period of dissolutioning is known. Most calculations use the assumption that the caprock formed during the time from Carrizo-Wilcox deposition to the present, which is a span of about 50 million years. Rates calculated by this method range from 0.031 to 0.183 mm/year. The maximum rate would breach a repository possessing an 800-ft thick buffer zone of salt in 1.3 million years.

The underlying assumptions caused the calculation of dissolution rates based upon caprock thicknesses are suspect in many ways. For example, the concentration of insolubles in dome salt is inadequately known. Individual salt domes may have quite different insoluble concentrations. A representative sampling of dome salt and definition of possible intradome compositional variations are needed to resolve this problem.

Another assumption requiring justification is the notion that all caprock formed in the last 50 million years. Convincing evidence exists that at least the Interior Gulf Coast salt dome considered in this reference site analysis (Hainesville Salt Dome) actually reached the surface and was truncated by surface erosion and dissolutioning. If this is the general case for Interior salt domes, then caprock may be a result of an extrusion episode occurring as long ago as Woodbine time (about 92 million years B.P.). Calculated rates of dissolution, based on a maximum caprock age of 92 million years, are a factor of two less than those based on a 50-million-year time span. Resolution of this uncertainty requires accurate dating of caprock and/or waters contained within the caprock.

Any salt dome that is currently undergoing dissolutioning should propagate a saline plume into the surrounding aquifer. Down-gradient measurement of water salinity (for instance, using suitably calibrated resistivity methods) should define this saline plume. This method has been used extensively to determine the extent (if any) of salt dissolutioning effected by the Carrizo-Wilcox aquifer system. Preliminary results indicate that from four to six salt domes in the East Texas basin are experiencing some degree of active dissolutioning.

Where saline plumes have been located, total dissolved solids concentrations can be used to estimate dissolution rates. The precision of this method is strictly dependent on the accuracy of ground-water parameters because the method is essentially an application of Darcy's Law. Using calculations of this type for a group of northeast Texas salt domes, it can be shown that an 800-ft salt buffer zone could be breached in about 2.7 million years. Assuming climatic changes that increase hydraulic gradients, such a breach could be moved up to about 2 million years.

The uncertainties inherent in this method raise questions as to its applicability for a safety assessment. Specifically, ground-water parameters are not well known for the near-dome environment. Values are usually those cited as average for the regional ground-water system. Such values are commonly distributed lognormally in natural systems, so that considerable variation is probable. Furthermore, resistivity methods may not be measuring saline plumes around salt domes, since they measure only ion concentrations. Ions may be present in the ground water from sources other than dissolution of a salt dome. For instance, though the Carrizo-Wilcox system is typically fresh, saline waters of unknown origin are occasionally penetrated by wells. Such waters may represent a local stagnation in ground-water flow, rather than a saline plume caused by the salt dome dissolutioning. Conversely, vertical movement of deeper saline waters into the aquifer is also a possibility. Near-dome environments typically contain numerous faults and upturned beds that may promote both upward migration of saline waters and local flow retardation.

Critical examination of rates of dissolution determined by methods described above reveals that they may be too great to extrapolate over long periods. Salt domes in the Interior Gulf Coast appear to develop from large massifs or pillows of salt. The volume of such salt pillows can be estimated by variation in sediment thicknesses around the salt dome. For example, it has been calculated that the initial salt pillow at Hainesville contained about 45 cubic miles of salt. The present Hainesville salt pillar contains about 9 cubic miles of salt. The remainder was lost through erosion or dissolutioning. Extrapolating the dissolution rates calculated above to the Hainesville case reveals that if they were operative throughout the salt dome's history, all of the salt in the salt dome would have been dissolved. Clearly, such rates are either incorrect, operated over a shorter span of time, or operated intermittently. Thus, it is vital to recognize that dissolution rates may accelerate or decelerate over time as a function of changing ground-water conditions.

In summary, calculation of credible, accurate dissolution rates is a major problem for salt dome assessment. Current methods may be adequate for giving an order of magnitude for potential salt dissolution, suggesting that natural salt dissolutioning poses little threat to a salt dome repository. However, the uncertainties inherent in current rate calculations are so high that a dissolution release scenario should be analyzed for its consequence in a safety assessment. The details for the natural dissolution scenario will be discussed in Chapter 5.

Salt Dome Growth or Diapirism

A number of theories have been suggested as the controlling mechanisms for salt dome growth. Among the more notable theories that have been postulated are Barton's (1933) theory of isostatic down-building and a similar theory by Nettleton (1934), known as the fluid mechanical concept. Halbouty and Hardin (1956) also propose several new ideas while building on these previous works. These salt dome growth theories, along with other proposed concepts and ideas, are discussed in some detail in Halbouty (1967). Some of the more recent work that has been done in the area of salt dome growth was done by Loocke (1978) and focused on the Hainesville Salt Dome. This resulted in a growth history for the Hainesville Salt Dome, along with other new ideas about the stability of many piercement salt domes within the Gulf Interior Salt Basin.

The following discussion was taken from Kehle (1980):

> Many "piercement" salt domes of the northern interior salt basins could serve as safe permanent storage sites for both nuclear and chemically toxic wastes. Suitable domes are stable and inactive, having reached their final evolutionary configuration at least 30 million years ago. They are buried to depths below the level to which erosion will penetrate during the prescribed storage period, and they are not subject to reactivation in the future. The cores of these salt domes are impermeable, permitting neither the entry nor exit of ground water or other unwanted material.
>
> ### Stable Salt Domes
>
> Stable domes are those that have reached their final evolutionary configuration. This status is characterized by a salt spine protruding from an eroded hole in the roof of a collapsed salt pillow, the latter being the reservoir that fed salt to the spine during an earlier period of maximum uplift. Such domes are not capable of reactivation because the reservoir of salt feeding the growth of the spine (the underlying salt pillow) has been completely evacuated. Neither additional sediment loading nor submergence will reactivate such a dome, because the original pillow has already collapsed entirely. Like a flat tire from which all air has escaped, no further collapse of the initial salt pillow is possible once all the salt has been squeezed from it.
>
> Nor will the salt spine float up through the overlying sedimentary rocks. In fact, buoyancy, per se, is never really operative in the evolutionary history of a dome. The stresses caused by buoyancy are insufficient to rupture the cover of sedimentary rocks. More importantly, the sediments surrounding the dome will not flow into

the void that would be created if the dome should begin to rise. In fact, the salt spine itself, being more fluid than the surrounding sediments, would flow back into the void, thus terminating any tendency for the spine to ascend.

Recognizing Stable Salt Domes: Stable domes are characterized by three factors: 1) a completely evacuated predecessor structure, 2) steep or overhanging flanks, and 3) continuous sedimentary layers across the crest of the structure.

Determining the growth history of a candidate dome verifies its evolutionary state. This is accomplished by reconstructing the growth history, step by step, using high-quality reflection seismic profiles. The profiles need to cross the dome as well as the surrounding area in a variety of directions. This affords the required data to permit a complete three-dimensional reconstruction.

Use of this method permits the identification of a predecessor salt structure for each piercement dome. These predecessors may be pillows, anticlines or similar structures. The time at which the sedimentary cover of the predecessor structure is breached is readily ascertained from seismic data. The collapse of the predecessor structure can also be tracked. This tracking of the predecessor's collapse establishes conclusively whether all or most of the salt has been evacuated from the predecessor structure, which in turn demonstrates whether there is any possibility of the reactivation of dome growth. At the same time, the rate of uplift of the salt stock can be determined by dividing the surface area of the stock by the volume reduction of the predecessor structure at a number of successive times. A plot of uplift rate versus time for a mature dome will exhibit a maximum in the rate of uplift (as much as 2000 feet per million years) during periods of maximum salt extrusion. A steady reduction of the uplift rate occurs after this maximum. The uplift rate declines to zero when all the salt has been evacuated from the predecessor structure.

Each dome follows this evolutionary history. Once a dome is past the extrusion phase, it is incapable of reactivation. Deceleration of the growth rate continues until it ceases altogether. Our observational skills are inadequate to identify the final date at which the last millimeter of uplift occurred, but that final date has no bearing on the problem at hand. Once the growth rate of a dome decelerates to a negligible value, the potential for further growth is limited to such a small value as to have no bearing on the safety of a repository.

Epeirogenic Displacement

Epeirogenic activity consists of broad, gentle movements of the crust that occur in stable cratonic areas, as opposed to the intense, orogenic deformations that occur within mobile belts.

Since Middle Triassic time, the Gulf Coast region has been the site of a small amount of crustal warping in the form of subsidence. According to R. O. Kehle,[a] tectonic subsidence (produced by cooling of a thermal anomaly) prevailed until Early Tertiary. Subsidence of the Interior salt basins ceased at that time because sedimentation in these basins had kept pace with subsidence. As a result, the Interior basins have been essentially filled and, therefore, have no potential for further subsidence resulting from sediment loading. In contrast, sedimentation in the Central basin (present Gulf of Mexico) during Mesozoic time was slower than subsidence. Although tectonic subsidence ceased by Early Tertiary, the Central basin continued to subside because of sediment loading. Load-induced subsidence of the crust beneath the northern Gulf of Mexico still occurs today, as the Mississippi River dumps large volumes of sediment into the basin. Subsidence should cause no concern with respect to safety of a waste repository in a salt dome, because the Interior salt domes, not the Gulf Coast domes, are being considered as possible sites. It has been suggested that the Gulf Coast is a potential site of lithosphere uncoupling and subduction because of the loading and thermal effects from the sediment prism that has been deposited in the Gulf of Mexico. This could happen during the next million years; however, it is a virtual certainty in the more distant future. Because of this and the possible effects it could have on both the epeirogenic displacement and faulting, it should be studied in more detail during future analyses of the Gulf Coast salt domes.

Orogenic Diastrophism

According to Kehle (1978):

> The northern interior salt basins of the Gulf of Mexico region are generally free of diastrophic activity that might pose a hazard to the safe storage of nuclear wastes. This fact is not surprising because these basins are located well within the North American tectonic plate, far away from both interplate and intraplate tectonic activity. Although the sediments in each of these basins are

(a) From an unpublished report to Law Engineering Testing Company, Marietta, Georgia, entitled Tectonic Framework and History, Gulf of Mexico Region (1978).

moderately deformed, most of the deformation resulted from nondiastrophic causes, principally movement within underlying salt layers. Those few structures resulting from crustal deformation are no longer active, being related to one of several ancient periods of deformation in the region. The only movement continuing today is subsidence of the coastal basin, which results in oceanward-tilting of the entire region. This tilting, in turn, causes some adjustment between basement blocks. These adjustments are accompanied by the release of seismic energy, but the resultant low-magnitude earthquakes pose no hazard to man-made structures.

The conclusion is that diastrophism will not breach a repository located in the reference salt dome.

Faulting

The danger presented to a nuclear waste repository by faulting is a commonly expressed concern. As will be shown below, however, faulting and attendant vibratory shaking do not present a credible hazard to a waste repository located within an East Texas salt dome.

Assessment of the danger posed by faulting and seismic activity requires examination of the following factors:

- location, age, displacement, and causes of faulting
- recorded seismicity
- effects of vibratory shaking and fault displacement on an underground facility.

Nature of Known Faults in the Gulf Coast Region

In the Gulf Coast region as a whole, four types of faults are present:

1. basement faults initiated in the Late Triassic by continental rifting associated with opening of the Atlantic and of the Gulf of Mexico;
2. flexure or boundary graben faults resulting from hinge-line bending and/or downdip salt flowage;
3. growth or penecontemporaneous faults developed in areas of rapid, thick sediment accumulation; and
4. faults associated with salt dome formation, denoted here as dome- or piercement-induced faults.

According to Kehle (1978a):

> There was major pervasive extensional faulting throughout the Gulf region during the early Mesozoic. This faulting resulted in significant crustal attenuation, thereby converting the previous continental area into the series of basins that exist today. This episode of major crustal disruption ceased entirely during the middle Jurassic, about 150 million years ago. Some faults within this system were reactivated during the middle Cretaceous, about 100 million years ago. But this latter episode was short-lived, probably confined to less than a 5 million year interval.
>
> Throughout the history of the area, these same basement faults served as the locus for adjustments between basement blocks during periods of basin subsidence. They accommodated differential subsidence of crustal blocks of different thickness by permitting decoupling between the blocks. Although the interior basins ceased subsiding about 45 million years ago, some decoupling still occurs today. This decoupling is the result of active subsidence of the Gulf basin to the South. Decoupling is accommodated piecemeal by small movements along the old faults, accompanied by minor releases of seismic energy. This kind of activity is likely the cause of the few minor earthquakes reported from this region.

Three major fault systems are located on the periphery of the basin. Of interest here are the Balcones Fault System, the Mexia-Talco Fault Zone, and the Mt. Enterprise Fault System. The Balcones, Mexia-Talco, and Mt. Enterprise fault systems are flexure or boundary graben faults. Though all of these fault systems are on the periphery of the East Texas basin, they will be briefly described for the sake of completeness.

The following paragraphs on the Balcones system were taken from Kehle (1978a):

> The Balcones fault system, which separates the Edwards Plateau from the Gulf of Mexico province, was active during the Miocene and possibly into the Pliocene. But no offsets of Pleistocene fans or terraces have been observed, indicating that the system has been inactive for several million years at least. Presumably, the faulting was related to the epeirogenic uplift of the western United States. Although related tectonic activity continues today, it apparently does not result in further tilting of the High Plains of Texas. Consequently, the Balcones fault system is no longer active.
>
> The Balcones fault system is capable of reactivation, should uplift of New Mexico and Trans-Pecos Texas resume. Whether this is likely is highly problematic. Details of the evolutionary history of incipient rifts are inadequately known to allow making absolute statements regarding the future history of this area.

> Because the Balcones fault system is located far from most candidate domes, this fault system poses no direct hazard to storage facilities located within the basins... .

The Mexia-Talco and Mt. Enterprise systems are most commonly represented by a complex graben. The following general discussion is taken from Kehle (1978b):

> The system of faults bounding the northern interior salt basin is only indirectly related to the basement-fault systems. The boundary faults are at the outer periphery of the Triassic block-faulted terrain. They have a long evolutionary history, being active about 110 million years from mid-Jurassic through Eocene time. Movement along the faults within the boundary-fault system apparently resulted from either salt flow away from a buried basement scarp, or from bending (because of differential subsidence) across a boundary between thin crust underlying the basins and thick crust underlying the surrounding continental mass.
>
> Neither process is operative today. 1) There is no bending because there is no subsidence. This is because the basins are filled to capacity with sediment, so no accommodation by subsidence is necessary. 2) No salt flows from beneath the fault system because all the salt has been evacuated previously. This evacuation is shown by both seismic and well data.
>
> Because of the nature of the causitive mechanisms, the faults in the boundary system are not subject to reactivation. For example, because all salt has been evacuated from beneath the boundary faults, no more can escape. Thus, this mechanism cannot cause further displacements. Similarly, because the basins are already full to capacity, no additional subsidence can occur. This lack of potential for subsidence can be explained by the fact that the basin, as well as the surrounding continental land masses, is in isostatic equilibrium. The absence of offsets in Pleistocene alluvial fans and river terraces along the boundary-fault system confirms the lack of movement in the recent geologic past. Our understanding of the cause of movement along the boundary-system faults allow us to state unequivocally that no future movement is possible until the tectonic regime changes.

Growth faults, like the fault systems discussed above, are not present in the East Texas basin. They occur as a result of thick sediment accumulation in the coastal plain, continental shelf, and the continental slope areas of the Gulf Coast region (Kehle 1978a). Growth faults that move aseismically are caused by sedimentary instability; hence, displacement generally ceases when the unstable shelf-edge environment builds farther gulfward (Law Engineering Testing Company 1978b).

Faulting is commonly associated with piercement salt dome formation. According to Kehle (1978b):

> Movement within the salt is accommodated by deformation in the overlying sediments. Structures of this type are local, and their formation is aseismic. Ground displacement is the only hazard they pose to man-made structures. Consequently, the only structures that need to be considered are those associated with candidate domes. Generally, these faults occur only within the sediments surrounding a dome and do not penetrate the salt core itself. Where this is true the faults would not affect the structural integrity of a repository. The faults will offset ground water flow, which may or may not be of consequence in the selection and design of a repository. Such determination will need to be made on a site-by-site basis.

Recorded Seismicity

The entire northern Gulf Coastal Plain is assigned a seismic risk of Zone 0 (no damage) or Zone 1 (minor damage), which corresponds to intensities V and VI of the Modified Mercalli (MM) Scale. The East Texas Basin and the Mississippi Basin straddle the Zone 0-Zone 1 boundary. The North Louisiana Basin is within Zone 1. This is the result of its proximity to the New Madrid seismic province.

Within the extent of the Gulf Coastal Plain seismic province, the maximum historic earthquake, less than VI MM, is the 1930 Donaldsonville event (southern Louisiana). VII MM events occurred in the adjacent Ouachita System seismic province, which extends inland from the peripheral flexure faults.

In general, the minor seismic events recorded in eastern Texas are not appended to known structures (e.g., the Mt. Enterprise Fault System). Exceptions include activity caused by growth faults in the Houston area, and events probably caused by pressurized brine injection into producing oil fields. Surface displacements have also never been associated with any recorded seismic event.

Effects of Vibratory Shaking and Fault Displacement

Sensitive surface facilities, such as nuclear reactors, require extensive engineering to withstand potential vibratory shaking induced by earthquakes. One would expect a subsurface facility, backfilled to entirely eliminate free surfaces, to experience very little vibratory excitation. In fact, data from underground nuclear explosions conducted at the Nevada Test Site indicate that open subsurface tunnels and boreholes experience no significant vibratory damage, even when ground motion is up to several tens of g (Wight 1978). The only significant damage reported in the 40 tunnels examined at the Nevada Test Site was caused by fault displacement rather than vibratory excitation. Given the low intensity of Gulf Coast seismic events, and assuming proper backfilling procedures, vibratory shaking is excluded as a credible hazard to a northeast Texas salt dome repository in a one-million-year time frame.

Because recorded seismicity in East Texas is not appended to known structures, it is possible to consider low intensity events as occurring randomly through the region. Thus, small displacement, normal faulting (high-angle reverse or thrust faults are virtually unknown in the Gulf Coast) can be assigned an occurrence probability in the salt dome vicinity over the next one million years. The probability of such an event is a function of the recorded frequency for the region.

The effect of small displacement, normal faulting upon the salt dome environment is a topic of current research. Indications are that such a structure would be, in essence, analogous to a salt dome-induced fault in geometry and probable effect. The mechanisms of such a fault would not, however, be related to salt dome growth. Differential sediment compaction, solution collapse, or secular motion on a flexure fault could conceivably cause small normal displacements. The Hainesville Salt Dome has existed for at least 38 million years (age of the youngest faulted near-dome sediments) with such fault structures nearby.

Conclusions on Faulting

Throughout this discussion, it has been assumed that the regional stress state of the East Texas region will not change in the next one million years. This assumption is compatible with both observed plate tectonic velocities of several centimeters/year and the millions of years of tectonic quiescence demonstrated in the geologic record.

The effects of near- and far-field faulting on a salt dome nulcear waste repository are not deemed credible release hazards for a million-year time frame. Specifically:

- Available evidence indicates that known faults in the East Texas basin are inactive.
- Recorded seismicity for the entire Gulf Coast is very low in intensity (maximum = VI MM).
- Vibratory shaking hazards for a properly backfilled subsurface facility are negligible even for very strong ground motion.
- Normal faulting of small displacement in the salt dome vicinity is assumed to have a finite occurrence probability over a one-million-year time period. The consequence of such faulting is not considered a credible disruptive event because of the existence of many similar faults that have not produced salt dome disruption over at least a 38 million-year time span.

Metamorphism

Metamorphism is the process by which consolidated rocks are altered in composition, texture, or internal structure by conditions and forces not resulting solely from burial and the weight of subsequently accumulated overburden. Pressure, heat, and the introduction of new chemical substances are the principle causes of metamorphism. The resulting changes, which generally include the development of new minerals, are a thermodynamic response to a greatly altered environment. Rocks can be affected by contact metamorphism or by regional metamorphism, both of which are related to orogeny or tectonism. The Gulf Coast region has been reasonably stable for a very long time. As stated by Law Engineering Testing Company (1978b), "...the Gulf Coast region does not show evidence of igneous activity since the end of the Cretaceous period, approximately 70 million years ago." The only crustal activity in the Gulf Coastal Plain at present is a very slow subsidence, and there is no indication that a change is imminent. Major orogenic activity and subsequent metamorphism cannot be expected to affect the Gulf Coastal region in the next one million years, and, hence, do not represent a credible breach scenario for the salt dome.

Magmatic Activity

Magmatic activity, both extrusive and intrusive, cannot be expected to affect a nuclear waste repository in a Gulf Coast salt dome within the next one million years. The Gulf Coastal Plain is not characterized by mobility; the only crustal activity at present is a very slow subsidence. The last magmatic activity in the Gulf Coast area occurred many millions of years ago. According to Law Engineering Testing Company (1978b), "...the Gulf Coast region does not show evidence of igneous activity since the end of the Cretaceous period, approximately 70 millions years ago." There is no indication that an increase in activity in the Gulf Coastal area is imminent, and magmatic activity cannot reasonably be expected to occur in this area within the next one million years.

Static Fracturing

Salt has the capacity to creep slowly and thereby to heal static fractures that might occur. Two types of static fracturing are surficial fissuring and hydraulic fracturing. These fracture mechanisms are non-tectonic.

Surficial Fissuring

According to Davis (1980), surficial fissures are near-surface fractures that result from tensile failure. They may be produced by stresses related to phenomena such as differential compaction of deep dessication sediments, changes of temperature, and short-term stresses from nearby earthquakes. These fissures are most common in valleys of the Southwest that contain nonindurated sediments. They are commonly found in Arizona, California, and Nevada. Surficial fissures are believed to extend to depths of about 100 meters. This type of feature should not affect a nuclear waste repository at a depth of several hundred meters. Furthermore, the ability of salt to self-heal would minimize the damage caused by these fissures if they could somehow reach to repository depth.

Hydraulic Fracturing

Hydraulic fracturing is often used to increase the permeability of a rock unit. Water is pumped into the formation until the strength of the rock is exceeded. The rocks fail by fracturing. Hydro-fracturing possibly may be induced in the rocks surrounding a salt dome, but there would be no reason to initiate such fracturing in the salt dome itself. Salt domes are obviously not good aquifers; they are rather impermeable, and any water obtained from a salt dome would be salt-saturated and unsuitable for drinking. It is, therefore, unlikely that humans would attempt to obtain water from a salt dome by initiating hydraulic fracturing. Salt domes might, however, be exploited for the minerals which they contain. Mining of salt domes will be addressed in Chapter 5.

Meteorites

Meteorite impacts are disruptive to the surface and near-surface of the earth, as such places as Meteor Crater in Arizona testify. The frequency of meteorite impacts is quite well documented from studies of both the earth and moon's surfaces, and the expected number of impacts for a given time period can be calculated from results of these studies (Hartmann 1978; Claiborne and Gera 1974).

The probability of a meteorite large enough to disrupt a repository at a depth of about 600 meters has been given as 2×10^{-6}-10^{-7} per million years, depending somewhat on the area of the repository being considered.

There is not universal agreement at this time on how the energy of a meteorite impact is dissipated. One recent study has suggested that about 40% goes to heating of the material, about 50% into crushing or plastic deformation, and about 10% into ejecta kinetic energy (O'Keefe and Ahrons 1977). The largest part of the ejecta-related energy goes into lifting shattered material, most of which falls back into or near the crater, and probably less than 1-3% of ejected material should be considered airborne.

Fracturing of material below the actual crater depth occurs in material that yields by brittle fracture. For high energy impacts, the fracturing can extend to 0.6 crater diameter in depth. If an impact occurred directly over a salt dome repository, fractures could extend to repository depth even though the crater itself did not reach the repository. Assuming fractures occurred and remained open, they could act as conduits for ground water, if present, and the scenario would become a variation of the dissolution case.

The low probability associated with the impact of a meteorite large enough to breach a salt dome repository makes this so unlikely that it should not be considered with other more likely events. Because of this low probability (10^{-6}-10^{-7} per million years), plus the fact that the probability is well established from observed data and is independent of terrestrial events, this phenomenon is not considered further here.

Undetected Features

An assumption implicit in the above discussions is that the best geological and engineering methods or judgments will be used during repository site selection and construction. However, human error or negligence cannot be entirely ruled out as a contributing factor in any given repository release scenario. Possible examples of engineering error include:

- failure to backfill and seal correctly portions of the repository or repository shafts
- construction-induced fracturing of the salt buffer zone around the repository
- incorrect spacing of waste canisters leading to local thermal and radiation gradients that exceed design limits.

Some of the above examples of engineering error may fall outside of the currently defined scope of AEGIS (i.e., covered under waste-induced effects and operational phase safety assessments). They are still of considerable interest to AEGIS because they may significantly alter the initial boundary conditions of the repository long-term isolation phase.

A possibility also exists that, despite best available geological and engineering judgment, important features or processes will remain undetected during repository site selection and construction. Examples include:

- on-going salt dissolution
- undocumented boreholes
- permeable zones (shear zones) within the salt dome.

Shear zones are vertically oriented planes within the salt dome along which sediment inclusions, anhydrite, and coarsely recrystallized halite are localized. In several mines located in coastal salt domes, shear zones have contained significant amounts of brine. Studies are currently being conducted to determine if the source of the brine is connate or exterior. Shear zones are believed to form during the process of salt dome growth (Kupfer 1974). As no further salt dome growth is possible in East Texas basin salt domes (see the section on diapirism), shear zones will not form in the future. The danger to the repository is from shear zones that may be undetected during repository site selection and construction.

Note that all these undetected features that would promote the same disruptive processes (i.e., dissolution) are actually analyzed in the dissolution scenario. Once credible probabilities are assigned to the occurrence of undetected features, they may be treated as subsets of fundamental disruptive phenomena.

HUMAN-INDUCED DISRUPTIVE PHENOMENA

A comprehensive assessment of the safety of a nuclear waste repository must include some analysis of how humans might cause a future interaction between remaining radioactive materials and the human environment. The consequences and likelihood of deliberate or inadvertent human intrusion, in terms of radionuclides released, could far outweigh the consequences of release through gradual ground-water contamination. For this reason, consideration of how future human activities might affect repository safety must be incorporated, in some manner, into potential Type 3 release scenario analyses.

At this time a structured methodology for dealing with potential human-induced repository breaches has not been developed. It seems unlikely that the probabilities for such events could be quantified as the events and processes in the geologic realm currently are. The history of human activities is extremely brief in comparison with geologic history. While the probability of occurrence of geologic activities can be quantified based on long-term histories of those activities, human activities cannot be similarly treated. Geologic processes are dated in millions of years; hominid predecessors, *Australopithecus* and *Homo habilis*, however, have existed only within the past few million years. The appearance of modern man is dated from about fifty thousand years ago, while the existence of agricultural systems and the recording by man of history can be traced for only a few thousand years. Any analysis that would attempt to categorize past human activities and project those categorizations into the future must currently be qualitative in nature and highly uncertain in its predictions.

An analysis of future human-induced activities that might compromise the integrity of a repository sited in a salt dome can be structured to discuss a range of potentialities. The methodology involves an examination of the range of known past human activities that might, if repeated, breach the repository. Separate analyses can be made of those activities that would breach the repository intentionally and those that would result in an inadvertent breach. In addition, some conclusions can be drawn about the probabilities of both types of breaches while the repository remains under the control of some governmental or institutional entity and while information about the nature of the repository and the materials it contains, is available for effective use.

Institutional Control and Information Transfer

There exist at least three phases of institutional control based on predictive reliability:

- short term (less than 50 yr after closure of repository)--reasonable predictions can be made about stability, goals and operation of human institutions, as well as degree of uncertainty
- intermediate term (100-200 yr after closure of repository)--predictions are based largely on extrapolation or projection of present trends; there is a limited degree of confidence, which decreases with time
- long term (more than 100-200 yr after closure of the repository)--uncertainties dominate.

Draft Environmental Protection Agency (EPA) regulations on disposal of high-level radioactive waste, available at the time of scenario development and in subsequent drafts, state that controls for the repository that are based on institutional functions cannot be relied on for longer than 100 yr after closure. For purposes of this analysis, loss of institutional control, regardless of cause, is presumed at 100 yr after repository closure.

One of the purposes of control of the repository site is the transfer of information about the nature of the repository and the dangers inherent in the release of the radioactive materials it contains. Implicit in the loss of physical control of the site is the possibility that effective intergenerational transfer of information would be lost, or that only a partial transfer through written records would be made. Current EPA draft regulations require supplemental controls to be designed using the most permanent markers and records practicable to communicate the nature and hazard of the material and its location. In spite of these precautions, some probability exists that information transfer might not effectively survive, intact and intelligible, for any period significantly longer than that presumed for institutional control to the degree necessary for reliance in protecting the accessible environment from the radioactive wastes.

The remainder of this analysis will look at the various potential reasons the site could be intentionally breached, the possibilities and results of potential inadvertent breaching, and the interactions of both institutional control and available information with the potentialities for breaches.

Intentional Breaching

Breaching a salt dome repository intentionally can be postulated for both short- and long-term periods of time. Such an intentional breach is here defined as a knowing intrusion into the repository structure for some deliberate purpose. In the short-term, it is presumed that institutional controls would still be in place and would be designed adequately to deter or repel any attempt at deliberate invasion of the repository site. More importantly, consensual deliberate intrusion while the repository is under institutional control would involve a contemporary societal decision to assume the burden of those actions. Hence, the onus of risk falls onto that society rather than today's.

Deliberate intrusion at some time in the future beyond that point at which institutional controls must be presumed lost is a more likely scenario. Given the complete loss of institutional control over the location and loss of hazard warnings, future human activities could deliberately intrude in such repositories without having or using reconnaissance technologies that would advise caution against radiation exposure. The comparative danger of intentional human intervention following waste emplacement and repository closure would probably be much greater if the wastes were in a surface or near-surface repository rather than in deep burial. Future societies capable of deep penetrations of geologic media would likely have a range of reconnaissance tools available and mechanical techniques for probing the environment near economic development activities. A society capable of intentionally breaching a repository as a known anomaly with unknown contents could be capable of assessing beforehand the possible consequences of that breach and thus assuming the risks inherent in such a breach.

On the other hand, the geologic repository program is based on a judgment that it is incumbent upon the present society, which is benefiting from the processes that generate hazardous materials, to minimize the danger to future societies from those materials. Therefore, inadvertent human intrusion must be addressed in assessing the post-closure safety of a nuclear waste repository.

Inadvertent Breaching

For purposes of this analysis, inadvertent breaches are those caused by activities carried out without knowledge of the presence or purpose of the repository, thus assuming that enough time has passed to make loss of institutional controls and/or effective information about the repository likely. The physical features that make a salt dome attractive as a repository for nuclear waste isolation also make it attractive for future alternative uses. Salt domes are large, accessible concentrations of a relatively pure mineral, making them valuable natural resources. Also, salt domes are attractive for underground storage space because of their impermeability, plasticity, relatively high thermal conductivity and geologic stability. Figure 4.2 depicts the potential competing uses of salt domes.

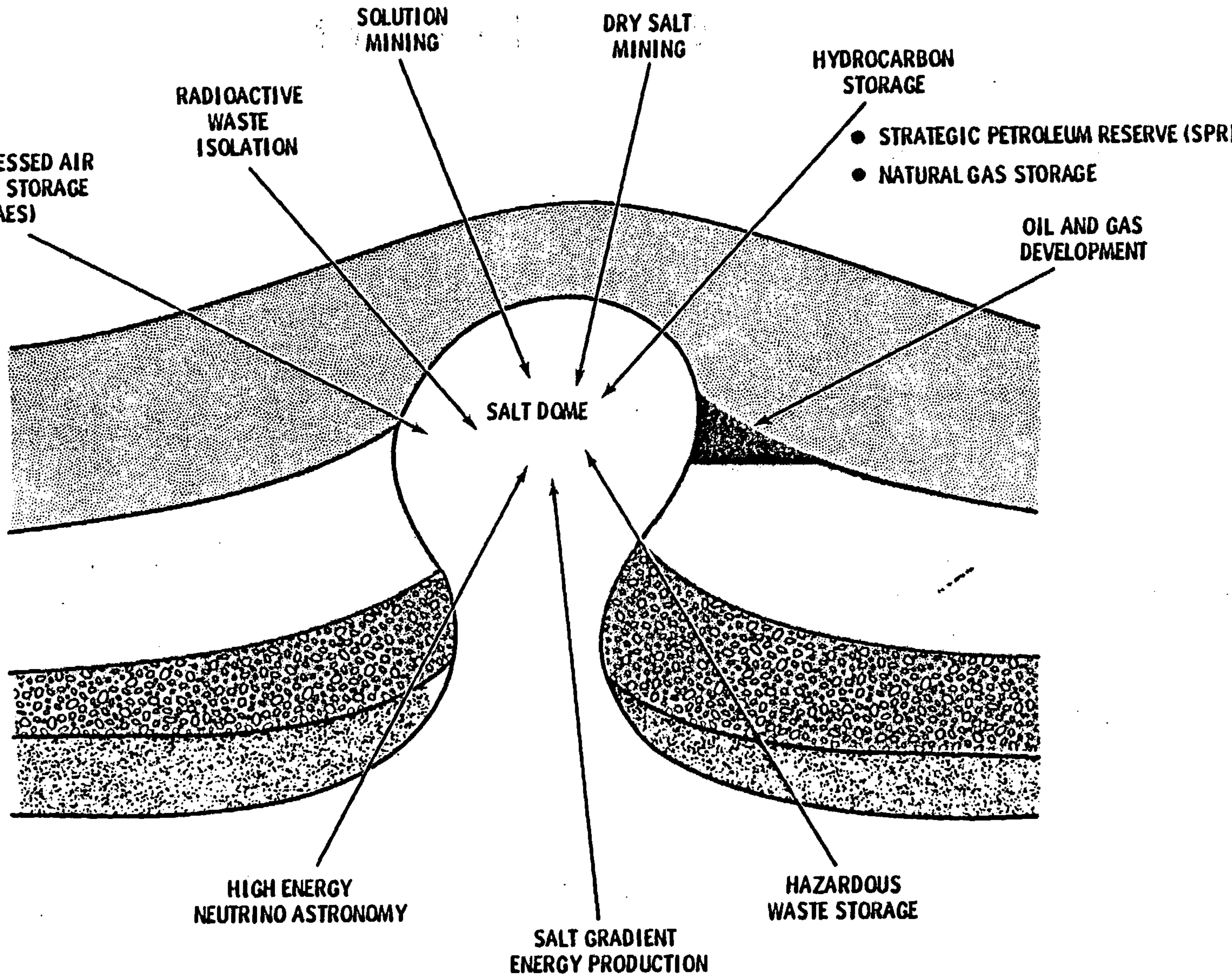


FIGURE 4.2. Potential Competing Uses of Salt Domes

The geologic advantages of salt domes for long-term isolation of radioactive wastes could be offset by the potential for inadvertent breaches caused by the known past and probable future competing uses of salt domes. The utility of salt domes for underground storage and as a valuable source of accessible minerals will encourage future use. Therefore, future human activities in or near a salt dome have a reasonable chance of occurring.

Exploration and extraction of minerals from a salt dome containing a nuclear waste repository could potentially result in the breach of that repository. The severity of the breach and the amount of waste material released into the accessible environment are dependent upon the method of exploration and extraction used, the location of exploration and/or extraction with respect to the repository, and the society's level of technology and/or ability to monitor for radioactivity. Even though a society does attain the ability to monitor for radioactivity, there is no reason to assume that monitoring would occur during routine exploration for, or extraction of, minerals. The human activities that lead to future unintentional intrusion into a salt dome repository are discussed in the following section.

Mineral Resource Exploration and Acquisition

Salt dome formations are frequently associated with deposits of shale, sulfur, oil, natural gas, and commonly very high grade salt (>95% NaCl). The minerals associated with a salt dome can vary greatly, depending on its depth, location, and the length of time since the salt dome was active. Historically, a number of salt domes have been involved in mineral exploration and mineral extraction. The methods and processes for exploration and extraction differ according to such factors as mineral type, depth to minerals, level of technology available, and economics. Basically, these methods include conventional mining and excavation (room and pillar), solution mining, and drilling.

Sulphur has been commercially mined or recovered from salt domes since about 1920. A typical salt dome sulphur deposit is contained in sulphur-bearing limestones in the caprock overlying the salt. Sulphur is extracted from salt dome formations using the Frasch Process. The Frasch Process, developed in 1894, involves drilling a well into the sulphur-bearing caprock, pumping hot water into the well to melt the sulphur, and withdrawing the sulphur slurry. The caprock creates a sealed vessel, so bleed-water wells are placed at the flanks to reduce pressure. Mining for sulphur in this manner would not result in the direct breach of a repository located in a salt dome; however, it could produce secondary effects (e.g., pressure-induced fractures) that could provide a pathway of radioactive material transport to the accessible environment.

Oil and natural gas deposits are commonly situated at the flanks of the salt dome formations. The Woodbine sand, which is several hundred feet thick in the interior of the Gulf Coast salt dome region (East Texas basin, Sabine uplift, and the region of the Mexia-Talco fault zone) has been known to carry oil and gas in great quantities. This formation and the oil and gas deposits are often associated with salt domes or along the fault zones caused by the rising of the salt dome. Pockets of oil and gas discovered within the salt dome are rare; most exploration occurs around the periphery of the salt dome. The probability of directly penetrating a canister when drilling randomly over the repository site is small. Secondary effects (e.g., ground-water alterations) caused by the drilling operations could provide pathways of radionuclide transport to the accessible environment. Such a scenario would have consequences less extensive than the scenario presented below and, therefore, is not further considered here. It would need to be addressed in an actual site assessment.

Historically, salt has been very important. Besides being biologically essential to humans and other animals, salt has been used in ancient civilizations as the basis of monetary systems (hence, the word salary). Almost five millenia ago, the earliest known treatise on pharmacology was published in China, a major portion of which was devoted to a discussion of more than 40 kinds of salt. The first patent issued by the British crown to an American settler gave a Massachusetts colonist the exclusive right to make salt by his particular method for 10 yr. The value of salt as an essential mineral resource to man is obvious. With increasing world populations, the demand for salt is also increasing.

Salt is mined from salt domes using both conventional mining operations (room and pillar) and solution mining methods. Conventional mining and excavation often reach depths of 1000 ft into the salt dome. Conventional mining could result in exposure of a small part of the repository. However, because this technique involves human presence within the mine, the thermal and radiation effects would limit the exposed volume, with direct deleterious effects on the mining personnel. Such a scenario would have consequences less extensive than the scenario presented below and, therefore, is not further considered here. It would need to be considered in an actual site assessment.

Solution mining is the predominant method of mining for salt in salt domes. It is also the most effective method of constructing caverns to provide storage space in salt domes. Solution mining can be performed without a high level of technology. The Chinese drilled wells for saturated brine to depths of 1000 to 2000 ft as early as 2000 B.C. Historically, solution mining in one form or another has provided an efficient method of obtaining salt brine.

Basically, solution mining is the removal of salts and evaporates by dissolution. Fresh water is injected into a salt deposit and brine is extracted. The methods of solution mining differ with application, but the controlling physical processes are the same. Diffusion and natural convection operate together to dissolve and transport salts within the underground cavity. Figure 4.3 shows a hypothetical solution mining operation. The less saline water at the top of the rock salt surface dissolves the salt. This dissolved salt increases the fluid density of the water and causes it to fall along the wall, continuing to dissolve and transport salt. The most dense, saturated brines are concentrated at the bottom of the cavity. This brine is removed to the surface.

The depths of the wells, the quantity of salt removed, and the size of the cavity constructed depend on the mining technique and the characteristics of the geologic medium. The applied mining technique is a function of the level of technology of that society. Present cavity volumes range in the millions of cubic meters. Acoustic and laser techniques are applied today to help control cavity shapes.

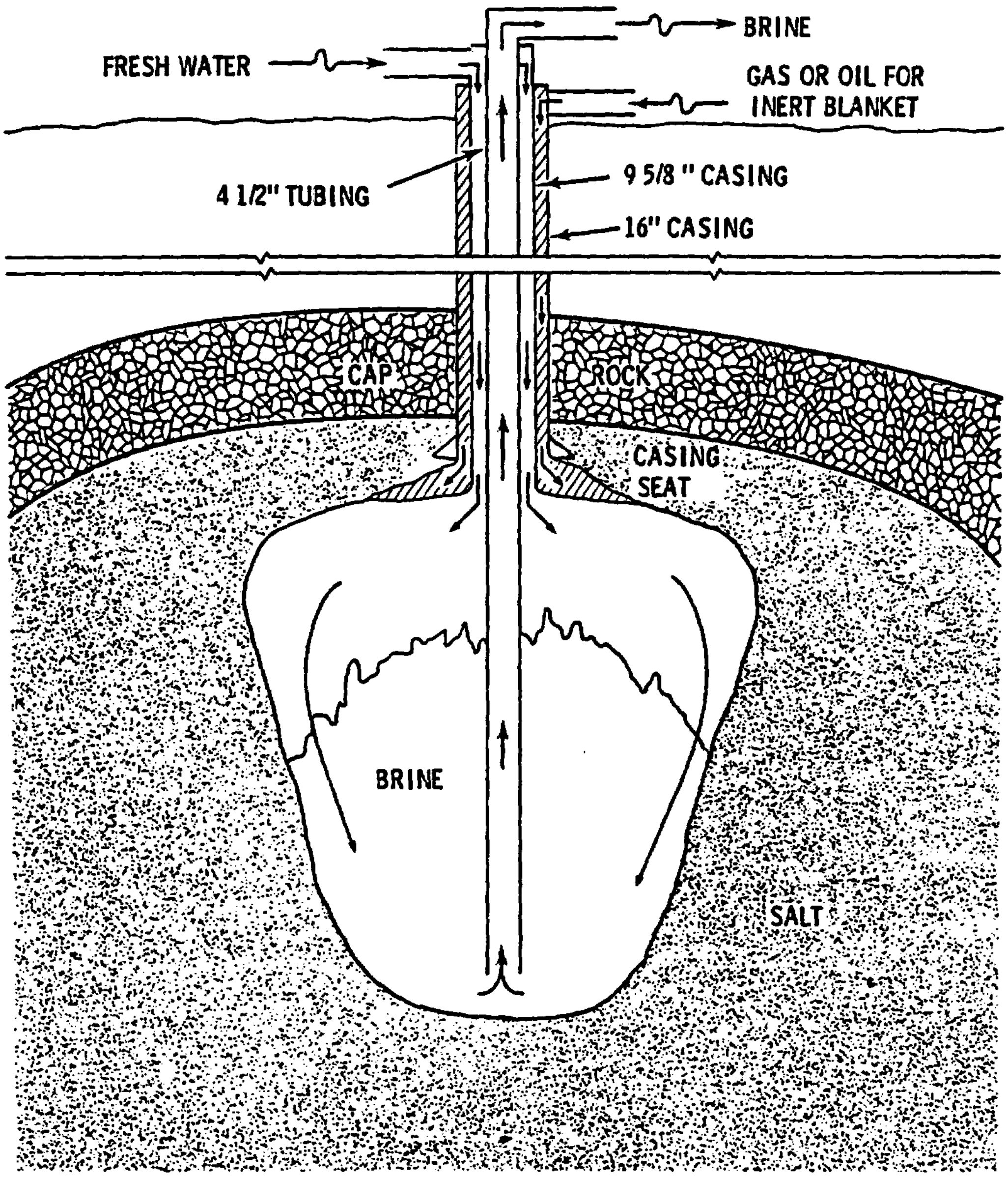


FIGURE 4.3. Hypothetical Solution Mining Operation

There are a number of conditions resulting from solution mining that could potentially directly breach a repository located in a salt dome and create a pathway of radionuclide movement to the accessible environment. The most immediate effects of solution mining in a salt dome are the evacuation of a large cavity, the use of large volumes of available fresh water, and the production of brine. Given that the solution process intersects the repository and that the contaminated brine is intended for consumptive use, the most immediate consequences would result from direct contamination of a human population from ingestion of table salt.

The probability of solution mining directly intersecting a nuclear waste repository is a function of the size and depth of both the underground cavity and the repository. The size and shape of the cavity depend on the method, proficiency, and technological abilities of the miners and on the character of the host media. The reference repository of this study occupies over 65% of the horizontal cross-sectional area of the salt dome (Figure 4.4). Because the depth of the repository and the depth of common solution mining are comparable, the probability of a repository breach seems extremely high, should solution mining occur in the repository salt dome.

In addition, potential secondary effects of solution mining such as induced hydraulic fracturing, accelerated natural dissolution rates, groundwater alterations, ground subsidence, and surface collapse could provide a pathway for radionuclide transport to the accessible environment. The impacts from these secondary effects would be evidenced over the long term. These would be analyzed in an actual site assessment.

Because solution mining for salt is a plausible method by which remote-controlled operations could expose sizeable portions of a nuclear waste repository without immediate recognition by the miners, a scenario was developed for consequence analysis. This scenario is described in Chapter 5.

Energy Storage and Production

Salt domes have been receiving increased attention for their value as underground storage media. The characteristics that make salt domes attractive for waste isolation (e.g., impermeability, plasticity, and relatively high

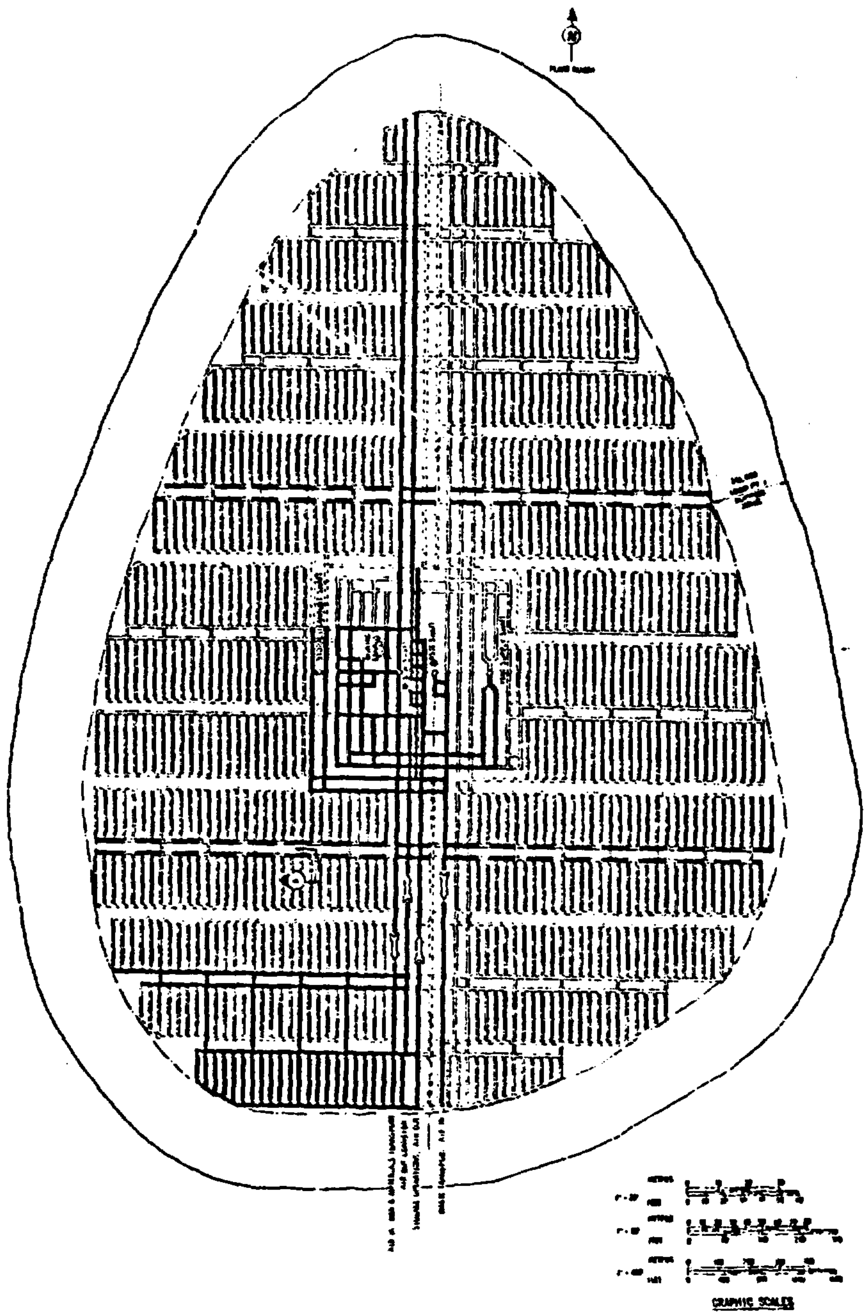


FIGURE 4-4. Areal Representation of the Hypothetical Nuclear Waste Repository Located in the Hainesville Salt Dome

thermal conductivity) also make them attractive for energy storage and production. Currently, technologies and activities to store and produce energy in salt dome cavities include compressed air energy storage (CAES), natural gas storage, and the Strategic Petroleum Reserve (SPR). Also, salt dome caverns have been suggested for use in salinity gradient energy production. Each of these technologies requires the use of an underground storage space or cavity. The predominant method of creating such underground cavities in rock salt formations is solution mining.

At times of surplus energy production large quantities of energy can be stored underground in the form of compressed air. During periods of peak demand this energy can be recovered. The 290 MW storage plant in Huntorf, West Germany, currently operates with two solution mined caverns. The 1,800-ft-deep caverns have a combined volume of 10,000,000 ft^3 and maintain air pressures between 650 and 1000 psi. The minimum depth requirement depends on the maximum pressure planned for the cavity. The most severe potential impacts on the repository, should a CAES cavern be located in the same dome, would occur from construction (solution mining) of the cavern. Operation of CAES at exceedingly high pressures or over long periods of time could produce fractures in the formation that might provide a pathway for radionuclide release to the accessible environment. Also, cavern or wellhead failure could lead to an atmospheric release of radionuclides.

Salt dome caverns are attractive underground space for storage of hydrocarbons. The Strategic Petroleum Reserve (SPR) program would create a reserve of crude oil in the U.S. through storage in underground space. Most of the SPR's 500 million barrels of oil is planned to be stored in salt domes. Currently, 300 million barrels of storage space exists in a variety of formations. In the past, natural gas has also been stored in salt dome cavities. One salt cavern in Saskatchewan contains 290,000 barrels of natural gas to a depth of 3700 ft. Twin caverns in the Emminence Salt Dome containing natural gas have a depth of 5700 to 6700 ft. The severity of potential future impacts in the accessible environment resulting from energy storage and production in a salt dome containing a nuclear waste repository is a function of the technique used in mining the cavity, location of the cavity, and the level of technology attained by the society constructing the cavity. The main impact on the repository from the storage of hydrocarbons in salt domes would result from solution mining a cavern. In addition, contaminated oil or gas distributed and consumed as an energy source would directly contaminate the accessible environment.

For the purposes of this exercise, the scenario of solution mining for salt is considered representative of the scenario of solution mining for the creation of a storage cavity. However, in an actual site assessment, such a set of scenarios would need to be analyzed.

Weapons Testing

The characteristics that make a salt dome desirable for weapons testing include high inherent plasticity, relative impermeability, and good radiation shielding. The Tatum Salt Dome in Mississippi has been used in the past for weapons tesing. Weapons testing (either nuclear or non-nuclear) would indicate a relatively high level of technology. A society with this level of technology may be able to detect radioactivity before the testing. However, the impacts on the repository from weapons testing in a society unable to detect radioactivity would probably be more severe. Secondary effects on the surrounding geology such as induced seismic activity or fracturing might also result in a radionuclide pathway to the accessible environment. The severity of the impacts is a function of the type of weapon tested, the magnitude of the explosion, and the location of the test in relation to the repository, in addition to the level of technology in the society and condition of the waste in the repository. The solution mining scenario is considered to be both more plausible and consequential than weapons testing, which is not further considered here. However, it would need to be analyzed in an actual site assessment.

Non-Nuclear Waste Disposal

Salt domes are attractive formations for the disposal of hazardous or toxic non-nuclear wastes. Production of hazardous wastes and the frequency and magnitude of disposal operations can be correlated to the level of technology in that society. However, an advanced society capable of producing large quantities of hazardous waste material would not necessarily be able or willing to provide monitoring to detect radioactivity. Liquid waste injection into the salt dome containing a repository could cause fluids to migrate or induce natural dissolution to create a pathway for movement of radionuclides to the ground water. The release of radionuclides as a result of non-nuclear waste disposal is a function of the depth and method of disposal, amount and types of wastes, and location of disposal in relation to the repository, in addition to the level of technology in the society and condition of the waste in the repository. The solution mining scenario is considered to be both more plausible and consequential than utilization for non-nuclear waste disposal, which is not further considered here. However, it would need to be analyzed in an actual site assessment.

Human Activities Affecting Breaching

In addition to deliberate and inadvertent breaches of repositories, future human activities in the area near the repository site could affect the long-term integrity of the repository. While the activities may not directly cause a breach, their cumulative effect could assist in magnifying the probability and/or consequences of a naturally induced breach.

The flow of underground waters can be altered to some extent by a number of human activities that affect the geologic media containing the ground-water system. Many of the activities previously discussed, such as conventional or solution mining, drilling, waste disposal, and energy production and storage, could potentially alter the ground-water system and provide a pathway for radionuclide movement. In addition to these activities, agricultural irrigation, creation of reservoirs, artificial recharge, and location of population centers in the vicinity of the salt dome containing the repository may affect the ground-water system pathways for radionuclide movement subsequent to a breach induced by other events.

Irrigation could possibly perturb ground-water flow systems in two ways: induced recharge to shallow unconfined aquifers by percolation of irrigation water, and a lowering of the water levels in an aquifer by withdrawing large volumes from irrigation wells, creating a sink. For irrigation to affect an unconfined system, the quantities of excess water must be sufficient to raise the zone of saturation. The resulting ground-water mound would locally have different hydraulic gradients than the undisturbed system. As a result, ground water would flow outward and downward from the mound until the local gradients are reestablished and the mound dispersed.

Pumping of large quantities of ground water could lower water levels and affect potentiometric surfaces. The extent of this effect would depend on the number of wells, the depth of the wells, the pumping rate, and the yield properties of the aquifer being used. Hydraulic gradients would change as water is withdrawn from the well(s). The effects of these alterations on a salt dome repository would depend on the well's distance from the salt dome and the near-dome hydrologic flow system. The near-dome hydrology would have to be determined from study of a particular salt dome. Also, alteration of the ground-water system in the area of the salt dome may induce or increase natural dissolution of the rock salt.

Reservoirs created by naturally occurring phenomena or human activities such as damming a river could alter the ground-water system by increased percolation of water to shallow aquifers, resulting in increased flow and increased ground-water level. Also, the weight from the additional water in the pool could cause loading and pressure effects on the land surface.

Population centers require sufficient supplies of fresh water to support domestic, urban, and industrial needs. The availability of an adequate water supply is often a determining factor in the growth of a population center. If a large population center were to develop near a salt dome repository, at least part of the water supply would probably be ground water from wells. The wells would probably be large in diameter, fairly deep, and open to several aquifer zones for large volume yields. The withdrawal and consumption of large quantities of water by these population centers could potentially result in the alteration of the ground-water system.

These activities and the resulting potential alteration of ground-water systems and impacts on the salt dome repository are dependent upon a number of factors. Some of these factors include the size of the human population, level of technology in the society performing the activity, location of activity in respect to the repository, and possible combination with naturally occurring phenomena. Some effects of such human activities will be addressed in alterations of the scenarios described in Chapter 5. In an actual site assessment, their consequences for direct or indirect release to the accessible environment would need to be analyzed.

RATES OF UTILIZATION OF GULF COAST SALT DOMES

As a part of the AEGIS scenario analysis task, Griswold (1980) investigated the current rates of utilization of salt domes in the Gulf Coast region of the United States. This information provides perspective on the likelihood of human exploitation or exploration into a salt dome containing a nuclear waste repository. This section largely follows from Griswold's report.

Salt domes are restricted to the Gulf Coast Embayment, which includes southern Arkansas, Mississippi, Alabama, Louisiana, and eastern and southern Texas. There are more than 300 salt domes known to occur in this area. The U.S. Bureau of Mines has compiled a summary of 329 known salt domes in the Gulf Coast Embayment (Hawkins and Jirik, 1966). As of 1965, mining or storage operations were being operated in 48 of the salt domes as indicated in Table 4.2.

The Bureau estimated that 130 of the 329 salt domes in the Gulf Coast Embayment offer potential for mining, brine operations, and/or creation of underground storage. In other words, 82 salt domes await exploitation by humans. The other 200 or so salt domes have features that would not make them appropriate for usage, including for a nuclear waste repository.

The U.S. produced a total of 4.4×10^7 tons of salt in 1978. Louisiana and Texas accounted for 55.5% of this production, all of which came from salt

TABLE 4.2. Operations in Gulf Coast Salt Domes (as of 1965)

Operation	Number
Conventional Mines Only	3
Conventional and Solution Mining	5
Solution Mining Only	16
LPG Storage	24
Total Salt Domes in Use	48

domes. About 75% of that quantity came from solution mining, the other 25% from conventional mining. The primary usage of brine is for chlorine-based chemical production; the primary use of conventionally mined salt is for road de-icing. The salt also goes to culinary usage.

Currently there are about 900 underground caverns in use for LPG storage in the U.S., with a total storage capacity of 3×10^8 barrels. About half that capacity is in salt domes in the Gulf Coast Embayment. Liquid petroleum storage is expected to increase dramatically in the next several years. The SPR program may require 7.5×10^8 barrels of storage, expected to be available by the year 2000. It is reasonable to assume Gulf Coast salt domes will continue to provide 50% of that capacity.

Calculations by Griswold (1980) indicate that of the 82 salt domes available for usage, all will be used within the next four centuries, based on current rates of utilization. These calculations were made on the basis of conservative assumptions. However, taking a less conservative approach, Griswold states that it is difficult to forecast any of the salt domes not being exploited (not just explored) in less than 1000 yr.

The conclusion is not that the probability of intruding a particular salt dome containing a nuclear waste repository necessarily is 1/400 or 1/1000 per year for the next few centuries. Site specific characteristics could make a salt dome chosen for a nuclear waste repository to be less, or more likely, more subject to exploitation for other usages. The conclusion is that the scenario of a human intrusion into a nuclear waste repository is highly credible and reasonable over the next few centuries, if not sooner, and virtually certain over the longer times of concern. The way to preclude such an intrusion is for continued control over the repository site, either through direct institutional control or through the effective passive transfer of information. Even if information exists that is designed to prevent some intrusion, however, intrusion can still occur.

CHAPTER 5

RELEASE SCENARIOS

A qualitative description of release mechanisms is an important part of release scenario development. The release mechanism can be discussed without reference to any disruptive phenomenon by describing qualitatively the pathway and transport medium influencing radionuclide movement. They are, in essence, the basis for the formulation of the release scenarios discussed in this chapter and for the evaluation of the breach consequences. Because of the exercise nature of this analysis and the data limitations for assessment of the potential disruptive phenomena, the potential release mechanism is the most important aspect of the release scenarios. Once the mechanism is described, the influence of the various potential disruptive phenomena can be postulated and addressed as parametric variations of the original mechanistic base case.

There are basically three categories of release mechanisms discussed and analyzed as scenarios. The first mechanism involves direct communication between the repository and the accessible environment. For the scenarios of this reference site analysis, this communication is the result of solution mining operations that occur following the loss of institutional control at 100 yr after closure. This scenario is referred to as the "solution mining operational phase scenario."

The second mechanism used in the release scenarios of this analysis involves communication between the upper Queen City aquifer system, the repository, and the Wilcox-Carizzo aquifer system. This occurs subsequent to the solution mining operational phase scenario and is based on the assumption that the solution mined cavity could potentially breach the side of the salt dome and provide the necessary flow-through pathway. It immediately follows the solution mining operational phase scenario and provides a mechanism for the long-term release of radionuclides to the geosphere for the geohydrologic transport models.

The third release mechanism used in this analysis describes communication through the repository by ground waters of the Wilcox-Carizzo aquifer system. The disruptive phenomenon involved in this scenario is the natural dissolutioning of the salt dome over long periods of time (i.e., one million years). Because of the low gradients in the Wilcox aquifer and the long time frame over which natural dissolution would probably occur, the consequences of this scenario will be bounded by the long-term flow-through solution mining scenario.

To model the consequences from one of these basic qualitative release mechanisms, it is necessary to quantify the various parameters involved. This requires quantification of various disruptive phenomena that could induce such a mechanism and postulation of a series of events both before and after the breach. The following detailed scenarios are presented in this manner. The basic mechanisms are considered to be both credible and viable; however, there is some uncertainty in the detailed description of the sequence of events postulated for the individual scenarios.

The series of events presented in the following release scenarios should not be considered as a prediction of the future state of the geosystem. Rather, the scenarios have been developed only to provide a quantification of the mechanism for the consequence analysis. Information in this report is intended to be realistic but conservative in developing these release scenarios, and existing scientific and engineering evidence has been used whenever possible. While the confidence in the release mechanisms is considered relatively high (i.e., they are considered to be credible, viable, and defensible for the existing geological environment), confidence in the specific details of the scenarios is significantly lower. For an actual license application SAR, the increased level of basic information on the site and the further detailed investigation of the release mechanisms and disruptive phenomena involved would help in limiting the uncertainty associated with the scenarios.

METHODOLOGY USED FOR SCENARIO ANALYSIS

The scenarios were developed using primarily an expert opinion and peer-review process. The AEGIS scenario team, along with assistance from several AEGIS consultants, developed a set of initial release scenarios. A draft document was developed that presented the various phenomena and their interactions, addressed their potential perturbations to the repository geosystem, and identified several release scenarios. Upon completion of this draft scenario report, a formal scenario review meeting was held at the Pacific Northwest Laboratory with personnel from AEGIS, ONWI, NUS Corporation (ONWI Repository Project Manager), Bechtel National Inc. (BNI) (ONWI Repository Project Manager), and Law Engineering Testing Company (LETCO) (ONWI Gulf Coast Geologic Project Manager) to discuss and review the preliminary scenarios. As a result, the scenarios were expanded and modified by the AEGIS staff based on the comments received during this meeting.

A revised draft scenario report was then formulated and reviewed at a second formal scenario review meeting held at the LETCO Offices in Marietta, Georgia. This meeting was attended by representatives from AEGIS, NUS, BNI, LETCO, and a group of consultants from the LETCO advisory review board. A third review meeting was held in Austin, Texas, with personnel from the Texas Bureau of Economic Geology (TBEG) to refine further the potential release scenarios. The revised scenarios were altered according to the comments from these two review meetings.

A final set of base case, far-field release scenarios was then developed and approved at the last scenario review meeting held at BNI offices in San Francisco, California. At this meeting the base-case release scenarios that resulted from the scenario development process were presented by the AEGIS staff to representatives from ONWI, BNI, NUS, and LETCO, and approved for use in the ensuing safety analysis. As a result of this meeting, two base case scenarios were identified: a human-induced solution mining scenario, which included both short-term and long-term releases of radionuclides, and a natural geological, long-term salt dissolution scenario. These scenarios were then further quantified by PNL and are discussed in detail below.

The final scenarios used for the safety analysis are considered to envelope the possible breaches of the reference salt dome repository. In particular the human-induced solution mining scenario, as described in this chapter, is considered by the AEGIS team to bound potential inadvertent human intrusion into the repository such as petroleum exploration, other resource development activities, and cavity creation. As such, this scenario breach is not dependent on the salt dome chosen for a repository. The solution mining, human-intrusion scenario is generic to salt domes. However, the natural geologic-based scenarios are much more dependent on the actual salt dome in question and its relationship to the surrounding geologic system. While the aspects of natural salt dissolution must be addressed for any Gulf Coast salt dome, other phenomena that were not identified as being credible disrupting phenomena at the Hainesville Salt Dome could play a significant role at other potential sites. As such the geological scenario developed for use in this reference site analysis should not be considered necessarily appropriate for other salt dome sites. The other major limiting factor for the geological natural dissolutioning scenario is the absence of consideration of repository- and waste-induced effects. These could significantly alter that scenario and others. In an actual site assessment, such effects would be explicitly included.

Natural Dissolution Scenario

Salt domes of the Gulf Coast Interior Basin possess many characteristics such as high inherent plasticity, extremely low porosity, and low hydraulic conductivity that make them attractive in terms of use as nuclear waste repositories. A potential weakness of salt, with respect to long-term waste isolation, is the high solubility of salt in water. Therefore, salt dissolutioning is an important consideration in the assessment of the stability of a nuclear waste repository located in a salt dome. Salt dissolution may be initiated or even controlled by a variety of human-caused events or processes (e.g., solution mining), as well as by the natural action of ground water flowing over or around a salt dome. This discussion is limited to the description of the mechanism and potential effects of salt dissolution occurring without the intervention of humans.

Calculations of dissolution rates have been made, based upon caprock thicknesses and concentrations of total dissolved solids in saline plumes. Assuming that caprock consists of insoluble, anhydritic impurities that are left behind when salt dissolutioning occurs, and assuming that these insoluble impurities constitute approximately 1% of the rock salt, Netherland, Sewell and Associates, Inc. (1976) calculated dissolution rates for northeast Texas salt domes. To obtain the observed thicknesses of caprock on some of the salt domes, maximum dissolution rates must have been about 6 x 10^{-4} ft/yr, provided that the caprock formed by dissolutioning during the last 50 million yr. Using that rate, it would take 1.3 million yr to dissolve an 800-ft buffer zone around the repository. Dissolution rates have also been calculated using concentrations of total dissolved solids in saline plumes. This method has been used to calculate dissolution rates for several northeast Texas salt domes. Using the maximum dissolution rate estimated for current climatic conditions (75 ft per 250,000 yr), the 800-ft buffer zone could be dissolved in 2.7 million yr. Under glacial climatic conditions, when hydraulic gradients would be increased, the maximum dissolution rate could also be increased. Therefore, under glacial conditions, the buffer zone could be dissolved in 2 million yr. Given that the climate will fluctuate during the next 1 million yr, the amount of time needed to dissolve the buffer zone is between 2 and 2.7 million yr. Therefore, salt dissolution is probably not a threat to repository intergrity for a 1-million yr isolation phase, even if the most conservative dissolution time is used (1.3 m.y.). However, because of the uncertainties in knowledge of dissolution mechanisms, the lack of information about the regional and near-dome hydrology and near-dome structure, and the lack of consideration of repository- and waste-induced effects, natural dissolution cannot be dismissed at this time as a potential release scenario for the Hainesville Salt Dome.

It is assumed that fresh water zones are in direct contact with the salt stock and that dissolved salt is being carried away from the salt dome by the flow of subsurface water in the Wilcox. Dissolution occurs where the salt dome intersects a fresh water or unsaturated saline aquifer or where structural features such as upturned beds or faults could allow vertical ground-water movement along the salt-host rock interface. Ground-water flux at the zone of dissolutioning is assumed to be great enough to remove saturated brines and to supply incoming fresh or undersaturated ground waters. The dissolved salt could be carried downstream through the aquifer. Dissolutioning of Northeast Texas salt domes should occur at or near the top of the salt dome, where the Wilcox aquifer is likely to come into contact with the salt. The dissolution should occur preferentially on the up-gradient (northwest) side of the salt dome, where the water first encounters the salt. As it flows over the top of the salt dome, the water will continue to dissolve salt, so that material would be removed from the top of the salt dome as well as from the flanks. Solution collapse would occur where significant amounts of salt were dissolved, so that the outer portions of the salt dome would become rubbly. At least part of the 800-ft buffer zone could be affected by the solution collapse. Dissolutioning of the buffer zone would be enhanced by the solution collapse, because permeability of the salt would be greatly increased. Thus, solution collapse could enable water to encounter the waste canisters even before all of the buffer zone had been dissolved and carried away. Near-saturated saline brines would be flowing over and around the waste canisters. After flowing through the repository, the brines would continue to move down gradient (to the southeast), probably flowing at the base of the Wilcox aquifer because of density differences.

This natural dissolutioning scenario assumes that at time one million yr the entire volume of waste within the repository is exposed for leaching by ground water. Even though the entire repository volume should not be exposed immediately when the breach occurs, the time required to expose the rest of the repository, probably on the order of 10^3-10^4 years, is insignificant compared to the 10^6-yr time frame required to initiate the containment failure.

The natural dissolutioning scenario is unlikely to occur within the 10^6-yr time frame, absent repository- and waste-induced effects. As discussed in Chapter 4, the reasonably expected time for dissolution to occur is closer to the order of 10^7 yr, or up to an order of magnitude greater than that used for this scenario. There appears to be no reasonable way the natural dissolutioning could occur in less than one million yr (absent human intervention). Thus, a 10^6-yr period is considered to be the lowest bound on this scenario. This is based on not considering the effects of the construction of the repository nor the effects of the nuclear waste itself. Should these repository- and waste-induced effects be considered, the time to natural dissolutioning might be shortened considerably.

As of the date of this salt dome reference site analysis, the consequences of such a natural dissolutioning scenario have not been evaluated. These consequences are obviously of less magnitude than those of the solution mining scenario discussed in the next section. Consequence analyses of the natural dissolutioning scenario could be performed in future work, and would need to be performed for actual site assessments.

Solution Mining Scenario

According to discussions from Chapter 4, following a loss of institutional control, future solution mining could perturb a salt dome containing a nuclear waste repository. Because of the many uncertainties inherent in dealing with potential mining technologies, it has been assumed that any such solution mining would intersect the waste repository and threaten a breach of isolation. Accordingly, the following release scenario has been developed. While the release mechanisms discussed in the remainder of this section are highly likely, the specific postulated sequence of events is uncertain.

Solution mining is used for a variety of purposes, including commercial salt production, storage cavity development, and petroleum production purposes. This scenario has been developed under the assumption that the solution mining is for commercial salt production (brining) because: 1) brining requires a relatively low technology base for commercial operations; 2) solution mining of salt domes at repository depths has occurred repeatedly before the technology level associated with the knowledge of nuclear phenomena and thus, could plausibly recur in the future without necessarily requiring a sophisticated technological base cognizant of nuclear science; 3) historically, there has been little control exercised over cavity shapes and dimensions; 4) there are a number of known sinkholes and solution collapse features associated with past brining operations in the Gulf Coast; and 5) it provides the most direct path for radionuclides to enter both the accessible environment and the human food chain through the consumption of culinary salt. Current trends in solution mining technology have been directed at controlling and monitoring cavity shapes and dimensions for better engineering control. However, for the purpose of this scenario, a conservative assumption has been based on the uncertainties in describing how the dissolutioning around the repository might take place. Because the waste-induced effects were not explicitly examined, it is conservatively assumed that all dissolutioning occurs within the repository area. The results are not sensitive to that assumption.

For the purposes of this scenario, the portion of the salt dome subject to the scenario at the repository depth is considered to be a 20-ft high, 2000-acre horizontal slice, with a total salt volume of 1.74 x 10^9 ft^3. The actual repository is represented by a 1375 acre by 20 ft high slice, with a salt volume of 1.2 x 10^9 ft^3. The repository is surrounded by an 800-foot buffer zone of salt (see Figure 5.1).

After the loss of institutional control, it is postulated that a solution mining (brining) operation starts production (post-closure time of 100 yr). This facility produces one million tons (15 x 10^6 ft^3) of salt per year for commercial purposes. This value is representative of a current large scale solution mining operation for salt. It is assumed that 3% of the total production is used as culinary salt. The 3% fraction is based on the percentage of the current total U.S. salt production used for human consumption (Bates 1969). This assumption received considerable comment by the outside reviewers of the working draft of this document, in that it nonconservatively results in a dose reduction by a factor of 33, and in that the other 97% of the contaminated brine was not considered in dose-to-human pathways. However, changing this to total consumption of the salt could be compensated as discussed below. The brining operation is assumed to have an operational life of 50 yr. At the end of the 50-yr mine life, approximately 61% of the repository could be exposed, based on the one million t/yr production cycle. Therefore, the waste could be exposed at a rate of 1.2% of the entire repository inventory for each year of the 50-yr operational life.

To produce one million tons of salt per year, the water flow removed for the solution mining process would be approximately 1200 gpm; the injection flow volume would be approximately 1400 gpm, with the additional 200 gpm replacing the salt volume removed. These flow rates could be derived through three or four production wells operating at a rate of 400 to 300 gpm per well, or through any other combination of wells and production rates.

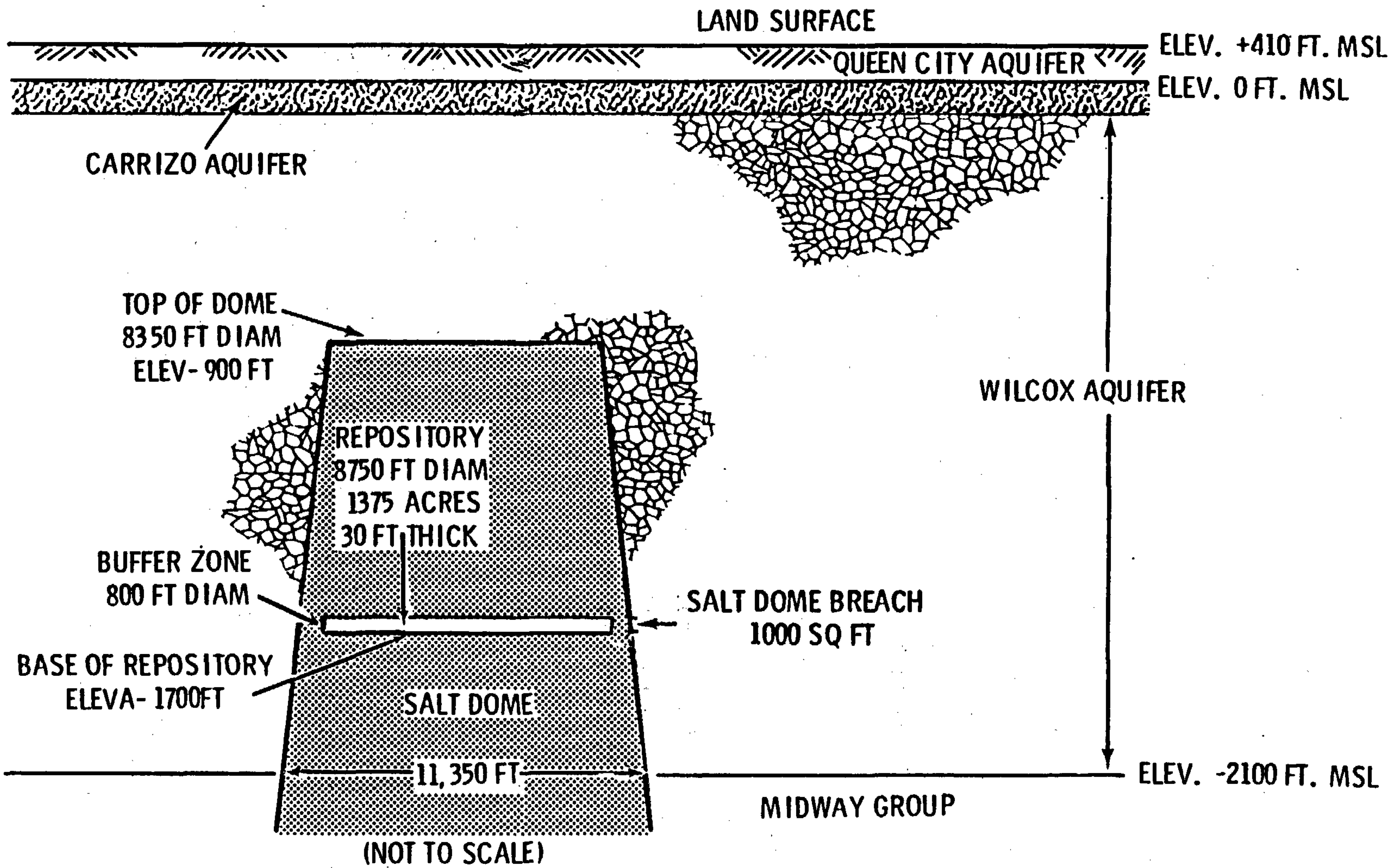


FIGURE 5.1. Schematic Representation of the Waste Repository and Host Environment

Comment was also received on the scale of such an operation. One review group (see Chapter 12) felt that such a large scale operation would be inconsistent with an apparent lack of control over the cavity shape. This and the problem with the 3% consumption assumption can readily be alleviated by considering a solution mining operation of scale reduced by a factor of 30, but for which virtually all the salt would go for culinary use. This latter assumption is more representative of current culinary salt productions from the highly pure salt found in salt domes, but the scale would be more in accord with a poorly controlled cavity. Under these alternative assumptions, there would be no change in the dose values calculated originally. This revised report reflects the calculations done on either the larger scale, less proportionate use of culinary salt asssumptions, or on the reduced scale assumptions. Thus, either set of assumptions can be considered applicable to these analyses.

These estimates assume that the salt is removed specifically in the area of the repository, because near-field waste-induced processes might prompt this type of dissolutioning. If the crushed salt backfill was nonhomogeneous at the time of the solution mining intrusion, it could also promote preferential dissolutioning within the repository boundaries resulting from a higher permeability than the host salt. It is also possible that the additional thermal loading induced by the presence of the waste could accelerate the creep of the surrounding host salt and homogenize the crushed salt backfill within a relatively short (100-1000 yr) time frame. If this homogenization were to occur, the dissolutioning might not be totally concentrated in the repository boundaries. As such, the fraction of the repository exposed during the brining operation could be reduced by significant amounts. However, as the waste-induced near-field analyses are currently beyond the scope of this program, the conservative case will be assumed (i.e., up to 61% of the repository could be exposed after 50 yr of mining). As indicated later, however, the actual portion of the inventory that could possibly be exposed becomes unimportant because of to solubility constraints on the brine solution and on Uranium-238, which comprises approximately 98% of the repository inventory. For the purposes of evaluating the consequences of the operational phase of the solution mining scenario, the parameters used for the scenario are outlined in Table 5.1. Again, either the assumptions orignally used or the alternative assumptions lead to identical consequences.

After 50 yr of solution mining, the brining operation is assumed to cease production. Such a production halt could result from a number of different reasons, including effects of economics, an altered technology base, a shift in demand, or operational problems caused by solution collapse, sinkhole formation, or by a breach of the salt dome itself. At the conclusion of the brining operation, it is assumed that one or more of the solution-mined cavities has breached the side of the salt dome, as illustrated in Figure 5.2. Thus, the stage is set for the proposed long-term release scenario.

To approximate the resulting hydrologic flow through the repository, the Finite Element Three-Dimensional Ground Water (FE3DGW) model was used. A discussion of the FE3DGW model and a detailed description of how it was used in this analysis are included in Chapter 6.

Given the assumption that fresh water will continue to flow through the repository and out into the Wilcox aquifer, the following chain of events is postulated as part of the long-term release resulting from the solution mining. After the halt of solution mining, it is assumed that the repository area continues to be dissolutioned by the flow of water from the Queen City aquifer. Water from the aquifer flows into the salt dome via the abandoned solution mining well casing, through the repository, and out through the breach in the side of the salt dome into the Wilcox aquifer. In the region surrounding the salt dome, the overlying Sparta-Queen City aquifer generally has a 50 ft higher hydraulic head than the Wilcox system. The head differential between the Queen City and the Wilcox is assumed to remain at 50 ft. For purposes of this analysis, the area of the opening into the Wilcox aquifer from the salt dome was arbitrarily assumed to be 1000 ft^2. The size of this opening and its effect on the scenario were analyzed using the FE3DGW model, and the results are presented in Chapter 6. Given a flow rate through the repository of approximately 260 gpm (calculated using the FE3DGW), it would take about 120 yr (assuming 61% is exposed initially) to expose the rest of the inventory, provided that

TABLE 5.1. Parameters for Solution Mining Operational Phase Scenario

Original Scenario Assumptions
Operational life of solution mine = 50 yr
Production per year = 1 million t/yr; 1.5×10^7 ft^3/yr
Percent salt used for culinary uses = 3% of salt production
Repository depth = 2100 ft below land surface
Repository volume (1375 acres x 20 ft) = 1.2×10^9 ft^3
Water injection flow rate = 1400 gpm
Solution withdrawal rate = 1200 gpm
Percent of inventory exposed per year = 1.2%
Percent of inventory exposed after 50 yr = 61%
Solubility limit for Uranium = 6 ppm
Alternative Assumptions Leading to Same Dose Consequences
Production of salt per year = 33,333 t/yr
Percent salt used for culinary use = 90%
Solution withdrawal rate = 40 gpm
Inventory exposure = 0.041%/yr = 2.0% in 50 yr
Other assumptions remain unchanged.

solutioning were to continue within the confines of the repository boundaries. With such extensive internal dissolutioning occurring over a 170-yr time frame, major solution-induced collapse of the overlying salt would almost certainly occur, ultimately rupturing the abandoned solution mining well casing. It is impossible to quantify how and when this type of collapse would occur.

The stability of the cavern would be very dependent on the actual cavity geometry. Assuming that the repository is preferentially dissolutioned, collapse features would probably begin occurring during the actual brining operation. Solution collapse could cause a permanent halt in production if the

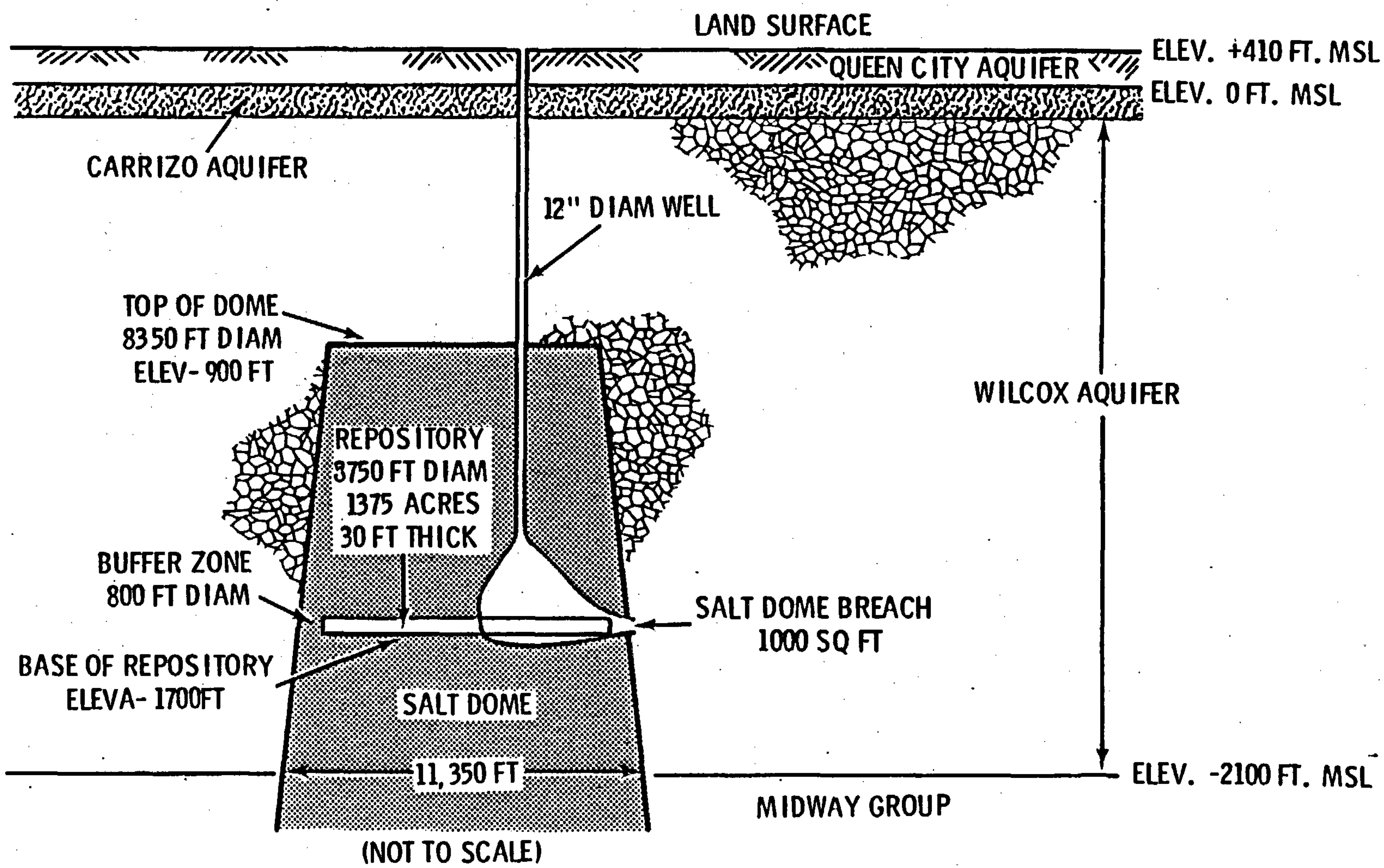


FIGURE 5.2. Schematic Representation of the Operational Phase Solution Mining Breach

collapse features were sufficiently severe. Collapse features, either occurring during the brining operation or some time after abandonment, could rupture the well casings and allow the 50-ft head between the Queen City aquifer and the Wilcox to be dispersed through the salt dome and into the Wilcox aquifer. This would mean that the water flow across the salt dome and the repository might be reduced by up to one order of magnitude. As a result, the time required to expose the entire repository inventory and concurrent dissolutioning of the salt dome would be increased accordingly. However, to simplify the near-dome FE3DGW hydrologic model, and because of the inherent uncertainties and the conservative nature of this analysis, it is assumed that the 260 gpm flow continues for a period of about 15,000 yr. During this period of time, the entire salt dome immediately above the repository could be removed. Once the top of the salt dome has dissolved, a major collapse feature would exist over the remaining portion of the salt dome, providing a connection, with a 50-ft head differential, between the Queen City aquifer and the Wilcox aquifer. However, unlike the previous system in which the abandoned brining operation's well casings provided a direct path for the flow into the repository, the head would now be dispersed over a 2700-ft high section of Wilcox-Carrizo. For this stage of the scenario, it is assumed that the inventory is concentrated over the 1375 acres of the former repository, within 30 ft of the top of the remaining salt dome. Because the head would be dispersed over almost the entire thickness of the combined Wilcox-Carrizo aquifer, the flow over the inventory was again calculated using the FE3DGW model (Chapter 6). The calculated flow over the inventory would be about 36 gpm. This scenario is depicted in Figure 5.3.

The flow rate is assumed to continue to flow over the waste, leaching the radionuclides at a saturation level of 6 ppm for uranium until the waste is dissolved. This then represents the long-term release, where for approximately the first 15,000 yr the flow over the inventory would be 260 gpm; then following major solution collapse, the flow would be reduced to about 36 gpm. Because of its higher solubility limit (410,000 ppm) salt will be dissolved much faster than the spent fuel, with an assumed uranium solubility limit of

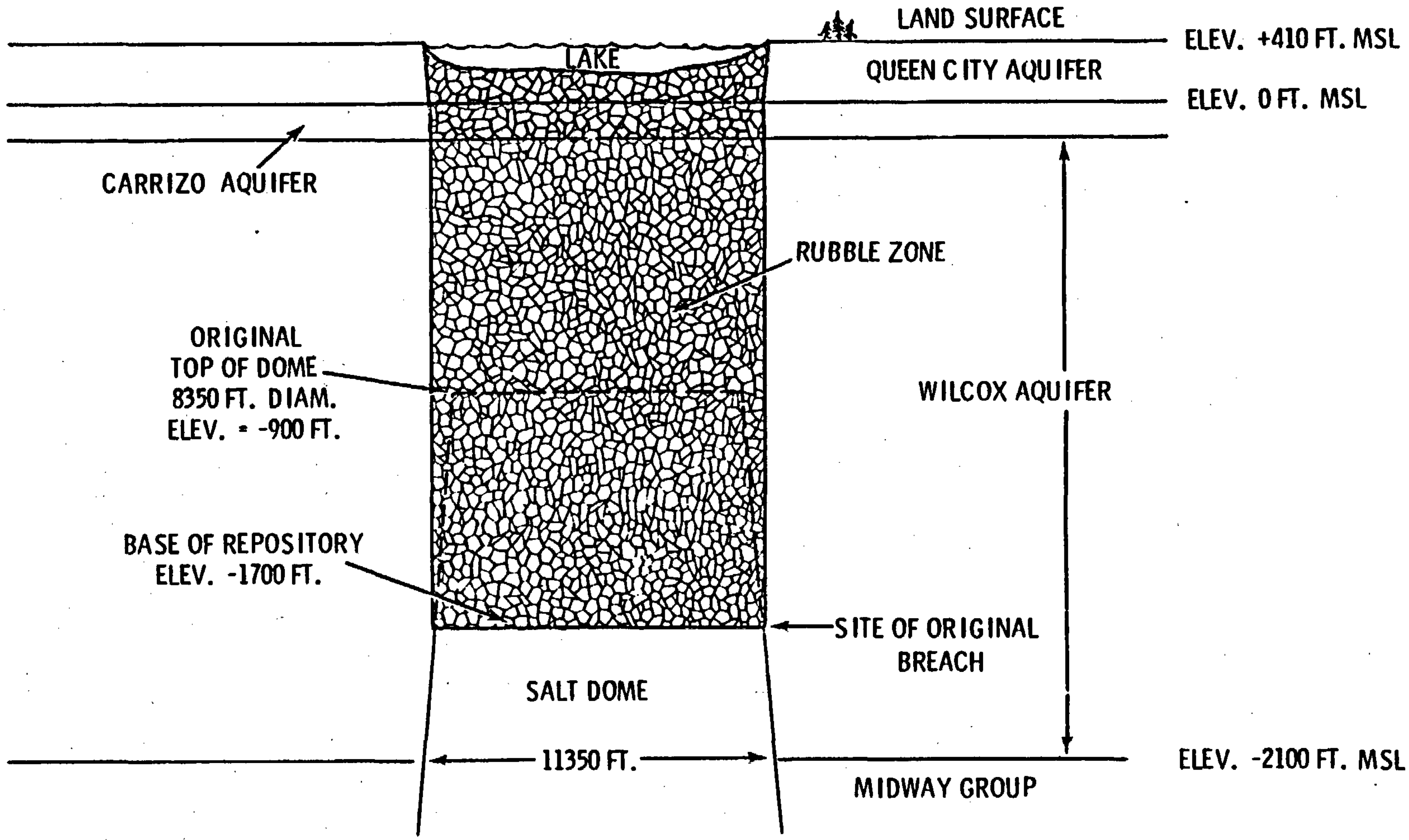


FIGURE 5.3. Schematic Representation of the State of the Geologic System Following Solution Collapse

6 ppm. Because of this, it is necessary to model the radionuclide transport in the scenario after the top of the salt dome has been removed, leaving the large portion of remaining waste inventory exposed.

The insoluble anhydrite residue from the salt dissolution could slow, and possibly halt, the salt dissolution following major solution collapse. Assuming a total salt volume in the salt dome above the repository level (including buffer zone) of 5.5×10^{10} ft^2, and 2% insoluble anhydrite in the salt formation, a total of 1.1×10^9 ft^3 of anhydrite would be present following dissolution of the entire salt dome above the repository. Assuming that these insolubles are dispersed evenly over the entire 2000 acres of salt dome at the repository level, the accumulation depth would be about 12 ft. (This assumes a density similar to the original salt.) For purposes of this scenario, the effects of the anhydrite accumulation were only accounted for after the total collapse occurred, and only then for providing a mechanism for slowing the dissolution of the salt dome below the repository depth. It was not assumed that the anhydrite would impede the flow across the remaining spent fuel inventory.

Regional Scenario

A hydrologic model has been developed for the purpose of making predictions concerning the transport of radioactive contaminants from the Hainesville Salt Dome in the event that the nuclear waste repository is breached (see Chapter 7). The model simulates the actual hydrogeologic system and allows determination of certain properties of the system that cannot be directly measured. Parameters of the hydrogeologic system can be changed so that movement of ground water, as the transporting fluid for the radioactive contaminants, can be estimated for several different sets of conditions. In particular, parameters must be altered to allow for future changes in the hydrogeologic system.

To simulate ground-water movement at the time of a future breach, hydrologists must use parameters that describe the future system. Accordingly, changes in hydrogeologic parameters over time and in response to various geologic phenomena must be described. Specifically, bounding conditions for the future system must be established so that they can be used as input for the hydrologic transport models.

A base case, which simulates as closely as possible the present hydrogeologic system, has been established (refer to Chapter 7). Three elements of the system must be changed to account for future conditions. These elements are: 1) amount of precipitation, 2) base level and hydraulic gradients, and 3) location of discharge areas. Table 5.2 summarizes the changes that might occur in these parameters. Values of a fourth element, transmissivity, must be bounded for the hydrologic and transport modeling.

According to Davis (1980), future compaction, weathering, fracturing, and cementation could change present-day transmissivities by several orders of magnitude. However, for the purposes of this analysis, transmissivities are assumed to stay within the measured ranges. A more thorough analysis would require better definition of the range of values for transmissivity, but detailed, site-specific data would be necessary for that sort of analysis.

The advent of a glacial episode and the associated climatic changes are considered to be among the more important phenomena that could influence the geohydrologic system surrounding a salt dome repository. Under potential future climatic conditions, precipitation in the Interior Gulf Coast salt dome area could be expected to increase by less than a factor of 2 (Kukla 1978). Such an increase in precipitation should cause very little increase in the amount of water that enters the ground as recharge. At present, only a small

TABLE 5.2. Changes of Parameters to Account for Future Conditions

Parameter	Change
Precipitation	Increased by less than a factor of 2 (under glacial conditions); very little increase in infiltration
Base Level and Hydraulic Gradients	Increased slightly as a result of sea level lowering and increased erosion (induced by glaciation)
Discharge Area	Water would discharge into Sabine River as a result of decreased water withdrawal at East Texas Oil Field

percentage of East Texas rainfall infiltrates into the ground-water system; most of the water that is available for recharge goes to surface runoff and evapotranspiration. In the hydrologic model the maximum amount of infiltration that could be accepted by the soil (according to its reported transmissive properties) was less than one inch. A precipitation increase of less than a factor of 2 should cause very little increase in the amount of infiltration because of the saturated nature of the present system. Hence, most of the increase should show up as additional runoff.

Glaciation would result in a lowering of sea level. However, according to Davis (1980), a drop in sea level will not drastically alter the hydraulic gradients in aquifers 100 to 200 miles inland. Because of the shallow coastal waters, lowering of sea level will cause the shoreline to move to the south far offshore of the current coastline. Increased distance of travel will offset the added head differences, which result from sea level lowering, so that hydraulic gradients in the deep, regional, confined aquifers should not be increased by more than about 30%.

Lowering of sea level would also result in increased downcutting by rivers and streams. Increased erosion would lower the local base levels and could provide head drops sufficient to increase hydraulic gradients in near-surface aquifers, such as the Queen City, by 40% to 60%. Gradients in aquifers that are deeper than a few hundred feet, such as the Wilcox-Carrizo, would probably be increased by less than 10% (Davis 1980).

A change in discharge area could be induced by a cessation or decrease of water withdrawal in the vicinity of the East Texas Oil Field. Currently, there is a depression of the ground-water potential contours in Gregg and Upshur Counties as a result of withdrawal of water for industrial and municipal purposes. If the depression were still in existence at the time of a breach, the radionuclides would be transported from the salt dome toward the depression. A future decrease of water withdrawal at the East Texas Oil Field would allow discharge of water into the Sabine River and into the Big Cypress Bayou. Under those conditions, the radionuclides would be transported from the salt dome toward the new discharge areas.

The only regional scenario modeled for this analysis to date is for elimination of the East Texas Oil Field with subsequent water flow into the Sabine River and Big Cypress Bayou. Other alterations of the regional hydrology may be simulated in later analyses and would be simulated in an actual site assessment.

CHAPTER 6

NEAR-DOME HYDROLOGIC SIMULATION

In the region surrounding the salt dome, the overlying Sparta-Queen City aquifer generally has a 50 ft higher hydraulic head than the Wilcox aquifer system, which is in contact with the salt dome. The solution mining breach scenario initiates ground-water flow through the repository with this 50-ft hydraulic head differential between the Queen City and Wilcox aquifers. The ground-water flow patterns near the salt dome were simulated using the Finite Element Three-Dimensional Ground-Water (FE3DGW) flow model (see Appendix B). For this near-dome study, which has point source/intensive subregional recharge and vertical variation in thickness and hydraulic properties, the FE3DGW provides the means to represent effectively the problem by varying the node spacing both horizontally and vertically.

HYDROGEOLOGY OF SUBREGION SURROUNDING THE SALT DOME

To provide a reasonable, conservative assessment of the geotransport consequences from the solution mining scenario, the maximum (47,000 gal/day/ft) transmissivity measured for the Wilcox-Carrizo aquifer was used. The top 100 ft of the aquifer (referred to as the Carrizo sands) has a measured average hydraulic conductivity of 99 gal/day/ft^2 (transmissivity of 9900 gal/day/ft). The remaining transmissivity (47,000-9900 = 37,100 gal/day/ft) is assigned to the Wilcox aquifer (average thickness of 2000 ft). This gives a hydraulic conductivity of 18.55 gal/day/ft^2 for the Wilcox aquifer.

The salt dome is actually egg-shaped in cross section; however, for this simulation it was approximated by a truncated conical section of 11,350 ft diameter at -2100 ft elevation, with 8350 ft diameter at -900 ft elevation at the top of the dome. For a circular repository of 8750 ft diameter (1375 acres) at -1700 ft elevation, the salt dome provides an 800 ft circular buffer zone. Figure 6.1 is the schematic description of the hydrogeology of region surrounding the Hainesville salt dome.

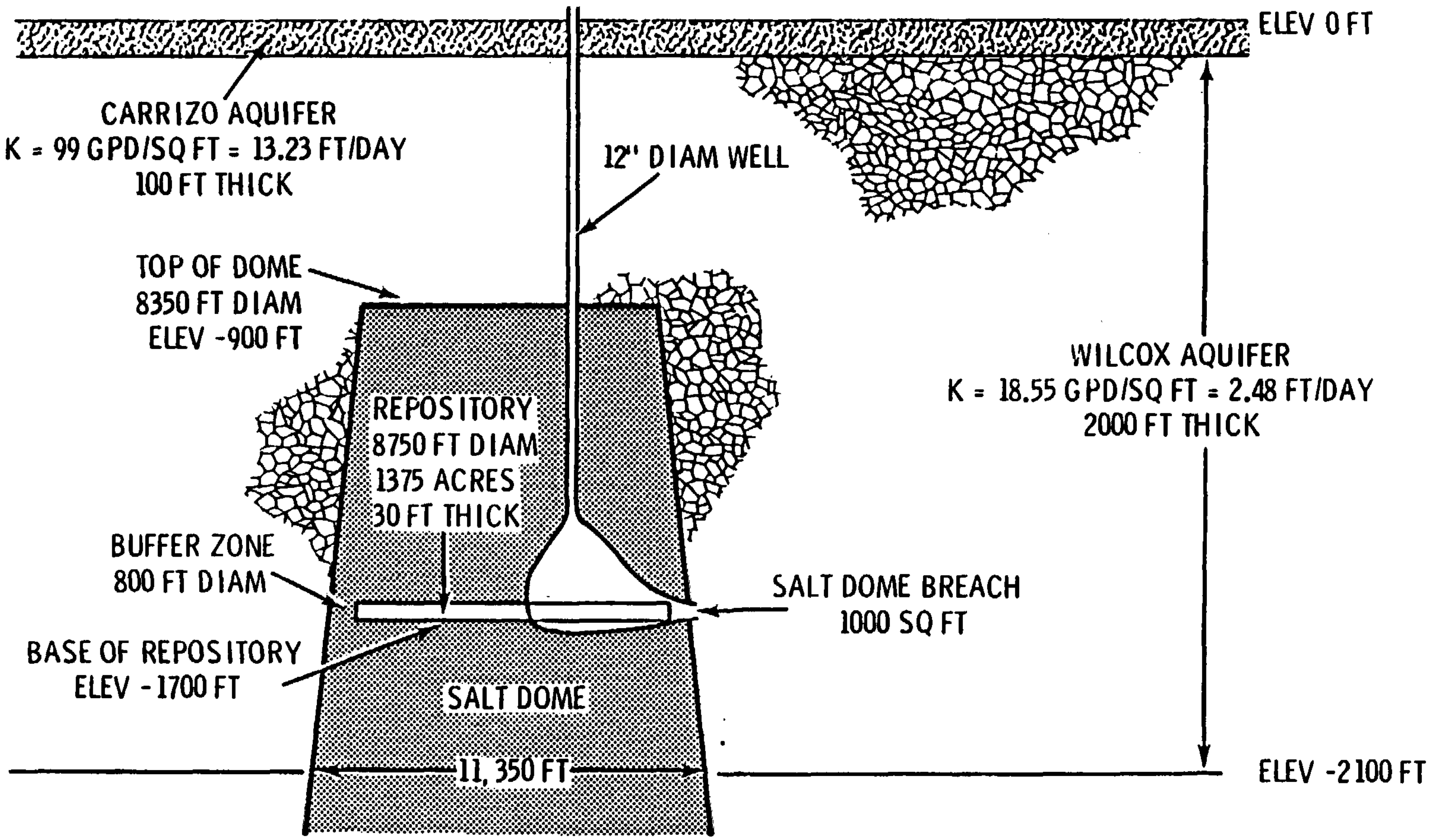


FIGURE 6.1. Schematic Representation of Salt Dome Hydrogeology

The regional ground-water gradient of 1 ft/1000 ft is used for defining the boundary conditions of the subregion. The subregion modeled is extended (up and down gradient and laterally) beyond the effects of local perturbations caused by the solution mining induced breach. Because there is bilateral symmetry, only half of the region was simulated.

FORMULATION OF THE TEST CASES

The first of two near-dome scenarios was modeled with a 1000 ft^2 breach area and no reduction of the hydraulic conductivity around the breach. This is a conservative assumption because:

- the breach area will increase gradually, but the adjoining material may collapse and reduce the effective opening. In the simulation the size of 1000 ft^2 was maintained for the determination of the ground-water flow.
- the concentrated salt solution from the salt dome will reduce the hydraulic conductivity in the region around the breach because of a change in viscosity and a precipitation of salt. For this simulation no such reductions were considered.

The second near-dome scenario was modeled assuming that:

- the flow through the abandoned solution mining bore hole has dissolved all of the salt dome above the level of the repository. the cavity thus created is filled with material assumed to have twice the permeability of the original Wilcox aquifer, the increase in permeability being attributed to the collapse.
- the Sparta-Queen City aquifer, or the lake formed in the depression after a collapse, continually provides an unlimited reservoir with 50-ft higher head than the regional ground-water potential at the center of the salt dome.
- the recharge is occurring in all of the region above the circular repository of 8750 ft diameter (1375 acres) and in the 800 ft buffer zone around the repository.

All the above conditions are conservative assumptions because:

- to dissolve the entire salt dome above the repository, the flow through the abandoned bore would hole will have to occur continuously for approximately 15,000 yr, with the assumption that 260 gpm (predicted by near-dome simulation) of fresh water leaves at the saturated concentration of 410,000 ppm. This is a conservative assumption because such an abandoned bore hole may get clogged with debris or may collapse because of corrosion.
- the present differential head between the Queen City and Wilcox aquifers is 50 ft; but with the flow into the collapsed material, the head difference will not remain constant.

The following are the brief details of hydrologic modeling of the two near-dome simulation cases.

<u>Model for Determining the Flow Rate Out of a 1000-ft^2 Salt Dome Breach Opening</u>

The Wilcox-Carrizo subregion considered is 80,000 ft in length in the direction of the general ground-water flow (25,000 ft up gradient and 55,000 ft down gradient from the center of the salt dome) and 35,000 ft in width. For the general region, a grid of 5000 ft was used, and the salt dome was represented by radially oriented elements (Figure 6.2). The three inner circles represent the top of the salt dome (Figure 6.3). The diameter of radially oriented elements was varied to account for abrupt changes in the thickness of the Wilcox aquifer overlying and adjoining the area of the salt dome. For vertical representation, the general model used only three vertical nodes, to represent the Carrizo and Wilcox aquifers. In the area with radial elements, however, the vertical subdivision was increased to five nodes below each surface node. At the salt dome breach an element of 500 ft^2 (31.62 ft vertical and 15.8 ft horizontal, to represent half the hole in the simulated zone) was established. Figure 6.3 is the general representation of the stratification details that were used for the whole subregion. Figure 6.4 shows the stratification near the salt dome, illustrating the variable grid used to simulate the salt dome and the breach.

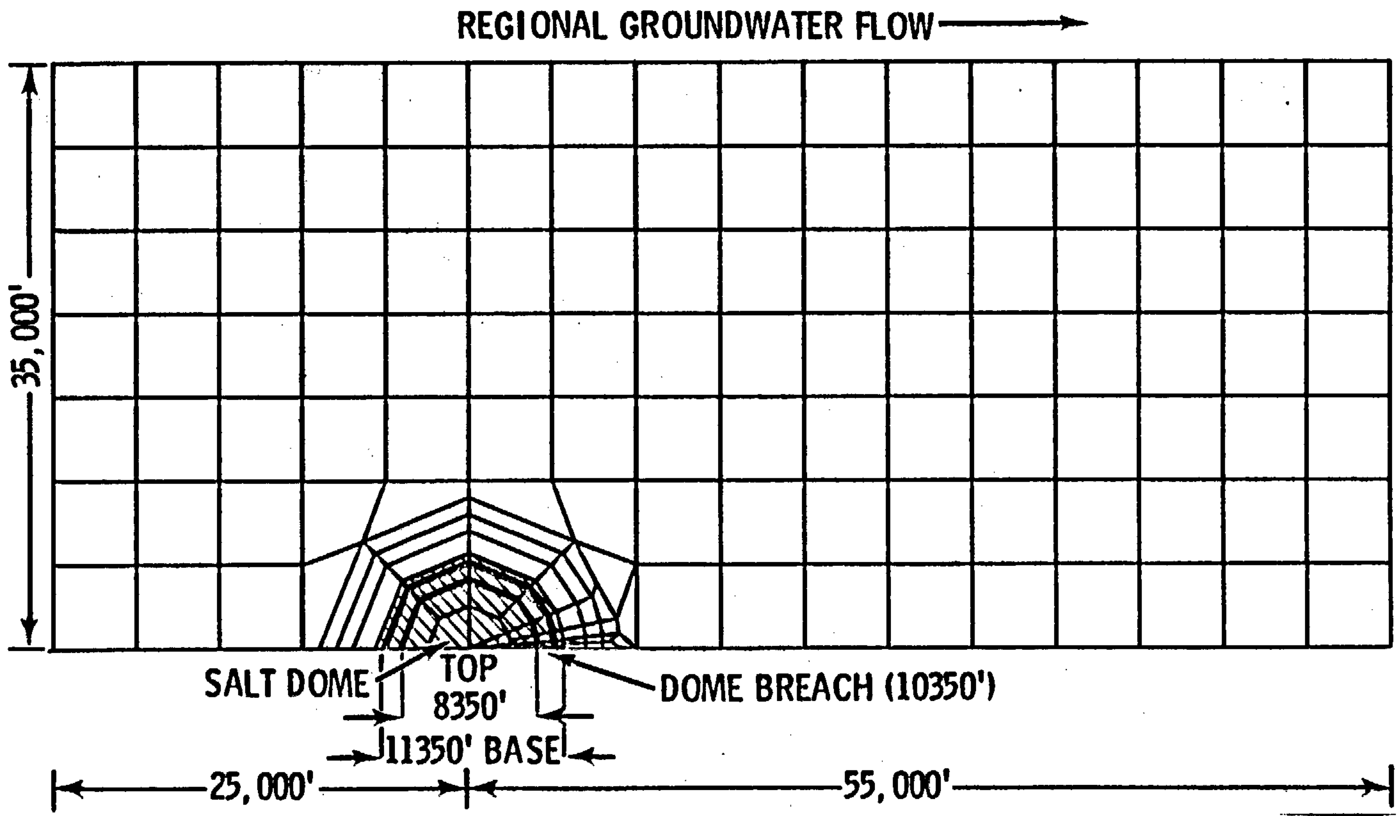


FIGURE 6.2. Finite Element Grid with Closer Node Spacing Near the Salt Dome Breach

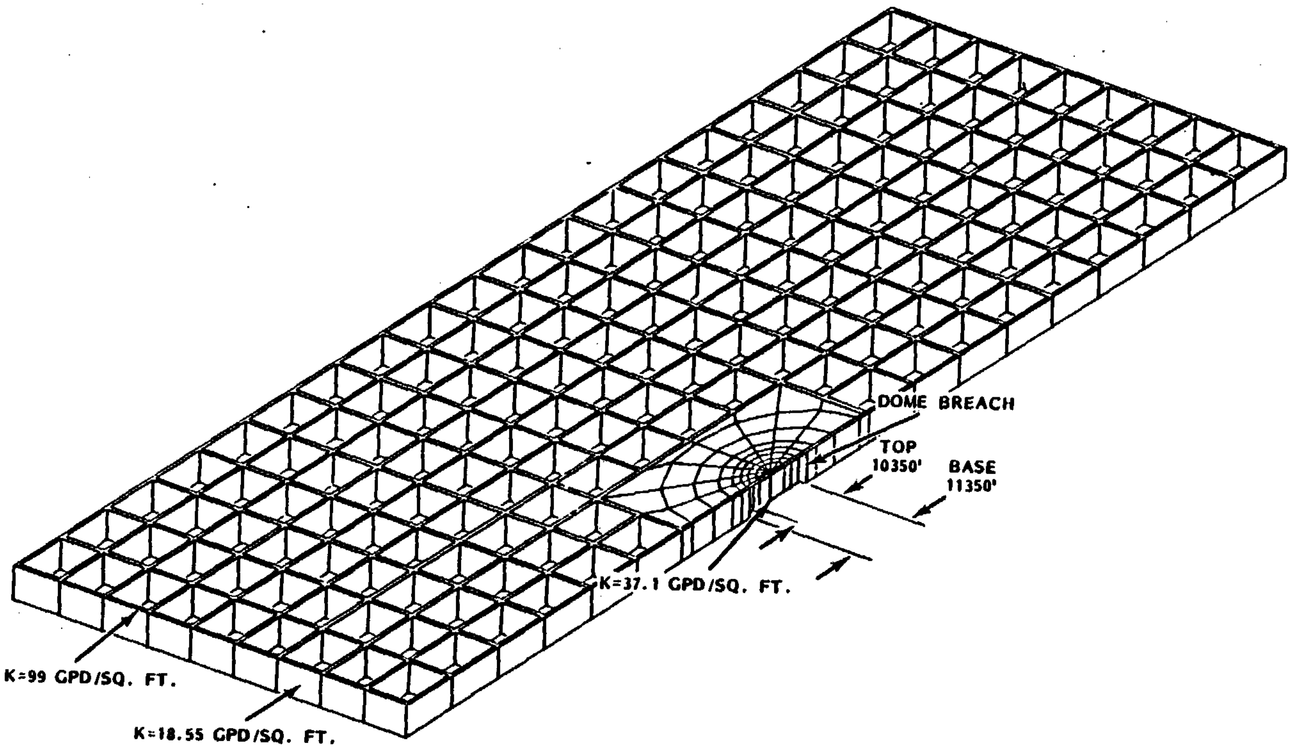


FIGURE 6.3. Regional Stratifications Used for Simulation of Flow Through the Salt Dome Breach

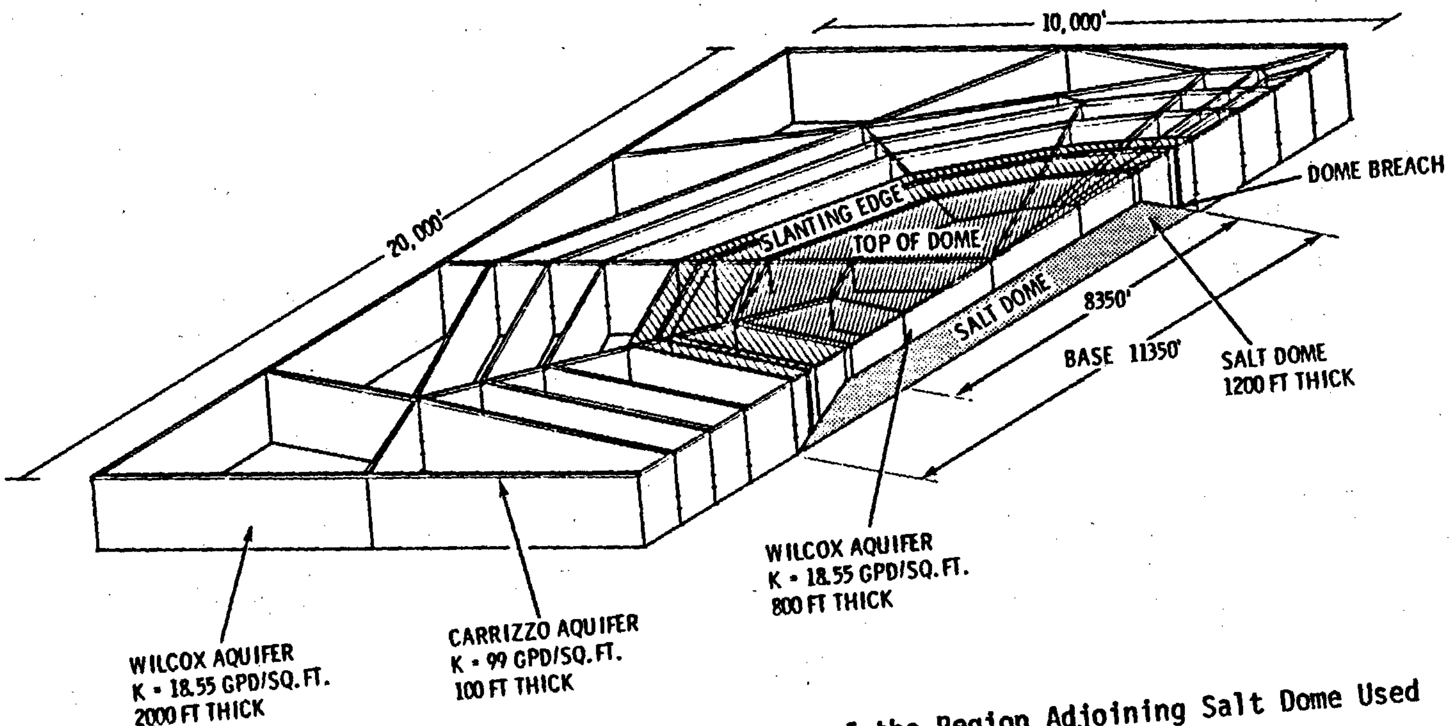


FIGURE 6.4. Three-Dimensional Stratifications of the Region Adjoining Salt Dome Used for Simulation of Flow Through the Salt Dome Breach

A steady-state simulation of the hydrology was done, assuming no breach. Then the rate of flow through the salt dome breach opening was adjusted until the differential driving head at the hole was 50 ft. A flow rate of approximately 25,050 ft^3/day from the hole was found to be necessary to attain the 50-ft differential head. Because only half the simulated region was modeled, this flow rate was doubled; the equivalent flow rate thus derived is 260 gpm. This represents the rate at which ground water flows from the Sparta-Queen City aquifer, into the repository cavity, and out into the Wilcox aquifer system.

In the solution mining scenario, a 1-ft diameter pipe of approximately 1700 ft in length was assumed. The head loss in the pipe (bore hole transporting water from the surface to the cavity), resulting from friction, entrance, and velocity head loss is approximately 0.32 ft (Table 6.1) for 260 gpm. No adjustment of flow to account for the head loss through the pipe was made because the magnitude of this effect is not significant.

The effect of the size of the breach opening on the rate of flow was not examined specifically for this simulation because an earlier simulation with a smaller salt dome (7000-ft-diameter base, 5000-ft-diameter top and 1000-ft height) showed that an increase in the size of the breach opening did not increase the rate of flow linearly. Table 6.2 presents the summary of the results with regard to the size of the opening, based on the previously modeled smaller salt dome. With the 13.5 times larger breach opening, the corresponding increase in flow rate was only 15%. Therefore, the size of the opening appears not to be a critical factor. The most critical factors affecting the rate of flow out of the breach are the permeability adjoining the breached area and the differential head that provides the driving force.

Model for Determining Flow After Salt Dome Collapse

This test case was fomulated assuming that the salt dome down to the repository elevation (-1700 ft) has been dissolved subsequent to 15,000 yr of salt dissolutioning after the breach caused by solution mining. The cavity of 10,350-ft-diameter (1930 acres) is filled with collapsed material of twice the permeability of the original Wilcox aquifer (Figure 6.5). The Queen City

TABLE 6.1. Estimation of Friction, Entrance, and Velocity Head Loss in Bore Hole Pipe

$Q = 260$ gpm $= 0.58$ cfs
$L = 1700$ ft
$D = 1$ ft
$V = \frac{4Q}{D^2}$
$K = 0.5$ factor for sharp-cornered entrance
$K_s = 0.36 =$ factor for new welded continuous steel pipe

Velocity head loss $= H_v = \frac{V^2}{2g} = .0085$ ft

Entrance (sharp corner) head loss $= H_E = K\frac{V^2}{2g} = .0043$ ft

Friction losses (Scobey formula)

$$H_F = K_s \frac{V^{1.9}}{D^{1.1}} \times L = .31$$

Total head loss $= H_V + H_E + H_F = 0.32$ ft

TABLE 6.2. Effects of Size of Breach on Opening on Flow Rate*

Size of Opening into Wilcox Aquifer (ft^2)	Rate of Flow (50-ft Head Differential) (gpm)
1,000	316
3,364	332
13,465	364

* Results of earlier study with a somewhat smaller salt dome and a continuous permeable sand layer at the breach elevation.

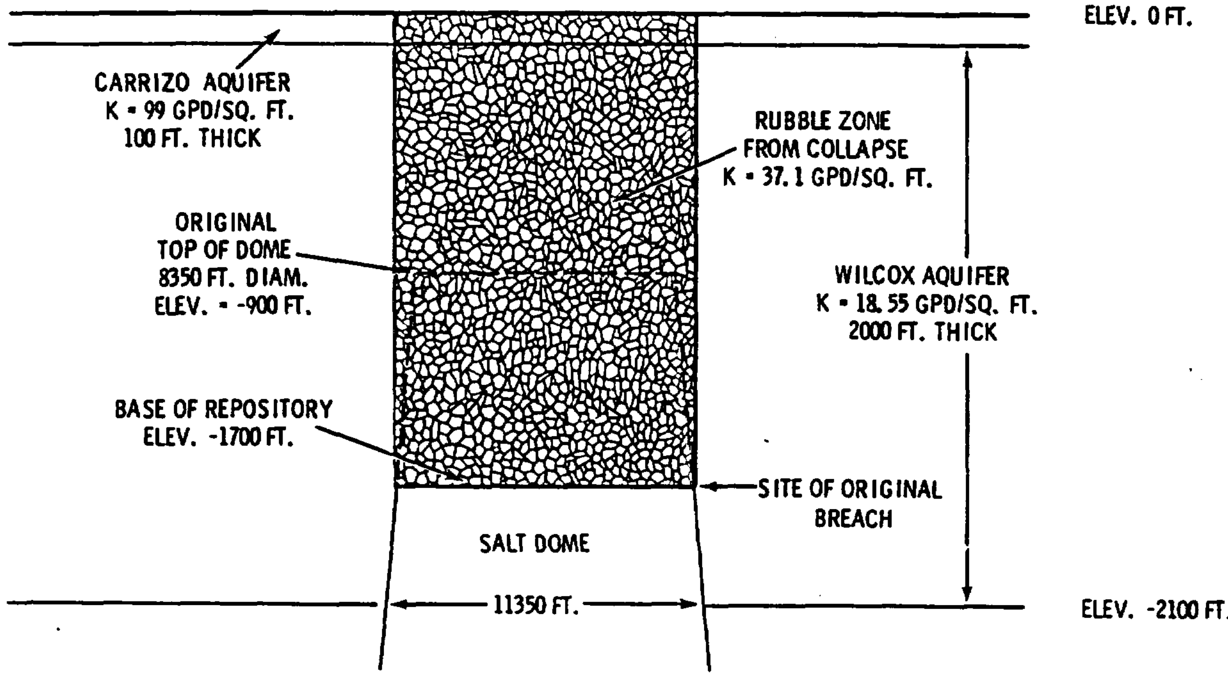


FIGURE 6.5. Schematic Representation of Collapsed Salt Dome

aquifer and the lake formed subsequent to the collapse of the salt dome provide an unlimited source to recharge with a 50 ft differential head across the entire 10,350-ft diameter.

Because the general ground-water gradient in the Wilcox aquifer is 1 ft/1000 ft, the 50-ft additional driving force may significantly affect the flow pattern up to 50,000 ft up gradient. The subregional boundary was kept 80,000 ft (Figure 6.6) from the center of the salt dome. The down gradient boundary was defined at 110,000 ft. A 90,000-ft width was considered from the center of the salt dome.

Unlike the point source used to represent the flow through the salt dome breach, the recharge for this case takes place over the entire 1930 acres. For general aquifer representation a grid of 10,000 ft^2 was used. Near the salt dome radially oriented elements (each representing 1/8 segment for the half circle) were defined. Figures 6.7 and 6.8 describe the regional and local stratification around the salt dome after the collapse.

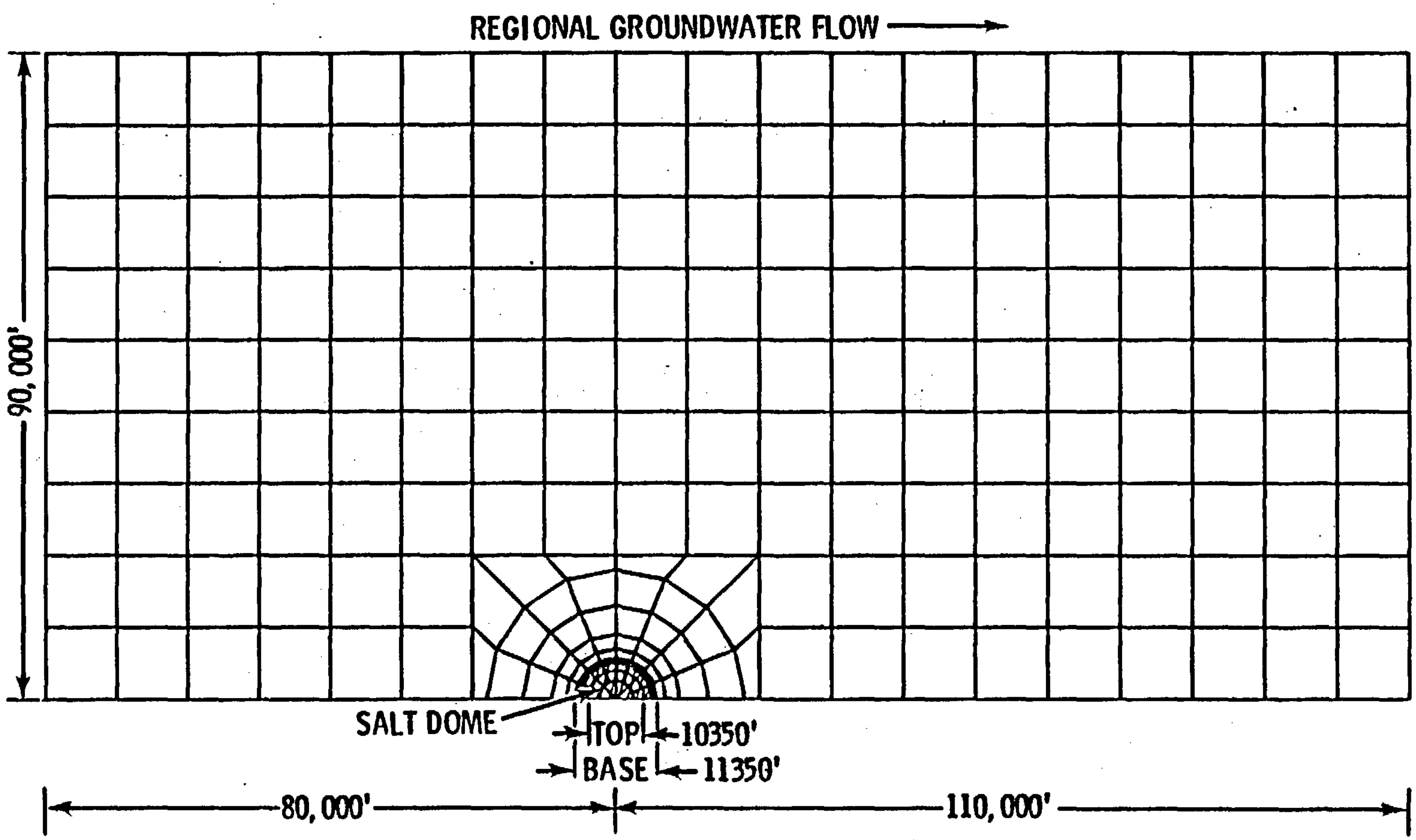


FIGURE 6.6. Uniform Finite Element Grid for Simulation of Flow After Salt Dome Collapse

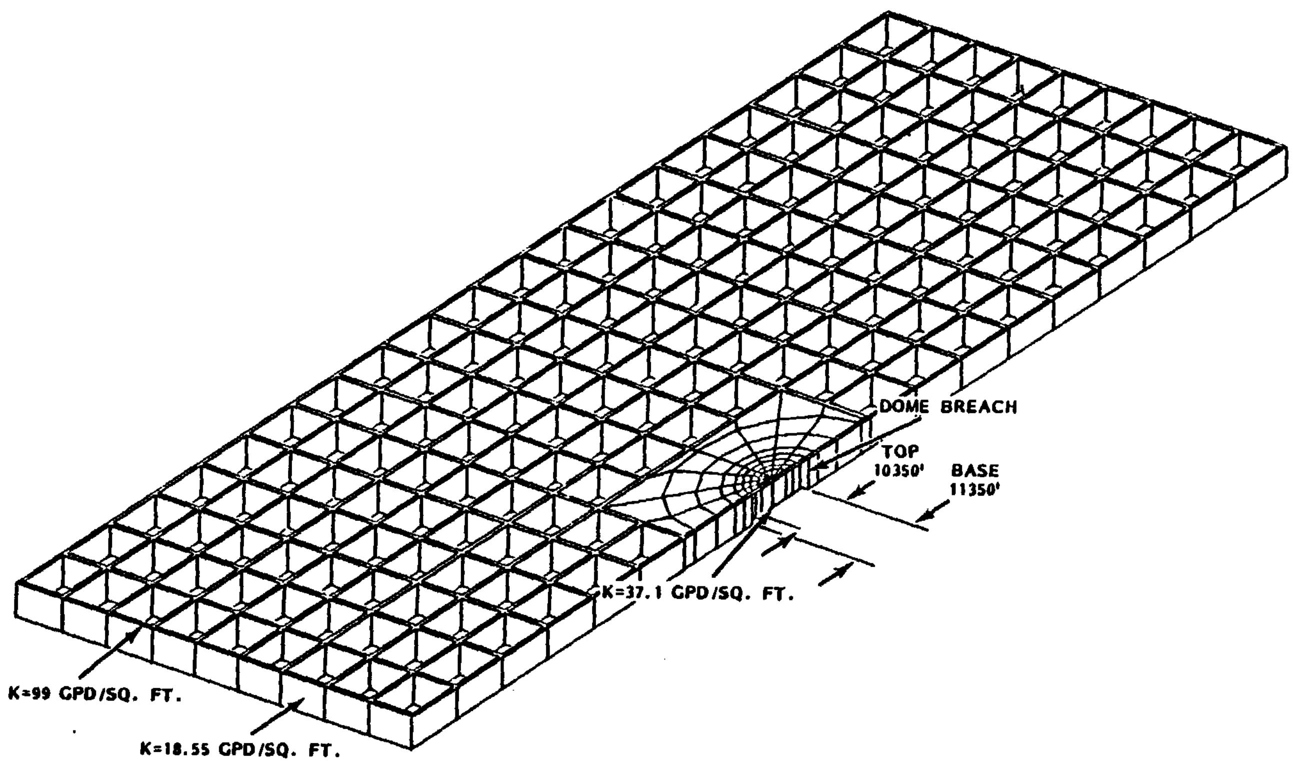


FIGURE 6.7. Regional Stratifications Used for Simulation of Flow After Salt Dome Collapse

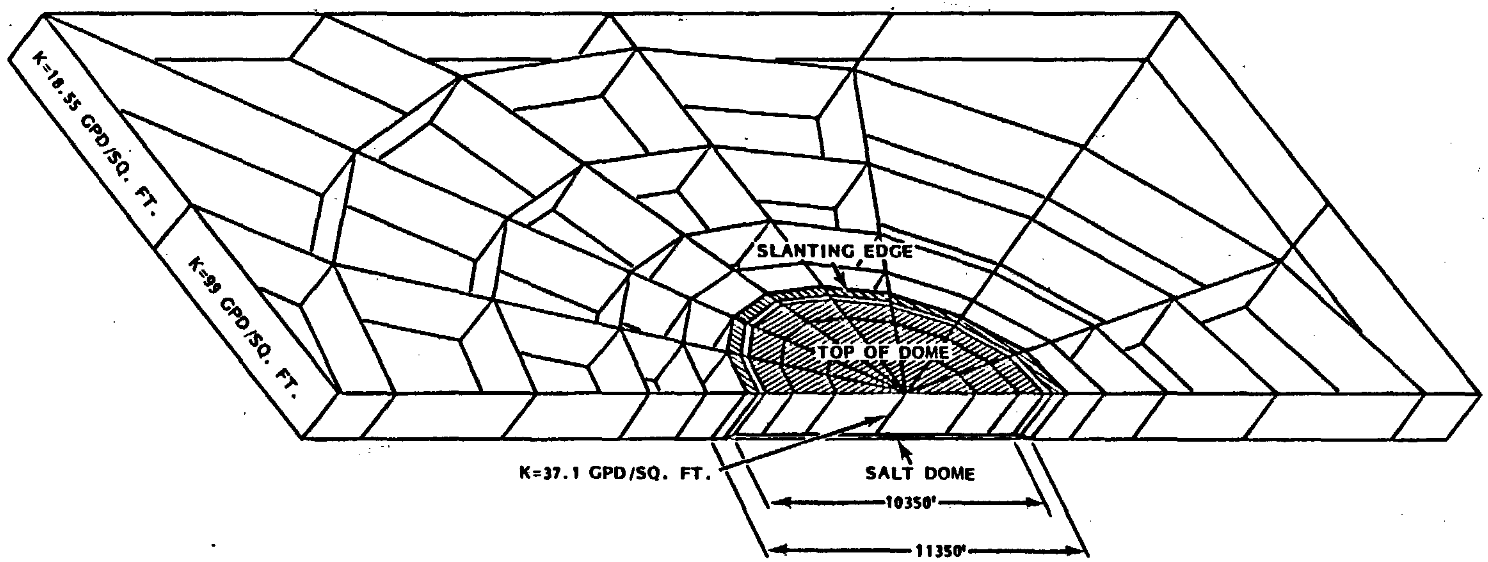


FIGURE 6.8. Three-Dimensional Stratifications of the Region Adjoining Salt Dome After Collapse

For estimation of flow through a 30-ft-thick layer over the repository (chosen to represent twice the height of the waste canisters), vertical logs in all the radially oriented elements near the salt dome have nodes at -1670 and -1700 ft MSL. Steady-state three-dimensional simulation, using the FE3DGW model, was done to estimate the hydraulic head distribution under the prescribed conditions.

A computer program was used to calculate the flow vector in the x-, y-, and z- directions at the center of each element. The radial outward flow between -1670 ft and -1700 ft MSL elevation around the repository was estimated to be 3426 ft^3/day. Because half of the subregion is simulated, this flow was doubled for use in the regional flow model. The converted figure for horizontal flow over the 30 ft high layer is 35.6 gpm. Because the primary objective here was to account for maximal flow, no density effects were considered. With density-dependent simulation the flow rates would be somewhat less than the predicted results.

CHAPTER 7

REGIONAL HYDROLOGIC SIMULATION

Prediction of radioactive contaminant transport requires an estimation of water movement, because water is the primary carrier of waste in hydrogeologic systems. Any release from the Hainesville Salt Dome would enter the Wilcox-Carrizo aquifer, and the contaminants from such a release would flow with the ground water to some point of release to the accessible environment. The purpose of the hydrologic modeling is to simulate the pressure head response of the real-world system and to predict the flow paths and velocities of ground-water movement. To accomplish this objective, a region must be modeled that is large enough to include the natural phenomena that play a significant part in the hydrologic system. Those phenomena, which cannot be included because of size limitations, must be introduced through the boundary conditions.

Specifically, the regional hydrology model was used to define the potential distribution, the streamlines of flow, flow tubes, and travel times from input data describing the hydrogeologic system and release scenario chosen. The East Texas region was modeled with the steady-state version of the Variable Thickness Transient (VTT) Model (see Appendix C).

CONCEPTUAL MODEL

The region modeled is approximately 120 miles by 130 miles, so that a regular finite difference grid of nodes, each 2 miles on a side, was used. The geologic configuration shows a multi-aquifer system where the surface aquifer, the Sparta-Queen City, is isolated by a semi-confining Reklaw clay layer. Neither of these formations extends over the entire region. Because of this isolation, it was deemed unnecessary to include the Sparta-Queen City aquifer in the model. Beneath the Reklaw lies the Carrizo and Wilcox Formations, which combined form the primary regional aquifer. Below the Wilcox, the Midway

Formation provides an effective bottom boundary to the system. Where the Reklaw does not overlay the Carrizo, the aquifer is unconfined (see Figure 7.1). In the unconfined area the water table is in contact with surface streams, receiving rainfall infiltration. To simulate the stream interaction with the aquifer, a two-layer conceptual model was postulated. The Carrizo and Wilcox sands constitute the modeled aquifer, and the second layer consists only of the streams. This arrangement permits the use of an inter-aquifer transfer coefficient to control stream bed effectiveness and thereby eliminates the necessity of assuming that streams fully intercept the aquifer. The elevations of the streams were taken from topographic maps and were interpolated between contours. The inter-aquifer transfer coefficients and permeability distributions were adjusted in calibration of the model to yield a reasonable base flow from the ground-water system to the streams of the region.

Beneath the Wilcox-Carrizo aquifer lies the Midway Formation, which consists of clays with hydraulic characteristics too small to be measured accurately. Thus the Midway was chosen as the bottom boundary for the ground-water model.

Model Boundaries

The boundaries chosen for the hydrologic model were held potential (Dirichlet) boundaries along the northwest, northeast, and south side, as shown in Figure 7.1. Between these held potential boundaries, boundaries that allow no flow to cross were chosen. These were chosen along what appeared to be streamlines of flow rather than along an impermeable geologic boundary. The northwestern boundary had a value to 450 ft above mean sea level, with one area on the west held at 500 ft. The boundaries on the northeast and south were held along a potential line at 200 ft. Flow would enter from the higher potential and exit the lower potential, affected in between by infiltration, transmissivity of the aquifer, leakage to streams, and injection and withdrawal of water.

Rainfall Infiltration

Within the modeled region in the areas where the Wilcox-Carrizo aquifer outcrops, infiltration from rainfall influences the ground-water elevations. Even though the East Texas area receives high annual rainfall, only a small

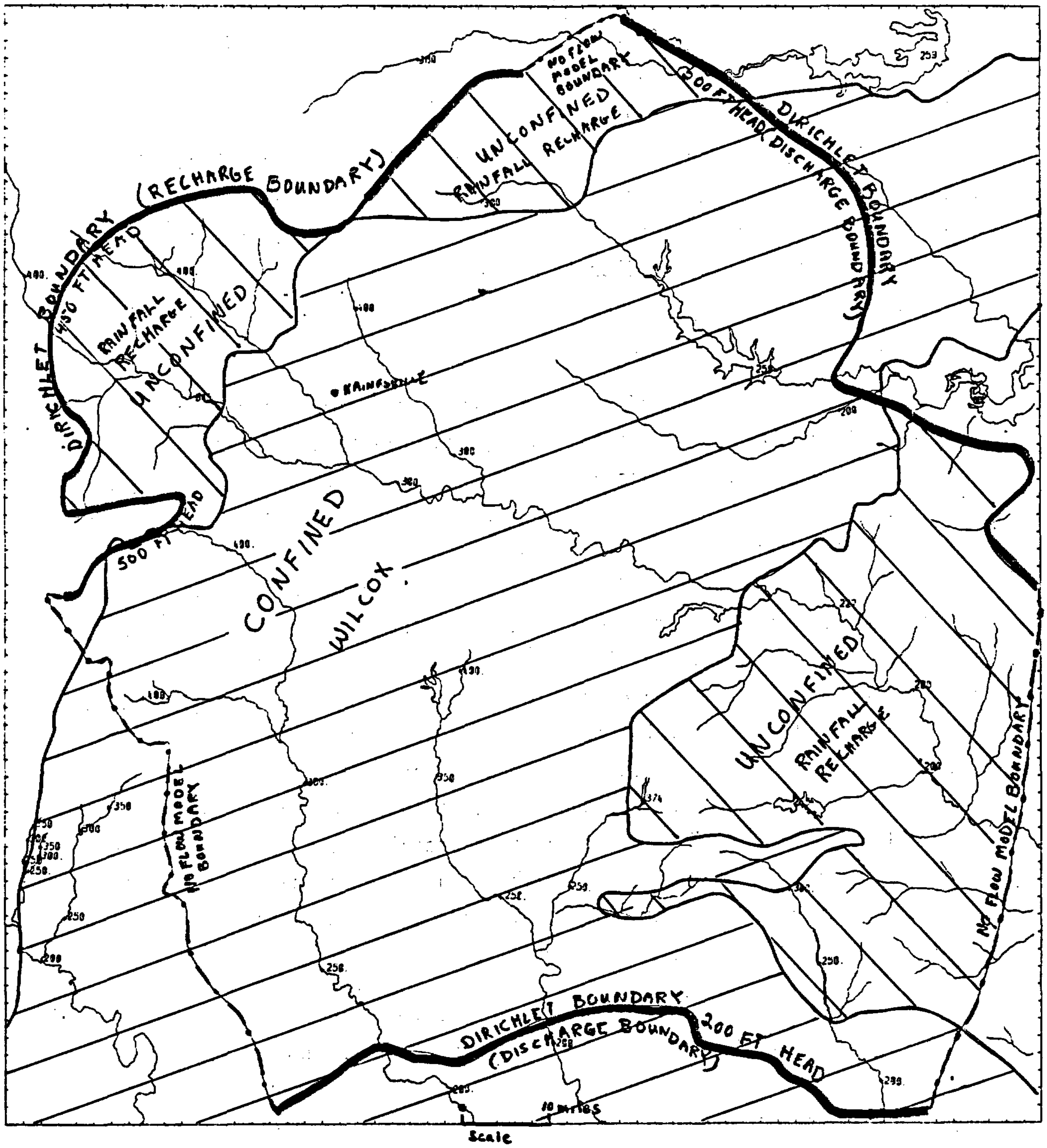


FIGURE 7.1. Geometry and Boundary Conditions for the Wilcox-Carrizo Aquifer

percentage infiltrates to ground water. Table 7.1 shows potential evapotranspiration (PET) and actual evapotranspiration (AET) values calculated, using a modified Thorntwaite & Mather method from monthly weather data collected at Longview and Palestine, Texas.

Runoff accounts for a large percentage of the amount available for recharge. Initial simulations arbitraily using 4 in. of infiltration in the model showed that the reported transmissivity properties of the soil would not accept this amount. The infiltration was adjusted in the unconfined area to vary between 0.25 in on the northwestern edge to 0.9 in. on the eastern side.

Hydraulic Conductivity-Transmissivity

Transmissivity is one of the most difficult parameters of a ground-water system to quantify. Well pumping tests yield only single point measurements and are influenced by many local factors, whereas regional data are needed. Table 7.2 summarizes the available measured values of transmissivity, permeability, and thickness of the major aquifer. There are too few measurements to characterize adequately this area of over 10,000 square miles. These measurements did provide minimum, maximum, and average values for the primary aquifer. The transmissivity distribution was developed using the map of the net sand (Figure 7.2), which covers the confined area of the model. To cover the remainder of the area, the map was extended outward toward the boundaries. The map was digitized and used as the measure of the aquifer thickness. The average transmissivity for the sands was divided by the thickness, and this was used as the initial distribution for permeability. These values were adjusted in some areas during the calibration phase of the modeling process to realize a better match of the potential surface with existing field data.

Stream Aquifer Interaction

Streams were modeled over the unconfined parts of the Wilcox aquifer by holding the potential head of the streams at the land surface according to elevations from topography maps. An inter-aquifer transfer coefficient was used between the streams and the aquifer to control the effective transmission of the water to or from the stream. The model was adjusted so that approximately .01 of the mean annual flow of the streams was seepage from ground

TABLE 7.1. Arithmetic Mean Weather Data and Calculated AET, PET and Excess Precipitation

	Longview, Texas	Palestine, Texas
Arithmetic Mean Annual Temperature	66.4°F (19.1°C)	66.6°F (19.2°C)
Precipitation	46.2 in. (1172.5 mm)	40.5 in. (1032 mm)
Potential Evapotranspiration	40.9 in. (1039.8 mm)	40.6 in. (1031.8 mm)
Actual Evapotranspiration	32.1 in. (814.6 mm)	33.5 in. (851.1 mm)
Available for Runoff and Recharge	14.1 in. (357.2 mm)	7.1 in. (181.3 mm)
Percent of Precipitation as Runoff and Recharge	31%	17%

TABLE 7.2. Summary of Transmissivity, Permeability and Unit Thickness Data

	Wilcox	Carrizo	Carrizo-Wilcox
Transmissivity (gal/day/ft)			
Number of Measurements	44	14	23
Average Value	8,076	13,078	12,097
Minimum Value	600	2,000	2,970
Maximum Value	47,000	20,800	38,000
Standard Deviation	10,140	5,143	8,322
Permeability (gal/day/ft^2)			
Number of Measurements	39	14	10
Average Value	76	185	99
Minimum Value	3	22	56
Maximum Value	338	450	244
Standard Deviation	80	92	54
Thickness of Unit (ft)			
Number of Measurements	42	14	10
Average Value	116	75	91
Minimum Value	15	40	30
Maximum Value	633	110	141
Standard Deviation	124	22	33

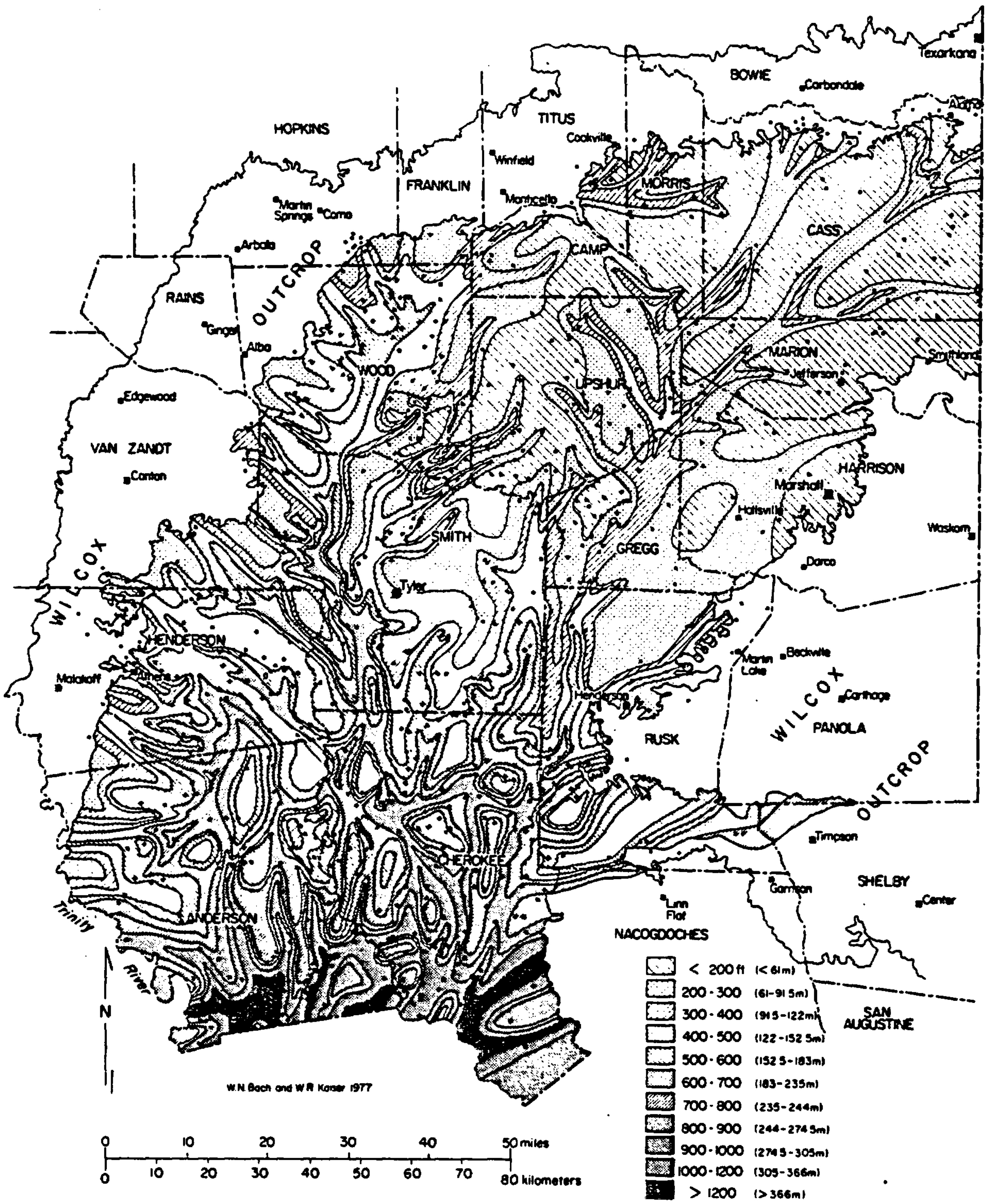


FIGURE 7.2. Net-Sand Map of the Undivided Wilcox Group. Wilcox outcrop from Barnes, 1965, 1966, and 1967.

water. This was based on data from the USGS (1959) which show minimum flow in streams in the Sabine River Basin to be about 1% of the flood stage flows.

Additional Stress on the Ground Water

A notable feature of the ground-water potential contours of the Wilcox-Carrizo aquifer is the depression in Gregg and Upshur Counties, which contain a major part of the East Texas Oil Field. Broom (1969) reported that for municipal purposes in Gregg and Upshur Counties in 1966, about 1.1 mgd (1200 acre-ft/yr) of water was being used for domestic purposes and about 1.6 mgd (1800 acre-ft/yr) was used for industrial purposes. The model calibration required that about 1600 acre-ft of water per year be withdrawn to create a similar ground-water depression.

Potential Distribution

A potentiometric surface map was drawn for the Wilcox-Carrizo aquifer from 717 head measurements. This map was digitized and used as the starting potentiometric surface for the modeling. Calibration of the model included checking how closely the hand-drawn potentials checked with the well measurements. When modeling a ground-water system, an attempt is made to adjust the model so that the potential surface has nearly the same or better accuracy than the hand-drawn potentials, when compared statistically to the well measurements. The hand-drawn potentials have an average difference of 26.7 ft, with a root mean square of 38.7 ft. The calibrated model results for the same wells show an average difference of 32 ft and a root mean square of 45 ft. This was considered sufficient to predict flow directions and travel times for the release consequence analyses.

RESULTS OF HYDROLOGIC SIMULATIONS

Three scenarios were chosen for hydrologic simulation: the base case, simulating the current ground-water system; a second case, postulating the end of water removal from the aquifer in Gregg and Upshur Counties; and a pumping well scenario, postulating a domestic pumping water well 6 km down gradient of the edge of a salt dome.

Base Case

A base case chosen for the first scenario was the case that simulates the present day ground-water system, including the depression in Gregg and Upshur Counties. Flow that originates at or passes over the Hainesville Salt Dome in the Wilcox-Carrizo aquifer travels in a southeasterly direction, then eastward into this depression. Figure 7.3 shows the streamlines drawn between these areas.

According to the near-dome hydrologic modeling (see Chapter 6) and release scenario analyses (see Chapter 5), a flow of 260 gpm is released from the salt dome. Integration around the salt dome on the down gradient side captured equal flow totaling 260 gpm within the seven flow tubes.

For the transport simulations, the seven flow tubes were combined into a one-dimensional tube of appropriate size and length. A dispersion length was calculated, which accounts for the variation within the two-dimensional flow system. This is because the results of interest are the rate of release of radioactivity per unit time into the surface water system and the distribution of that release in time, rather than the spatial variation among the paths. The observed travel time variation in the seven flow tubes was used to determine an average travel time and velocity. The maximum and minimum travel time was 18,800 years and 11,900 years, respectively. The flow tube lengths were from 21,900 ft to 18,300 ft. Velocity variation was from 11.66 ft/yr to 15.33 ft/yr, with an average of 13.26 ft/yr. The macroscopic dispersivity was calculated from the velocity variation to be equal to 770 ft.

Second Case

The second case was postulated with the discontinuance of water being removed from the aquifer in Gregg and Upshur Counties. This would permit the water passing the Hainesville Salt Dome to discharge into the Sabine River and the Big Cypress Bayou near the northeastern model boundary. Figure 7.4 shows the new contours of potential and the calculated flow tubes containing the 260 gpm flow released from the salt dome breach.

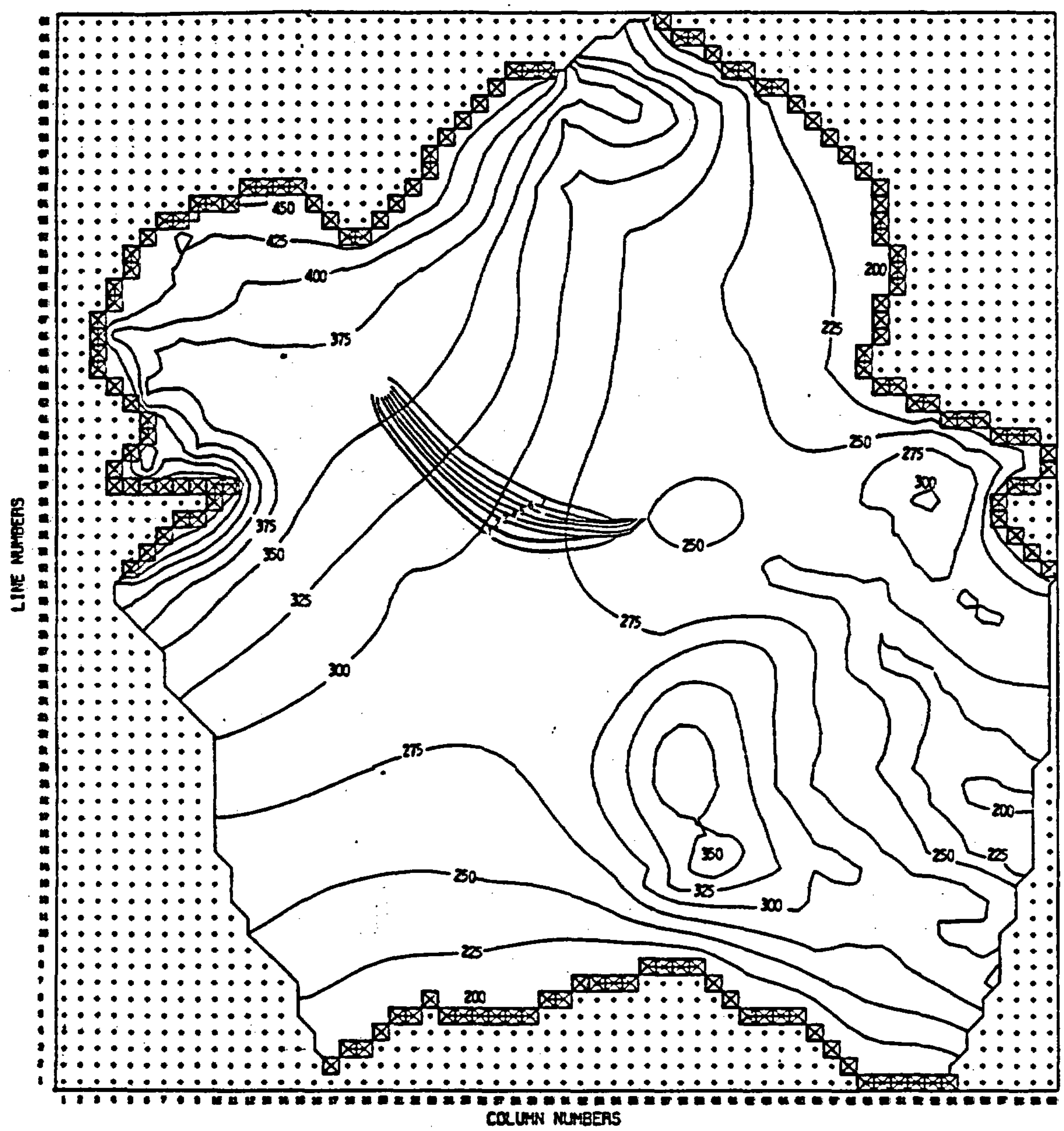


FIGURE 7.3. Modeled Ground-water Aquifer Showing Potential Contours and Flow Tubes from the Hainesville Salt Dome, Case 1

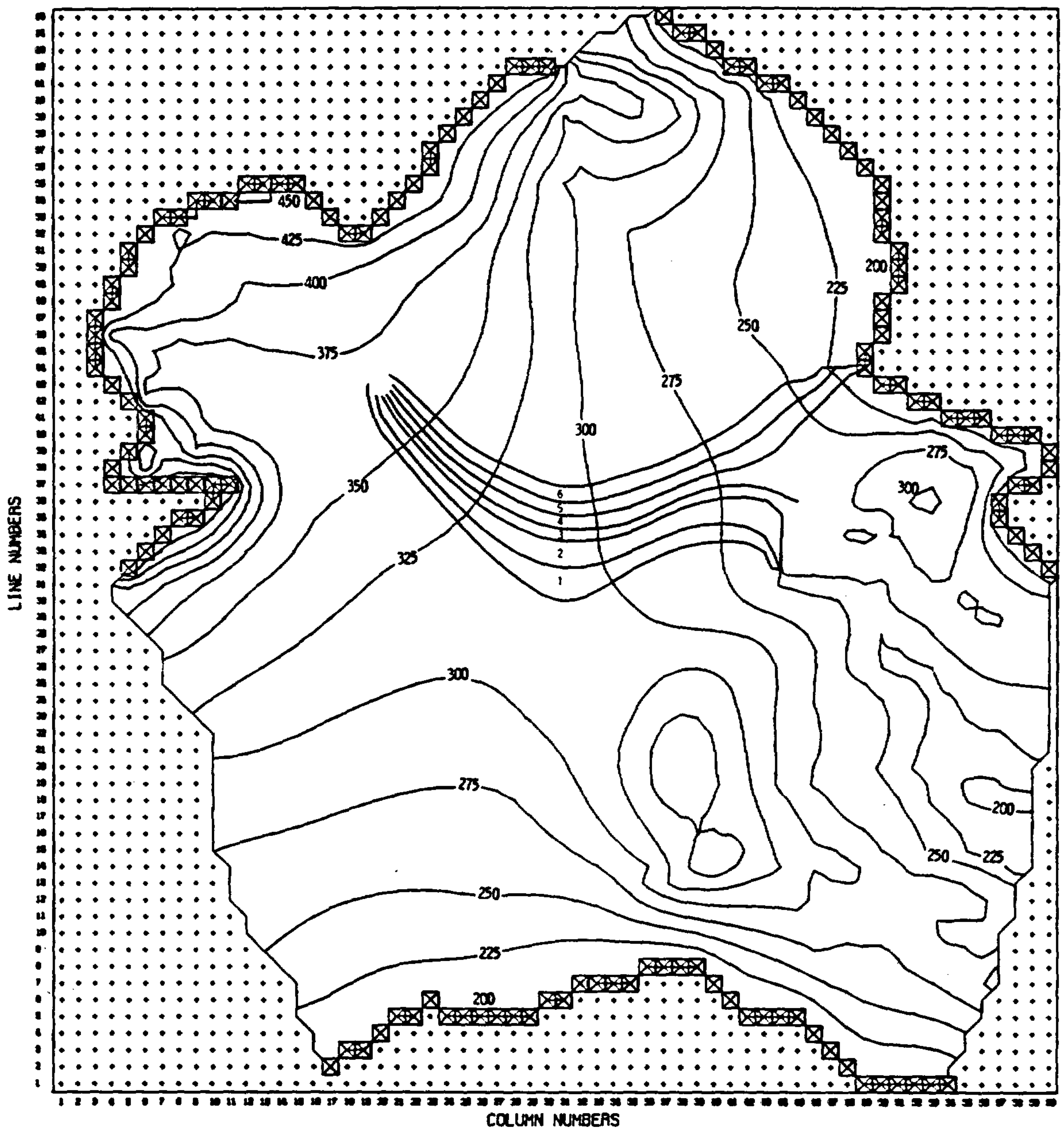


FIGURE 7.4. Modeled Aquifer Showing Potential Contours and Flow Tubes from the Hainesville Salt Dome, Case 2

The flow from the salt dome proceeds southeasterly and divides to enter the Sabine River and the Big Cypress Bayou at the edge of the confining Reklaw Formation. The center streamline terminates at the stagnation point that divides the two flow systems. The average flow velocities, travel times, and lengths of the flow tubes are shown in Table 7.3.

Pumping Well Scenario

A domestic pumping water well was postulated at a distance of 6 km down gradient of the edge of the salt dome, based on the location that can currently provide potable water. (In an actual site assessment, this would be changed to match the requirements of federal regulations.) The contaminated water was assumed to be picked up in a 400 gpm well discharge.

One feature of the VTT code used for these simulations is the ability to do more detailed simulations in the area of interest by focusing on a subregion of the modeled area, creating a smaller area of higher resolution. This is done by first simulating the large area of low resolution to provide the boundary condition for the small area, high resolution region. The new subregion model is then run to predict in more detail the potential contours for this region.

Figure 7.5 illustrates such an expanded smaller region. The node spacing for this region was 1320 ft. Point source data for the release and pumping are the same as in the large region model. Flow originates from the release point at the Hainesville Salt Dome and enters the well near the 344-ft contour.

Flow tubes were generated and travel times for each streamline were computed. The average flow tube length was 22,900 ft and the travel time was 1050 yr. The flow tubes are numbered on Figure 7.5.

TABLE 7.3. Case 2 Flow Tube Data

	Sabine Discharge	Big Cypress Discharge
Average travel time	43,000 yr	38,550 yr
Average length	326,500 ft	343,400 ft
Average velocity	7.59 ft/yr	8.91 ft/yr

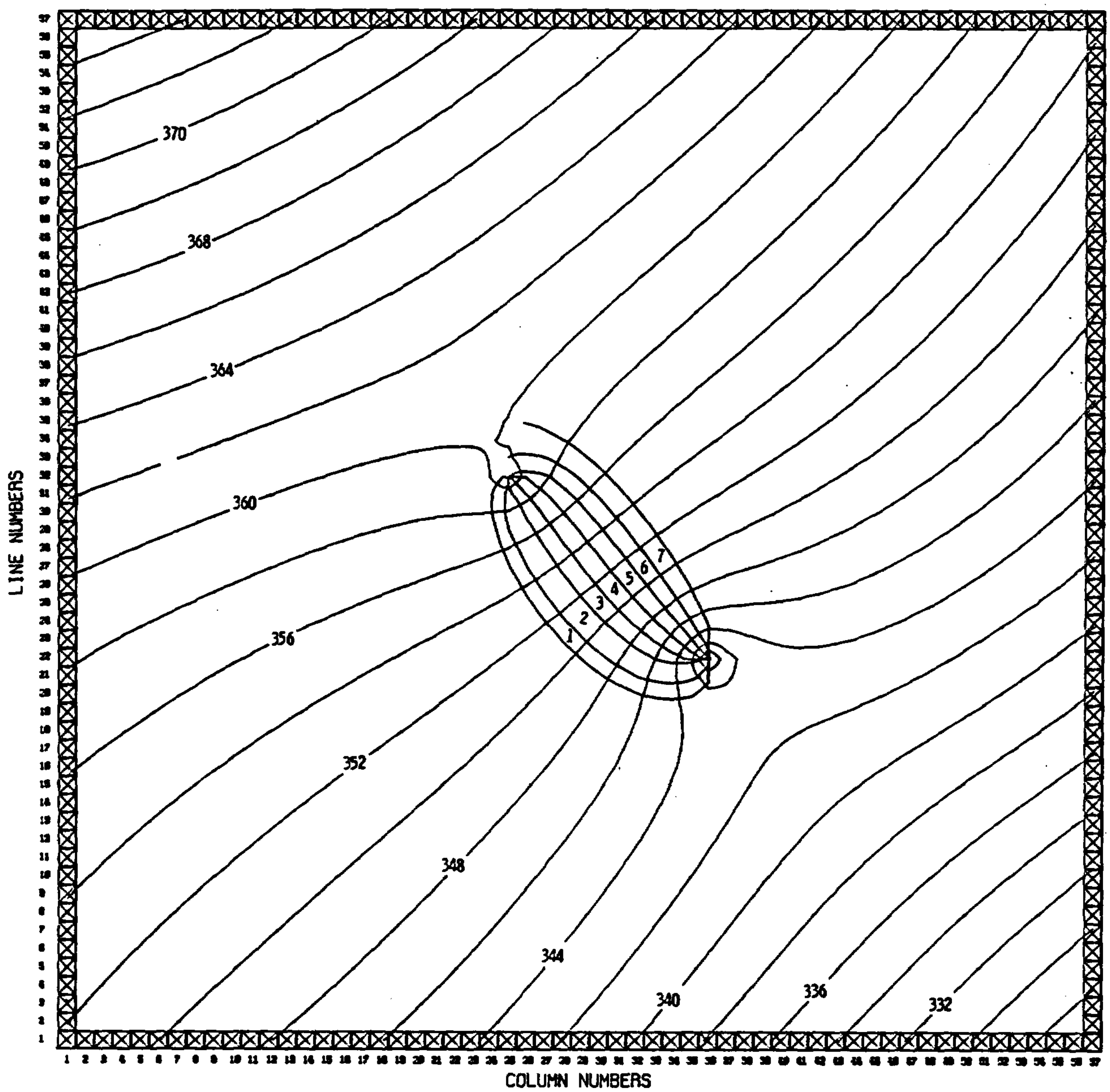


FIGURE 7.5. Subregion Model With Plotted Contours and Flow Tubes from the Edge of the Salt Dome to a Pumping Well

Simulation of this scenario is rather inconsistent in that subsequent to the breach in the salt dome, the ground water is nearly saturated with brine. Thus, the well at 6 km could not yield potable water. Indeed, the salt plume is calculated to last about 15,000 yr along a pathway for which it also (by chance) takes about 15,000 yr to travel. During this period there is no location along the streamlines that will give potable water. However, subsequent to the dissolutioning of the salt dome, potable water could be obtained directly above the repository. For this analysis this inconsistency was not resolved. The well at the current potable location was arbitarily selected to demonstrate the methodology used to analyze a well scenario. In an actual site assessment the well analysis would be in accord with the appropriate regulations defining the accessible environment.

CHAPTER 8

TRANSPORT SIMULATION

Ground-water flow patterns and velocities ultimately determine the dispersal and arrival times of dissolved radioisotopes leached from a geologic repository. In principle, the classical convective-diffusion equation depending on the ground-water velocity at each aquifer location and each geological stratum can be solved for the concentration of transported radioisotopes over time. Such a calculation would, however, require a thorough knowledge of the release rates from the breached repository, the hydrodynamic dispersivity defined over the entire region, and a complete characterization of the chemical phenomena of contaminant sorption on geological media. Acquisition of all such data on a geological scale is not currently achievable. In predictions of contaminant transport through a ground-water system, the inherent spatial variability of media properties is an additional obstacle. This stochastic aspect affects the assumed validity of the classical transport equation when applied to large regions for predictions over thousands of years.

In view of the limits and uncertainties in the site characterization data, a one-dimensional transport model having a stochastic formulation was used for the far-field transport simulations of this reference site analysis. The specific geometry of the repository is considered to be not important in the far-field. Only the near-dome simulation warranted three-dimensional analysis; however, in an actual site assessment, if the data are sufficient, the three-dimensional model could be used for far-field simulations.

TRANSPORT MODEL

A one-dimensional Multicomponent Mass Transport model (MMT1D--see Appendix D), based on the method of discrete parcel random walk, was used to simulate the movement and to predict the concentrations of radioisotopes released by the nuclear waste repository. The basic operational concepts incorporated in the model are:

- convective transport and dispersion
- soil media sorption equilibrium
- radioactive decay of contaminants
- repository release rates.

The one-dimensional model is made to represent a real system's three-dimensional flow by associating a width and height with the lines of travel, which are the streamlines obtained from the hydrologic modeling of the water flow (see Chapter 7). A collection of streamlines beginning at the repository and ending at a release region at the surface water systems is collectively called a flow tube. The flow tube's width and height represents the extent of lateral transport (dispersion) expected during transit along that flow tube length. Furthermore, flow tubes are dimensioned to be mass conservative by requiring all material released by the repository to remain within a tube until exiting.

Convective Transport and Dispersion

The mass of radioisotopes is subdivided by the model into many parcels that are released into the ground-water stream according to a specified repository release rate, which was determined from the breach scenario, near-dome simulation, and leaching/solubility considerations. Parcels of radionuclides not interacting with the porous media are transported away with a velocity equal to the average of velocity of the ground water along the streamlines defining the flow tube. Radionuclides that are adsorbed move with a retarded velocity equal to the average velocity divided by a retardation factor K, given by:

$$K = 1 + \ Kd$$

where Kd is the sorption equilibrium constant for the particular radionuclide and is the ratio of geomedia bulk density to geomedia porosity.

Dispersion can be defined most simply as the phenomenon associated with the mixing between different concentration regions. It is a consequence of random motions deviating from the mean flow velocity. The extent of dispersion for a particular system is quantified by the dispersion length or dispersivity. A random walk process is used by the model to simulate the dispersion of radioisotopes. During transit with a retarded average flow velocity, parcels are given random displacements as a function of the dispersion length. Such a random process generates the concentration solution to the partial differential equations of transport. In order that dispersion in a one-dimensional flow tube might represent the combined effects of both dispersion and velocity variation between streamlines, an effective macroscopic dispersion length parameter was employed. This parameter represents the velocity variance of parcels traveling along different streamlines comprising the flow tube.

Geological Media Sorption Equilibrium

The Kd values represent the ratio of the activity of the radioisotope sorbed onto a geologic medium to that remaining in solution under equilibrium conditions. Immobilization is primarily viewed as an adsorption process but can occur by other chemical mechanisms. It is assumed that the water velocity is low enough that the equilibrium assumption is valid.

The geotransport aspect of the salt dome repository scenario requires consideration of two sets of Kd values for some of the radionuclides present in the inventory. As nuclear waste is released by the dissolving salt dome, the Kd used is that measured in concentrated salt solution; when the salt dome dissolution is complete, the Kd used is that measured in ground water containing bicarbonate. Generally, the Kd value of variable sorption nuclides is greater in bicarbonate ground water than in a salt solution. (A notable exception is Tc, which has its greater value in salt solution.) The result is lower retardation for radioisotopes traveling along within the salt plume, resulting in shorter travel times than would be the case for the bicarbonate solution. To handle this change in Kd values subsequent to passage of the salt plume, alterations of the original MMT model were made to include dependence of Kd on the location of the released salt plume.

Radioactive Decay

The radioisotopes contained in both the repository and the flow tubes undergo radioactive decay. Released parcels of fission or activation products have their mass reduced according to a simple first-order exponential decay as they transit the flow tube. Transuranic radionuclides are involved in four decay chains: the actinide series, the uranium series, the neptunium series, and the thorium series. Mass balance is maintained in the MMT model by creating daughter parcels with total activity equal to that derived from chain decay. Only parent and daughter nuclides with relatively long half-lives are considered for transport simulations. Daughter nuclides with relatively short half-lives that are in secular equilibrium have the location and spatial distribution of their parents.

RELEASE SOURCE TERM

A release source term curve reflects the details of the release scenario and is the primary factor establishing the initial radioisotope concentrations during transport simulation. Without the effects of sorption and dispersion, released concentration levels propagate along the flow tube with the groundwater flow velocity, altered only by radioactive decay. Sorption differences among radionuclides and dispersion cause separation in the concentration distributions.

The release source term of each radionuclide is a function of exposed surface area, leach rate, solubility, and water flow rate exiting from the repository. For the base case salt dome breach scenarios, the exposed surface area was found not to be limiting. A solubility limit of 6 ppm for uranium was assumed, while all of the other radionuclides were assumed to be released at proportional rates, resulting in congruent dissolution for all radionuclides at a single fractional release curve (see Chapter 10).

The rate of waste dissolution in metric tons (1000 kg) per year was determined as follows:

- Leaching rate (metric t/yr) = 0.002 x flow rate (gpm) x solubility (ppm). Total uranium inventory calculated from the assemblies list equaled 7.8 x 10^4 metric tons. Assuming a constant flow rate yields:
- Leaching time (yr) = 3.9 x 10^7/flow rate (gpm) x solubility (ppm). Similarly, with 410,000 ppm as the solubility of salt, the rate of dissolution of the salt dome in ft^3/yr in terms of flow rate in gpm is:

- Salt dissolution rate (ft^3/yr/gpm) = 1.4×10^4 (ft^3/yr/gpm of flow). Using the volume of a truncated cone from the top of the salt dome to the repository depth, the volume of salt was estimated to equal 5.5×10^{10} ft^3. Again assuming a constant flow through the salt dome, the time for dissolution above the repository is:
- Salt dome dissolution time (yr) = 3.8×10^6/flow rate (gpm).

Near-dome simulation (Chapter 6) of the hydrologic system provided an estimate for the water flow rate of 260 gpm during salt dome dissolution. After the salt dome collapse and the resultant termination of the salt release, the flow rate penetrating the nuclear waste region equaled 35.6 gpm. At a flow rate of 260 gpm, the salt dome dissolves in 14,700 yr. During this period, the fraction of the nuclear waste inventory leached at 6 ppm concentration is 0.59. The remaining 0.41 of the waste is leached in 75,000 more years by the 35.6 gpm flow at 6 ppm for uranium.

CONCENTRATION ESTIMATION

Concentrations of radioisotopes were calculated by a summation of parcel weights over time intervals as the parcels exit the flow tube. The parcel flux obtained from that summation was divided by the total Darcy flow within the tube to obtain concentration. Because the summation of parcel weights constitutes sampling a random walk transport process, the primary concentration versus time curve displays statistical fluctuations. The expected concentration curve was obtained by averaging the primary curve with a time series filter to remove most of these fluctuations. As a result of this methodology, the concentration graphs include small variations.

RELEASE CONSEQUENCES ANALYZED

Geotransport was evaluated for four cases:

Case 1. Base Case, with the exit point in the East Texas Oil Field as in the present hydrologic system. Breach occurs at 150 yr and at 1050 yr after the repository closure (i.e., after 50 years of solution mining which begins at time 100 or 1000 yr after closure).

Case 2. Base Case, with the East Texas Oil Field removed from the hydrologic model. This gives exit points in the Sabine River and Big Cypress Bayou. Only the release at 150 yr post-closure was analyzed.

Case 3. Well Pumping Case, with the well located 6 km from the salt dome. Only the release at 150 yr post-closure was analyzed.

Case 4. Base Case with the East Texas Oil Field removed, exit into the Sabine River only, using lower bound Kd values.

The nuclides considered in the four scenarios are listed in Table 8.1. The initial inventory is the total inventory from the PIR assemblies list (provided to AEGIS by BNI) of 10 yr old waste at the beginning of emplacement in the repository. The 200-yr inventory is that of 200-yr-old waste in the repository, with geotransport beginning at that time. Radioisotope half-lives and average Kd values are also provided in Table 8.1. Simulations were run to 2 million yr, except the well pumping case terminated at 150,000 yr. This was done because residual radionuclides with large retardation factors would have decayed before exiting to the surface. A beta value of 6.0 and an effective porosity value of 0.2 were used in all runs. The effective porosity was provided by the water flow modeling (Chapter 7) and is used to convert water velocity (Table 8.2) into Darcy water flux by mulitplication.

The elimination of the East Texas Oil Field resulted equally in a Sabine River discharge and a Big Cypress Bayou discharge. Release inventory, therefore, was divided equally between two flow tubes. In all cases, the flow tube dimensions were calculated to subtend the repository and include 260 gpm (1.8×10^7 ft^3/year) of ground-water flow. The transport parameters are provided in Table 8.2.

The tube dimensions, flow velocities, and travel times given in Table 8.2 are average values based on the streamlines of the flow tubes. The dissolved salt release begins at year 200 and ends with year 14,917. (Note that dates in this section refer to the age of the waste.) The region of concentrated salt solution moves with the ground-water velocity in each case and requires the given travel time to traverse the flow tube. The dispersion parameters represent the macroscopic velocity variation over streamlines comprising each flow tube; they are not the porous media dispersivity.

TABLE 8.1. Simulation Inventories, Half-Lives, and Kd Values

Nuclide	Half-Life (years)	Initial Inventory (curies)	Decayed* Inventory (curies)	Kd** (ml/g) Salt	Water
Fission and Activation Products					
^{3}H	12.35	3.45E7	4.59E2	0	0
^{14}C	5730	1.14E5	1.11E5	0	0
^{79}Se	6.5E4	2.98E4	2.97E4	24	24
^{90}Sr	28.5	4.30E9	3.32E7	0	270
^{99}Tc	2.13E5	9.72E5	9.71E5	1.6	0
^{129}I	1.57E7	2.29E3	2.29E3	0	0
^{135}Cs	2.3E6	2.84E4	2.84E4	0	11
Decay Chains					
Thorium Series:					
^{240}Pu	6540	3.85E7	3.77E7	250	73
^{236}U	2.34E7	1.84E4	1.86E4	1.5	1.5
^{232}Th	1.4E10	0	1.83E-4	40	40
Neptunium Series:					
^{241}Am	433	3.26E8	2.37E8	0	75
^{237}Np	2.14E6	2.25E4	4.05E4	0	6.6
^{233}U	1.58E5	0	2.80E1	1.5	1.5
^{229}Th	7340	0	2.34E-1	40	40
Uranium Series:					
^{242}Pu	3.87E5	1.31E5	1.30E5	250	73
^{238}U	4.47E9	2.45E4	2.45E4	1.5	1.5
^{230}Th	7.7E4	9.01	8.43E1	40	40
^{226}Ra	1600	2.41E-2	3.94	15	15
Actinium Series:					
^{243}Am	7370	1.16E6	1.14E6	0	75
^{239}Pu	2.44E4	2.36E7	2.35E7	250	73
^{239}U	7.04E8	0	4.63	1.5	1.5
^{231}Pa	3.25E4	0	9.52E-3	40	40

* Decayed inventory for 200 year-old waste at time 150 years post-closure.
**See Chapter 11.

TABLE 8.2.

Case 1. East Texas Oil Field:

Path length	196,700 ft
Flow tube dimensions	29, 400 x 234 ft
Travel time	14,800 yr
Flow velocity	13.26 ft/yr
Dispersion parameter	770 ft

Case 2. Sabine River and Big Cypress Bayou:

	Sabine	Cypress
Path length	326,500 ft	343,400 ft
Flow tube dimensions	20,900 x 288 ft	30,600 x 167 ft
Travel time	43,000 yr	38,550 yr
Flow velocity	7.6 ft/yr	8.9 ft/yr
Dispersion parameter	164 ft	504 ft
Flow	130 gpm	130 gpm

Case 3. Well Pumping Case:

Path length	22,900 ft
Flow tube dimensions	10,000 x 418 ft
Travel time	1,050 yr
Flow velocity	21.8 ft/yr
Dispersion parameter	162 ft
Flow	260 gpm
Pumping rate	400 gpm

The concentrations of radioisotopes are based on the flow rate through each tube, except that in the well pumping case, the exit concentrations are diluted by the 400 gpm removal rate. Additional water is assumed to enter the well.

Graphs of concentration versus time for five simulation runs representing the four cases are provided in the appendices. In those graphs, the initial inventory is that at 200 yr, and the cumulative release (present inventory) is defined as the total inventory under the graph, equaling the total curies exiting before decay takes place to the surface (Table 8.3).

TABLE 8.3. Cumulative Radiocontaminant Discharge in Curies for the Four Release Scenarios After Geotransport Based on Solution Mining Beginning at Time 100 Years After Closure

Cumulative Discharge (curies)

	Simulation Number				
Nuclide	(1)	(2a)	(2b)	(3)	(4)
^{14}C	5.21E3	8.90E1	1.52E2	2.50E4	8.88E1
^{79}Se	0	0	0	0	0
^{99}Tc	5.43E5	2.46E5	3.88E5	4.32E5	2.46E5
^{129}I	2.28E3	1.14E3	1.14E3	2.28E3	1.10E3
^{135}Cs	2.49E4	7.74E3	7.71E3	1.66E4	7.68E3
^{240}Pu	0	0	0	0	0
^{236}U	2.90E4	1.44E4	1.44E4	2.91E4	1.44E4
^{232}Th	1.13E-1	4.73E-2	4.84E-2	7.96E-3	3.87E-1
^{241}Am	0	0	0	1.07E6	0
^{237}Np	8.05E4	3.53E4	3.50E4	8.67E4	4.0E4
^{233}U	7.31E4	4.90E4	5.12E4	1.52E4	2.84E4
^{229}Th	4.47E3	2.08E3	1.95E3	7.49E2	1.17E3
^{242}Pu	0	0	0	0	0
^{238}U	2.45E4	1.22E4	1.22E4	2.45E4	1.22E4
^{234}U	9.64E4	2.83E4	3.06E4	1.31E5	3.39E4
^{230}Th	4.33E3	1.24E3	1.37E3	3.59E3	1.07E3
^{226}Ra	9.48E3	2.55E3	3.19E3	8.30E3	1.73E3
^{243}Am	8.75E4	3.08E3	4.55E3	3.29E5	3.08E3
^{239}Pu	2.26E2	8.36	6.81	3.89E2	9.27
^{235}U	8.16E2	4.12E2	6.00E5	7.82E2	5.50E5
^{231}Pa	2.75E1	7.48	1.26E1	2.96E1	5.93

(1) Case 1. East Texas Oil Field discharge.
(2a) Case 2. Sabine River discharge.*
(2b) Case 2. Big Cypress Bayou discharge.*
(3) Case 3. Well pumping case.
(4) Case 4. Sabine River discharge.* Lower bound Kd.
* Represents half of released inventory.

NOTE: The format used here is analogous to scientific notation, e.g., 5.21E3 = 5.21×10^3

Unusual effects of salt concentration affecting the sorption Kd are observed for the fission products. In all cases, ^{3}H and ^{90}Sr decay before exiting to the surface. Carbon-14 has the shortest half-life of the activation products that exit. It moves at the water velocity in both the salt solution and bicarbonated water.

Figure 8.1 shows carbon concentrations for Case 1. As a consequence of a substantial macroscopic dispersion parameter, ^{14}C arrives at the exit about 2000 yr sooner than predicted by an average water travel time. The extended tail on the graph results from the protracted release at a reduced rate between times 15,000 to 90,000 yr, after the salt dome has dissolved. The short half-life causes ^{14}C to vanish after 30,000 yr.

Figure 8.2 displays ^{14}C concentration under the same hydrologic conditions, but including initiation of the solution mining at 1000 yr after closure. The exit inventory is 92% of that in Figure 8.1. In view of the fact that all radionuclides with a longer half-life, including the transuranics, will not decay more quickly than ^{14}C, a 1000 yr delay before geotransport would yield little difference in consequences over the minimal 15,000-yr travel time. The differences are even less for long half-life nuclides with non-zero Kd values. Thus the 100- and 1000 yr solution mining scenarios would yield essentially equivalent consequence results from geotransport. This is an important result, in that it shows the geotransport consequences of a breach are not affected by whether it initiates at 100 or 1000 yr after closure. Additionally, this shows that engineered barriers totally effective for 1000 yr after closure (assuming they could be designed) would not significantly reduce the consequences via geotransport from a repository breach, if the transport time to the accessible environment is as long as in this system.

Figure 8.3 shows ^{129}I, a long-lived isotope, also with no sorption retardation. Iodine arrives as two, joined square pulses, resulting from the corresponding periods of constant release rates; that is, 59% of the inventory between 200 and 15,000 yr, and 41% between 15,000 to 90,000 yr.

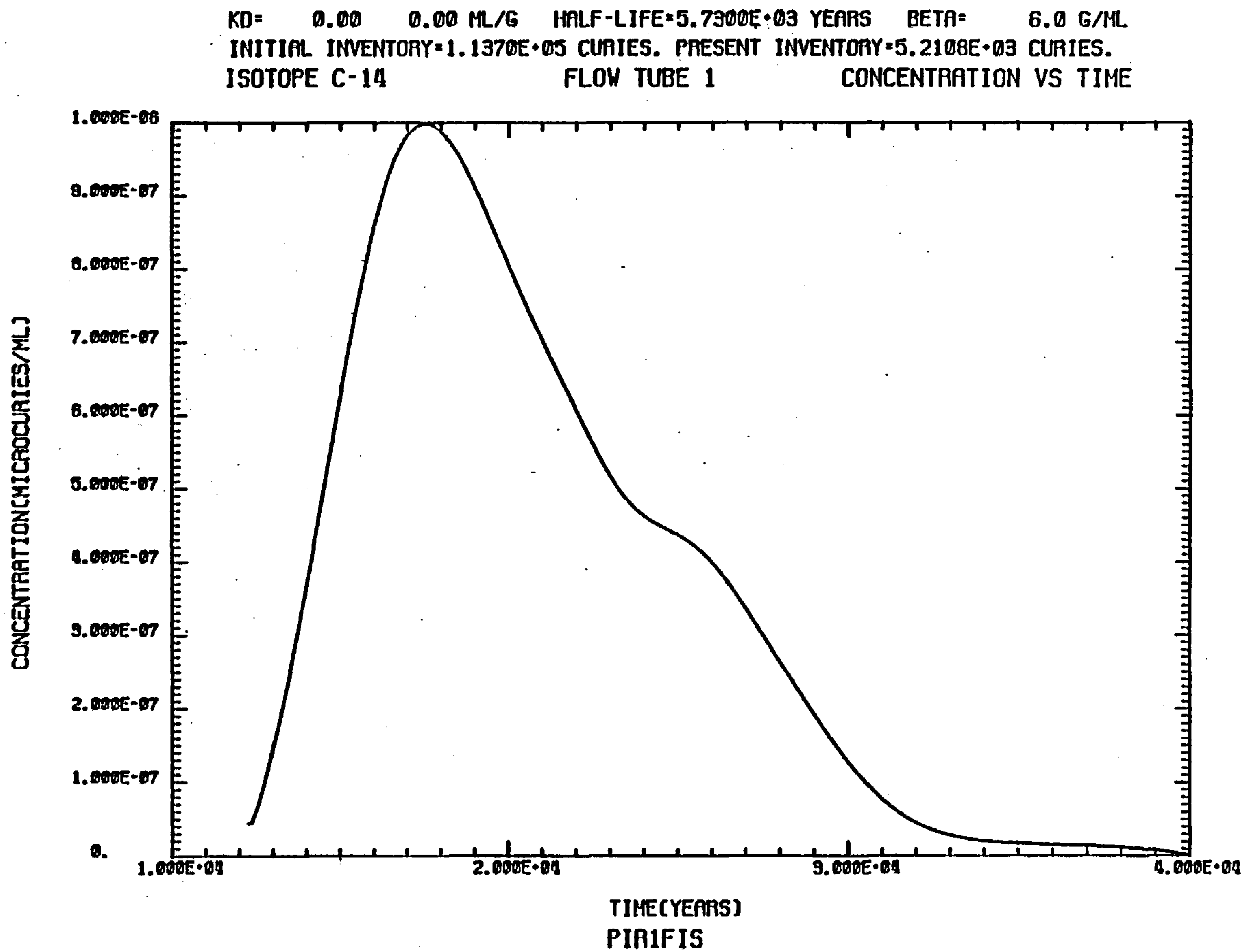


FIGURE 8.1. Isotope C-14, Concentration vs Time

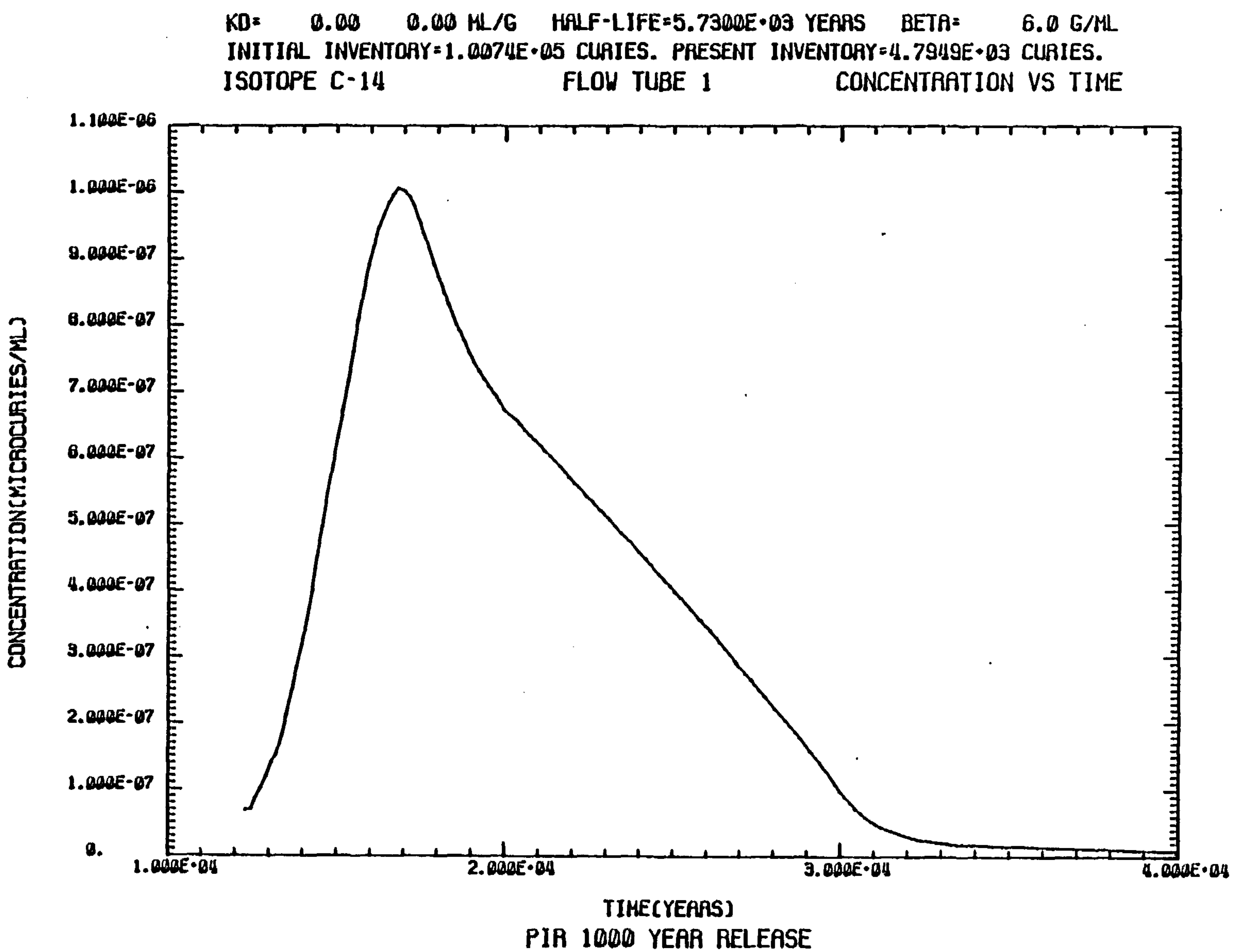


FIGURE 8.2. Isotope C-14, Concentration vs Time

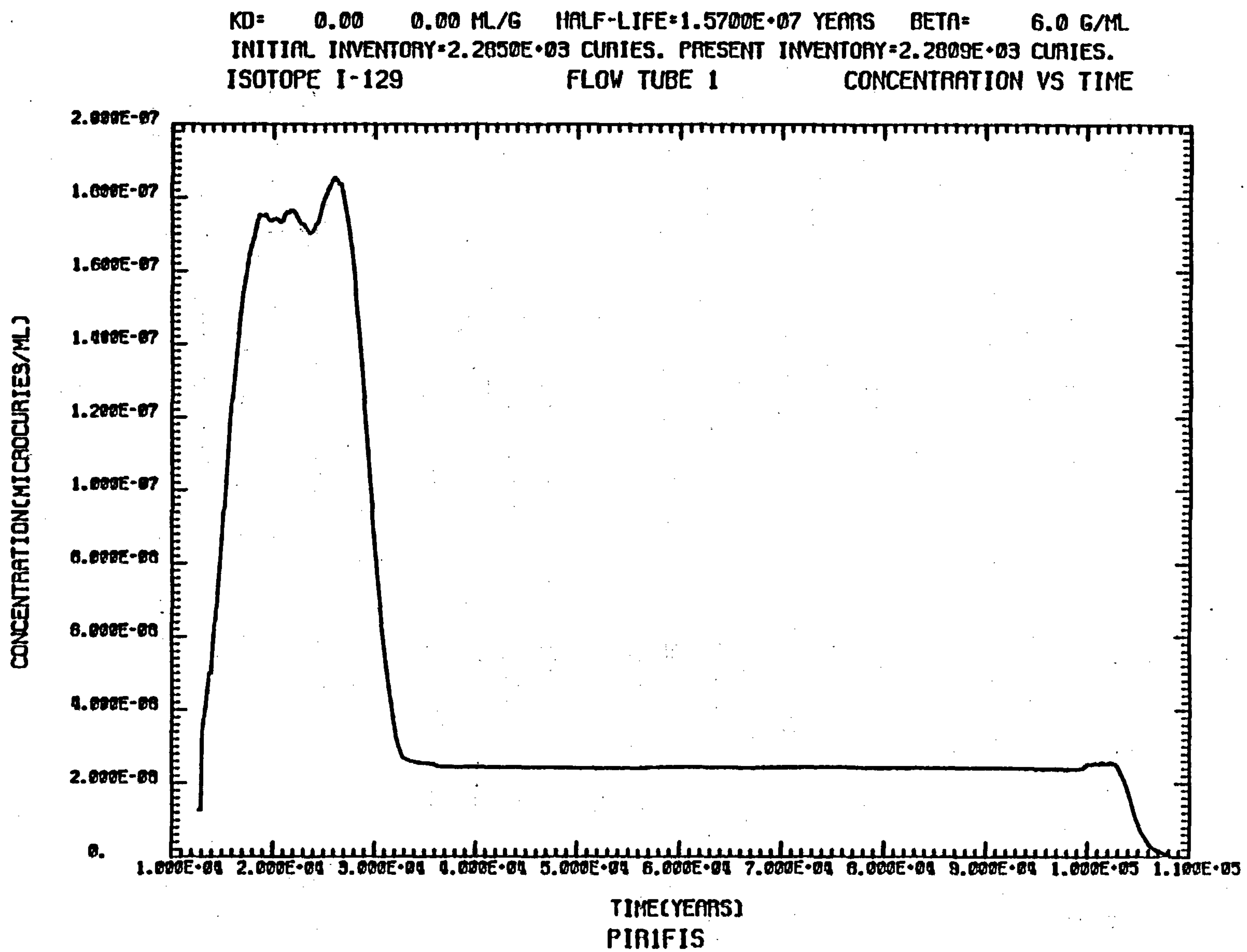


FIGURE 8.3. Isotope I-129, Concentration vs Time

Nuclides having a greater Kd in bicarbonate water than in salt solution display an unusual behavior. Initially released in salt solution, they travel faster than in bicarbonated ground water, where the travel times are subsequently decreased. On the other hand, effective macroscopic dispersion spreading is increased by the time of exiting of the salt plume's trailing edge, with retarded velocity. Figure 8.4a-c illustrates that behavior for ^{135}Cs as a result of zero Kd in salt solution. Cesium released into the salt plume is carried away at water velocity, whereas the cesium released after salt dome dissolution is complete travels with a substantially reduced velocity. The opposite situation occurs for ^{99}Tc, which has a greater Kd in salt than in water. This reversed variation of Kd causes the nuclide to accumulate behind the salt plume's trailing edge. Figure 8.5 shows ^{99}Tc concentration.

Analysis of the decay chain concentration distributions is further complicated by the same behavior observed for fission activation products. Absence of initial inventories provided to AEGIS for the nuclides ^{232}Th, ^{233}U, and ^{235}U is noteworthy. These long-lived chain members are eventually included by parent chain decay. Nuclides with a short half-life at the top of the chains typically do not exit before decaying in Cases 1, 2, and 4. An exception is ^{243}Am, because it has a Kd value of zero in salt solution.

A particularly interesting example is provided by decay chain 2 of the base case (Case 1 simulation). Figure 8.6 shows that ^{237}Np has a fractured release. The daughter nuclide concentration of ^{233}U shown in Figure 8.7 is a consequence of three distinct decay periods. Between 15,000 and 150,000 yr, the uranium derives from decay of the first ^{237}Np pulse traveling with the salt plume. In the period 150,000 to 240,000 yr, uranium accumulated near the repository from the bicarbonate water retarded ^{237}Np, producing a peak value near 200,000 yr. The second ^{237}Np pulse approaching the discharge creates a second uranium peak between 500,000 to 600,000 yr. The last chain member, ^{229}Th (Figure 8.8) duplicates the parent ^{233}U concentration distribution. This is caused by the sorption retardation and short half-life of ^{229}Th.

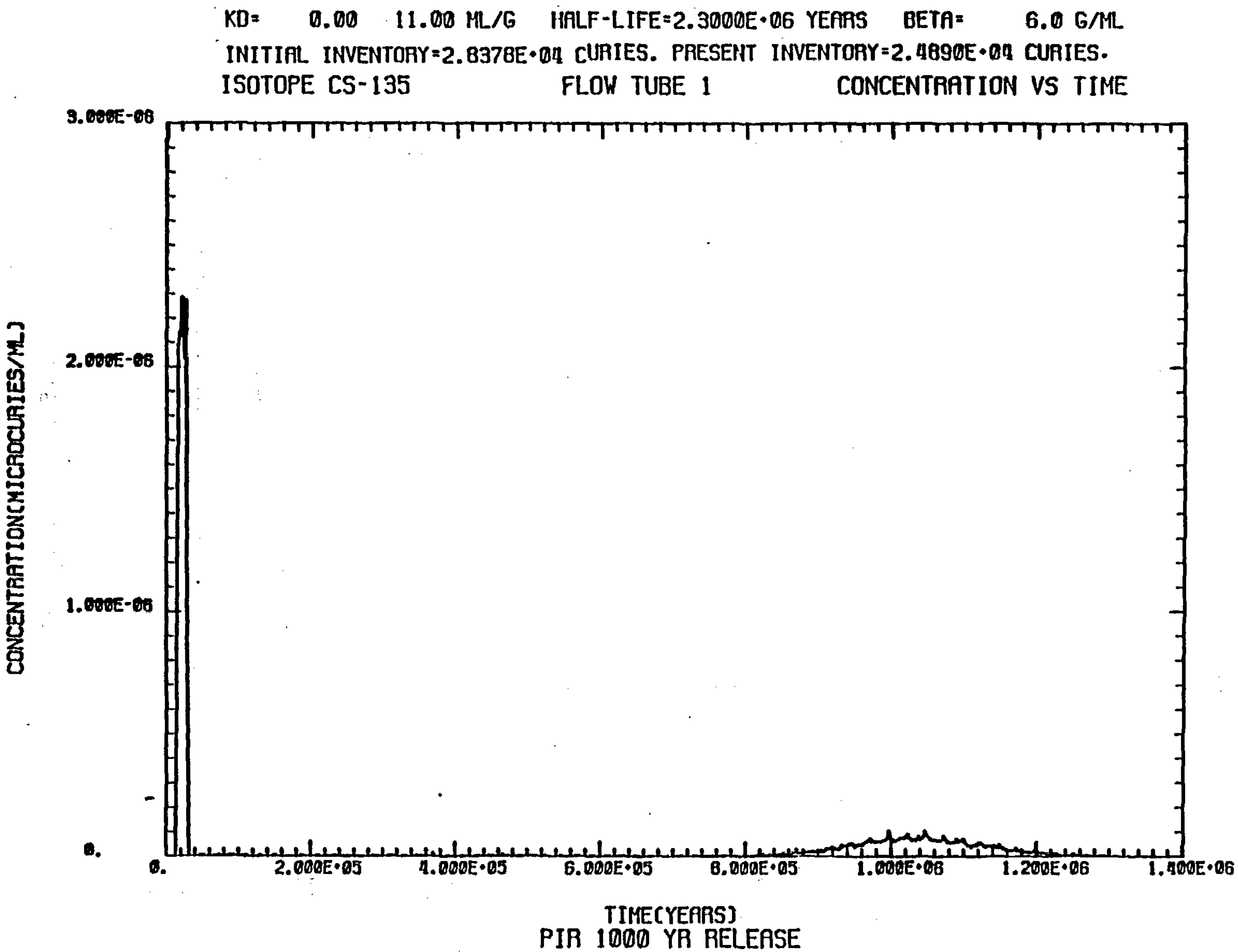


FIGURE 8.4a. Isotope CS-135, Concentration vs Time

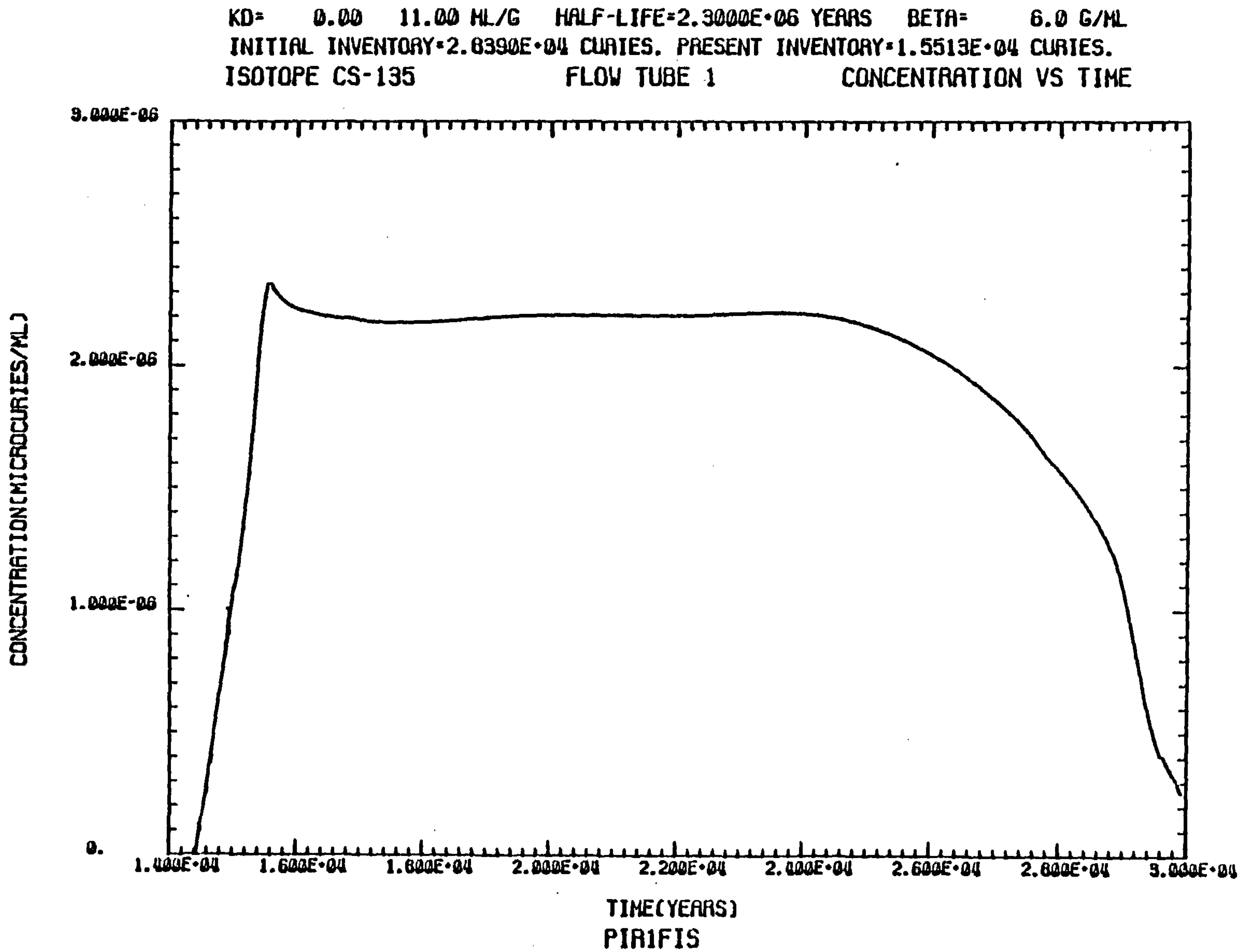


FIGURE 8.4b. Isotope CS-135, Concentration vs Time

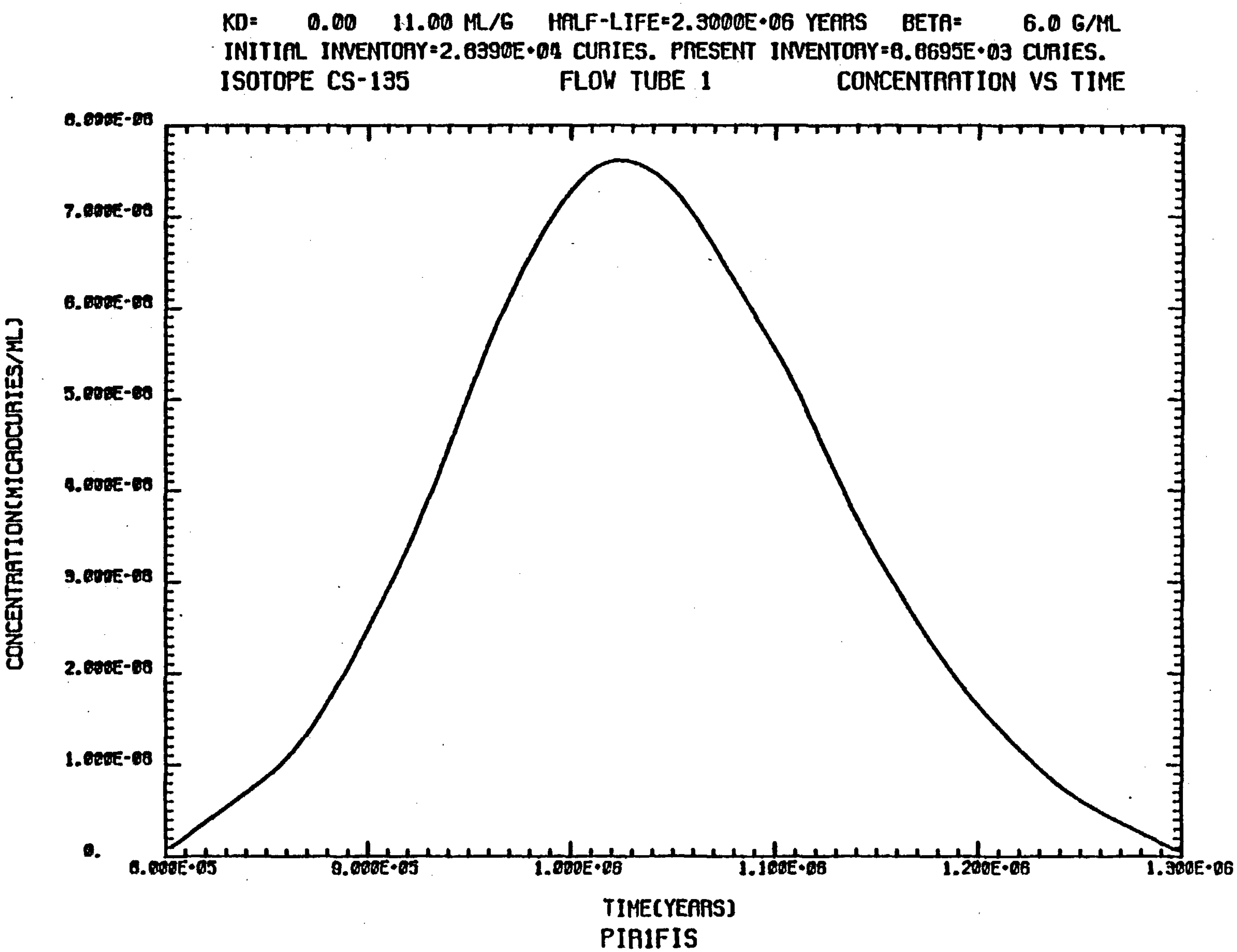


FIGURE 8.4c. Isotope CS-135, Concentration vs Time

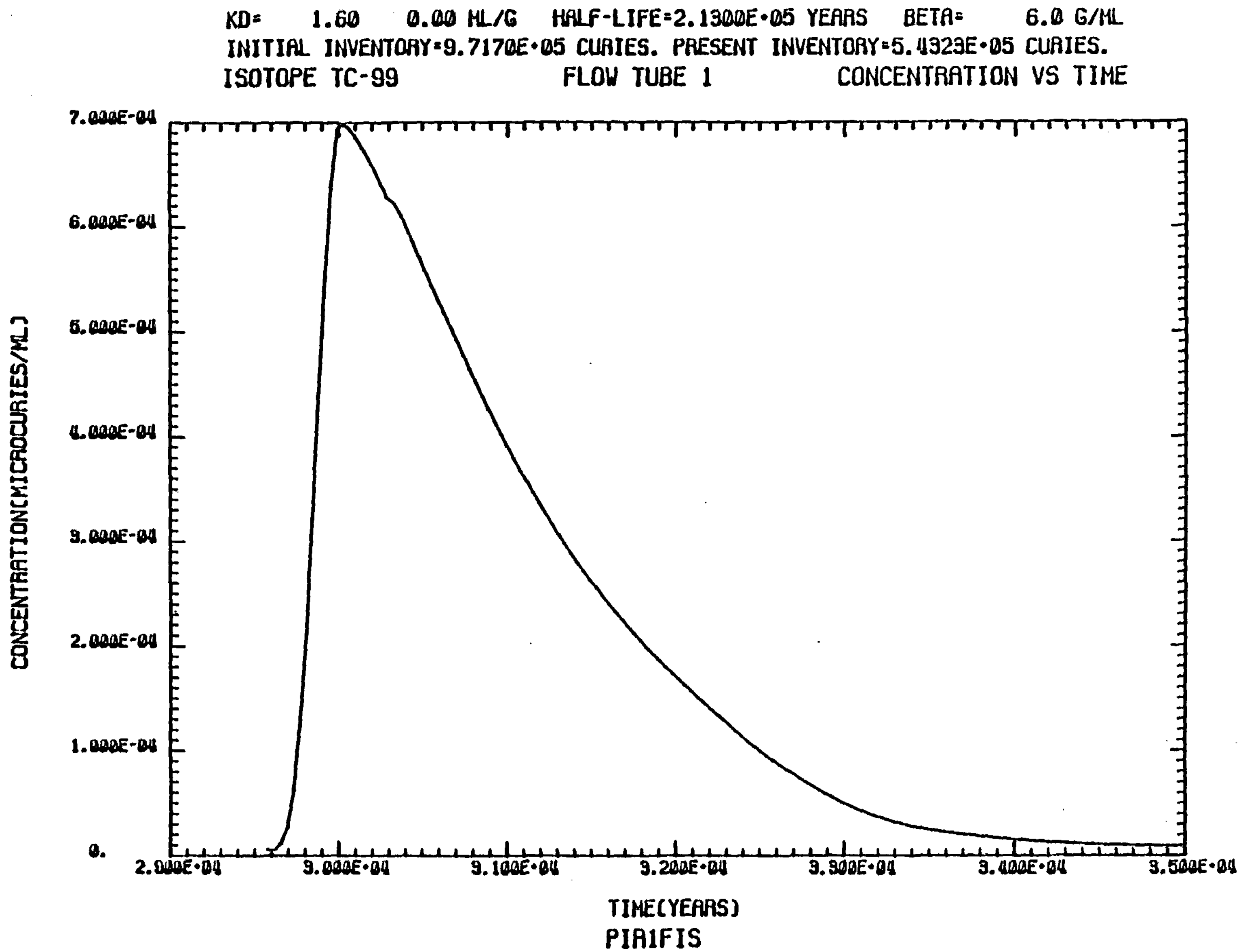


FIGURE 8.5. Isotope TC-99, Concentration vs Time

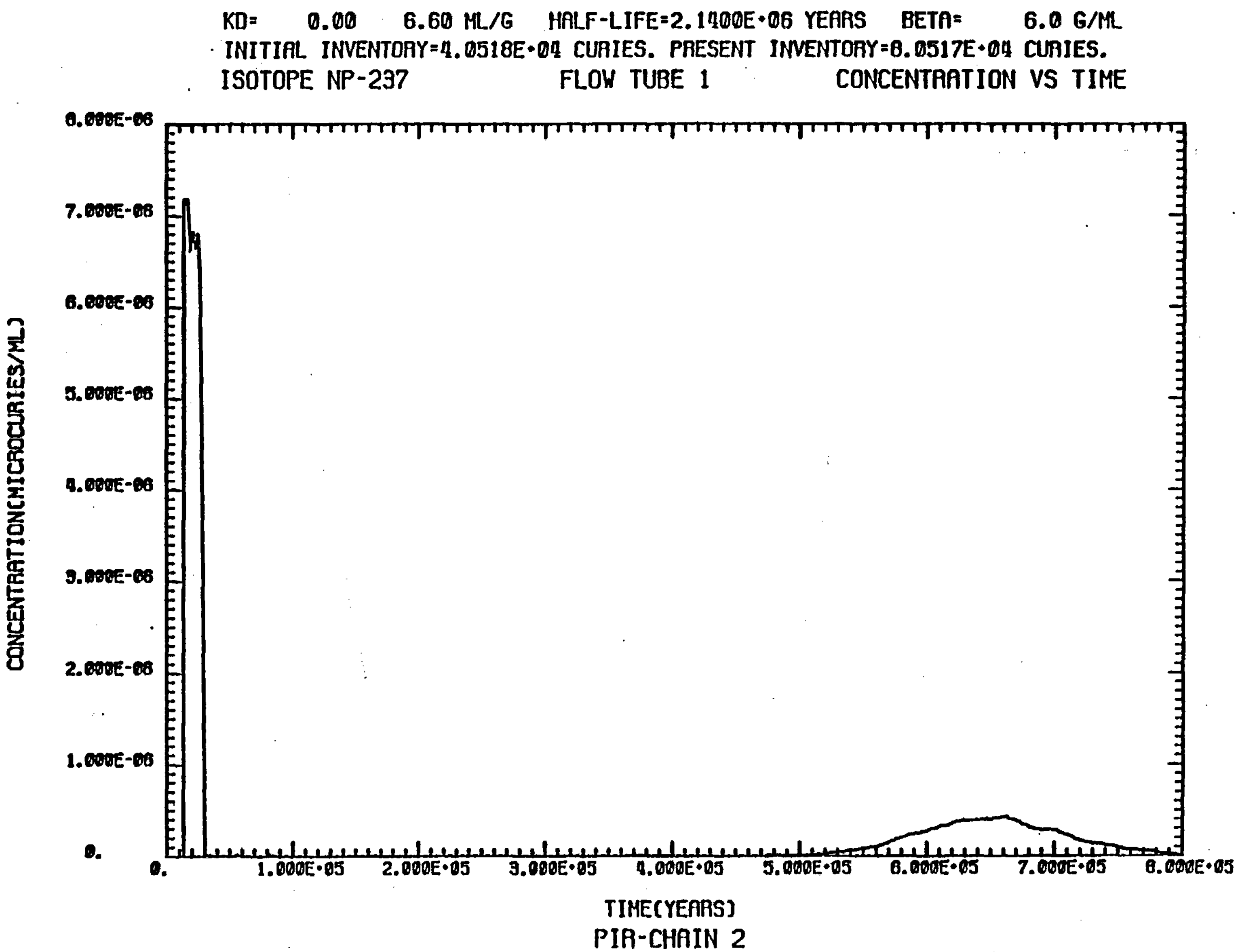


FIGURE 8.6a. Isotope NP-237, Concentration vs Time

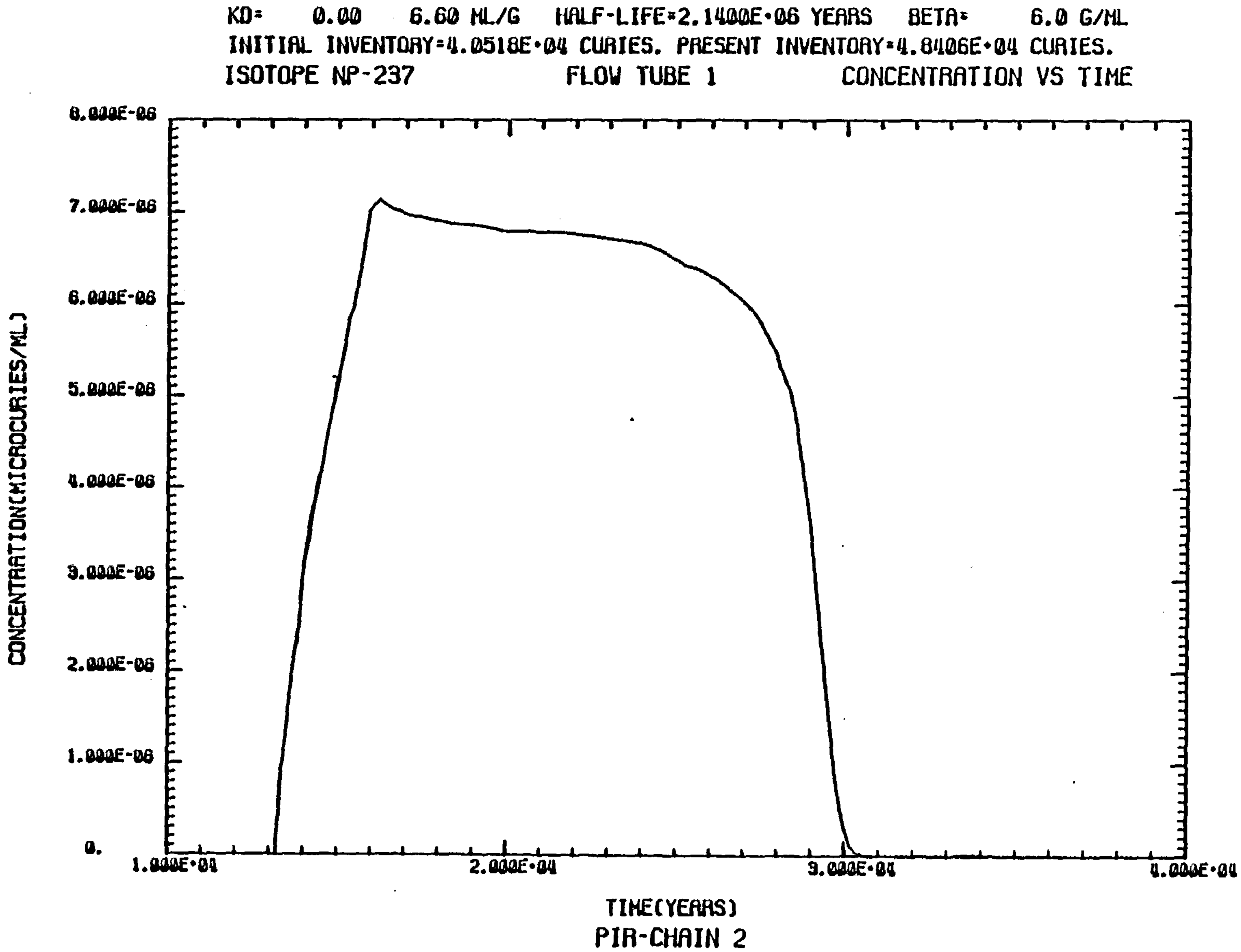


FIGURE 8.6b. Isotope NP-237, Concentration vs Time

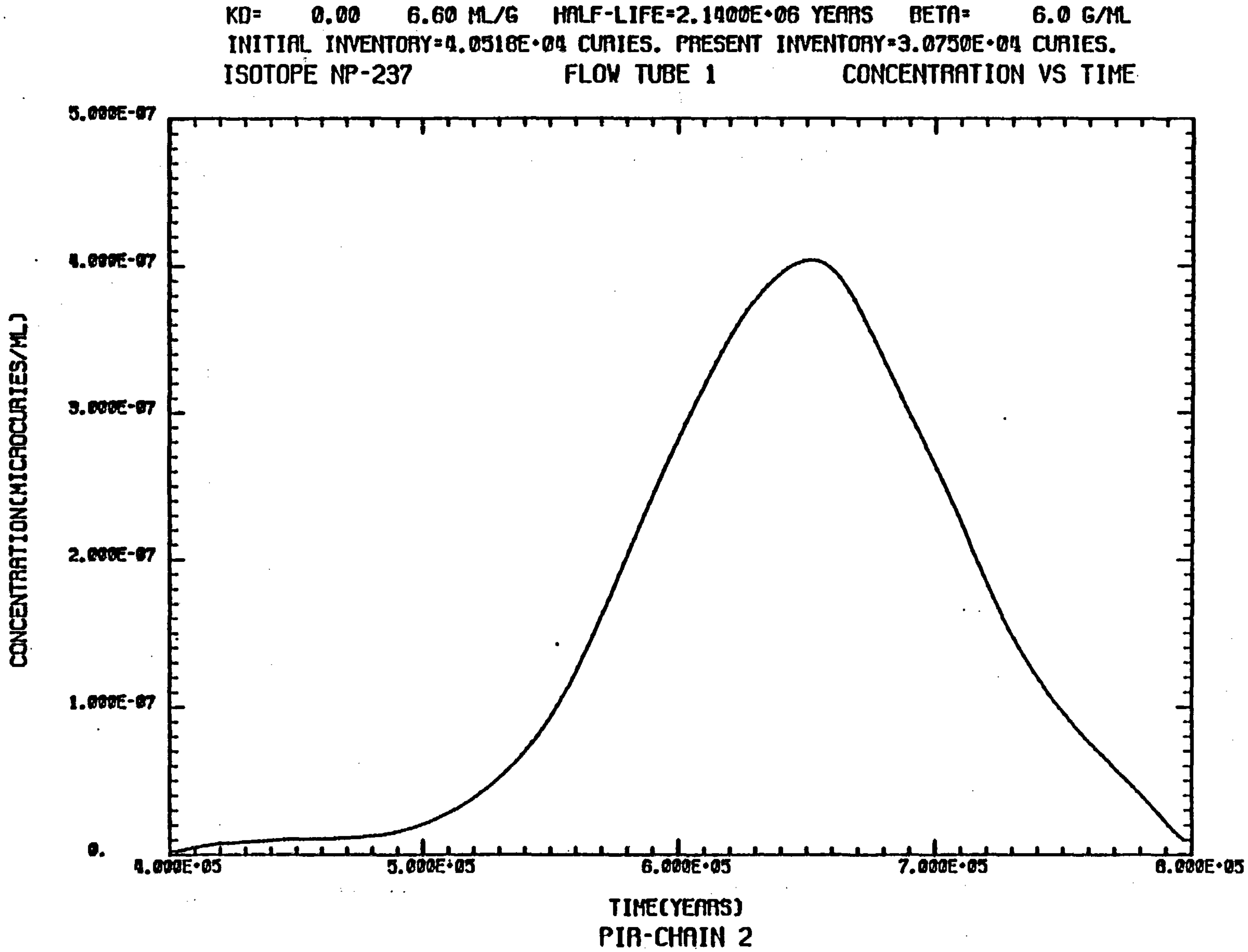


FIGURE 8.6c. Isotope NP-237, Concentration vs Time

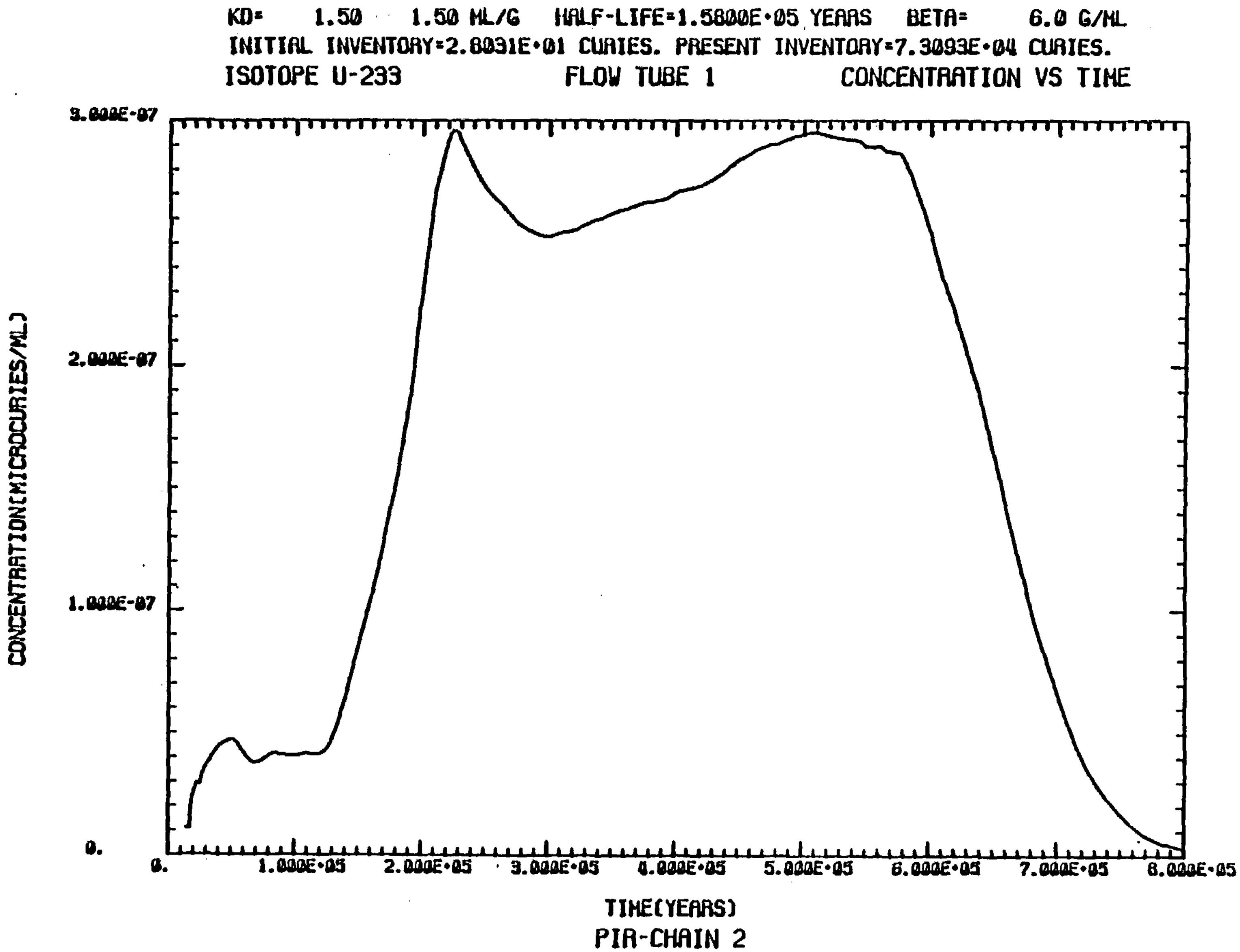


FIGURE 8.7. Isotope U-233, Concentration vs Time

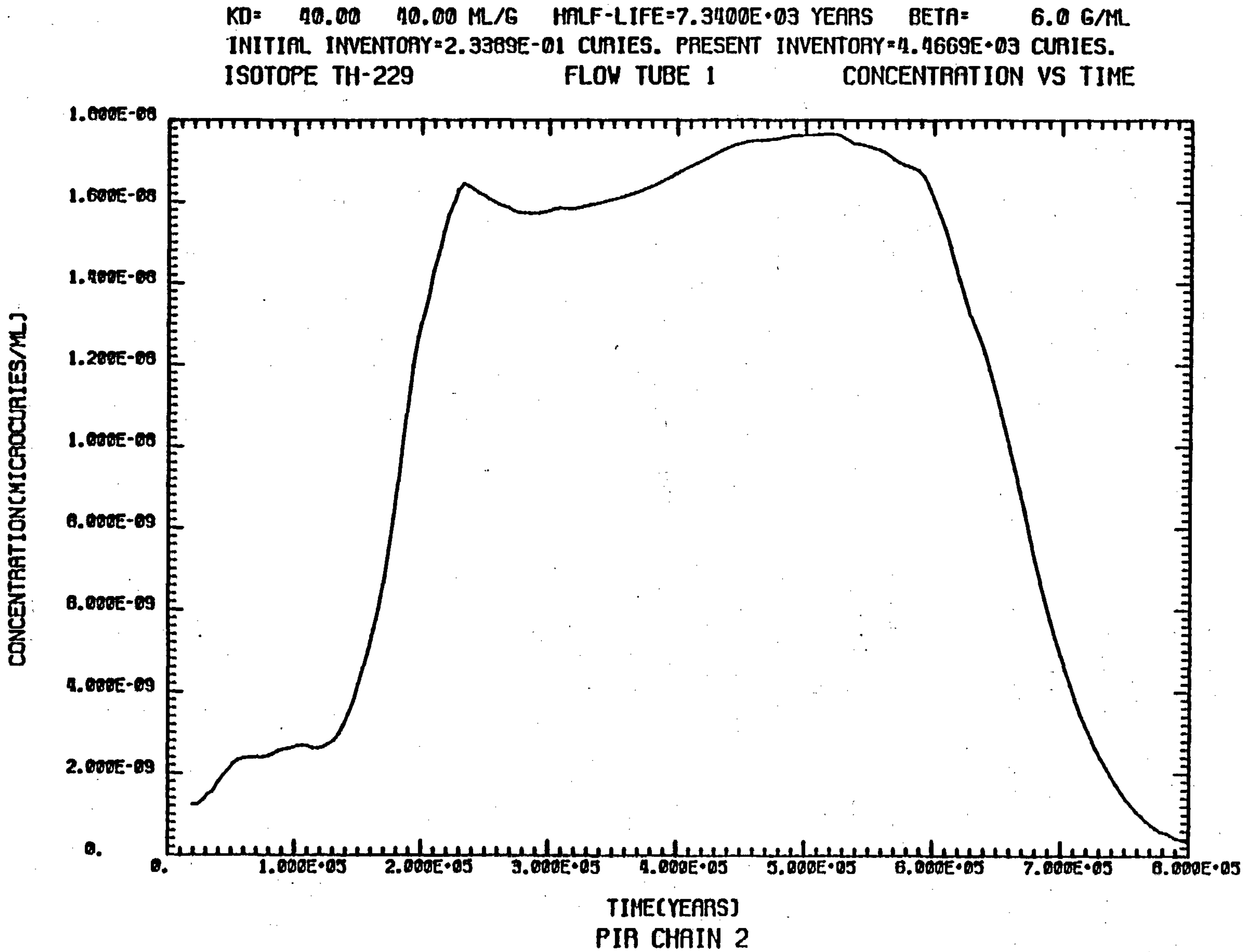


FIGURE 8.8. Isotope TH-229, Concentration vs Time

Case 3, the Well Pumping Case, represents the consequence of a relatively early radioisotope release, as only a thousand years is required for some nuclides to reach the well at a distance of 6 km. The conservative assumption was made that all of the nuclides exiting the repository are withdrawn at the well. The graphs for these simulation runs illustrate the results, which differ from the other scenarios having considerably longer travel times.

Case 4 simulation runs represent the effects of decreased sorption on the geotransport of the radioisotopes. These runs use the lower bound Kd values. Only the Sabine River discharge part of the scenario is used for comparison with simulation runs of Case 2. Travel times are predictably reduced by ratios of the changed retardation factor(s) to the original average value(s). The fission products do not yield very different results, but uranium arrives about 100,000 yr sooner with the lower bound Kd. Daughter nuclides appear to acquire greater concentration when their parents have a longer decay period, corresponding to greater travel time. Low initial daughter inventories and long half-life contribute to that effect. An exception occurs for ^{235}U, in that a greater quantity of parent nuclide ^{239}Pu decays near the salt dome, producing more curies of ^{235}U during the simulation period.

The MMT model has the capability of producing information on radioisotope concentration as a function of distance from the repository. This is achieved by summing parcel weight within distance intervals. Concentration levels over the flow tube length propagate toward the discharge point with their apparent retarded velocities. Appendix G contains some sample graphs for 15,000 and 30,000 yr following the repository breach in the well pumping case. Salt dissolution terminates at 15,000 yr, and those nuclides having variable Kd's display a release pattern caused by retention of nuclides near the repository. Neptunium and cesium isotopes provide good examples. In the cases of nuclides not exiting in 2 million years for the other scenarios, concentration versus distance graphs are included with those for time, provided in Appendix G.

MEASURES OF DISPERSION USED IN THE SIMULATIONS

The hydrodynamic dispersion coefficient D, required as a parameter for the transport model, must be empirically evaluated using the specific geological media involved. Commonly its value is not available. In a three-dimensional flow, the lateral dispersion coefficient establishes the transfer rate of radioisotopes between streamlines of varying flow velocity. In a macroscopic flow tube the dispersion caused by velocity variation between streamlines usually dominates the porous media longitudinal dispersion, which is a microscopic scale phenomenon. Thus, from the perspective of a one-dimensional flow tube representation of a real three-dimensional flow, dispersion is mainly a consequence of the macroscopic variation in convective transport of nuclides. Radioisotopes entering a specified flow tube are assumed to follow with equal likelihood any streamline within. On the other hand, concentrations of discharged nuclides having variable transit times are determined by the flow tube's entire discharge volume. This is because exiting parcels of radioisotopes cannot be localized with any greater accuracy than the tube's cross-sectional area.

In view of those considerations, an effective macroscopic dispersion parameter is constructed as follows. Let p denote the pth streamline comprising a flow tube having P streamlines. Streamline length is L, and travel time is t. An estimate of an effective dispersion parameter, D*, is obtained by equating the random walk variance in parcel locations and that derived from convective velocity variation.

Let:

$$t = \frac{1}{P} \sum_{p=1}^{P} tp \qquad (8.1)$$

$$L = \frac{1}{P} \sum_{p=1}^{P} Lp \qquad (8.2)$$

denote average values. Travel time variance is:

$$\sigma_t^2 = \frac{1}{P-1} \sum_{p=1}^{P} (t-tp)^2 \qquad (8.3)$$

Average flow tube velocity is:

$$\nu = L/t \tag{8.4}$$

The estimate of variance in location is:

$$(\nu\,\sigma_t)^2 = 8\ D^*\ t \tag{8.5}$$

Then, the estimated effective dispersion length d is:

$$d = \nu\,\sigma_t\ /8\ t. \tag{8.6}$$

Unlike the true hydrodynamic dispersion length, the effective value depends on travel time. The complete location variance equals the sum of variances because of hydrodynamic dispersion and travel time; thus, the complete dispersion coefficient equals $D + D^*$.

Required means and variances for streamline lengths and travel times were obtained from hydrologic modeling. Effective dispersion was assumed to dominate the transport.

CHAPTER 9

DOSE CALCULATIONS

As discussed in the section on human intrusion (Chapter 4), there are significantly different time frames involved with the safety assessment of a nuclear waste repository. Over the million-year time frame with which AEGIS scenario methodology deals, geological events and processes occur. This time frame exceeds what is necessary for biological evolution. The 10^5-yr time frame corresponds to full cycles of climate changes, and also is adequate for biological evolution and speciation. The biologically identical equivalent of modern man, Cro-Magnon, dates from about 50,000 yr before present; in the last 50,000 yr there has been essentially no biological evolution for Homo sapiens. During that period, cultural evolution has predominated. Only within the last 10,000 yr or so has there been a planned agricultural food base for any human populations. Finally, the cultural evolution within the last few centuries has been explosive, as measured by such parameters as population density and mobility, utilization of resources, and information content.

Because of this wide divergence in the time frames applicable to cultural versus geological processes, it is not appropriate to predict cultural impacts over geological times. One such cultural impact is measured as dose to individuals or to populations. Such dose calculations are dependent on demography or diet and on the recyling through ecological systems of those radioisotopes that are analogous to nutrient elements. As the demographic patterns, feeding habits, and ecosystem recycling pathways may change rapidly in periods as short as a few centuries, it is misleading to provide dose calculations for 10^6 yr in the future based on the current social structure. The AEGIS team believes dose predictions should be limited to only the early period of post-closure safety assessments. Nevertheless, based on a number of comments received from the external peer reviewers, this revised report does contain dose calculations out to one million years. These are presented not as predictions of what the expected doses actually would be; rather, they provide an indication of the effects of long-term nuclear decay on the consequences of the analyzed scenarios relative to current population parameters.

GENERAL POPULATION DOSE CALCULATIONS

For this reference site analysis, AEGIS chose the limit of 1000-yr post-closure based on the draft of proposed EPA standards available at the time of this work, which stated that health effects need only be addressed for 1000 yr. (That limit no longer remains in more recent drafts of the EPA standards.) The result of this limitation is that dose calculations were originally presented only for the operational aspects of the solution mining scenario at times 100 yr and 1000 yr after closure. The revised report has doses for later intrusion periods. No dose calculations were performed for radioisotopes that subsequent to the solution mining intrusion were transported through the geosystem.

The solution mining scenario involves the extraction of salt and radioactive wastes from the salt dome repository. The salt is removed as a brine solution, with the salt recovered by several methods, such as the vacuum pan and grainier processes, or by solar driven evaporation of the brine. The main use of salt is as an industrial chemical in production of soda ash (for glass), caustic soda (for the paper industry), and other industrial chemicals such as chlorine, chlorates and hydrochloric acid (Bates 1969). Salt is also used for the production of soap, in the textile industry, for water treatment, and for ice control. The food industry uses salt in refrigeration, meat packing, fish curing, dairy product processing, and as table salt.

For this analysis, the main route of exposure of the general population from contaminated salt brines is taken to be the use of salt in the food industry, as the ingestion of salt is the most direct and probably most consequential, pathway. To date other pathways leading to dose to humans have not been investigated. In an actual site assessment, some other vectors would be addressed. The exposure pathway here is ingestion of culinary salt, including salt present in cured meats and fish and processed dairy products. During the preparation of salt for culinary use, some of the radionuclide activity might be removed as impurities; however, no credit was taken for removal in the consequence analysis because such purification might be highly dependent on the particular technology used.

The assumptions used in the base case dose consequence analysis include:

- Salt mine production is one million tons of salt per year.
- The mine operates for 50 yr without detection of radioactive wastes.
- Three percent of production is used as culinary salt and ingested by humans.
- Each person ingests 1800 g salt per year.

The alternative set of assumptions leading to identical consequences are:

- Salt mine production is 33,333 tons/yr.
- The mine operates for 50 yr.
- 90% of production is used for culinary salt.
- Each person ingests 1800 g/yr.

These assumptions are based on the following considerations. The one million tons of salt per year is representative of a current large scale salt production effort. Up to 3×10^6 tons/yr have been produced from a solution mine, and the Commercial Waste Management Study (CWMS 1980) assumed a production of 2.6×10^6 tons/yr. Such a level of salt production is unlikely for a 50-yr period. The 50-yr lifetime for the solution mine operation was arbitrarily chosen, and this value coincides with the CWMS value. Also, the 3% and 1800 g/yr per person values reflect the numbers used in the CWMS study. The 3% level is based on the fraction of total salt produced in the United States that is directly ingested, and the 1800 g/yr is based on consumption of 5 g/day in table salt or as a part of processed foods. (More recent data indicate this value should be increased by about a factor of 3, which would likewise increase the individual doses by a factor of three.)

The alternative assumptions address an apparent inconsistency between the size of the mining operation and the uncontrolled cavity formation. For a salt dome being used to produce culinary salt, up to 90% of the brine is used for culinary salt. Thus, increasing the 3% factor to 90% allows a reduction of the scale of mine operations 30-fold, even though the dose consequences would be identical.

Based on either set of these assumptions, the population served by the annual mine production is calculated to be 15 million persons. Note that this population level is demographic-independent: the number of persons exposed depends on the amount of salt available rather than on particular population distributions. The population level was calculated as follows:

$$0.03 \times 10^6 \text{ tons/yr} \times 2000 \frac{\text{lbs}}{\text{ton}} \times 454 \frac{\text{g}}{\text{lbs}} \times \frac{1 \text{ person}}{1800 \text{ g/yr}} = 1.5 \times 10^7 \text{ persons}$$

The fraction of wastes in the repository removed during the 50 yr of operation was calculated to be 0.97%. This fraction is based on the solubility limit for uranium of 6 ppm (see Chapter 10) and an effluent water flow rate of 1200 gpm for the brining operations, and was calculated as follows:

$$6 \times 10^{-6} \frac{\text{parts}}{\text{part}} \times 1200 \frac{\text{gal}}{\text{min}} \times 5.260 \times 10^5 \frac{\text{min}}{\text{yr}} \times 50 \text{ yr} \times 3785 \frac{\text{g}}{\text{gal}}$$

$$= 7.2 \times 10^8 \text{ g}$$

The total weight of uranium in the repository is 7.4×10^{10} g. Thus, the fraction of the uranium leached during 50 yr of solution mining is:

$$\frac{7.2 \times 10^8 \text{ g (leached)}}{7.4 \times 10^{10} \text{ g (in repository)}} = 9.7 \times 10^{-3}$$

The fraction of the inventory consumed with culinary salt is then 3% of 9.7×10^{-3}, as only 3% of the mined salt is used as culinary salt.

$$9.7 \times 10^{-3} \times 0.03 = 2.94 \times 10^{-4} = \text{fraction of inventory consumed.}$$

Similar calculations using the alternative set of assumptions would also result in the same fraction of the inventory being consumed.

The fraction consumed can also be expressed as an equivalent number of fuel assemblies. The hypothetical repository will contain 1.52×10^5 BWR fuel assemblies and 1.08×10^5 PWR fuel assemblies, according to information provided to AEGIS from BNI. Thus,

$1.52 \times 10^5 \times 2.94 \times 10^{-4} = 44$ BWR assemblies

$1.08 \times 10^5 \times 2.94 \times 10^{-4} = 31$ PWR assemblies

Using these estimates, 70-yr radiation dose commitments were calculated for individuals and for the population consuming culinary salt over various time periods during the 50-yr mine operational period. Tables 9.1 through 9.4 list the 70-yr radiation doses calculated for salt ingestion periods of 50, 1, 10, and 25 yr, respectively. The metabolic models and data presented in ICRP Publication 2 (1959) were used to estimate organ doses for intake via direct ingestion (using the computer code PABLM--Napier et al. 1980). Listed are the doses to individuals and the population for the solution mining scenario with mining starting 100 yr and 1000 yr after closure. (See Appendix J for details of these dose calculations.) All dose values in Table 9.1 through 9.11 (except 9.5) are appropriate for either the original assumptions or the alternative assumptions.

The CWMS analysis assumed discovery of the contamination of the culinary salt after one year of consumption. For this analysis, however, The AEGIS staff assumed that the contamination would not necessarily be discovered. Because the solution mining intrusion could occur by a population that has a technological base less sophisticated than today's or that has no knowledge of nuclear phenomena. Alternatively, the society could be aware of nuclear technology, but because of loss of effective information about the repository, no monitoring of the salt for radioactivity would occur. This is supported by the fact that today essentially none of the solution mining productions of salt in the United States are monitored for radioactivity.

TABLE 9.1. Radiation Doses Calculated for Solution Mining Scenario

(Uranium Solubility Limited, 50-year Ingestion--Base Case)

A. 70-Year Population Dose,* man-rem

Decay Time	Organ of Reference: Total Body	Bone	Lung	Thyroid
100 Years	1.6×10^{11}	6.5×10^{11}	2.8×10^{9}	4.7×10^{6}
1000 Years	1.3×10^{9}	3.0×10^{10}	3.7×10^{4}	4.7×10^{6}
B. 70-Year Individual Dose Commitments, rem				
100 Years	1.1×10^{4}	4.4×10^{4}	1.8×10^{2}	3.2×10^{-1}
1000 Years	8.4×10^{1}	2.0×10^{3}	2.5×10^{-3}	3.1×10^{-1}

* Based on affected population of 15 million. All figures in Tables 9.1 through 9.11 (except 9.5) are appropriate for either the original assumptions or the alternative assumptions.

TABLE 9.2. Radiation Doses Calculated for Solution Mining Scenario

(Uranium Solubility Limited, 1-year Ingestion)

A. 70-Year Population Dose, man-rem

Decay Time	Organ of Reference: Total Body	Bone	Lung	Thyroid
100 Years	3.3×10^{9}	1.4×10^{10}	5.5×10^{7}	9.5×10^{4}
1000 Years	3.5×10^{7}	8.6×10^{8}	7.5×10^{2}	9.4×10^{4}
B. 70-Year Individual Dose, rem				
100 Years	2.2×10^{2}	9.6×10^{2}	3.7	6.3×10^{-3}
1000 Years	2.3	5.7×10^{1}	5.0×10^{-5}	6.3×10^{-3}

TABLE 9.3. Radiation Doses Calculated for Solution Mining Scenario (Uranium Solubility Limited, 10-year Ingestion)

A. 70-Year Population Dose, man-rem

Decay Time	Organ of Reference: Total Body	Bone	Lung	Thyroid
100 Years	3.3×10^{10}	1.4×10^{11}	5.5×10^{8}	9.5×10^{5}
1000 Years	3.3×10^{8}	8.2×10^{9}	7.5×10^{3}	9.4×10^{5}
B. 70-Year Individual Dose Commitments, rem				
100 Years	2.2×10^{3}	9.5×10^{3}	3.7×10^{1}	6.3×10^{-2}
1000 Years	2.2×10^{1}	5.5×10^{2}	5.0×10^{-4}	6.3×10^{-2}

TABLE 9.4. Radiation Doses Calculated for Solution Mining Scenario (Uranium Solubility Limited, 25-year Ingestion)

A. 70-Year Population Dose, man-rem

Decay Time	Organ of Reference: Total Body	Bone	Lung	Thyroid
100 Years	8.3×10^{10}	3.5×10^{11}	1.4×10^{9}	2.4×10^{6}
1000 Years	7.7×10^{8}	1.9×10^{10}	1.9×10^{4}	2.4×10^{6}
B. 70-Year Individual Dose Commitments, rem				
100 Years	5.5×10^{3}	2.3×10^{4}	9.2×10^{1}	1.6×10^{-1}
1000 Years	5.1×10^{1}	1.2×10^{3}	1.2×10^{-3}	1.6×10^{-1}

To see the effect of this nonmonitoring assumption on dose burdens, the dose calculations were also performed for consumption periods of 1, 10, and 25 yr, i.e., less than the mining operation period of 50 yr. The direct comparison between these results and the CWMS results (see CWMS 1980, Table 3.1.53) can be made by inspecting Table 9.1B for the 1000-yr dose to whole body. The value of 2.3 rem of this study compares with the CWMS value of 0.49 rem. The CWMS study assumed a larger salt production and higher water solutioning flow rates than this analysis. CWMS also assumed a leach rate times surface area source term, whereas this analysis shows solubility to be limiting. Additionally, there are differences between the assumed inventories of the CWMS and this study. The net effect is less than a factor of 5 higher estimate in this study than in the CWMS study.

Another factor needs to be considered in this dose analysis. Calculations are shown for the original assumptions only on the 3% of the radioisotopes delivered to the surface. The other 97% of the waste at the surface are disregarded in the dose calculations. What actually would happen to that 97% has not been resolved to date, except for the analysis of doses to the solution mine operators by direct exposure. Future calculations could consider possible dose burdens from this source of 97% of the radioisotopes delivered to the accessible environment. This is not as important a problem for the alternative assumptions, where only 10% of the radioisotopes would not go to direct culinary pathways.

Finally, data are shown for the total quantity (curies) of each isotope delivered to the surface (Table 9.5) and ingested as table salt (Table 9.6) associated with 50 yr of solution mining operatons.

OCCUPATIONAL DOSE CALCULATIONS

The dose levels shown in Tables 9.1 through 9.4 could indicate levels of radioactivity high enough to cause lethal effects on the operators of the solution mine. This could result from direct exposure or from inhalation of particulates. This latter factor would be exacerbated considering that climatic conditions in the region of the Hainesville Salt Dome are likely to have humidities that would preclude natural evaporation of the brine. If so, the salt production could involve forced heating of the brine, with concomitant

TABLE 9.5. Total Curies of Isotopes Delivered to Surface, 50 Years of Solution Mining (Large Scale Operations Assumptions)

Isotope	Time After Closure 100 Years	1000 Years	10,000 Years	30,000 Years
H3	2.1×10^3	0	0	0
C14	1.1×10^3	967	327	29
Cl36	10	10	6.7	6.7
Fe55	7.0×10^{-6}	0	0	0
Co60	10	0	0	0
Ni59	2.4×10^3	2.4×10^3	2.2×10^3	1.9×10^3
Ni63	1.6×10^5	187	0	0
Se79	297	283	257	207
Kr85	1.0×10^4	0	0	0
Sr90	4.7×10^6	1.0×10^{-3}	0	0
Y90	4.7×10^6	1.0×10^{-3}	0	0
Zr93	2.3×10^3	2.3×10^3	2.3×10^3	2.2×10^3
Nb93m	1.9×10^3	1.9×10^3	1.9×10^3	1.9×10^3
Nb94	733	700	533	260
Mo93	17	13	1.6	1.6×10^{-2}
Tc99	9.3×10^3	9.3×10^3	9.0×10^3	8.3×10^3
Pd107	80	80	80	80
Sn121m	90	3.7×10^{-4}	0	0
Sb125	1.1×10^{-4}	0	0	0
Te125m	2.7×10^{-5}	0	0	0
Sn126	533	533	500	433
Sb126	77	77	70	60
Sb126m	533	533	500	433
I129	23	23	23	23
Cs135	273	273	273	270
Cs137	7.3×10^6	7.3×10^{-3}	0	0
Ba137	7.0×10^6	7.0×10^{-3}	0	0
Pm147	3.2×10^{-4}	0	0	0
Sm151	1.3×10^5	153	0	0
Eu154	2.3×10^3	0	0	0
Eu155	1.8	0	0	0
Subtotal	2.4×10^7	2.0×10^4	1.8×10^4	1.6×10^4

TABLE 9.5. (contd)

Isotope	Time After Closure 100 Years	1000 Years	10,000 Years	30,000 Years
Pb210	1.0×10^{-2}	2.0	87	303
Pb214	1.8×10^{-2}	2.0	87	303
Bi210	1.0×10^{-2}	2.0	87	303
Bi214	1.8×10^{-2}	2.0	87	303
Po210	1.0×10^{-2}	2.0	87	303
Po214	1.8×10^{-2}	2.0	87	303
Po218	1.8×10^{-2}	2.0	87	303
Rn222	1.8×10^{-2}	2.0	87	303
Ra226	1.8×10^{-2}	2.0	87	303
Th230	0.9	1.0	330	300
Th234	237	237	237	237
Pa233	290	700	833	833
Pa234m	237	237	237	237
U234	1.1×10^{3}	1.4×10^{3}	1.3×10^{3}	1.3×10^{3}
U236	177	187	243	277
U238	237	237	237	237
Np237	290	700	833	833
Np239	1.1×10^{4}	1.0×10^{4}	4.7×10^{3}	733
Pu238	7.3×10^{5}	733	0	0
Pu239	2.3×10^{5}	2.2×10^{5}	1.7×10^{5}	1.0×10^{5}
Pu240	3.7×10^{5}	3.3×10^{5}	1.3×10^{5}	1.7×10^{4}
Pu241	7.7×10^{5}	13	7.0	1.2
Pu242	1.6×10^{3}	1.3×10^{3}	1.2×10^{3}	1.2×10^{3}
Am241	2.7×10^{6}	6.3×10^{5}	6.7	0.3
Am243	1.1×10^{4}	1.0×10^{4}	4.7×10^{3}	733
Cm242	1.7×10^{3}	27	0	0
Cm244	2.2×10^{4}	0	0	0
Subtotal	4.8×10^{6}	1.2×10^{6}	3.2×10^{5}	1.3×10^{5}
TOTAL OF ALL ISOTOPES	2.9×10^{7}	1.22×10^{6}	3.4×10^{5}	1.5×10^{5}

TABLE 9.6. Ingested Curies of Isotopes for 50 Years of Consumption of Table Salt (Either Large or Small Scale Assumptions)

Isotope	Time After Closure: 100 Years	1000 Years	10,000 Years	30,000 Years
H3	62	0	0	0
C14	32	29	9.8	0.9
Cl36	0.3	0.3	0.2	0.2
Fe55	2.1×10^{-7}	0	0	0
Co60	0.3	0	0	0
Ni59	72	72	66	56
Ni63	4.9×10^{3}	5.6	0	0
Se79	8.9	8.5	7.7	6.2
Kr85	310	0	0	0
Sr90	1.4×10^{5}	3.1×10^{-5}	0	0
Y90	1.4×10^{5}	3.1×10^{-5}	0	0
Zr93	69	69	68	67
Nb93m	58	58	58	57
Nb94	22	21	16	7.8
Mo93	0.5	0.4	4.9×10^{-2}	4.8×10^{-4}
Tc99	280	280	270	250
Pd107	2.4	2.4	2.4	2.4
Sn121m	2.7	1.1×10^{-5}	0	0
Sb125	3.4×10^{-6}	0	0	0
Te125m	8.2×10^{-7}	0	0	0
Sn126	16	16	15	13
Sb126	2.3	2.3	2.1	1.8
Sb126m	16	16	15	13
I129	0.7	0.7	0.7	0.7
Cs135	8.2	8.2	8.2	8.1
Cs137	2.2×10^{5}	2.2×10^{-4}	0	0
Ba137	2.1×10^{5}	2.1×10^{-4}	0	0
Pm147	9.7×10^{-6}	0	0	0
Sm151	3.8×10^{3}	4.6	0	0
Eu154	68	0	0	0
Eu155	5.3×10^{-2}	0	0	0
Subtotal	7.2×10^{5}	6.0×10^{2}	5.4×10^{2}	4.8×10^{2}

TABLE 9.6. (contd)

Isotope	Time After Closure 100 Years	1000 Years	10,000 Years	30,000 Years
Pb210	3.0×10^{-4}	6.1×10^{-2}	2.6	9.1
Pb214	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Bi210	3.0×10^{-4}	6.1×10^{-2}	2.6	9.1
Bi214	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Po210	3.0×10^{-4}	6.1×10^{-2}	2.6	9.1
Po214	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Po218	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Rn222	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Ra226	5.3×10^{-4}	6.1×10^{-2}	2.6	9.1
Th230	2.6×10^{-2}	0.3	3.3	9.0
Th234	7.1	7.1	7.1	7.1
Pa233	8.7	21	25	25
Pa234m	7.1	7.1	7.1	7.1
U234	33	41	40	38
U236	5.3	5.6	7.3	8.3
U238	7.1	7.1	7.1	7.1
Np237	8.7	21	25	25
Np239	330	310	140	22
Pu238	2.2×10^{4}	22	0	0
Pu239	6.8×10^{3}	6.6×10^{3}	5.2×10^{3}	3.0×10^{3}
Pu240	1.1×10^{4}	1.0×10^{4}	4.0×10^{3}	510
Pu241	2.3×10^{4}	0.4	0.2	3.5×10^{-2}
Pu242	38	38	37	36
Am241	8.1×10^{4}	1.9×10^{4}	0.2	9.5×10^{-3}
Am243	330	310	140	22
Cm242	51	0.8	0	0
Cm244	660	0	0	0
Subtotal	1.5×10^{5}	3.6×10^{4}	9.7×10^{3}	3.8×10^{3}
TOTAL OF ALL ISOTOPES CONSUMED	8.7×10^{5}	3.7×10^{4}	1.0×10^{4}	4.3×10^{3}

increase in the aerosol production. These and other occupational factors could possibly result in direct, short-term health effects on the miners. If the brine, which yields such high population and individual doses via salt consumption, consitutues a major direct health hazard itself, then a mechanism would exist whereby the mine operations would terminate before general population exposure. This cessation of operations would occur irrespective of the level of sophistication of the technology of the extant society; i.e., no active monitoring for radioactivity would need be ongoing. Rather, short-term, major health effects or deaths readily identifiable with the salt mine operation would cause any society to cease operations. The consequences of the intrusion would be so immediate and deleterious locally that mitigation of broader impacts would ensue. Based on these consideration, AEGIS calculated the estimated doses to the solution mine operators.

One of the premises of AEGIS's human intrusion evaluations is to minimize the dependency of the results on specific technological levels or practices. This presents problems in estimating occupational doses, because such doses would be highly sensitive to the nature of the job being performed, the spatial distribution and size of brine storage areas, and the nature of the brine transportation and handling activities. To avoid this problem, AEGIS calculated the maximum exposure that the brine could provide to an operator, assuming conditions unrealistically conservative for any mining technology. Should these very conservative doses prove inadequate to cause mine cessation, any more reasonable exposure would result in lower doses and would also be inadequate.

To provide this maximum bound on the external exposure that a worker could receive, it was assumed that the external dose rate from any storage vessels, tank trucks, pipelines, open vats, or other operational structures containing contaminated brine could not be as high as the external dose rate that could be obtained by a worker being immersed in a large volume of the brine itself. Thus, the maximum bound was based on a worker being inside the brine solution for 8 hr/day, 5 day/wk, 50 wk/yr, or a total of 2000 hr/yr. While it may be possible that precipitation of radioactive solids from the brine could create a local source of higher radioactivity than the brine, it is felt that total immersion in a large volume of the brine for continuous exposure throughout the year would more than compensate for any such spatial differences.

The results from the external dose calculations are presented in Table 9.7. Values are presented for the two different times of initial human intrusion for both annual and total mine lifetime periods. Again, the values presented in these tables are valid for either the original or alternative assumptions.

The other potential dose pathway to mine operators involves inhalation of the air in the vicinity of the brine, in which contaminated brine contributes particulates as aerosols. To provide a very conservative upper bound on the aerosol dose rates, it was assumed that the air contained one milligram of salt particles, each one micron in diameter, per cubic meter of air. This density was based on the particulates representative of a substantial dust storm at the Pacific Northwest Laboratory facilities. Again, continuous exposure for 2000 hr/yr was assumed. As in the case for the external dose calculations, this calculation was felt to be many times greater than would reasonably be expected for an actual solution mine operation. Total mine lifetime doses for this inhalation vector are listed in Table 9.8.

If the health effects from these exposures could be predicted to occur in a short enough time period and with distinct enough symptoms, then it could reasonably be concluded that the effluent brine from the solution mining operation itself would be a signal to the intruding population that it must terminate operations, thereby mitigating the general population consequences. However, it is the opinion of the AEGIS staff that the radiation doses presented in Table 9.7 and 9.8 are not sufficiently acute to ensure that any serious

TABLE 9.7. Estimated Total Body Occupational Dose Rates from Immersion in Effluent Salt Brine From Solution Mining

Time of Intrusion	Dose Rates (rem/yr)	50-yr dose (rem)
100 yr	1.2×10^{2}	6.0×10^{3}
1000 yr	5.2×10^{-1}	2.6×10^{1}

TABLE 9.8. Estimated Occupational Radiation Doses from Inhalation of Salt Particulates from Solution Mining

Time of Intrusion	50-yr Dose (rem)			
	Organ of Reference			
	Total Body	Bone	Lung	Thyroid
100 yr	4.1×10^2	9.0×10^3	5.6×10^2	3.9×10^{-4}
1000 yr	1.2×10^2	2.7×10^3	1.6×10^2	3.9×10^{-4}

health effects would be produced and recognized in a time span of less than several years. The connection of long-term health effects or deaths to the source of radiation exposure would be tenuous and cannot be relied upon to trigger the early termination of the mine operations. Serious health effects within the large, general population of consumers of the contaminated culinary salt would probably be inevitable before the effects from external and inhalation exposures would be identified for the mine operators, even under the conservatively unrealistic exposure conditions assumed for these occupational calculations.

LONG-TERM DOSE CALCULATIONS

One of the basic premises of AEGIS dose calculations is that they become more uncertain as a function of time into the future. This relates to the fact that the parameters controlling doses to humans are often highly dependent on culture and demography. Thus, extrapolations of current food trophic structures, human consumption patterns, and demographic characteristics are tenuous into the long term. AEGIS has a general policy not to perform dose analyses beyond 1000 yr. Nevertheless, in the review of the working draft of this report, it was widely suggested that dose calculations be performed for periods further into the future, as indicators of the relative hazard of the nuclear waste repository over the long term. It is in that context that the calculations in this section are presented; i.e., they provide an indication of the consequences of the postulated scenario, given current populational parameters, but taking place after the spent fuel has decayed for periods of 10,000 yr to 1,000,000 yr. These calculations should not be construed as providing the same level of certainty as similar calculations for earlier time periods.

A new inventory was required for these calculations to be performed because the ORIGEN-generated inventories originally provided to AEGIS from BNI only covered periods up to 30,000 yr post-closure. The long-term inventories were generated by the version of the ORIGEN code operational at PNL. The input to the PNL ORIGEN runs was based on the characteristics provided to AEGIS of the spent fuel entering the repository, obtained from the CRRD (1979) document. ORIGEN runs were then made and repeated with minor adjustments so the PNL ORIGEN output for 10,000 yr approximated the comparable output from the BNI-provided ORIGEN runs. The differences in these runs are so minor that there is no effect on the resulting dose calculations reported below.

The output from the PNL ORIGEN runs is listed in Appendix L. This information was used to produce source terms for the dose calculations precisely as described above for times 100 yr and 1,000 yr after closure. The results from the dose computer runs are listed in Appendices L and M, and they are summarized in Tables 9.9 and 9.10. Table 9.11 is presented to show how the dose burdens received from ingestion of contaminated culinary salt compares with the total body dose burdens received from background.

Predictions of doses to individuals and populations are very tenuous for time periods far into the future. However, the comparisons seen in these tables suggest that, all other factors being equal, the adversely consequential aspects associated with a solution mine operation from an inadvertent human intrusion into a nuclear waste (spent fuel) repository located in a salt dome are not mitigated by the passage of time. Even at one million years after closure, the total body doses from the human intrusion scenario developed here for solution mining into a salt dome repository would be twenty times background for an individual every day of a 70 yr lifetime, and there would be sufficient quantity for that to apply to 15,000,000 such individuals.

This trend is counter to the prevalent idea that after a certain period of time (usually taken to be 10,000 yr) the potential hazards of nuclear waste are less than for the original, natural ore bodies. The key reason for this divergence is that the calculations presented here are for a spent fuel repository located in a medium that is edible, providing a potential, direct vector

TABLE 9.9. Long-Term Population Dose Burdens from Solution Mining into the Hainesville Salt Dome

A. Base Case — 50 yr Ingestion, 70 yr Population Dose (man-rem)

Decay Time (yr) (Time of Intrusion)	Total Body	Bone	Lung	Thyroid
100	1.6×10^{11}	6.5×10^{11}	2.8×10^{9}	4.7×10^{6}
1,000	1.3×10^{9}	3.0×10^{10}	3.7×10^{4}	4.7×10^{6}
10,000	7.0×10^{8}	4.4×10^{9}	3.1×10^{4}	4.7×10^{6}
50,000	2.8×10^{9}	4.8×10^{9}	2.5×10^{4}	4.7×10^{6}
100,000	4.3×10^{9}	6.5×10^{9}	2.4×10^{4}	4.7×10^{6}
500,000	3.8×10^{9}	5.8×10^{9}	2.0×10^{4}	4.6×10^{6}
1,000,000	2.1×10^{9}	3.3×10^{9}	1.6×10^{4}	4.5×10^{6}

B. Base Case — 1 yr Ingestion, 70 yr Population Dose (man-rem)

Decay Time (yr) (Time of Intrusion)	Total Body	Bone	Lung	Thyroid
100	3.3×10^{9}	1.4×10^{10}	5.5×10^{7}	9.5×10^{4}
1,000	3.5×10^{7}	8.6×10^{8}	7.5×10^{2}	9.4×10^{4}
10,000	1.8×10^{7}	1.2×10^{8}	6.3×10^{2}	9.4×10^{4}
50,000	6.9×10^{7}	1.3×10^{8}	5.0×10^{2}	9.4×10^{4}
100,000	1.0×10^{8}	1.7×10^{8}	4.9×10^{2}	9.4×10^{4}
500,000	9.3×10^{7}	1.5×10^{8}	3.9×10^{2}	9.1×10^{4}
1,000,000	5.1×10^{7}	8.7×10^{7}	3.3×10^{2}	9.0×10^{4}

for the highly localized radioactive wastes to reach and be ingested by humans. The natural ore bodies, on the other hand, are relatively dispersed and, more importantly, are not edible.

TABLE 9.10. Long-Term Individual Dose Burdens from Solution Mining into the Hainesville Salt Dome

A. Base Case — 50 yr Ingestion, 70 yr Individual Dose (rem)

Decay Time (yr) (Time of Intrusion)	Total Body	Bone	Lung	Thyroid
100	1.1×10^4	4.4×10^4	1.8×10^2	3.2×10^{-1}
1,000	8.4×10^1	2.0×10^3	2.5×10^{-3}	3.1×10^{-1}
10,000	4.7×10^1	2.9×10^2	2.1×10^{-3}	3.1×10^{-1}
50,000	1.9×10^2	3.2×10^2	1.7×10^{-3}	3.1×10^{-1}
100,000	2.9×10^2	4.3×10^2	1.6×10^{-3}	3.1×10^{-1}
500,000	2.6×10^2	3.9×10^2	1.3×10^{-3}	3.0×10^{-1}
1,000,000	1.4×10^2	2.2×10^2	1.1×10^{-3}	3.0×10^{-1}

B. Base Case — 1 yr Ingestion, 70 yr Individual Dose (rem)

Decay Time (yr) (Time of Intrusion)	Total Body	Bone	Lung	Thyroid
100	2.2×10^2	9.6×10^2	3.7	6.3×10^{-3}
1,000	2.3	5.7×10^1	5.0×10^{-5}	6.3×10^{-3}
10,000	1.2	8.3	4.2×10^{-5}	6.3×10^{-3}
50,000	4.6	8.5	3.4×10^{-5}	6.3×10^{-3}
100,000	7.0	1.2×10^1	3.2×10^{-5}	6.3×10^{-3}
500,000	6.2	1.0×10^1	2.6×10^{-5}	6.1×10^{-3}
1,000,000	3.4	5.8	2.2×10^{-5}	6.0×10^{-3}

The rates of use of this edible medium, salt domes, strongly suggest their full exploration and depletion will occur in a relatively short time frame (in a few centuries). Further, the medium itself does not provide a barrier to the delivery of the radioisotopes to the accessible environment; indeed, the medium provides a rather strong attraction for such an event.

TABLE 9.11. Relative Total Body Dose Burdens Compared to Natural Radiation Background

Time of Intrusion (yr after closure)	Factors Above Background* (50-yr ingestion individual doses)
100	1,571.4 x
1,000	12.0 x
10,000	6.7 x
50,000	27.1 x
100,000	41.4 x
500,000	37.1 x
1,000,000	20.0 x

* Background is here taken to be 100 mrem/yr, or approximately 7 rem per 70 yr lifetime. Actual background varies from this depending on the location of the individual.

Further, the medium can be extensively exploited without early health effects on the intruders, because the remote-controlled operations do not yield acute occupational doses. Therefore, only specific engineered measures to preclude the inadvertent use of a specific salt dome containing a nuclear waste repository could provide the barrier to that vector. Such measures would include information systems to preclude entry, engineered barriers to provide containment, or other measures to shorten the period of exploitation of the salt dome. However, the calculations presented in this section show that such engineered measures must be effective over geologic times exceeding one million years to prevent the adversely consequential impacts on future populations by the radioactive wastes in a salt dome repository. This conclusion is generic to, and applicable only for, salt domes.

CHAPTER 10

SOURCE TERM

Chapters 4 through 9, describing the methodology used in this analysis, have specifically involved components of the AEGIS program. Chapters 10 through 11 relate to the source term and sorption data being developed by the WRIT program for use by AEGIS in its post-closure analyses.

This chapter deals with the source term of radioisotopes leaching from the waste and entering the ground-water system, and begins with a description of the methodology WRIT has, or will have before licensing a repository. This is followed by a discussion of the leach data and solubility limits used for this analysis.

INTRODUCTION TO METHODOLOGY

In the design of a nuclear waste isolation system, the waste form itself constitutes the innermost barrier to the release of radionuclides. The waste form is the provider of the source term of radionuclides that is used in AEGIS release consequence models to assess the safety of a nuclear waste repository. One objective of waste form release studies is to quantify radionuclide release rates under anticipated repository conditions and to investigate the mechanisms of release. The key to predicting waste form behavior from short-term laboratory tests lies in the understanding of the mechanisms of waste form alteration and the stability of the reaction products to further change.

The radionuclide source term is the physical input to migration and sorption studies. Because actual leachate solutions have different properties from a synthetically prepared solution, a more realistic estimate of radionuclide migration behavior is gained by the use of actual leach solutions. Thus, a second objective of waste form release studies is to provide characterized leachate solutions for sorption studies.

To be responsive to the needs of AEGIS release consequence analyses, two major types of conditions must be addressed:

- an "open" system, where an event has caused failure of all barriers, and solution contacts the bare waste form; fracture flow allows for minimal chemical alteration and sorption reactions between the waste form and surrounding barriers (canister, engineered barriers, backfill, and host rock)
- a "closed" system, where solution gradually permeates toward the waste form, chemically altering the various barrier materials in the process; the effects of chemical alteration and nuclide sorption reactions are brought to bear in this systems approach, integrating all barriers to radionuclide release.

In the first case, the simple system of waste form plus solution, release is commonly described by a leach rate. In the latter case, release is a combination of leaching and sorption/desorption interactions complicated by recrystallization and precipitation reactions, resulting in a system release rate.

Methodology Available or Under Development

WRIT has been conducting experiments to date centered on studying waste form-generic solution interactions corresponding to the "open" system. The main parameters of concern are time, temperature, solution chemistry, and solution flow rate. Because site-specific information was not available at the time these tests were started, a range of solutions was chosen:

- WIPP "B" salt brine (Dosch and Lynch 1978)
- NaCl solution, 1.76 g/l
- $CaCl_2$ solution, 1.66 g/l
- $NaHCO_3$ solution, 2.52 g/l
- deionized water.

To try to standardize the testing methods, three tests have been used to study radionuclide release:

1) a modification (more frequent sampling) of the International Atomic Energy Agency (IAEA) (Hespe 1971) leach test procedure that simulates a changing flow rate of solution

2) static leach tests, which are sampled as a geometric progression in time; these tests simulate a non-flowing solution and address solubility and approach to steady-state phenomena

3) continuous flow leach tests that model velocities that could be attained in aquifers.

The effects of temperature are being considered by studying a range from 25 C to 250 C. The waste forms being studied in this first stage of WRIT experiments on waste form-solution interactions are:

- High-level wastes:

  a. Spent Fuel: 1) static and IAEA leach tests on irradiated spent fuel; 2) effects of solution oxidation potential on UO_2 matrix dissolution; and 3) chemical distribution in irradiated spent fuel

  b. High-level Waste Glass: 1) static, IAEA, and continuous-flow tests on actinide-doped waste glass; and 2) effects of solution oxidation potential on radionuclide release.

- Transuranic waste forms:

  a. static and IAEA tests on concrete, polymers, glass, urea-formaldehyde, and bitumen prepared with actual TRU-contaminated incinerator ash.

The repository design presented to AEGIS and WRIT included only spent fuel in the inventory.

The spent fuel oxidation study is designed to measure the radionuclide release rates after oxidation of the spent fuels in various storage solutions and to identify the release mechanism at single crystal UO_2 surfaces. The first task will determine the congruent dissolution period and release rate for spent fuels oxidized in solutions. The increase of radionuclide release rate, which may be caused by oxidation of the UO_2 matrix to UO_3 XH_2O, will be related to the amount of dissolved oxygen content in water. The second task will compare the oxidation and leaching kinetics at elevated temperatures for single crystal UO_2 surfaces and other uranium surfaces. The composition and microstructure of the uranium oxide and uranium oxide-hydrate films will be characterized and correlated to the leaching kinetics. A high activation-energy oxidation path will be sought for stabilization of the UO_2 surfaces in the presence of oxygen in storage solutions.

Predicting releases from spent fuel requires an assumption of the distribution of radionuclides at the leachate-spent fuel interface. This fission product distribution is heterogeneous and is dependent on burnup and irradiation temperatures. There is a need to know the leach rate variation with the degree of inhomogeneity of the radionculides. The first phase of studies on this problem will involve the measurement of fission product chemistry distribution in spent fuel with known in-reactor parameters. This distribution, based on temperature and burnup, will be compared to modeling based on thermodynamic predictions. The second phase will involve measurement of leach rates for spent fuel samples with known chemical distribution and a repetition of the chemical distribution analysis to detect the changes in the surface chemistry.

The effects of radiation are being incorporated in these studies by tests using nonradioactive, isotope-doped material for studying elements without radiochemical interferences, and using fully radioactive wastes. Thus, for spent fuel, both UO_2 and actual spent fuel are being used. For waste glass, actinide and special fission product-doped glasses are being studied to maximize solution and surface data collection without high radiation field and radiochemical interferences. The results will be verified by a more limited series of tests on fully radioactive waste glass. The radiation levels are low enough to do all work on actual TRU wastes.

In addition to performing radiochemical solution analyses from which leach rates may be calculated, it is necessary to understand the major processes involved when a waste form is in contact with a solution, to extrapolate short-term laboratory tests to relatively short geologic times of several hundred years. Thus, WRIT is starting detailed solid state and solution analyses to gain knowledge of the mechanisms of release. In addition to isotope release concentrations, valence state and nuclide solution species experiments are being performed. Solid state analysis will include detailed mineralogic studies to identify alteration products such as recrystallized minerals.

WRIT has started its second phase of studies that addresses the interactions of the waste form with the surrounding barriers to be incorporated into repository design, such as the waste canister, engineered barriers, backfill material, and host rock media. Figure 10.1 illustrates a simple multiple barrier system. These integrated tests, which more accurately reflect the real repository, will provide an understanding of the effect of this complex system on the degradation of the waste form, release of radioisotopes, and their interactions with the immediate surroundings.

Comprehensive Waste Form Performance Testing Methodology

The study of waste-media interactions requires a multidisciplinary approach, involving aspects of geology, chemistry, materials sciences, and physics. There are few theories or mathematical descriptions that to date adequately describe waste leaching, corrosion, adsorption, or desorption. The bulk of the endeavors in waste-media interaction studies is typified as being experimental in nature.

As water migrates toward a waste form, it is changed chemically by the geochemical, thermal, and radiation fields it encounters. To describe the solution that finally reaches the waste form, the material in the solutions path must be characterized. This includes the waste form, canister, engineered barriers, backfill, and host rocks.

Basic physical, mechanical, and chemical properties of the parts of the waste-rock system need to be measured, including the variability in parameters and functional dependency on temperature, pressure, time, and moisture content. Parameters include elemental composition, valence state distribution in the solid, specific surface area, thermal conductivity, shear strength, permeability, pH, Eh, crystalline phases present, and their composition. In the case of the waste form, the effects of self-radiation damage and element transmutation also need to be studied.

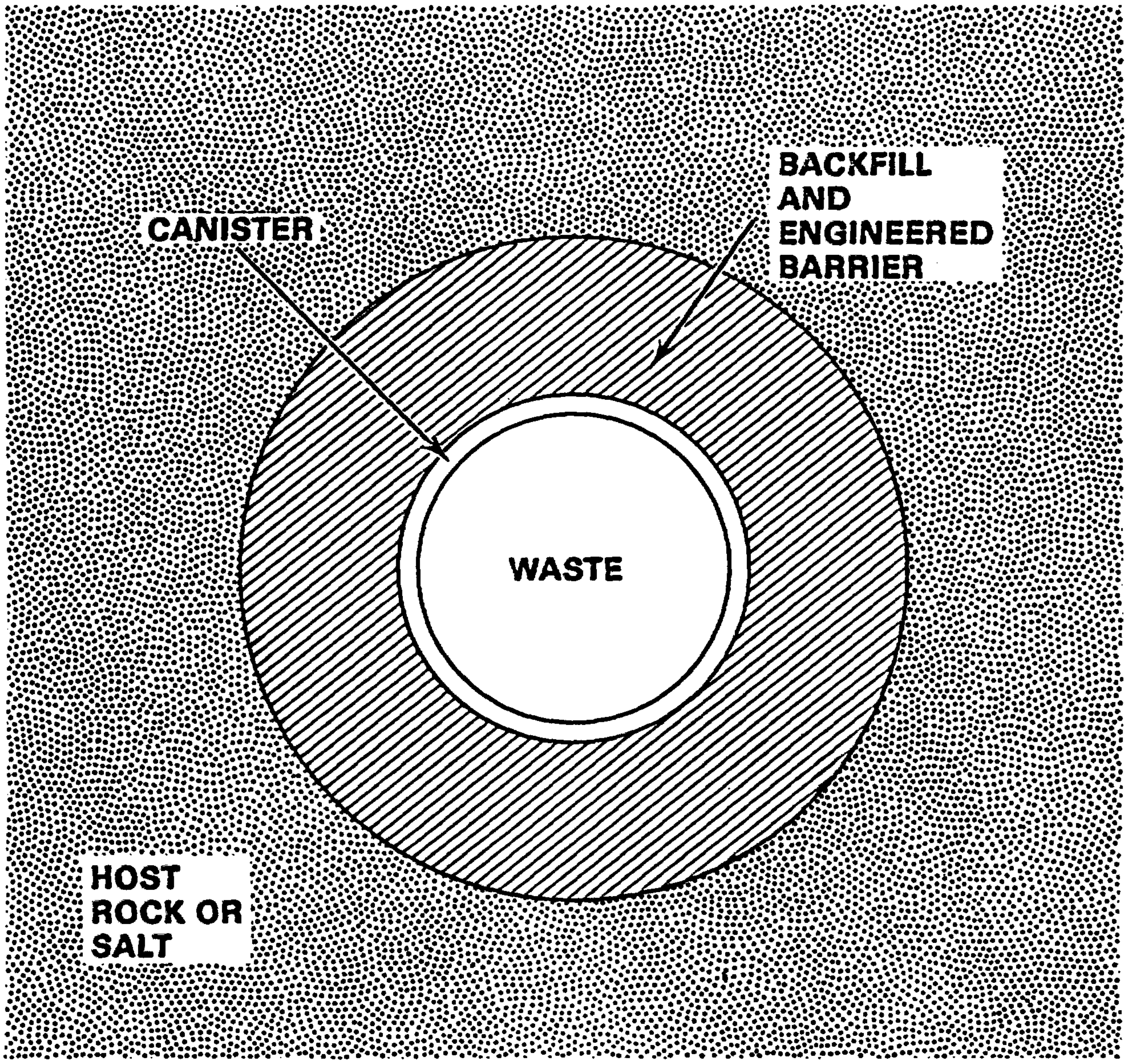


FIGURE 10.1. Multiple Barrier System, Near-Field Region

Information on the binary rock-water system is needed as a function of temperature, pressure, time, ground-water composition, and quantity of water influx rate. Physical attributes that need to be monitored include thermal expansion, permeability, and stress-strain changes. Chemical characteristics to be monitored as a function of the identified variables include mineralogic changes and radionuclide sorption changes. The resulting solution would interact with backfill and engineered barrier materials. The effects of radiation fields need to be added to the parameter effects at this point because of the proximity to the waste form.

Evaluations of the water-backfill interaction must be performed, whether the backfill is host-rock material or artificially introduced, getter materials such as clays, sands, host rock, or combinations thereof. The getter-backfill material may have the additional property of minimizing, delaying, or eliminating waste-water or waste-canister-water-geomedia interactions, which would occur if the backfill material were not present. The backfill material may be viewed as an engineered secondary barrier. Three of its major purposes are: providing a barrier to water intrusion (e.g., a swelling, low porosity clay); chemically or physically sorbing radioactive species in solution; or chemically buffering the near canister physico-chemical environment.

Engineered barrier interactions to be studied include water-barrier interactions, canister-overpack interactions, barrier-backfill-geomedia interactions, and engineered barrier physico-chemical durability or corrosion resistance. Interactions need to be investigated as a function of ground-water composition, chemistry, flow rate, temperature, pressure, radiolysis effects, and time. All engineered barriers are considered to be segments of the multibarrier concept. The hydrothermal interactions and radiation-induced interactions affecting backfill materials will be evaluated. Sorption/ desorption of leached nuclides under repository temperature and redox conditions should be experimentally analyzed. The effect of corrosion products formed on nuclide adsorption needs to be addressed. Solutions generated by these tests must be thoroughly characterized as they (along with the solutions generated from water-rock interactions) are the leach solutions that will contact the waste form and its canister. Physical properties such as gas and liquid permeability, thermal conductivity, stress and strain changes, and water absorption properties need to be studied along with chemical properties such as mineral or chemical stability and nuclide adsorption properties.

The radioactive waste canister is another segment of the multibarrier concept. The adequacy of the canister should be assessed relative to its intended purpose--a shipping canister, limited lifetime container (e.g., for approximately 50 yr for retrievability purposes), or extended lifetime container (e.g., for 500-1000 yr, past the thermal period of fission products). For the last purpose, the extent to which the canister can physically delay or minimize water-waste interactions could be of great importance.

Using metallurgical and associated techniques, candidate waste canister materials need to be evaluated for general corrosion, pitting, crevice corrosion, stress corrosion cracking, and effectiveness as a barrier for retarding near-field interaction leading to radionuclide migration. The effects of temperature, pressure, radiation, solution chemistry, aqueous phase (dry, moist, inundated), stresses, sensitization and welding, and effects of optimum emplacement or credible accident conditions should be studied.

Nuclear waste forms in contact with ground water may have a tendency for chemical reaction, depending on the temperature and composition of the waste. Likewise, there will be a tendency for chemical reaction between the waste and the minerals that make up the repository wall rock, reactions which, in general, are greatly enhanced by the presence of water and heat. Should water enter a breach in the canister, the chemistry would be dominated by the chemistry of the waste, and could be called a "waste-water" interaction. As the reaction zone proceeds outward from the canister, the chemistry comes to be dominated more and more by the chemistry of the rock. These reaction zones can, therefore, be identified as:

- waste form - canister - solution alteration; waste form dominates
- waste fluid - engineered barrier reactions; engineered barrier dominates
- waste fluid - engineered barrier - host rock interactions; host rock dominates
- waste fluid - host rock reactions away from engineered barriers, but still under the influence of temperature and radiation fields
- waste fluid - multiple rock media interactions at ambient temperature and away from radiation fields.

Although these zones blend continuously into each other as a function of distance outward radially from the canister, they are useful distinctions for the understanding of geochemical interactions.

LEACH VALUES PROVIDED FOR THE REFERENCE SITE ANALYSES

IAEA leach testing of spent fuel fragments was initiated in FY-1978 at PNL. The material originated from the HB Robinson II reactor, coming from a fuel bundle discharged on 6 June 1974 with an average burnup of 28,026 MWD/MTU. After the rods were cut into 4 in. sections, the fuel was removed by push rods. The resulting material was packaged for shipment to PNL. Upon receipt at PNL, the material was sized by WRIT staff into +8 mesh particles for leach testing. Another sample, taken at random, was dissolved and radiochemically analyzed so that the starting element concentrations would be known. Samples were also mounted, polished, and examined by metallography for microstructural characterization of the fuel.

A sample taken at random from the as-received spent fuel was screened in the hot cell to provide a particle-size distribution for surface area calculation. This distribution is shown in Table 10.1.

Metallographical examination of the spent fuel fragments showed the presence of closed porosity (Figure 10.2). Cathodic etching of the surface showed grains with little change in size from the pellet center to outer edge (magnified portion of Figure 10.2).

Chemical concentration profiles for selected radionuclides were recorded as fluorescence x-ray intensities on a shielded electron-beam microprobe x-ray analyzer. Various fuel fragments, typical of the samples in the leach tests, are now being analyzed. The data presented here are for a fragment of spent fuel, with a burnup of 28.0 MWd/kgU, and show a segment of a transverse section (see Figure 10.3). The microprobe was programmed to step-scan the sample from Point A, at the outside diameter of the pellet, to Point B near the center of the pellet. Concentration profiles for elements measured by step-scanning are expressed as x-ray intensities in Figures 10.4 through 10.6. Elemental profile across the transverse section from point A to B (see Figure 10.3) yield the following information:

TABLE 10.1. Particle-Size Distribution, 28,000 MWd/MTU Spent Fuel

Sample size = 1915.42 gms

Sieve #	Sieve Opening (mm)	wt (gms)	Fraction Retained (%)
3	6.73	0	0
4	4.73	192.883	10.07
5	4.00	634.765	33.31
10	2.00	1031.170	53.84
20	0.841	35.205	1.84
40	0.420	11.242	0.587
60	0.250	4.979	0.0260
80	0.177	1.424	0.0743
100	0.149	1.042	0.0544
140	0.105	1.204	0.0629
200	0.074	0.769	0.0402
200	0.074	0.737	0.0345

Plutonium — The plutonium is enriched at the outside diameter (OD) of the spent fuel pellet by a factor of 3, compared to the concentration at the center of the pellet. There is a 47% reduction in plutonium concentration 300 m inward from the OD, and the concentration drops another 28% over the next 3600 m (Point B).

Cesium — The cesium distribution in the spent fuel fragment was uniform from the OD to the center. All evidence of surface enrichment is absent. Any cesium iodide that may have been present at the OD-zircalloy-clad gap after reactor discharge could have been removed from the OD surface during decladding.

Ruthenium — The concentration of ruthenium at the OD is 27% higher than at 100 m inward. Within the next 600 m the ruthenium concentration drops 13%, and then remains essentially constant through to the center of the fuel pellets.

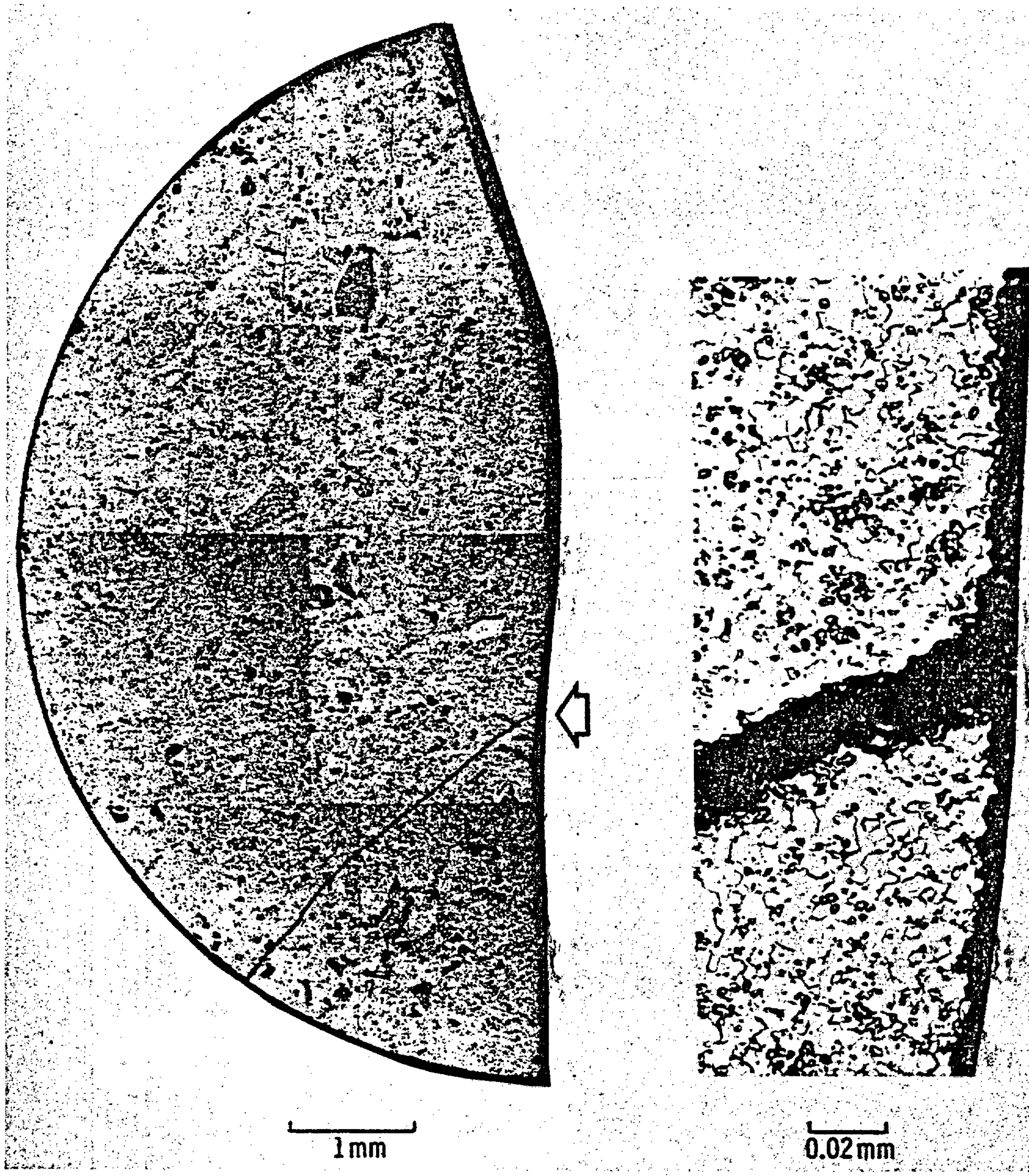


FIGURE 10.2. Appearance of Spent Fuel with a Burnup of 28.0 MWd/KgU (Photo # 7903589-5)

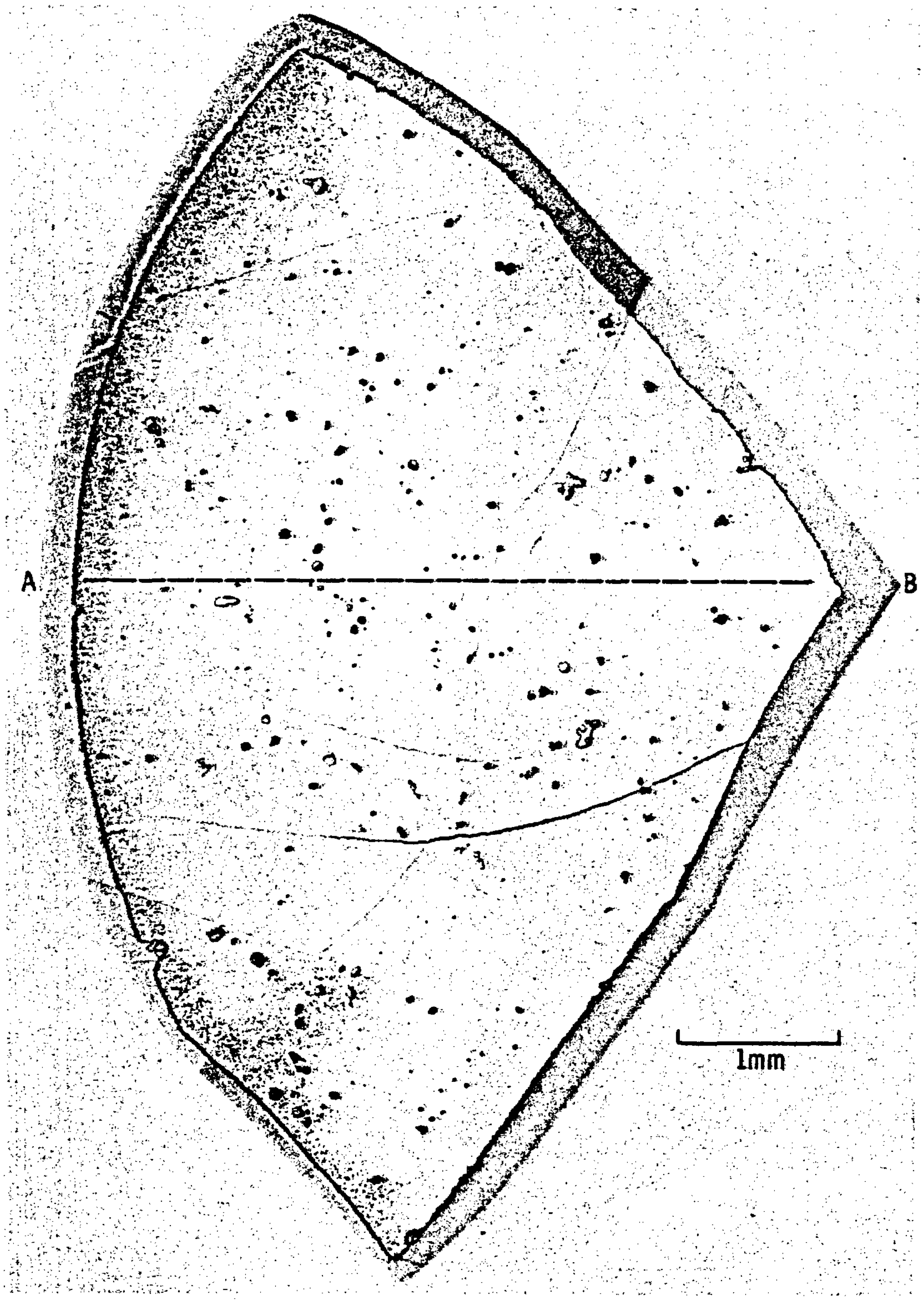


FIGURE 10.3. Fragment of H. B. Robinson II Fuel, 28.0 MWd/kgU, Showing Microprobe Step-Scanning Path, A to B
(Photo #7903589-7)

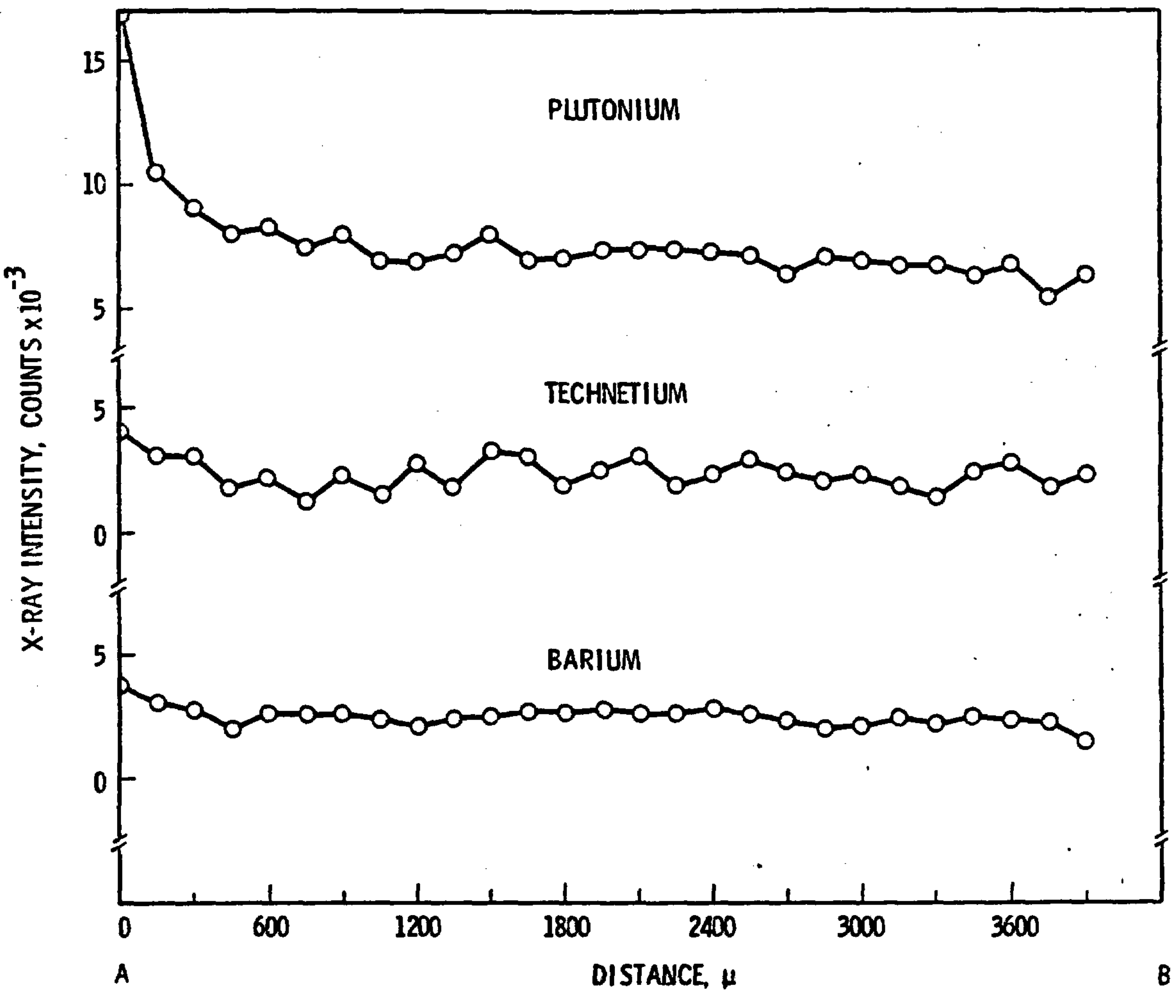


FIGURE 10.4. Microprobe Measured X-ray Intensities for Plutonium, Technetium and Barium
(Photo #7903589-4)

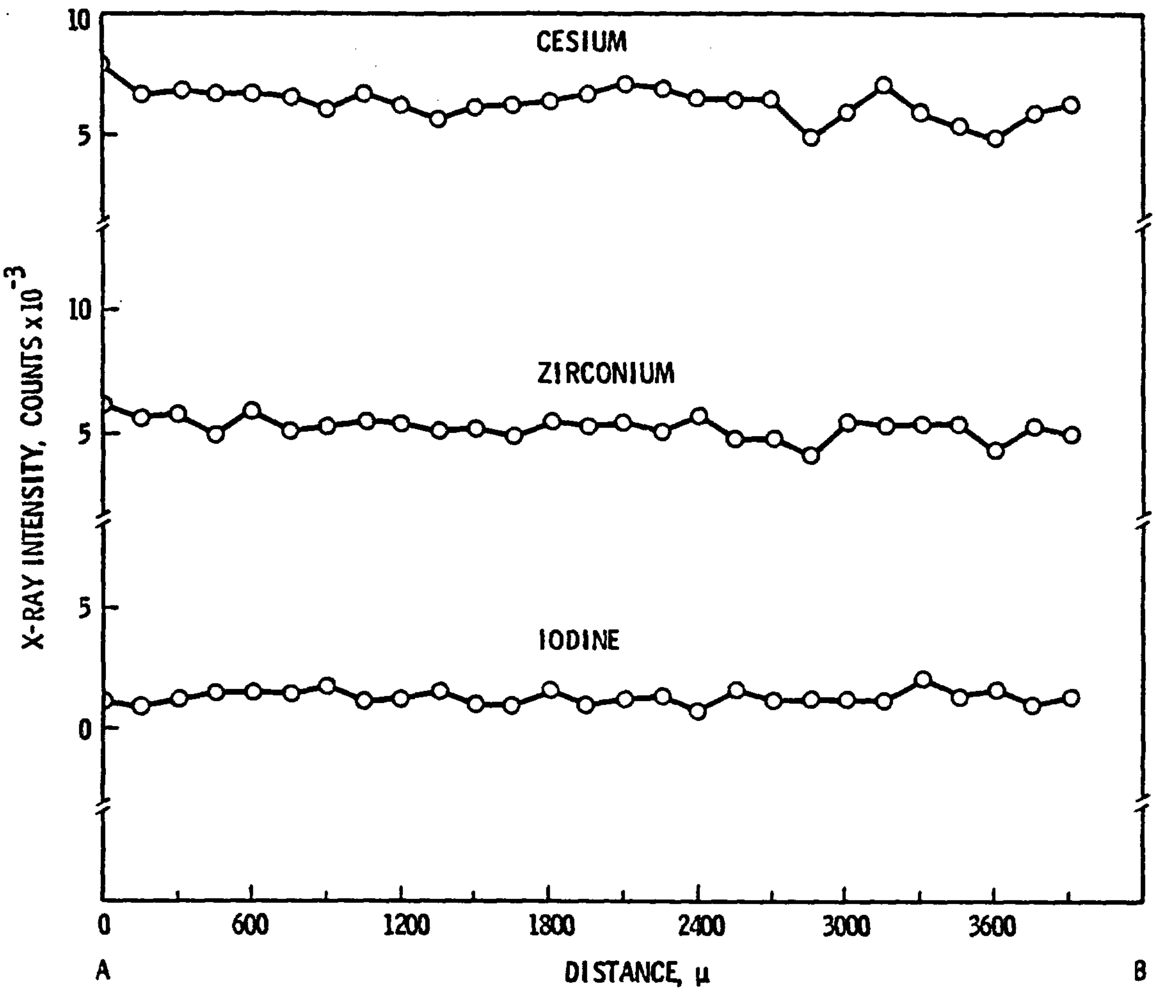


FIGURE 10.5. Microprobe Measured X-ray Intensities for Cesium, Zirconium and Iodine
(Photo #7903589-2)

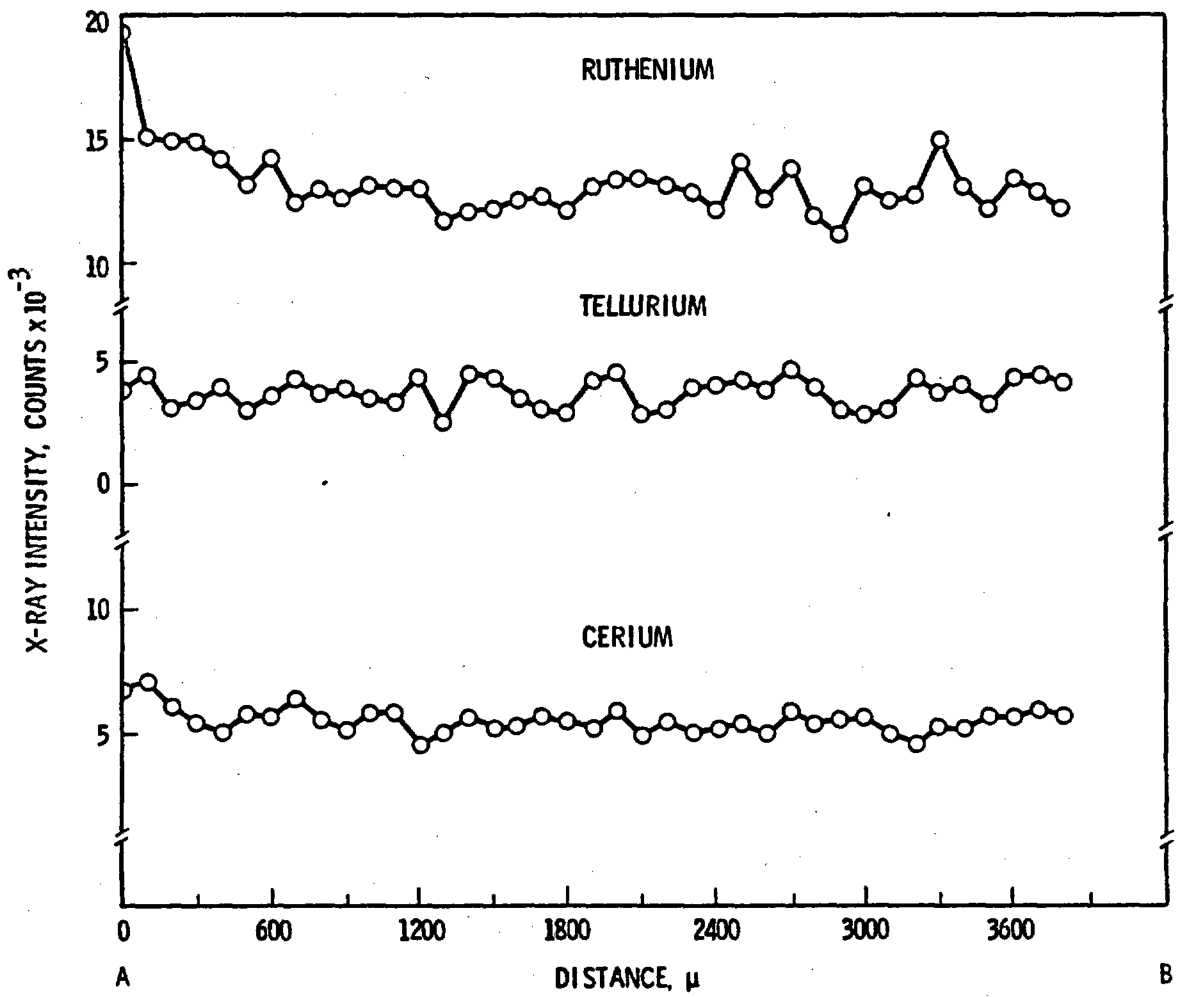


FIGURE 10.6. Microprobe Measured X-ray Intensities for Ruthenium, Tellurium and Cerium

(Photo #7903589-3)

Tellurium: The tellurium concentration is uniform throughout the spent fuel pellet.

Cerium: The cerium concentration is about 30% higher at the OD and at about 20 m inside the OD. From the 200 m mark to the center the concentration is uniform.

Technetium: The technetium concentration is about 30% higher at the OD than in the remainder of the pellet. This enriched zone is about 100 m wide.

Barium: The barium concentration is about 30% higher at the OD than in the remainder of the pellet. This enriched zone is about 150 m wide.

Zirconium: The zirconium concentration is uniform throughout the spent fuel pellet.

Iodine: The iodine concentration is uniform through the spent fuel pellet.

The IAEA leach test procedure includes immersion of a sample in a solution, according to a fixed ratio of exposed surface area of sample to volume of solution of 1 to 10 (cm^2/cm^3 basis). The solution is then left in contact with the sample according to progressively longer time intervals. Table 10.2 shows the sampling schedule for the IAEA test used. For the spent fuel tests, approximately 15 grams were used per test, having a geometric surface area of approximately 30 cm. Figure 10.7 shows the leach tests container details. For these tests the solution volume was 300 ml and leaching was at 25 C. The air-saturated leachate solutions used for the spent fuel leach tests are as follows:

- WIPP "B" natural salt brine (Table 10.3)
- synthetic high ionic strength calcium ground water (1.66 g/l $CaCl_2$)
- synthetic high bicarbonate ground water (2.52 g/l $NaHCO_3$)
- synthetic high ionic strength sodium ground water (1.76 g/l NaCl)
- deionized water.

TABLE 10.2. IAEA Leach Test Schedule

Cumulative Time	Time Intervals for Leach Solution Changing	Series Number	Number of Leach Solutions Analyzed
Days	1	1	1
	2	2	2
	3	3	3
	4	4	4
Weeks	2	5	5
	3	6	6
	4	7	7
	5	8	8
	6	9	
	7	10	9
	8	11	
	9	12	10
Months	3	13	11
	4	14	
	5	15	12
	6	16	
	7	17	13
	8	18	
	9	19	14
	10	20	
	11	21	15
	12	22	

The tests were run in triplicate, resulting in a total of 15 tests. On a given sampling day, the basket holding the beads was carefully removed and a sample withdrawn after swirling the jar of solution. This sample was then acidified to a pH of 1, using concentrated nitric acid, to prevent radionuclides from adhering to the wall of the glass sample container. To verify that the nitric acid was effective in preventing loss of radionuclides on the sample container walls, the sample container was emptied of solution, releached in nitric acid, and samples of the resulting solution and the sample container were counted. The results showed that the pH 1 solution of nitric acid was very effective, as insignificant amounts of radionuclides were found on the container walls.

The original polyethylene jar (Figure 10.7) was next filled with 300 ml of 5 M HNO_3 + 0.05 M HF. This solution was used to remove any isotopes that had adhered to the jar walls. After a period of time equal to the original leaching period, a sample was withdrawn and analyzed. The result of this radionuclide analysis was added to that from the original leach solution to arrive at a leach rate of a given radionuclide from the spent fuel.

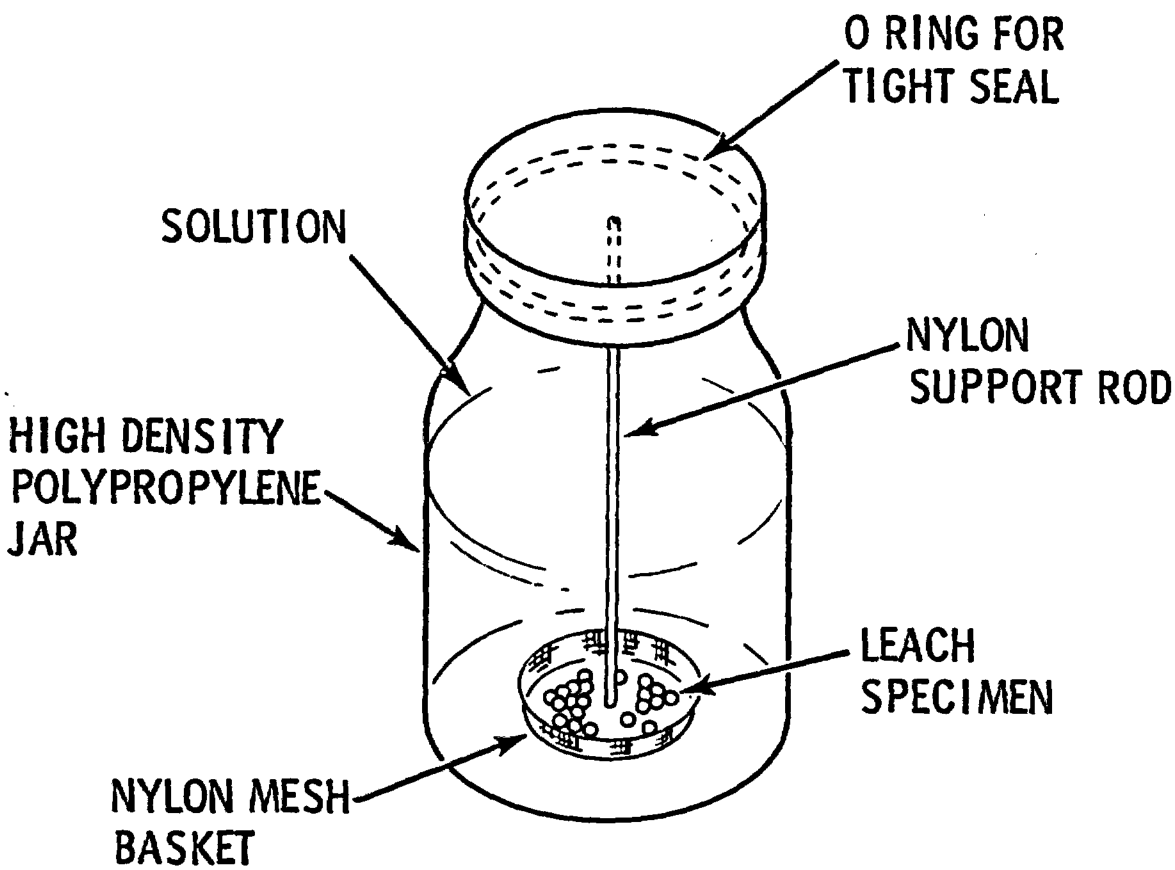


FIGURE 10.7. IAEA Leach Test Container

TABLE 10.3. Chemical and Ionic Composition of Salt Brine

Compound	Concentration (g/l)	Ion	Concentration (mole/l)
NaCl	287.0	Na^+	5.0
Na_2SO_4	0.0062	K^+	0.00038
$Na_2B_4O_7$ $10H_2O$	0.0160	Rb^+	0.000012
$NaHCO_3$	0.0140	Cs^+	0.000008
NaBr	0.5200	Mg^{++}	0.00041
KCl	0.0290	Ca^{++}	0.022
KI	0.0130	Sr^{++}	0.00017
$MgCl_2$	0.0400	Fe^{+++}	0.000036
$CaCl_2$ $2H_2O$	0.0033	Cl^-	4.94
$FeCl_3$	0.0060	Br^-	0.0050
$SrCl_2$ $2H_2O$	0.0330	I^-	0.000079
Rb_2SO_4	0.0016	HCO_3	0.00016
CsCl	0.0013	SO_4	0.036
TOTAL DISSOLVED SOLIDS		297.2 g/l	
pH (adjusted)	6.5		

The measurements of radionuclides were all made using accepted radioanalytical methods. Gamma emitters were measured by gamma energy analysis using a multichannel analyzer with a Ge-Li detector. To improve the measurement of minor constituents, the majority of the cesium was removed by extraction with tetraphenylboron in amylacetate (Finston 1961) and the sample recounted.

Plutonium and curium concentrations, with the exception of the brine samples, were determined by alpha energy analysis of a direct mount of the sample. In brine samples, the plutonium was extracted into TTA-xylene (Moore 1957), plated, and counted on an alpha proportional counter. Curium was separated by ion exchange, plated, and alpha counted. Strontium was separated by ion exchange and beta counted; repeat counts were made and the strontium-90 was calculated from the yttrium-90 ingrowth (Koltoft and Elving 1966). Uranium was determined by fluorometry (Centanni and De Sesa 1956; Price, Ferreti, and Sqartz 1953).

The equation used to calculate the isotopic leach rates is as follows:

$$R_i = \frac{a_o}{A_o St} \tag{10.1}$$

where:

R_i = incremental leach rate (g/cm^2-day)
a_o = activity of isotope in leachate, (counts sec^{-1})
A_o = specific activity of isotope in sample (counts sec^{-1} - g^{-1})
S = geometric surface area of sample (cm^2)
t = leaching time (day).

Table 10.4 shows the leach rate information on the radionuclide release from spent fuel available at the time of the reference site consequence analysis. Figure 10.8 shows the leach rate plots.

Based on these spent fuel leach data and some recent literature, the following conclusions were reached for this reference site analysis:

- The maximum expected U concentration in solution, based on the leachate analysis and references (Grandstaff 1976; Holland and Brush 1978), is _10 ppm in oxidizing conditions and pH 6.0. Such conditions are expected for this scenario, where surface or near-surface water would be in contact with the waste. Once this concentration is reached, further spent fuel dissolution occurs only by ingress of fresh water (i.e., solubility provides an upper bound on the source term). For this analysis, 6 ppm was taken to be the representative base case value. More recent data suggest this value should be higher.

- The leach rate data shown in Figure 10.8 suggest congruent dissolutioning of the spent fuel is occurring. A major consideration in this statement is a recognition that Pu, Cm, Ce, and Eu almost certainly are incorporated as a homogeneous solid solution in UO_2. Hence, there is no logical reason to expect any significant leach rate difference for these elements. Because the leach rates for the

TABLE 10.4. IAEA Leach Test, Spent Fuel, WIPP "B" Brine (g/cm^2-day)

	Leach Time (days)					
	1	2	3	4	11	467
$^{239,240}Pu$	2.4×10^{-5}	9.2×10^{-6}	9.7×10^{-6}	5.9×10^{-6}	2.3×10^{-6}	3.7×10^{-6}
^{244}Cm	1.2×10^{-4}	1.2×10^{-5}	2.6×10^{-5}	1.1×10^{-5}	7.1×10^{-6}	1.0×10^{-6}
$^{90}Sr, ^{90}Y$	1.5×10^{-4}	$2/1 \times 10^{-5}$	2.5×10^{-5}	1.2×10^{-6}	6.8×10^{-6}	3.1×10^{-6}
U	4.0×10^{-5}	8.0×10^{-6}	3.0×10^{-5}	2.0×10^{-5}	3.0×10^{-6}	6.0×10^{-7}
^{134}Cs	1.3×10^{-3}	6.0×10^{-5}	4.6×10^{-5}	1.3×10^{-5}	8.9×10^{-6}	2.6×10^{-6}
^{137}Cs	1.2×10^{-3}	5.9×10^{-5}	5.1×10^{-5}	2.0×10^{-5}	1.2×10^{-5}	3.8×10^{-6}
^{144}Ce	8.2×10^{-5}	4.9×10^{-6}	1.3×10^{-5}	3.2×10^{-6}	2.3×10^{-6}	2.6×10^{-7}
^{106}Ru	2.4×10^{-5}	3.5×10^{-6}	1.1×10^{-5}	3.6×10^{-6}	2.9×10^{-6}	2.7×10^{-7}
^{125}Sb	1.0×10^{-4}	4.1×10^{-5}	2.3×10^{-5}	1.1×10^{-5}	4.4×10^{-6}	2.8×10^{-6}
^{154}Eu	1.4×10^{-4}	7.8×10^{-6}	2.8×10^{-5}	1.2×10^{-5}	7.0×10^{-6}	1.3×10^{-6}

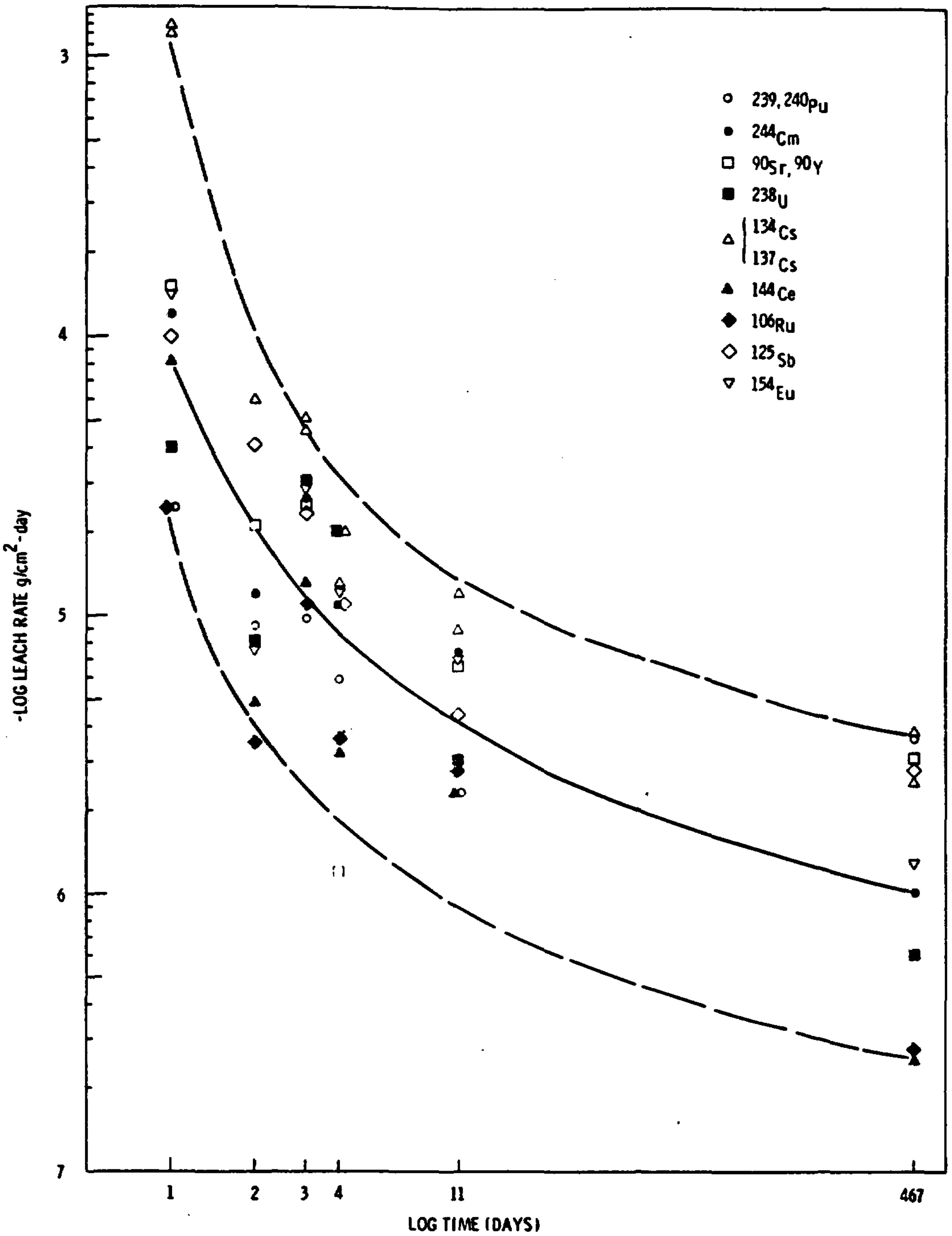


FIGURE 10.8. Spent Fuel - IAEA Leach Test, WIPP "B" Brine

fission products fall within the band of the matrix elements, the effective leach rates approximately follow a congruent dissolution mechanism. The average of the experimental leach rates is 1.0 x 10^{-6} g/cm^2-day at 25 C at 467 days, and this was still decreasing monotonically.

- A reasonable upper boundary of 1 x 10^{-5} g/cm^2-day at 25 C is based on current WRIT work (leach rates in simulated ground water, brine, and deionized water have never exceeded 1 x 10^{-5} g/cm^2-day) and the literature (Grandstaff 1976; Holland and Brush 1978), provided the pH does not fall below 6. In low pH, total carbonate concentration becomes very important.
- A lower effective leach rate of 1 x 10^{-8} g/cm^2-day at 25 C is an upper bound on leach rates. This would be the case if low oxygen content solutions are encountered. As shown by Grandstaff (1976), lowering the oxygen content reduces the uranium solubility.
- The temperature dependence used for this analysis assumes an activation energy of 14$\pm$2 kcal/mole, as given by Grandstaff (1976). For temperature expressed in K, and a leach rate of 1 x 10^{-6} g/cm^2-day at 25 C, the expression including the temperature dependence is:

$$R(\text{g/cm}^2\text{-day}) = 1.6 \times 10^4 \exp \; -7000/T(\text{ K}) \tag{10.2}$$

The concentration of all elements in solution is determined by the spent fuel composition; we assume congruent dissolution up to the assumed 6 ppm solubility limit for uranium. When the solubility limit of U is achieved, the amount of each radionuclide going into solution is proportional to the rate of uranium release, as described below.

SOLUBILITY LIMITS

The rate at which nuclear waste dissolves in solution is limited by both the solubility of the various elements and by the leach rate constant. This constant has units of mass per time per surface area. Therefore, as the surface area exposed to leaching increases, the amount removed in solution will increase. As the solubility limit of an element is approached, the amount of material dissolving becomes balanced by an equal amount precipitating. Consequently, only the concentration at or below the solubility limit can be removed from the repository. Given a repository that is being exposed incrementally (e.g., during the solution mining operation), a given leach rate constant will limit the dissolution rate until sufficient surface area is exposed. At this point, the amount of an element going into solution will be at the solubility limit, and from then on the dissolution rate will be governed solely by the solubility of the elements. If the rate is known at which the repository is being exposed to dissolution, then the point in time at which the solubility limit is reached is a function only of that solubility and the leach rate constant.

Dissolution Rate Based on Solubility

$$\text{Dissolution Rate } \left(\frac{g}{day}\right) = \text{Solubility (ppm)} \times \text{Flow Rate (gpm)}$$

$$\times \frac{1440 \text{ min}}{\text{day}} \times \frac{3.78 \text{ l}}{\text{gal}} \times \frac{1 \text{g}}{10^3 \text{mg}}$$

$$= \frac{5.44 \text{ min l g}}{\text{day gal mg}} \times \text{Solubility (ppm)}$$

$$\times \text{Flow Rate (gpm)} \qquad (10.3)$$

Dissolution Rate Based on Leach Rate Constant

$$\text{Dissolution Rate } \left(\frac{g}{day}\right) = \text{Leach Rate Constant } \left(\frac{g}{cm^2\text{-day}}\right)$$

$$\times \text{Total Source Area } (cm^2) \times \text{Fraction Exposed}$$

$$= 2.1 \times 10^{11} \ (cm^2) \times \text{Leach Rate Constant } \left(\frac{g}{cm^2\text{-day}}\right)$$

$$\times \text{Fraction Exposed} \qquad (10.4)$$

where:

Total Surface Area = $2.1 \times 10^{11}\ \text{cm}^2$

In the salt dome solution mining scenario, the fraction exposed can be determined from the salt removal rate (= 410 g salt per liter of water). It is assumed that the salt is being removed in a direction within the salt dome that increases the exposure of the waste to the solution. Then,

$$\text{Fraction Exposed} = \frac{\text{Fraction Exposed}}{\text{Day}} \times \text{Days of Exposure (D.E.)}$$

$$= \frac{\text{Salt Removal Rate} \times \text{Flow Rate}}{\text{Total Salt Weight}} \times \text{D.E.}$$

The repository has an area of 1375 acres and is 20 ft high. Therefore,

$$\text{Total Salt Weight (g)} = \frac{1375\ \text{acres}}{640\ \text{acres/sq mi}} \times \frac{(5{,}280\ \text{ft})^2}{\text{sq mi}} \times 2.83 \times 10^4\ \frac{\text{cm}^3}{\text{ft}^3}$$

$$\times\ 2.16\ \text{g/cm}^3 \times 20\ \text{ft} = 7.3 \times 10^{13}\text{g} \qquad (10.5)$$

$$\text{Fraction Exposed} = \frac{410\ \text{g/l}}{7.33 \times 10^{13}\text{g}} \times 3.78\ \frac{\text{l}}{\text{gal}} \times (\text{Flow Rate gpm})$$

$$\times\ \frac{1440\ \text{min}}{\text{day}} \times \text{D. E. day} = 3.1 \times 10^{-8}\ \frac{\text{min}}{\text{gal-day}}$$

$$\times\ (\text{Flow Rate gpm}) \times \text{D.E. day} \qquad (10.6)$$

Equations 10.4 and 10.6:

$$\text{Dissolution Rate (g/day)} = 6.5 \times 10^3\ \frac{\text{min-cm}^2}{\text{gal-day}} \times \text{Leach Rate Constant}\left(\frac{\text{g}}{\text{cm}^2\text{-day}}\right)$$

$$\times\ \text{Flow Rate (gpm)} \times (\text{D.E. day}) \qquad (10.7)$$

Dividing Equation 10.3 by 10.7:

$$\frac{\text{Dissolution Rate from Solubility Limit}}{\text{Dissolution Rate from Leach Rate Constant}}$$

$$= \frac{5.44\ \frac{\text{min-l-g}}{\text{day-gal-mg}} \times \text{Solubility (ppm)} \times \text{Flow Rate (gpm)}}{6.5 \times 10^{3}\ \frac{\text{min-cm}^2}{\text{gal-day}} \times \text{Leach Rate Const}\ (\frac{\text{g}}{\text{cm}^2\text{-day}}) \times \text{Flow Rate (gpm)} \times \text{D.E.}}$$

$$= 8.4 \times 10^{-4}\ \frac{\text{l-g}}{\text{mg-cm}^2} \times \frac{\text{Solubility (ppm)}}{\text{Leach Rate Constant}(\frac{\text{g}}{\text{cm-day}}) \times \text{D.E.}} \quad (10.8)$$

The rates will equal each other when the solubility limit is reached, (i.e., the ratio of the rates will be 1). The time at which this occurs is:

$$\text{Time} = 8.4 \times 10^{-4}\ \frac{\text{l-g}}{\text{mg-cm}^2}\ \frac{\text{Solubility (ppm)}}{\text{Leach Rate Constant}(\frac{\text{g}}{\text{cm}^2\text{-day}})} \quad (10.9)$$

This is the time after initial exposure on which solubility begins to control the dissolution rate. This relationship is shown in Figure 10.9.

Equations 10.3 and 10.4 can be combined to determine the fraction of the waste exposed at which the solubility limit is reached for a given leach rate constant. This will also be a function of the flow rate.

Equations 10.3 and 10.4:

$$5.44\ \frac{\text{min-l-g}}{\text{day-gal-mg}} \times \text{Solubility (ppm)} \times \text{Flow Rate (gpm)} =$$

$$\text{Leach Rate Constant}\ (\frac{\text{g}}{\text{cm}^2\text{-day}}) \times \text{Total Surface Area (cm}^2\text{)}$$

$$\times \text{ Fraction Exposed} \quad (10.10)$$

Consider a solubility for uranium of 6 ppm:

$$1.6 \times 10^{-10}\ \frac{\text{min-g}}{\text{day-gal-cm}^2} \times \frac{\text{Flow Rate (gpm)}}{\text{Leach Rate Constant}\ \frac{\text{g}}{\text{cm}^2\text{-day}}} = \text{Fraction Exposed} \quad (10.11)$$

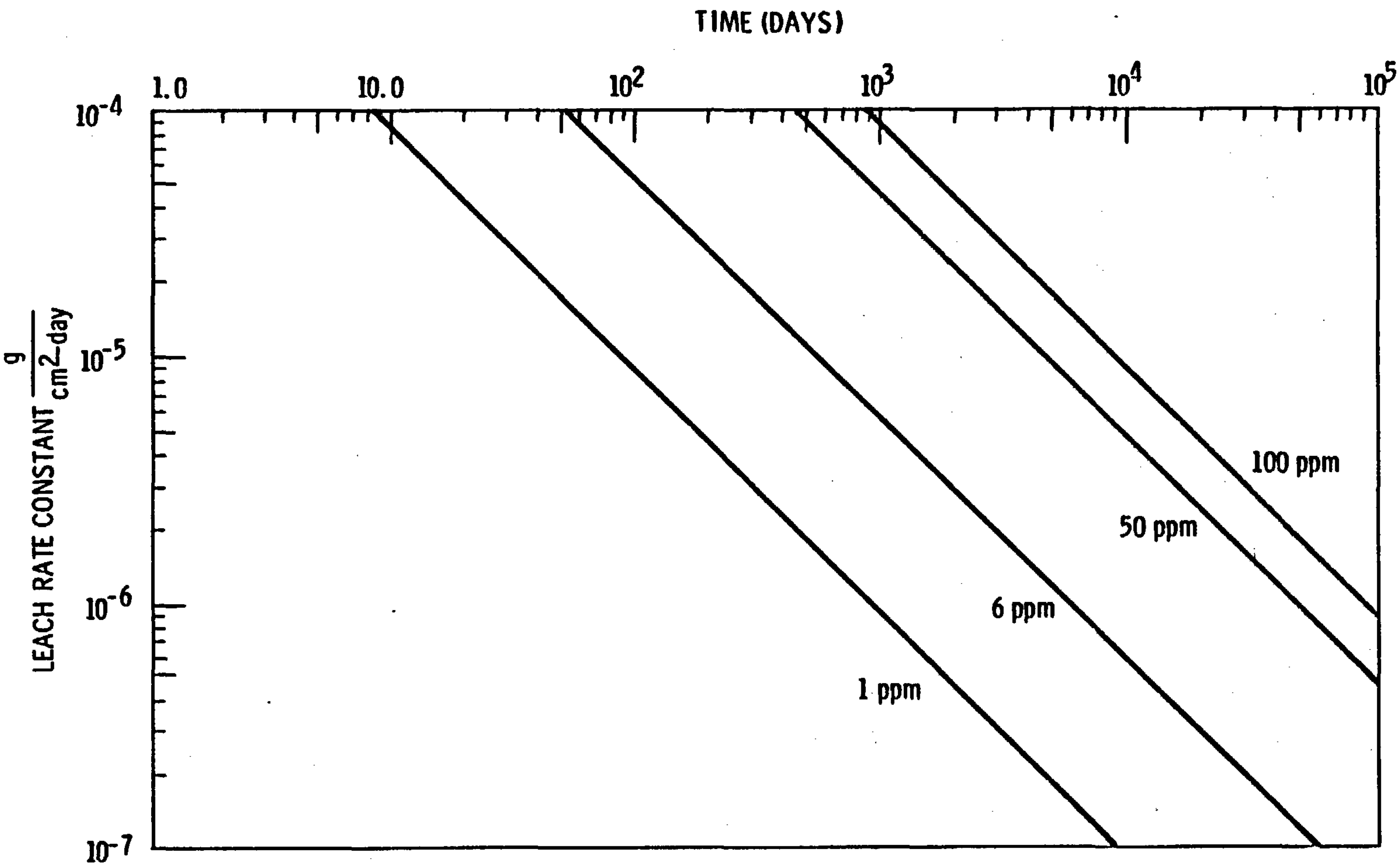


FIGURE 10.9. Day Upon Which Solubility Limit Becomes Dominant

This relationship is shown in Figure 10.10. Note that for the reference repository base case, the source term is solubility limited within 1.5 yr of the beginning of the operational phase of the solution mining intrusion. This is based on a leach rate of 10^{-6} g/cm^2-day at 25 C, adjusted for temperature effects to approximately 10^{-5} g/cm^2-day. This leach rate coincides with the value used in the CWMS study. Subsequent to cessation of this operational phase and rupture of the side of the salt dome, the flow through the repository into the aquifer is solubility limited throughout the source term period (i.e., during the 15,000-yr period of salt dome dissolutioning and the subsequent 75,000-yr period of waste dissolutioning).

For this revised report, the alternative set of assumptions, of a smaller solution mine rate but increased culinary salt production, would lead to a smaller amount of the repository being exposed (by a factor of 30). The water flow-through rate would be equally reduced, so that the incidence of and timing of solubility limitation would not change.

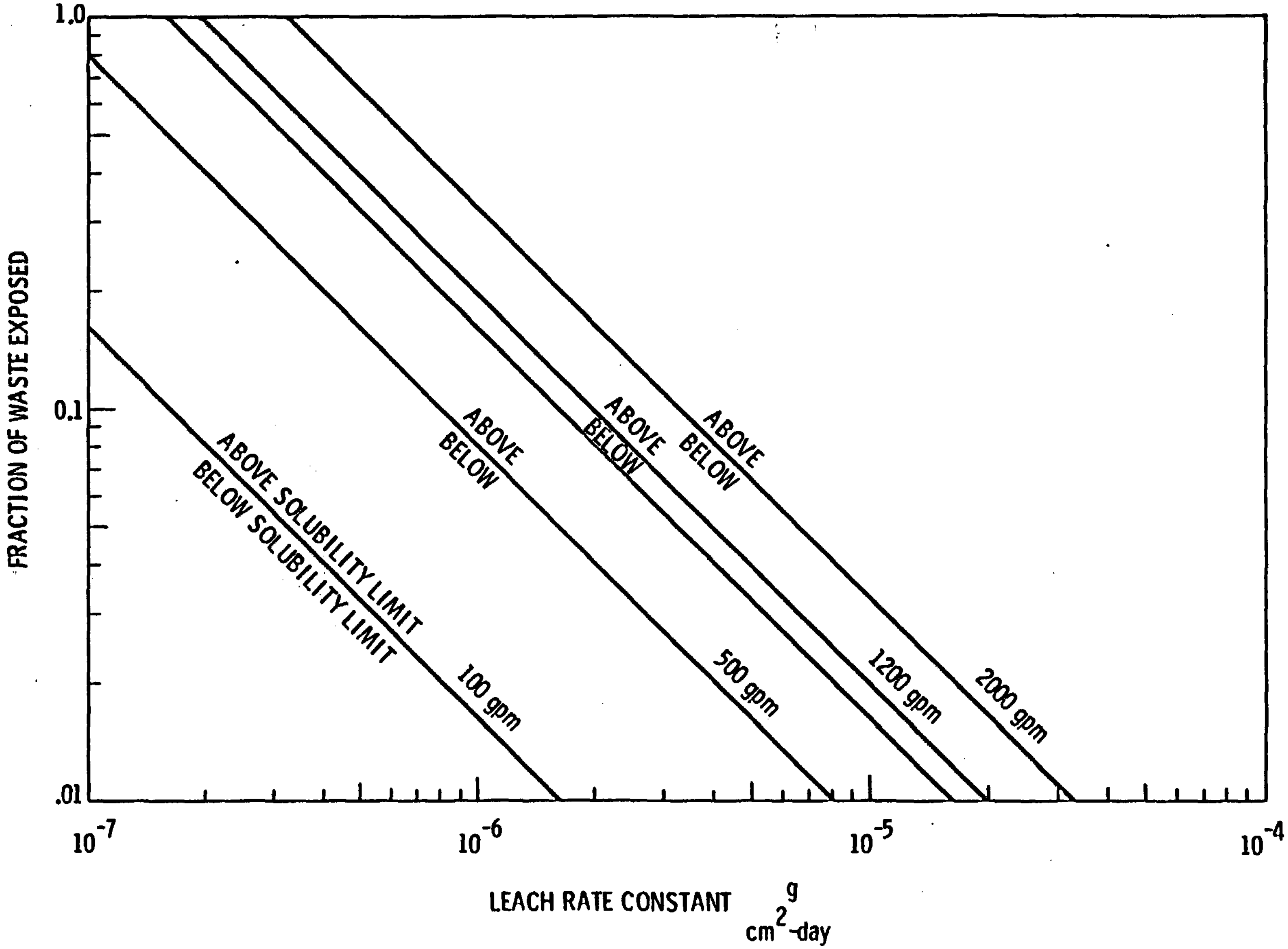


FIGURE 10.10. Fraction of Waste Exposed Needed to Reach Solubility Limitations for Specific Flow Rates and Leach Rate Constants

CHAPTER 11

SORPTION DATA

This chapter deals with the sorption of radioisotopes by the geological media through which they may transit; it begins with a description of Kd methodology and its limitations. This is followed by a description of the procedures used to acquire sorption data for this analysis by the WRIT program.

INTRODUCTION TO METHODOLOGY

The migration rates and adsorption-precipitation processes describing the fate of leached radionuclides percolating through geomedia are being determined by parts of the WRIT program. To quantify migration rates for radionuclides, the distribution coefficient (Kd) has been used, defined as the ratio of the quantity of nuclide adsorbed onto the geomedia to the quantity of nuclide remaining in the contacting solution. The retardation coefficient (R) is defined as the ratio of the velocity of the ground-water movement to the velocity of the nuclide movement. For flow in porous media the relationship is

$$R = \frac{V_{gw}}{V_{nuc}}, \quad V_{nuc} = \frac{V_{gw}}{1 + \rho_b/\theta \ Kd} \tag{11.1}$$

where:

V_{nuc} = velocity of nuclide
V_{gw} = average velocity of ground water
ρ_b = media bulk density
θ = media porosity
Kd = distribution coefficient (mass basis).

For flow in fractured media the relationship is:

$$R = \frac{V_{gw}}{V_{nuc}}, \quad V_{nuc} = V_{gw}/\ 1 + \frac{FV}{FA} Kd(a) \tag{11.2}$$

where:

FA = fracture surface area

FV = fracture volume

Kd(a) = distribution coefficient (surface area basis).

The variables used in Equation 11.1 are commonly measured in hydrologic studies (V_{gw}, ρ_b, θ) for porous media. Thus, with an empirical measurement of Kd for the nuclide of interest, the V_{nuc} and R are readily calculated. The variables in Equation 11.2 (V_{gw}, FA, FV) would be needed to predict hydrologic properties for flow through fractured media. Measurements for FA and FV to date have not been routinely determined. Assuming FA and FV are obtainable, the nuclide migration velocity is again calculable if the Kd(a) has been measured.

METHODOLOGY

In principle it is straightforward to measure the Kd for a nuclide by laboratory experimentation. Although there are some unresolved issues concerning standard technique to obtain Kd values, experimenters have traditionally used two types of procedures: static and dynamic. Studies are currently underway within WRIT to evaluate the various methodologies and to form a consensus on standard procedures.

The static or batch method for measuring Kd values involves contacting an adsorbent (rock) with a liquid adsorbate (nuclide in ground water) within a container. Usually, the experimental system is continually agitated to facilitate mixing and solution contact with the absorbent. At specified times the solid and solution are separated and the resultant distribution of adsorbate is determined. Critical examination of the batch method has shown several complications and potential limitations. WRIT has explored several of the complications to determine their effects on the prediction of nuclide retardation by geomedia. Specifically, the effects of solid-liquid phase separation techniques, container adsorption of tracer, method of tracer addition to ground water, and calculational schemes used to produce Kd values have been assessed.

To evaluate the Kd value for a radionuclide by batch methods, the solid adsorbent must be separated from the liquid. Two methods are used for making this phase separation: centrifugation and filtration. The definitions of soluble and suspended solids have not been rigidly established, nor is it clear, for purposes of nuclide migration, what molecular size would be so large that migration would be most influenced by physical filtration rather than by chemical sorption processes. Using some simplifying assumptions, one can ascertain the most likely maximum particle size in the centrate or filtrate and adjust techniques to give comparable results.

In the past WRIT experiments have often shown that centrifugation yields sporadic Kd results. In general, the variation appears to be caused by uncentrifuged particles with adsorbed or innate radioactivity appearing in the counted solution. The WRIT techniques are for phases to be separated by centrifugation, followed by filtration through 0.4 µm or smaller polycarbonate membranes.

Filtration of centrates often removes the variability in measured activity and can reduce the observed solution activity. More studies need to be performed to evaluate the apparent discrepancy between the observed larger-than-expected particulates in centrate versus the maximum-expected particulate size predicted from Stokes' falling velocity theory.

Blanks are commonly run with batch Kd experiments to account for container adsorption. The blank is a container without the sediment or rock present, in which the nuclide-spiked solution is treated in a similar fashion to other samples. A percentage of the activity originally present in the ground water will often be removed after contact with the blank container, especially for rare earth and actinide elements. At least two removal mechanisms are operating: container adsorption and solid formation (e.g., precipitation, polymer formation). This latter precipitation process will be a major contributor in the real world as temperature, pH, and redox conditions of the ground water change. The observed loss in solution activity is used to adjust the influent activity value used to calculate the Kd.

The present WRIT procedure usually is to count only the liquids, influent and effluent, and estimate the amount adsorbed on the solid by calculating the difference. A few WRIT subcontractors have proposed that the sample effluent and solid adsorbent be counted directly to calculate the Kd. This approach alleviates the need for container adsorption corrections but introduces the logistical problems of solid counting. Two approaches are used to count the solids: removing all the solids from the container and placing them in a suitable counting vial, or taking a known weight of a representative aliquot. The former procedure is often quite tedious for disaggregated materials, especially if the material is caked in the bottom of a centrifuge tube. The latter procedure is difficult when the adsorbent is heterogeneous, disaggregated material. During centrifugation or filtration, the disaggregated media will sort by particle size; thus, obtaining a representative subsample may prove difficult. Alpha, beta, weak gamma, and x-ray radiation will suffer from sample self-adsorption, so that obtaining an accurate count of radioactivity on the solid may be difficult or impossible.

The Kd value obtained by the batch method for certain elements appears to be sensitive to how the radiotracer is added to the ground water and/or geomedia. Some research indicates that for solubility-limited elements such as the rare earths and actinides, the tracer should be added to the ground water, equilibrated for several days, and filtered just before contact with the geomedia. This approach should remove any oversaturation-precipitation events that would appear like adsorption if the tracer had been added directly to the rock-ground-water slurry in the batch container, although further complications have been identified (Erdal et al. 1979).

Two equations may be applied to determine a Kd value from batch data. When only liquid samples are analyzed, Equation 11.3 applies. When both the liquid effluent and solid are counted, Equation 11.4 applies.

$$Kd = \frac{rAi - Ae}{Ae} \frac{V}{W} \qquad (11.3)$$

$$Kd = \frac{Ad}{Ae} \frac{V}{W} \qquad (11.4)$$

where

A_i = activity of tracer in influent or blank

A_e = activity of tracer in effluent after phase separation

r = correction factor for excess wash solution remaining if rock samples were pre-equilibrated with water without tracer before the sorption experiment

V = total volume of solution = (volume of A_i + residual wash solution)

W = for Equation 11.3, total weight of solid adsorbate used; for Equation 11.4, total weight of solid counted

A_d = activity of solid adsorbate.

For weakly penetrating radioactivity, the effects of self absorption can complicate accurate measurement.

The time dependence of Kd is conveniently studied by static methods. For many geomedia-ground-water-nuclide systems, adsorption reactions appear to reach equilibrium rapidly (within a few hours). For other systems (crushed basalt, granite, argillite) the values vary with time. In general the Kd values increase with time, possibly from weathering processes. The alteration products formed from weathering of primary minerals, in general, exhibit larger surface areas and higher exchange capacities. In a few instances, the Kd value for an element appears to decrease with time. One apparent reason for this is colloid formation that may be encouraged by physical grinding effects during shaking. Whether colloid formation will be important in the real world has not been ascertained. Months or years may be required to attain sorption equilibrium in some systems as secondary minerals are formed. Studies need to be made to identify those slow reactions that could reduce sorption measured in short-term laboratory experiments.

Batch experiments are more precise when the change in tracer solution concentration upon contact with the geologic material is neither very small nor large. If the Kd value is very small, the effluent activity is nearly the same as the influent, and counting statistics significantly affect calculations. If the Kd value is very great, the effluent will have very little activity left, and counting difficulties will result. By varying the solution to geologic media ratio over a range of 2 to 100, with an effluent/influent ratio of 0.2 to 0.8, researchers have discovered that batch Kd experiments are best used to measure Kd values between 1.25 and 400 ml/g.

The most commonly used dynamic method for determining Kd values is the low pressure column method on disaggregated materials. The method has been used for many years to substantiate Kd values determined by batch methods for sand soils. Within WRIT, the modification of the procedure to allow experimentation on intact or fissured core materials is being undertaken. By increasing the hydrostatic head with pressurized pumps, flow through intact cores of slightly to moderately permeable rocks can be attained.

Dynamic flow-through column experiments allow observation of nuclide migration rates and allow the calculation of nuclide Kd values for porous materials without significant sample alteration. Reversibility, multiple oxidation states, and multiple species can be observed. Physical transport of colloids and fine particulates can be studied, and realistic solution-to-solid ratios for both porous and fracture flow may be studied. Unsaturated as well as saturated flow can be studied. Disadvantages include the length of time necessary to perform the experiment (especially for strongly sorbed nuclides), the inability to create practical flow rates in tight rock materials, experimental artifacts such as channeling and wall effects caused by use of small column sizes, greater difficulty in control of Eh and pH, and lack of a data reduction scheme for nonideal (chromatographic) curves.

Normal flow rates for laboratory columns of permeable rock or soil (10^{-3} to 10^{-1} cm/sec) may require weeks or months for the nuclide to break through into the effluent. Flow rates in geologic media are expected to be several orders of magnitude slower (10^{-7} to 10^{-3} cm/sec). To produce short-term results, higher than realistic flow rates are used, and frequently kinetic effects are thought to dominate results. Under these accelerated conditions, the effective porosity of the media and the radionuclide residence time in the media decrease with increasing flow rates. This diminishes the measured radionuclide retardation and tends to make results conservative.

In FY-1978, dynamic Kd experiments using crushed montmorillonite percolated by either calcium chloride or sodium chloride were shown to yield comparable values with results obtained by batch and axial filtration techniques. One example of the comparison is shown in Figure 11.1 (Meyer et al. 1978).

Gravity flow column experiments sometimes exhibit a variable flow rate over time. Usually the observed flow rate will decrease with time, possibly caused by column plugging by fine grained materials. Often the flow rate drops to zero. Data reduction of breakthrough curves from a column under variable flow conditions is more difficult than under constant flow conditions.

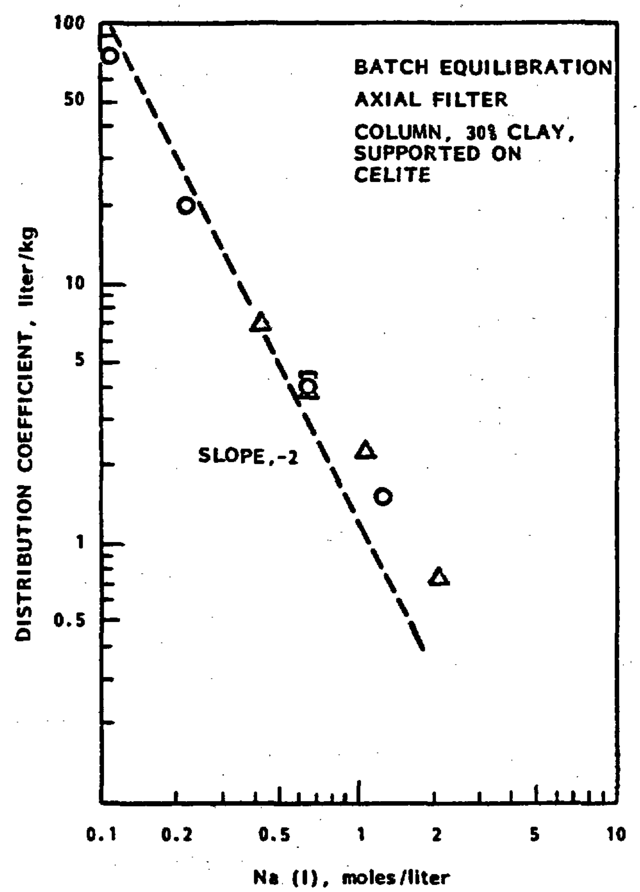


FIGURE 11.1. Distribution of Sr (II) Between Montmorillonite and Sodium Chloride - 0.1 M Sodium Acetate Solutions Low Loading Sr (II)

Typically, column experiments are performed to validate the migration potentials obtained from simpler static adsorption tests. The observed results of laboratory column experiments are affected by both the chemical interactions and hydrodynamic characteristics of the media placed within the column. Thus, to validate the chemical aspects, the hydrodynamic aspects must be understood and measured. A classical method of elucidating hydrodynamic properties, such as apparent porosity and dispersion, is to use tritiated water as a water tracer. In some cases, though, tritium migration does not appear to mimic the bulk water (Francis et al. 1979).

High pressure intact core methods are under study (Figure 11.2). For most deep geologic scenarios, this technique would apparently better simulate actual expected conditions than the static or packed columns methodologies.

Mathematical calculations show that for intact crystalline rock, extremely large pressures would be necessary to force water through the grain boundaries. For crystalline rocks, fracture flow appears to be the most feasible mechanism for nuclide transport. Proper experimental methodology to use in studies of flow through fractures or cracks will need to be assessed.

Dynamic experiments on machined (smooth) fissures have been performed in the laboratory (Seitz et al. 1979). Preliminary static experiments have been performed to ascertain the time needed to reach equilibrium and to obtain surface adsorption and desorption coefficients for the nuclide Am.

Fissure infiltration experiments at three velocities have been performed. Observed results were compared with a computer model, which includes first-order kinetic terms (Strickert et al. 1979). The general shape of the observed Am distribution on the fissure surface is predicted by the computer model, but in each instance the observed distribution exhibits a larger tail protruding down the fissure. Autoradiographs of the fissures showed that the adsorption was not uniform across the cross section. This was probably caused by nonuniform flow (wall effects) and grain edge and mineral-filled vein boundaries, but these effects were secondary. The conclusion drawn from the fissure experiments is that migration of nuclides in rock fissures is tractable and can be approximated by data from static experiments obtained on similar geometries, as

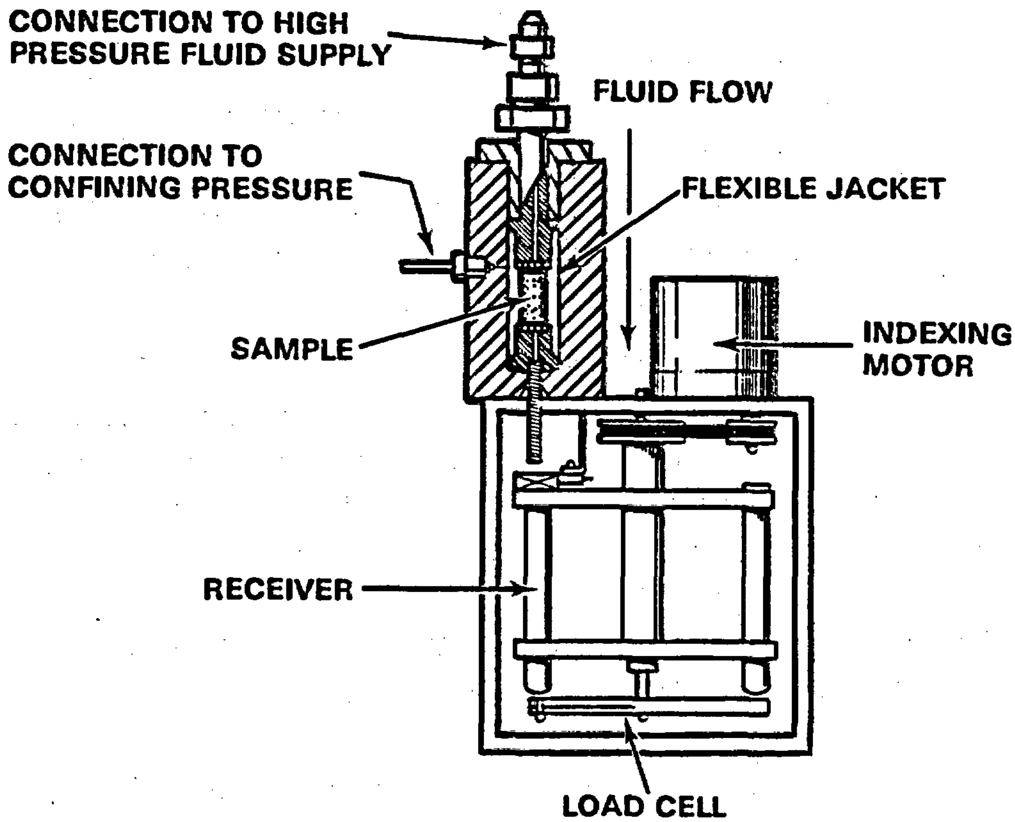


FIGURE 11.2. High Pressure Sorption Apparatus

long as kinetics are analyzed. The results show that the measurements of kinetic parameters are as important to understanding migration behavior as are measurements of the equilibrium adsorption values.

To date the retardation factors used in mathematical transport models have assumed reversibility (i.e., Kd for adsorption equals Kd desorption, and the rate of adsorption equals the rate of desorption). Experimental studies performed in WRIT by both static and dynamic methods (Burkholder et al. 1979; Brandstetter et al. 1979) have shown that for certain elements, the rate of desorption in short-term laboratory studies is slower than the rate of adsorption. When apparent steady-state conditions are met, the resultant Kd for desorption is higher than the Kd for adsorption. Thus, safety assessments based on Kd adsorption and reversibility may be conservative by up to one order of magnitude for nuclide retardation. Currentl results on dynamic Kd experiments on intact cores, although few in number, appear to give measurements of retardation lower (by a factor of 0.2 to 0.5) than for batch Kd or dynamic experiments on disaggregated material. The discrepancy and measurement difficulties are under continued investigation with the objective of developing standard methods and nuclide migration predictions. In-situ nuclide migration experiments will need to be performed at selected sites to verify the extrapolation of laboratory data to field conditions.

The two methods (static and dynamic) for radionuclide-geologic media interaction studies are complementary. The static method is most useful for screening investigations of radionuclide behavior in a variety of systems and for estimating the time needed to attain equilibrium. Static radionuclide adsorption distributions may then be compared to retardation factors obtained from dynamic systems under similar conditions to verify results. Crushed or uncrushed material may be used in either method, and equilibrium solution compositions obtained from static tests may be used in dynamic experiments. The most pressing current need is an understanding and a measurement method to relate Kd values obtained on crushed material or manufactured tablets to the variable and tortuous fissures and cracks that are expected to be the environment through which water would flow away from a deep repository situated in crystalline rock.

Until standard methods are agreed on, the proposed actions needed to obtain adequate sorption data to assess the consequences of disposal in a proposed repository include:

- laboratory study performed on the fresh, unweathered rock and on actual weathered rock or the types of secondary minerals that are expected to be formed
- reliance on many screening studies using the batch Kd method on disaggregated rock and a wide range of ground-water types and environmental conditions for all important nuclides. With proper experimental design and media-water characterization, statistical

methods can be used to relate the dependent variable (migration rate or Kd) to independent variables (rock type and solution type). From Kd data on a limited number of rock-water permutations, estimates can be made for Kd values for other conditions not studied. This statistical technique will facilitiate objective and quantitative sensitivity analysis.

- some additional dynamic sorption studies on dissaggregated rock and intact core for selected nuclides that appeared to be potentially relatively mobile
- a few dynamic sorption experiments of larger scale and duration or actual in-situ verification.

These will provide the empirical data required to assess migration from repositories and the predictor equations that can be used to assess the effect of varying factors (such as pH, Eh, geomedia type) on adsorption. The equations relating the adsorption distributions to different solution and geomedia properties are being developed by fitting a polynomial to the multidimensional curve that can be produced from the sorption experiments and rock and ground-water characteristics.

These nuclide migration data rely on laboratory analyses characterized by relatively short time spans. The applicability of scaling these results to the million-year time frame must be addressed. The short-term laboratory results will be used in computer transport models where the time extrapolation is performed. The model results will be compared against known theoretical concepts such as weathering, ore geochemistry, mineral stability, and thermodynamic Eh-pH diagrams.

NEED FOR COMPLETE CHARACTERIZATION OF ROCK AND GROUND WATERS

In most instances Kd values are sensitive to geomedia properties such as surface area, mineral composition, amorphous oxide, and organic content, and to ground-water properties such as the pH, Eh, and chemical composition. The Kd is also dependent on the species of nuclide present, its concentration, and the hydrodynamics of the system. The interactions that occur as the soluble radionuclides percolate through geomedia are presented in Figure 11.3. Therefore, to identify, interpret, or use a Kd value for any nuclide properly, a large amount of supplementary information is necessary. Ideally, all the parameters listed below would be determined; in reality as many of the parameters as possible should be measured.

Numerous characterizations should be performed on geologic media and their pore waters to allow calculations of migration rates or Kd values. The characterizations can be broken into two broad categories: physical or hydrologic, and geochemical. A list of characterizations and their relative importance to Kd value determination follows. If only partial geochemical characterization is possible, priority should be placed on the first seven items. For the physical and hydrologic characteristics, items 4, 5, and 6 or 7 are most important. It cannot be overemphasized that accurate characterization of field pH and Eh is critical and that laboratory simulations must control these two critical parameters at the appropriate values.

Important Geochemical Characterizations

1. Qualitative and quantitative mineralogy is needed, including primary and secondary crystalline materials, amorphous coatings, determined primarily by x-ray diffraction, x-ray fluorescence, chemical treatment techniques, and petrographic examination. Total oxides SiO_2, Al_2O_3, TiO_2, FeO, MnO, CaO, MgO, K_2O, Na_2O, P_2O_5 are typically determined. Calcium carbonate content, hydrous oxide content (amorphous and crystalline), and aluminosilicate contents are also important. Scanning electron microscopy and microprobes can be used to determine the microstructural mineralogy. These techniques can be very important in assessing the differences between the mineralogy and the weathering environments of cracks and fractures of the bulk rock material.

2. Cation-exchange capacity at appropriate pH values.

3. Ground-water pH, Eh, dissolved O_2, and/or species distribution of important redox couples (i.e., Fe^{2+}-Fe^{3+}, S^{2-}-S^{6+}, Mn^{4+}-Mn^{2+}), and temperature.

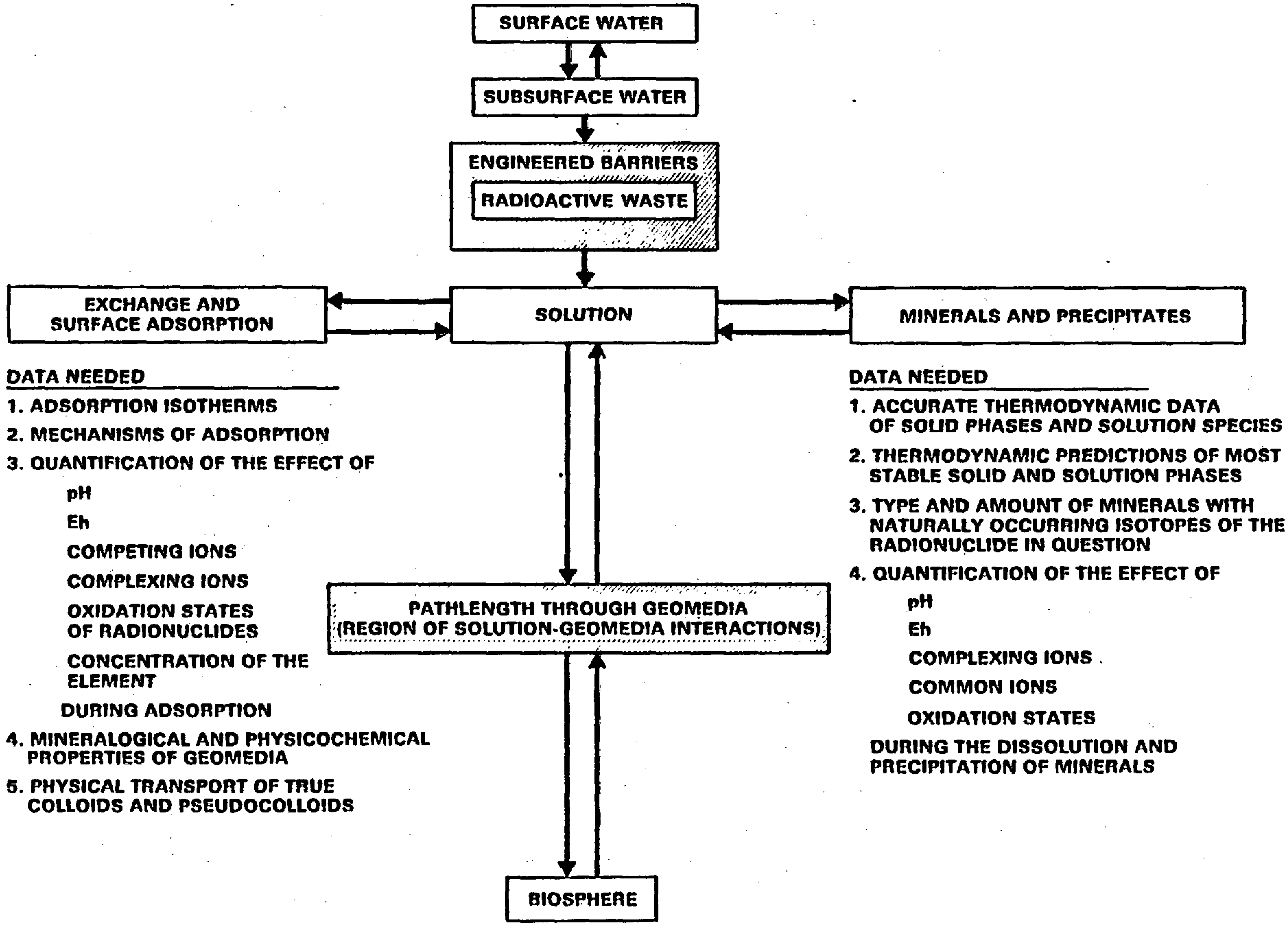


FIGURE 11.3. Radionuclide Interaction in Geologic Media

4. Ground-water major cation content (Na^+, Ca^{2+}, Mg^{2+}, K^+).
5. Ground-water major anion content (Cl^-, HCO_3^-, CO^{2-}, SO^{2-}, NO_3^-).
6. Ground-water SiO_2 content.
7. Organic content of geologic material.

Less Important Geochemical Characterizations

1. Anion exchange capacity at appropriate pH values.
2. Distribution of major cations on exchange sites.
3. Ground-water organic content, especially potential ligands (e.g., humic, fulvic acids).
4. Ground-water minor constituents, especially naturally occurring isotopes of important waste nuclides (Sr, Cs, I, U, Ra), chemically similar elements (Ba, Rb, Br, F), and potentially reactive elements (Fe, Mn, S, $P[PO_4]$).

Important Physical or Hydrologic Characterizations

1. Hydraulic conductivity.
2. Percent saturation.
3. Permeability.
4. Water velocities.
5. Surface area and particle size distribution (unconsolidated materials).
6. Porosity.
7. Percent fractures or fissures (consolidated material).
8. In-situ temperature.

To perform the necessary rock and ground-water characterization and subsequent nuclide adsorption experiments, the following sampling requirements are offered. For a thorough assessment of a specific site, 10-100 lb of each important rock material along the possible pathway back to the accessible environment is necessary. A portion of the rock (≥10 lb) should be intact core material with a minimum of contamination from drilling muds and fluids on which intact core sorption experiments can be performed. Where possible, the rest of the material (e.g., cuttings) should be as free of drilling muds as feasible.

Complete recipes (important parameters have been discussed above) for probable ground waters or gallon-sized samples (split and preserved by standard methods--Brown et al. 1970) should be supplied.

DATA PROCEDURES FOR THE REFERENCE SITE ANALYSIS

A description of the actions taken to produce the data used in the reference salt dome analysis follows. Because this is a reference site analysis, not an actual effort to license a repository, experimental measurements are limited. Throughout the description, annotation will be given on what further work would be performed if the exercise were to supply information for an actual repository site assessment. An assessment will be given as to whether the methodology needed is at hand or needs to be developed.

Geologic Setting

Based on the stratigraphic data provided to AEGIS and WRIT by Law Engineering Testing Company (LETCO), the release scenario and conceptual hydrologic models were used to develop the layered earth model. For purposes of the reference site analysis, the layered earth model assumes that the salt dome intersects the following strata listed from the top to bottom: aquitard (Reklaw Formation), high permeability aquifer (Carrizo and Calvert Bluff Formations), lower permeability aquifer (Simsboro and Hooper Formations), and aquitard (Midway Group Formations). Because all the scenarios of interest were found to have probable paths to the accessible environment within these formations, nuclide adsorption-desorption work was concentrated on these units.

Sampling Procedures

Only outcrop samples of relevant formations were available. All samples were gathered by LETCO at either road cuts or stream bank cuts and were provided to WRIT. An attempt was made by LETCO to collect samples that were representative of each formation. In most cases, at least two outcrop sites were visted in different parts of the basin for each complete sample. An average of about 15 lb was collected for each formation and enclosed in airtight plastic bags. A geologic map that indicates sampling locations was also provided to AEGIS and WRIT staff.

For an actual site assessment, core material from the repository depth would be required. Ideally, the material should be obtained without the use of drilling muds and complex chemical fluids that contaminate the samples and affect the sorption processes. Currently it is felt that such techniques exist, especially when coring shallow strata (<300 ft), but an actual demonstration in the unconsolidated Gulf Coast salt dome areas is needed. Another acceptable method would be to take large diameter field cores into the laboratory and under core a smaller diameter sample that does not contain significant amounts of drilling fluids and mud. For other more consolidated rocks (e.g., crystalline granite, basalt), the need for drilling muds should present fewer problems than those expected in the Gulf Coast salt dome sites. A study will be performed soon to investigate the feasibility of identifying, quantifying, and removing drilling mud contamination from small side wall cores drill cuttings, and cores from salt dome and bedded salt associated samples. The effects of drilling mud contamination on Kd determinations will also be studied. This will allow a more objective analysis of the necessity for specialized drilling in the formations surrounding potential repository sites.

Mineralogic Characterization of Outcrop Samples

Some general descriptive geology (qualitative mineralogy, physical size distributions, and aggregation status) was made available from LETCO. In addition, several of the outcrop samples were further characterized at PNL. Appropriate samples were air dried and disaggregated to pass through a 20 mesh screen. Large pieces of organic material were hand picked and discarded. Large rocks retained on the sieve were discarded. The samples that were dried were from outcroppings of the following formations:

Calvert Bluff	Simsboro
Carrizo	Reklaw
Hooper	Queen City.

The samples in general exhibited extensive weathering alteration. Red iron stains were quite visible. The Reklaw Formation is known to be an aquitard but the outcrop sample was quite sandy. The Lower Wilcox, comprised of the Hooper and Simsboro, is known to be a good aquifer, yet the outcrop samples were quite claylike. Texas Bureau of Economic Geology (TBEG) personnel noted that the Lower Wilcox does contain much fine material and that the flowing aquifer comprises interconnected sand lenses. The iron stains are not observed in drill cuttings of the actual subsurface strata.

Whole Sample Chemical Analyses

Chemical analyses of whole samples were performed at Washington State University on the dried and sieved Hainesville sediments. Approximately 20 g of a sample were placed in a swing mill and ground for six minutes. This provided a fine, even-grained powder to produce homogeneous samples. Seven grams of lithium tetraborate and 3.5 g of the rock powder were thoroughly mixed and fused in a graphite crucible at 1000°C for five minutes. Upon cooling, the lithium tetraborate bead was removed from the crucible, and the basal surface of the bead was ground flat. The flat bead surface was irradiated in a Philips P.W. 1410 manual x-ray spectrometer with a chromium tube. The count rate recorded for each major element was related to the calibration curves derived from the count rates of similar analyzed samples supplied by the U.S. Geologic Survey and the National Bureau of Standards. A computer program was used to make spectral corrections and to determine the elemental oxide values. The precision for each major element is given in Table 11.1, calculated from $\pm$ two standard deviations of triplicate analyses.

The whole sample chemical analyses are given in Table 11.2 for the six outcrop samples. The principal elements present were silicon, aluminum, and iron. Alkalies and alkaline earth elements were unusually low in concentration. The iron was reported as ferric iron because these sediments are well oxidized.

X-Ray Diffraction

Sample preparation for x-ray diffraction analyses included crushing and grinding a representative rock sample in an alumina mortar. The minus 200 mesh whole-rock powder was placed in a tray, and a Norelco x-ray diffraction unit was used to obtain an x-ray diffraction tracing. Diffraction peak heights and spacings were matched to those given in the powder diffraction data for minerals (Joint Committee on Powder Diffraction Standards 1980). Only mineral group names were identified. The feldspars and pyroxenes, for example, were not

TABLE 11.1. Precision of X-Ray Fluorescence Analyses at 95% Confidence Limits (Thirteen Sets of Triplicate Beads Were Used)

Major Elements	Total Analytical Precision, 2θ (fraction)
SiO_2	0.550
Al_2O_3	0.310
TiO_2	0.050
FeO (Total)	0.350
MnO	0.010
CaO	0.220
MgO	0.150
K_2O	0.030
Na_2O	0.160
P_2O_5	0.014

TABLE 11.2. Whole Sample Chemical Analyses of the Outcrop Samples

Oxide	Wt % a	b	c	d	e	f
SiO_2	79.83	70.06	76.77	86.59	83.79	84.64
TiO_2	0.57	0.71	0.70	0.38	1.07	0.57
Al_2O_3	10.23	11.85	14.10	7.15	8.08	9.46
Fe_2O_3	6.07	15.14	3.89	4.33	5.18	2.36
MnO	0.06	0.01	0.01	0.00	0.02	0.01
CaO	0.24	0.13	0.21	0.00	0.00	0.12
MgO	0.76	0.99	1.04	0.36	0.68	0.66
K_2O	1.40	0.39	2.16	0.75	0.51	1.49
Na_2O	0.82	0.57	1.07	0.39	0.58	0.65
P_2O_5	0.05	0.15	0.05	0.05	0.09	0.04
TOTAL*	100.00	100.00	100.00	100.00	100.00	100.00

a = Calbert Bluff Formation
b = Carrizo Sand
c = Hooper Formation
d = Queen City Sand
e = Reklaw Formation
f = Simsboro Formation

* These totals are based only on the analyzed oxides. Because H_2O and Carbon were not done, the actual totals will be less than 100% until water is figured into the totals. Clays are present.

further classified because the variety of feldspar and pyroxene is more easily determined by other techniques. Quartz (SiO_2) is the principal mineral phase in all of the samples (see Table 11.3).

An unusual aspect of the data of Table 11.3 is the occurrence of a smectite clay with kaolinite. The two clay mineral types usually do not occur together because they are characteristic of two different genetic environments (Millot 1970). Well-leached environments with acidic, low ionic strength solutions yield kaolinite; environments with alkaline, higher ionic strength solutions yield smectites and illite. The occasional presence of opal also suggests that the Hainesville outcrop sediments are still being weathered.

Optical Examination

Optical examinations and photography were performed on polished thin sections of the Hainesville outcrop samples. A few grams of a representative sample were mixed with a thermal-setting epoxy resin, solidified at 80°C, and the face of the mount containing the sample was ground and polished. Photographs of selected areas of the mount, as viewed in a Zeiss Ultraphot IIIB petrographic microscope, were obtained at 12x and 100x normal size.

Figures 11.4 through 11.6 show optical views at 12x and 100x under bright field, polarized light for the six Hainesville outcrop sediment mounts.

Calvert Bluff Formation

The Calvert Bluff mount photographs show many small, subangular mineral grains, principally quartz according to x-ray diffraction data, partly embedded in a very fine-grained matrix. The light gray material showing an occasional scratch is the embedding epoxy plastic. There is little apparent difference between this sample and the following Carrizo sand mount.

Carrizo Sand

This mount also shows a relatively monomineralic sediment composed of subangular, fine mineral fragments, which are mainly quartz. A coating layer can be seen on the exterior of some of the mineral fragment sections in the mount. The 100x magnification photograph shows predominately embedding plastic.

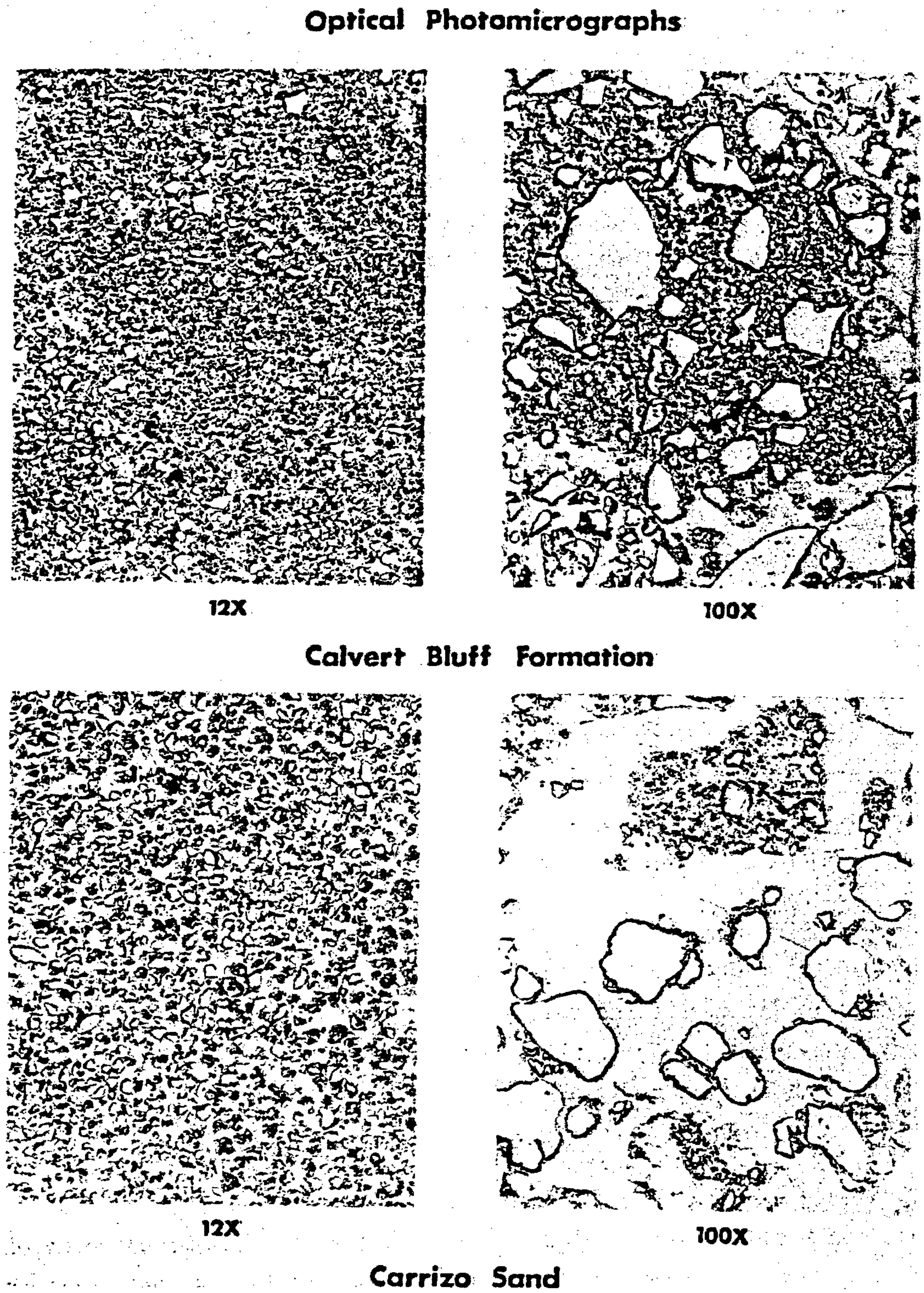


FIGURE 11.4. Optical Photomicrographs - Calvert Bluff Formation - Carrizo Sand (Original Photomicrograph recuced to 75%)

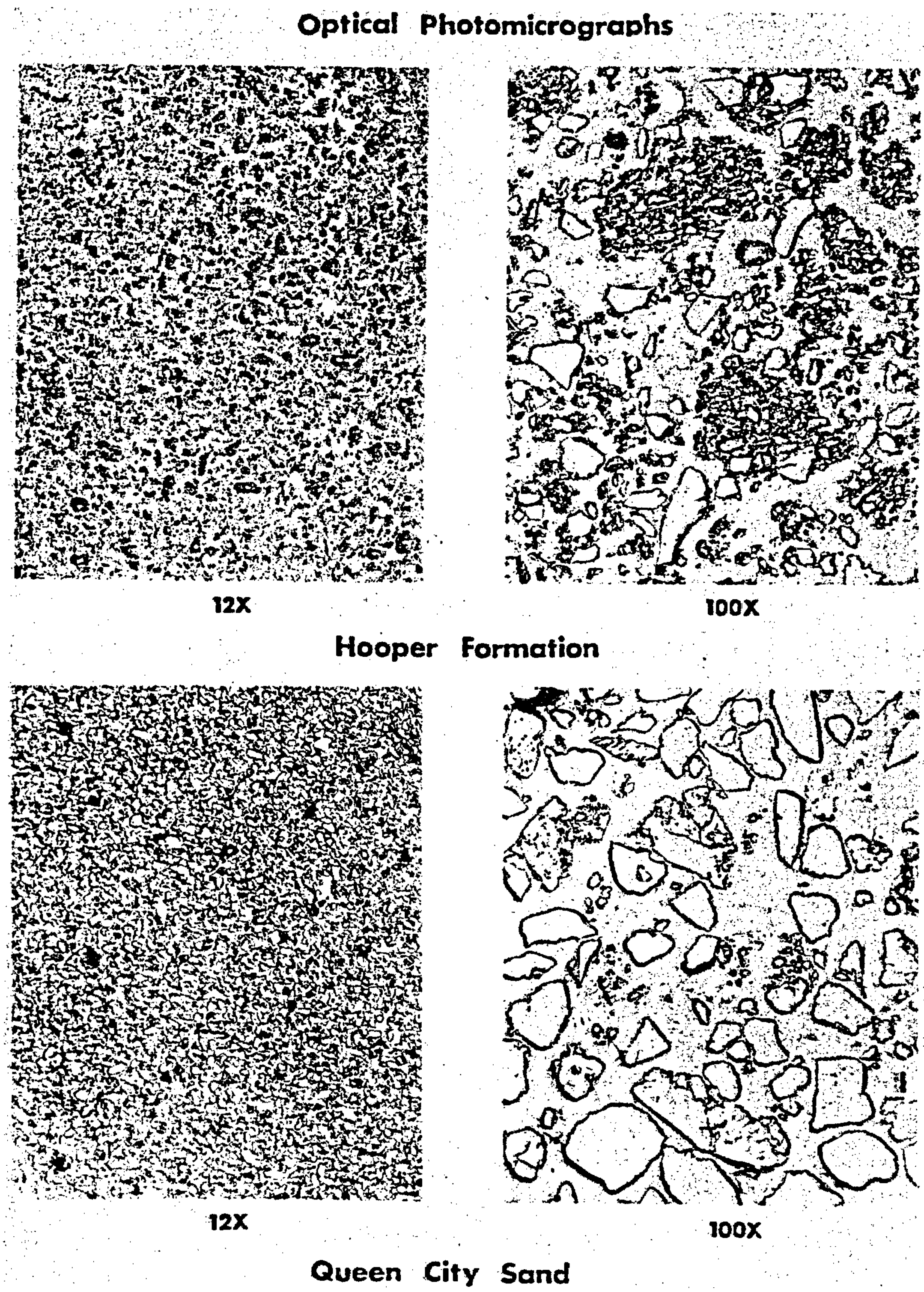
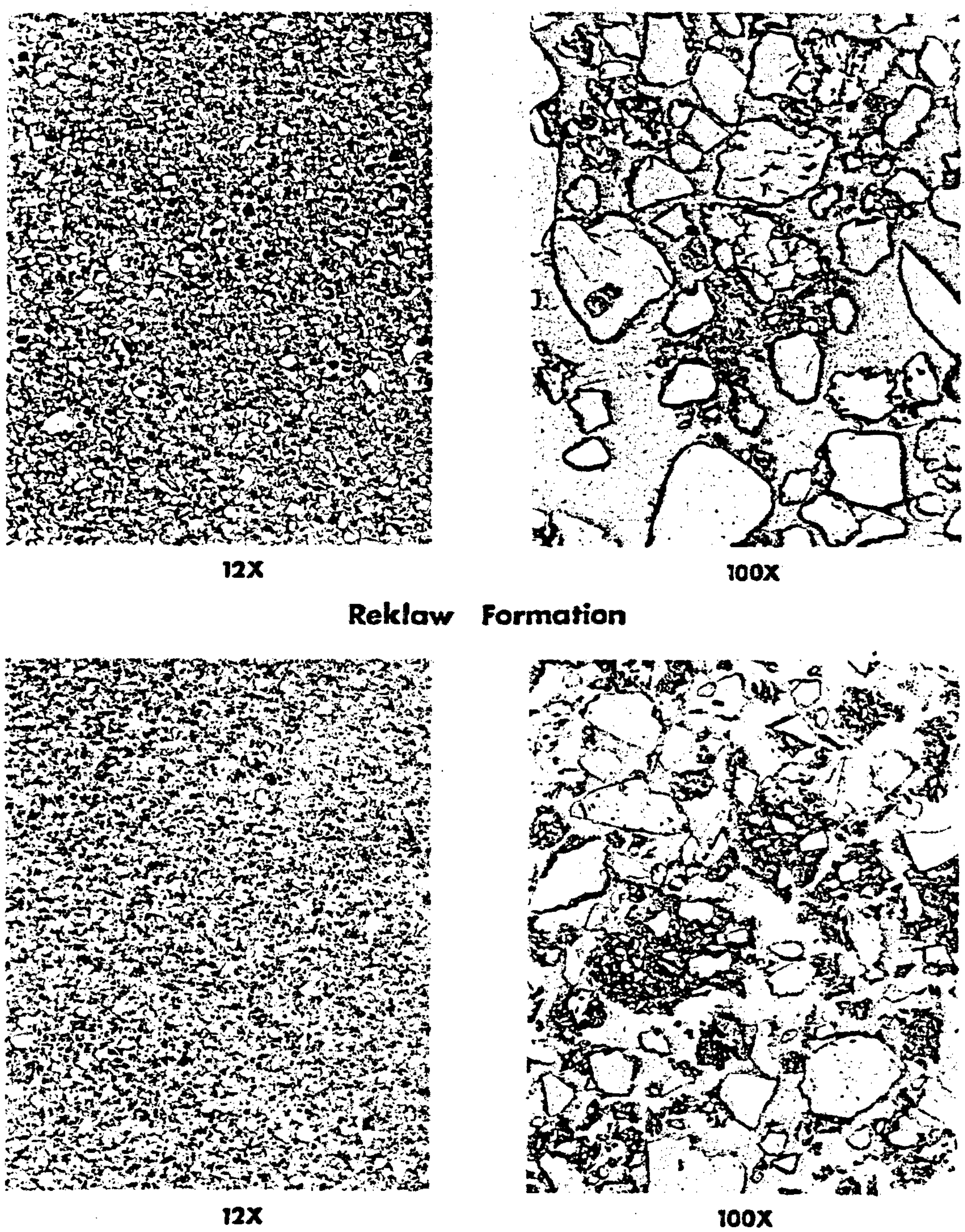


FIGURE 11.5. Optical Photomicrographs - Hooper Formation - Queen City Sand (Original Photomicrograph recuced to 75%)

Optical Photomicrographs



Simsboro Formation

FIGURE 11.6. Optical Photomicrographs - Reklaw Formation - Simsboro Formation (Original Photomicrograph recuced to 75%)

TABLE 11.3. Mineral Phases Found in the X-Ray Diffraction Tracings of As-Received Hainesville Outcrop Samples

Sample	Mineral Phases
Calvert Bluff Formation	Mainly quartz; minor illite, smectite, kaolinite, feldspar
Carrizo Sand	Mainly quartz; minor smectite, kaolinite, illite, feldspar
Hooper Formation	Mainly quartz; some feldspar; minor smectite, kaolinite, illite
Queen City Sand	Mainly quartz; minor feldspar, smectite, opal (-cristobalite)
Reklaw Formation	Mainly quartz; some opal (-cristobalite); minor kaolinite, smectite, illite
Simsboro Formation	Mainly quartz; minor feldspar, smectite, kaolinite, illite.

Hooper Formation

The Hooper material is more fine-grained than the Calvert Bluff or Carrizo sand. It contains many areas of clay-size particles surrounding predominately quartz mineral fragments.

Queen City Sand

This sample mount shows a better sorted, less angular, predominately quartz soil. According to the whole sample analyses of Table 11.2, the Queen City sand contains more than 86 wt% of silica, which is also a good estimate of its quartz content.

Reklaw Formation

The Reklaw sample mount shows a less well-sorted, mostly quartz sand, the fragments of which are often coated on their exterior surfaces by clays or amorphous materials. The nature of these coatings was investigated during the elemental x-ray emission work, and is reported under that following section.

Simsboro Formation

Quartz is the predominate mineral in the area of the mount examined. A few potassium feldspar fragments can be seen in the potassium emission photograph. Calcium is very low in content. High aluminum areas can be seen in the aluminum x-ray emission photograph, probably corresponding to gibbsite or amorphous aluminum areas. The white line across the lower right-hand corner of the electron scattering photograph is a mount coating artifact.

Electron Microprobe Feldspar Chemical Analyses

Two of the potassium-containing fragments seen in each of the six Hainesville outcrop samples were analyzed with the microprobe, with the results shown in Figures 11.7 through 11.12 and in Table 11.4. All were potassium feldspars, either microcline or orthoclase. Both feldspars are the same in chemical composition, but differ in structure. No plagioclase feldspars were seen, with the possible exception of a single fragment containing calcium in the mount of Calvert Bluff Formation sample. The potassium feldspar content of the Hainesville samples was not large, but it is still the second largest fragment mineral. Quartz is the most prevalent fragment mineral.

Conclusions

The Hainesville samples as received by WRIT from LETCO are soils developing on the outcrops of the six stratigraphic units. The weathering involved is of the lateritic or ferrallitic type (see Millot 1970). As lateritic weathering progresses, silicates are completely hydrolyzed, and quartz is finally solubilized, releasing silicon, aluminum, magnesium, calcium, sodium and potassium ions. Iron, aluminum, and silicon are partially retained to form the three main constituents of laterites, hydrated iron oxides, hydrated aluminum oxides and aluminosilicates in the form of kaolinite. The alkalies and alkaline earths are removed in solution.

The Hainesville samples have begun the lateritic weathering process, so that there has been enough weathering and oxidation to cause considerable differences in chemical and mineralogical constituents between the original

CALVERT BLUFF FORMATION
Elemental X-Ray Emission Photographs, 100X

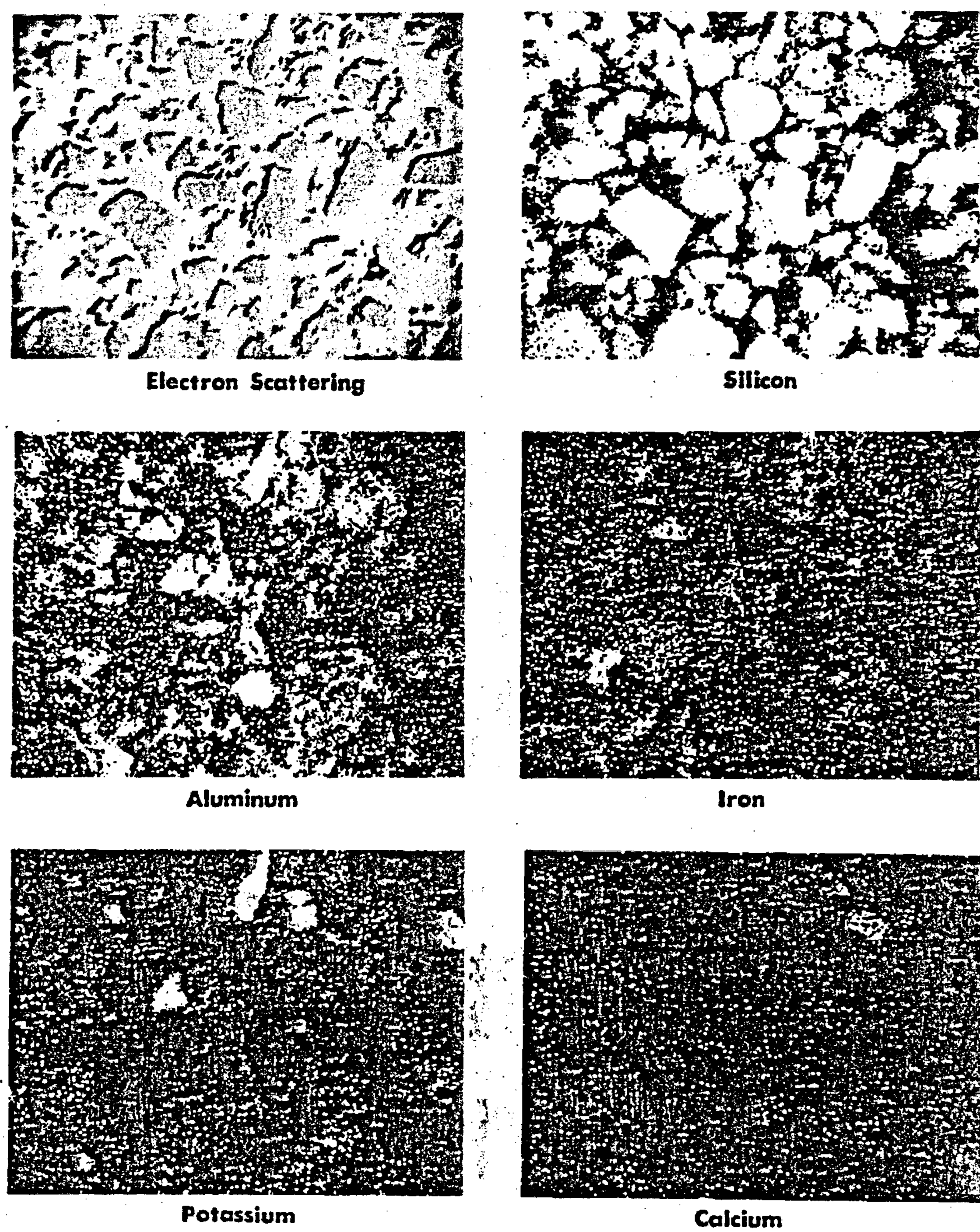


FIGURE 11.7. Calvert Bluff Formation - Elemental X-Ray Emission Photographs, 100X (Original Photomicrograph recuced to 75%)

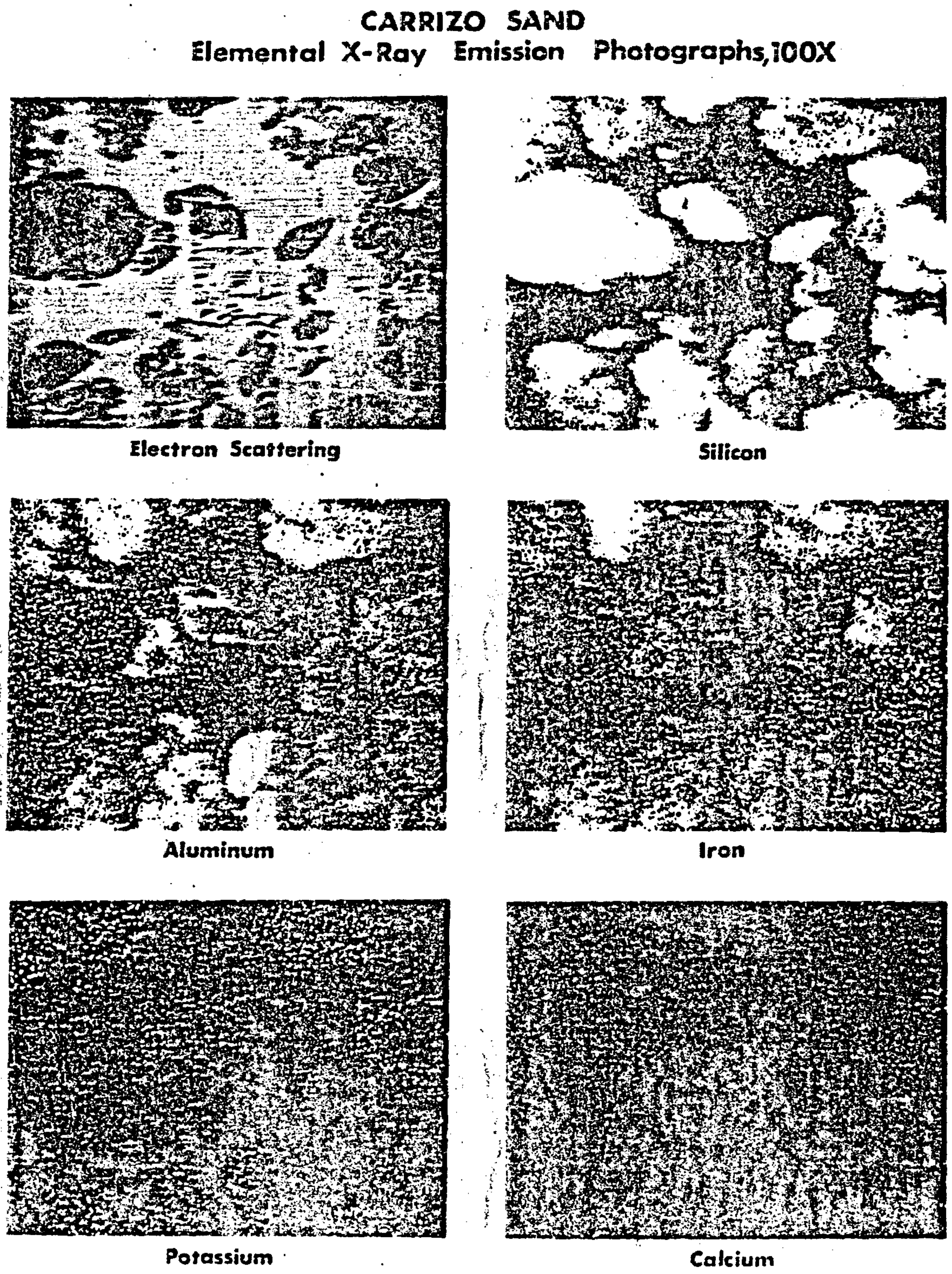


FIGURE 11.8. Carrizo Sand - Elemental X-Ray Emission Photographs, 100X (Original Photomicrograph recuced to 75%)

HOOPER FORMATION
Elemental X-Ray Emission Photographs,100X

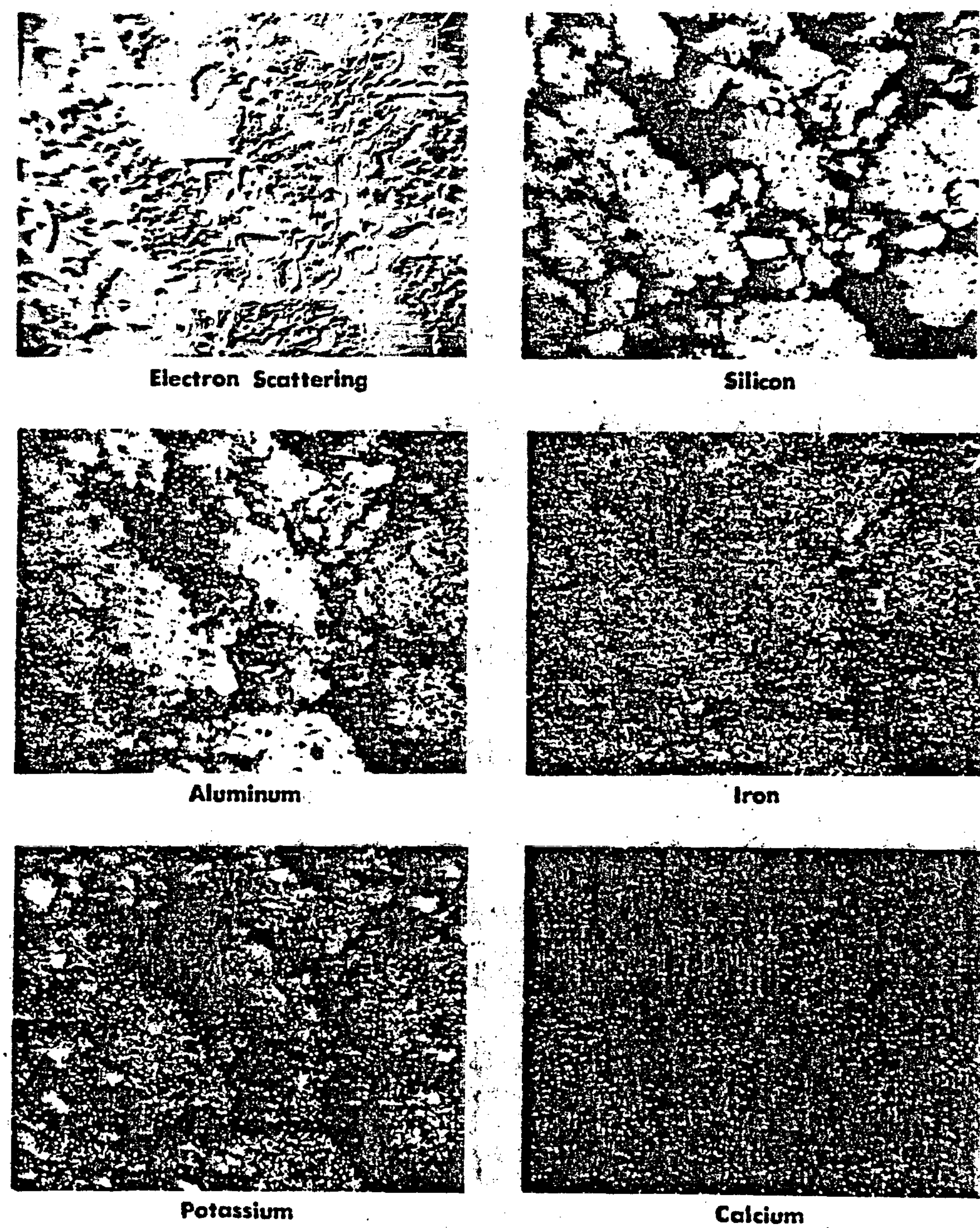


FIGURE 11.9. Hooper Formation - Elemental X-Ray Emission Photographs, 100X (Original Photomicrograph recuced to 75%)

QUEEN CITY SAND
Elemental X-Ray Emission Photographs, 100X

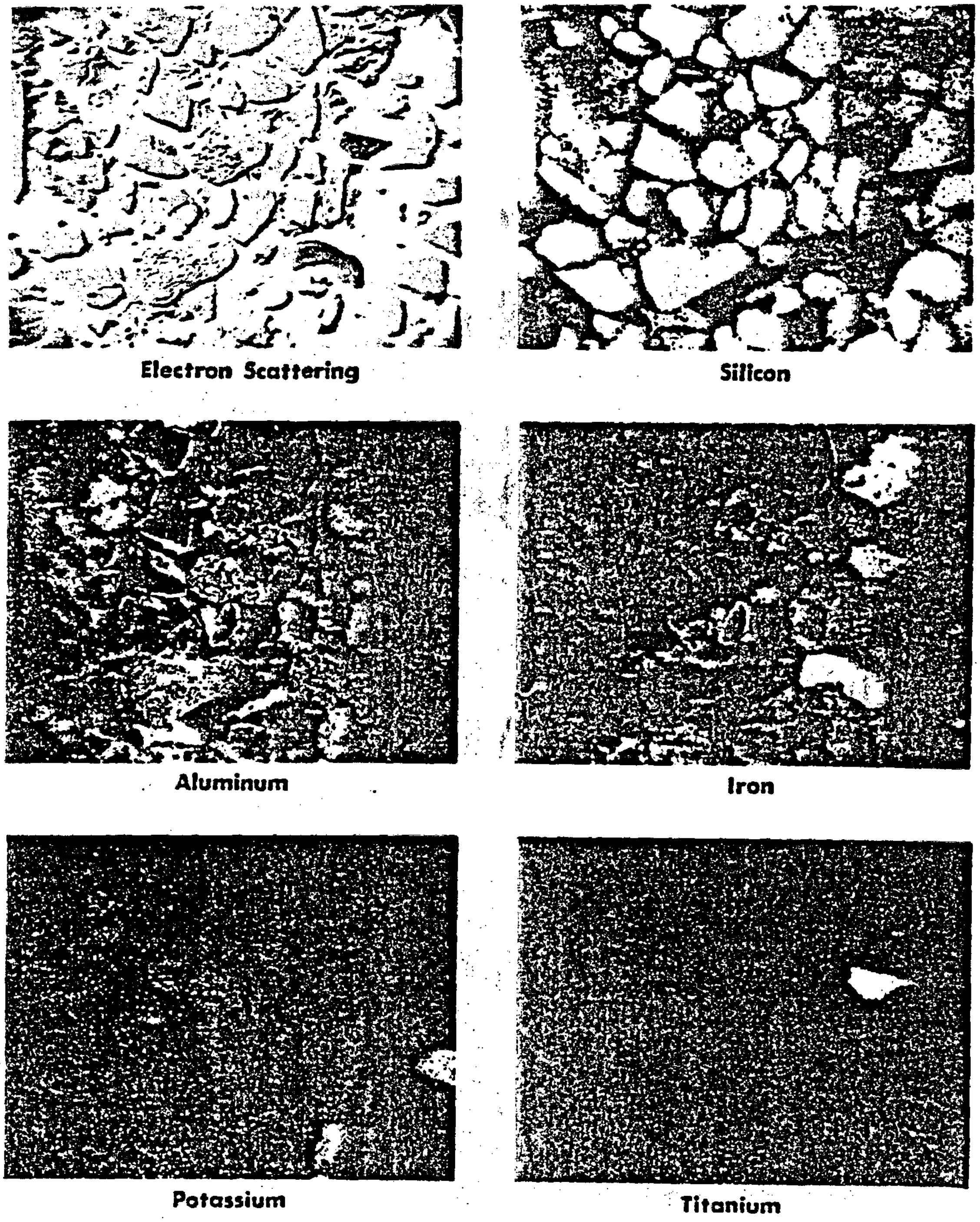


FIGURE 11.10. Queen City Sand - Elemental X-Ray Emission Photographs, 100X (Original Photomicrograph recuced to 75%)

REKLAW FORMATION
Elemental X-Ray Emission Photographs, 100X

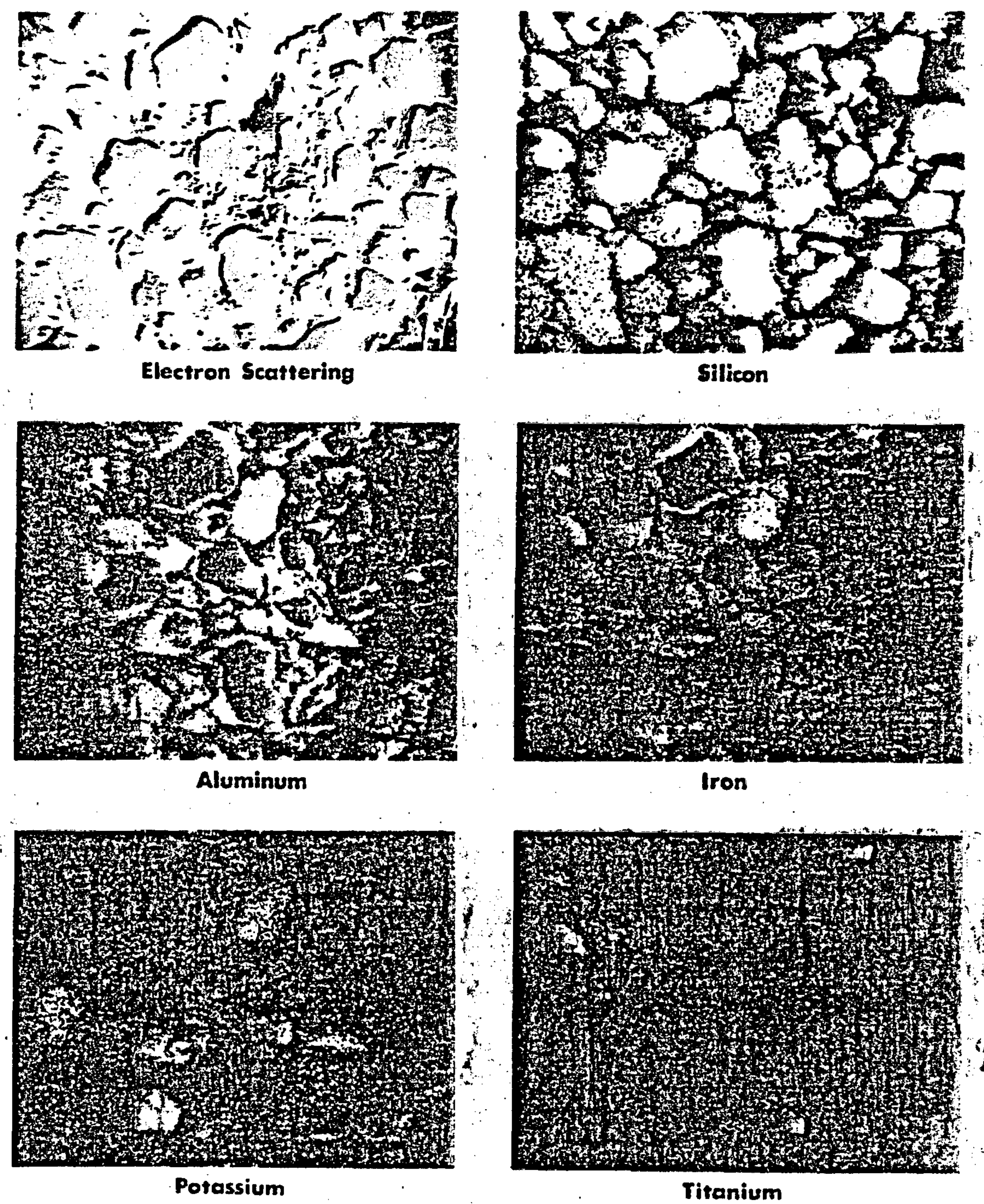


FIGURE 11.11. Reklaw Formation - Elemental X-Ray Emission Photographs, 100X (Original Photomicrograph recuced to 75%)

SIMSBORO FORMATION
Elemental X-Ray Emission Photographs, 100X

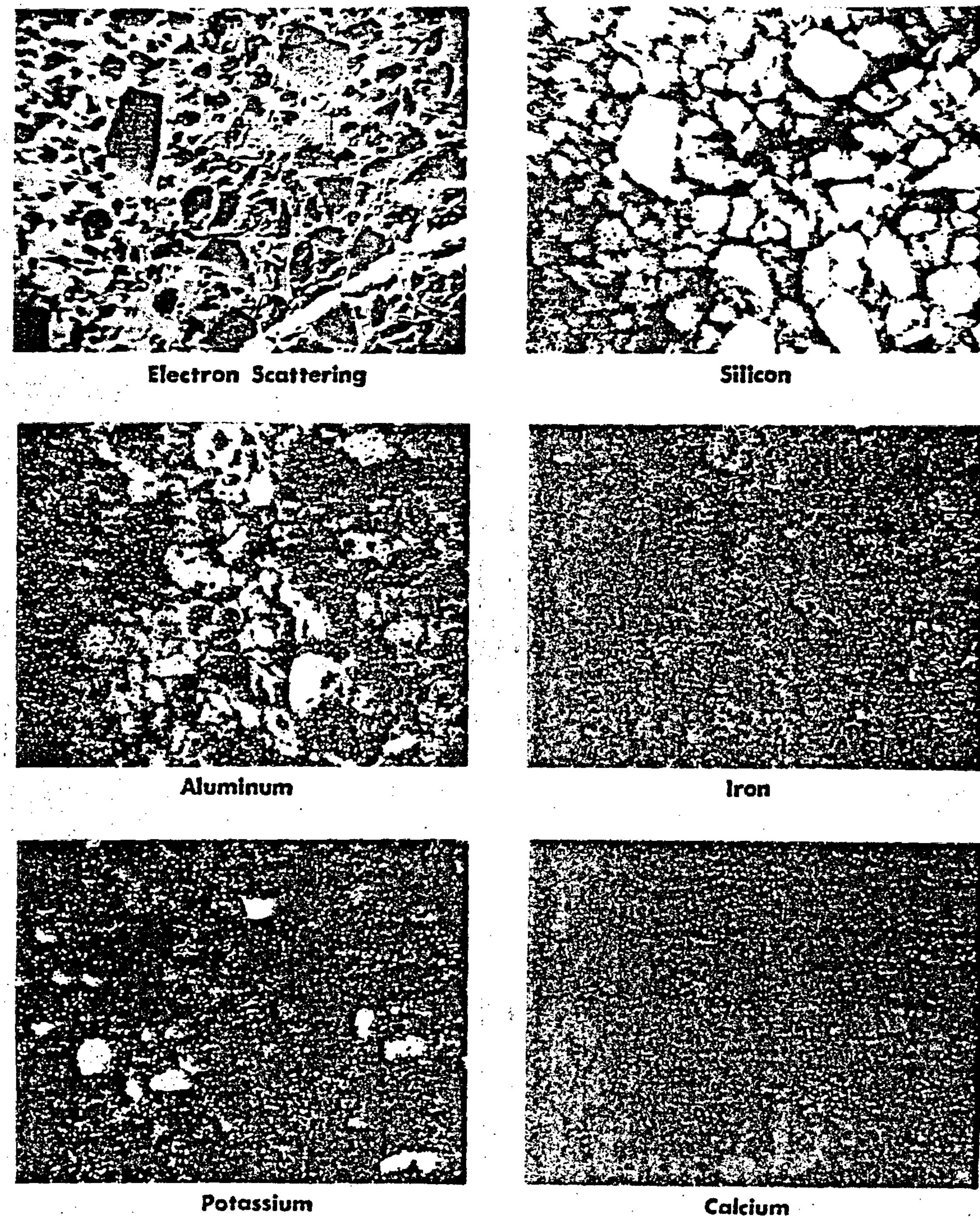


FIGURE 11.12. Simsboro Formation - Elemental X-Ray Emission Photographs, 100X (Original Photomicrograph recuced to 75%)

TABLE 11.4. Electron Microprobe Chemical Analyses of the Feldspars Commonly Found in the Hainesville Samples (The Cationic Contents of a Feldspar Molecule Containing 32 Oxygen Atoms Also is Given to Allow Comparisons. All of the Feldspars are Microclines or Orthoclases.)

	Wt %											
Oxides	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2	F1	F2
SiO_2	65.5	64.4	65.3	64.3	65.2	64.9	63.0	64.7	67.3	64.7	63.4	66.3
TiO_2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Al_2O_3	18.4	18.3	16.3	16.8	15.5	17.5	22.3	19.0	16.0	16.5	19.1	19.5
BaO	0.4	0.9	0.5	0.4	0.2	0.3	0.2	0.1	0.4	0.6	0.4	0.9
CaO	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.1	0.1	0.1	0.1	0.1
MgO	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FeO	0.2	0.1	0.6	0.3	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.2
K_2O	14.1	15.7	15.0	15.6	16.4	16.8	11.4	16.0	16.4	16.1	15.7	15.2
Na_2O	1.4	0.6	1.0	0.3	0.3	0.4	3.5	0.8	0.3	0.4	0.4	0.4

A1 = Calvert Bluff formation; $(K_{3.73}, Na_{0.22})(Al_{4.02}, Si_{12.00})O_{32}$
A2 = Calvert Bluff formation; $(K_{3.32}, Na_{0.48})(Al_{3.98}, Si_{12.06})O_{32}$
B1 = Carrizo Sand; $(K_{3.62}, Na_{0.36})(Al_{3.62}, Si_{12.31})O_{32}$
B2 = Carrizo Sand; $(K_{3.78}, Na_{0.20})(Al_{3.77}, Si_{12.22})O_{32}$
C1 = Hooper Formation; $(K_{3.96}, Na_{0.6})(Al_{3.47}, Si_{12.38})O_{32}$
C2 = Hooper Formation; $(K_{3.98}, Na_{0.15})(Al_{3.85}, Si_{12.07})O_{32}$
D1 = Queen City Sand; $(K_{2.65}, Na_{1.23})(Al_{4.78}, Si_{11.45})O_{32}$
D2 = Queen City Sand; $(K_{3.76}, Na_{0.28})(Al_{4.11}, Si_{11.91})O_{32}$
E1 = Reklaw Formation; $(K_{3.85}, Na_{0.12})(Al_{3.47}, Si_{12.41})O_{32}$
E2 = Reklaw Formation; $(K_{3.66}, Na_{0.15})(Al_{3.69}, Si_{12.28})O_{32}$
F1 = Simsboro Formation; $(K_{3.74}, Na_{0.16})(Al_{4.21}, Si_{11.87})O_{32}$
F2 = Simsboro Formation; $(K_{3.54}, Na_{0.16})(Al_{4.19}, Si_{12.09})O_{32}$

source rocks and the soils developing on them. Presumably radionuclide Kd values determined on the soil and original rock could differ considerably as well, most likely nonconservatively.

Additional work performed in an actual site assessment to characterize the geologic samples would include: determination of cation-exchange capacity, surface area, and quantitative mineralogy, including hydrous iron oxides, carbonate and organic contents. Methods for each of these determinations are quite standard, and thus readily available and well suited for usage on sedimentary materials. Time and cost constraints, coupled with the earlier characterization results that led to questioning the appropriateness of the outcrop samples, all contributed to the decision not to perform the total geologic media characterization. If this were an actual site assessment such characterization would have been performed.

GROUND-WATER CHARACTERIZATION

Samples of ground water from the Wilcox aquifer were not available for this study. In lieu of this, two samples of ground water from the vicinity of the Avery Island Salt Dome were analyzed. Cations were determined by inductively coupled plasma emission spectroscopy (ICP). Anions were not determined, but would be analyzed by ion chromatography and standard colorimetric techniques in an actual site analysis. The cation concentrations for the two Avery Island samples are shown in Table 11.5. Sample #1 was from a well near the salt dome. Sample #3 was collected from a pool on the floor of the conventionally mined salt mine. The results shown in Table 11.5 give an estimate of the detection limits of trace metals within the brine matrix. The results for Cu and Zn are suspiciously high, while analysis of K is not very reliable. Determination of K will necessitate separate analysis by atomic absorption (AA). Analysis of brine by ICP and/or atomic absorption is adequate for the safety assessment needs. Fresh waters are even more amenable to analysis by ICP or AA. The measurements of dissolved oxygen content, Eh, and pH were not performed because these measurements should be made in-situ or soon after sample collection. For an actual site assessment, ground-water sampling and analyses should be performed on waters from existing aquifers following methods prescribed by USGS (Brown et al. 1970).

For the Hainesville Salt Dome reference site analysis, information from TBEG and from the release scenarios developed by AEGIS was used to synthesize two appropriate ground waters. The first is a brine solution, to represent the high density plume that drops off the shoulder of the salt dome. This plume is continually diluted by Wilcox aquifer water, and thus does not have constant salinity. WRIT chose a value of 10,000 ppm NaCl as a working value. Under present dissolution conditions, the 10,000 ppm iso-concentation line extends about 1 km from the salt dome. Subsequent consequence analyses,

TABLE 11.5. Ground-water Analyses (Concentrations mg/l)

	Sample #1	Sample #3
Na	40,850	111,650
Ca	625	2,195
K	300	*
Mg	100	520
Sr	6.5	27
Li	2.5	2.5
Al, Si, P, Fe	5	5
B	3.5	2.5
Mn	3.5	20
Ba, Ag, Cd, Co, Ni	0.5	0.5
As	1.5	0.5
Cr, Ti, Zr	2.5	2.5
Cu	3.5	3.5
Mo	25	25
Pb, Sb, Se, Sn, Th	5	5
Tl	5	22.5
U	2.5	11.5
Zn	25	40

*interference

however, showed that after the breach the saline plume would extend to the point of discharge (see Chapter 7). The salt brine recipe used is:

10,000 ppm	NaCl	"Brine"
10 ppm	$CaSO_4$	

The second ground water represents the existing Wilcox aquifer, several kilometers away from the salt dome, where the brine influence is diluted. The water is sodium bicarbonate dominated and has the following recipe:

1,260 ppm	$NaHCO_3$	"Wilcox"
7 ppm	$CaSO_4$	

BATCH Kd EXPERIMENTS ON THE OUTCROP SAMPLES

Preliminary mineralogy results showed all samples to be mainly quartz, with minor amounts of secondary clays. From visual (color) and textural (sand vs. clay) indications, the following formations were mixed together and given generic names "aquifer" and "aquitard."

"Aquifer"	mixed	403.07 g	Calvert Bluff
		403.07 g	Carrizo
"Aquitard"	mixed	403.13 g	Hooper
		403.11 g	Simsboro

Subsamples of the "aquifer" and "aquitard" and ground waters were given to PNL and LASL personnel. The following "cookbook" batch Kd directions were provided to the experimenters:

1. One g samples of "aquifer" and "aquitard" are to be weighed into 50 ml polycarbonate Oak Ridge-style centrifuge tubes.
2. Two cold washes of the appropriate ground water are to be performed. The first wash (30 ml) will last for 4 days ($\pm$8 hr). The second wash (20 ml) will last for 3 days ($\pm$8 hr).
3. Separation will be made by centrifugation, at least 16,000 g for 20 minutes.
4. The weight of residual cold solution will be measured.
5. Traced ground waters will be made by adding trace amounts of radioisotopes and pre-equilibrating for 3 days before use. Just before use, the ground water will be filtered through 0.4 μm Nucleopore filters. The spikes may be added by directly injecting small quantities of acid stock or by drying the tracer and adding ground water. The amount of tracer should be kept low and the molarity reported.
6. The contact time of the batch experiments will be 21 $\pm$1 days. The experiments will be performed at room temperature. One half of the experiments will be performed in air and one half the experiments will be performed in anoxic chambers.
7. The final solids to solution ratio will be 1 g/ 30 ml spiked water. At 21 days pH, Eh, and T° will be recorded. Solutions will be separated by centrifugation, at least 16,000 g for at least 20 minutes.

8. Blank (without soils) containers will be run in triplicate at each Eh to check for container adsorption. Soil samples themselves may be counted to double check container adsorption. Blanks will be treated as follows: two cold washes of 10 ml each followed by 30 ml hot solution. Only 10 ml are to be used at first to conserve the solution.

9. Kd values will be reported for both blank-corrected or direct counted soils if the values differ significantly.

10. Optionally, samples may be filtered after initial counting to check for colloids.

11. Results on the triplicates will be reported as a mean ± 1 standard deviation. Other options include: a) measurement of macro and trace elements in ground waters at the end of the experiment, b) measurement of Kd at other (extra times), both shorter or longer than 21 days, and c) desorption experiments.

Experimental Results on Outcrop Samples

The average batch Kd values (corrected for blank container wall adsorption) are reported in Table 11.6 for the most important long-lived fission, activation product, and actinide elements. Tc was omitted because of a delay in the arrival of the needed tracer. Ba is currently used as an analog for Ra. The averages are based on the triplicate analyses. The ± values signify one standard deviation. All results were determined in the adsorption direction; desorption experiments were not performed. In addition to Kd value, the final solution pH, final ground-water composition, percentage of nuclide adsorbed on blank container walls, and initial tracer molarity were measured.

If this were an actual site assessment, several more experiments would have been completed. Several additional ground waters would have been run to provide more data on the effects of variable ground-water composition. Kd adsorption at various times would have been collected to address sorption time dependency. Desorption experiments would have been performed to assess the degree of reversibility. After preliminary batch Kd values had been evaluated, subsequent dynamic flow-through column or intact core sorption

TABLE 11.6. Experimental Kd Values (ml/g) After 21 Days of Shaking

Nuclide	Laboratory	Aquifer-Wilcox		Aquifer-Brine		"Aquitard"-Wilcox		"Aquitard"-Brine	
		Oxic	Anoxic	Oxic	Anoxic	Oxic	Anoxic	Oxic	Anoxic
Se	PNL	80 ± 9	76 ± 1	1,230 ± 210	940 ± 210	24 ± 3	35 ± 7	890 ± 250	750 ± 90
Sr	PNL	420 ± 20	≥1,600	10.0 ± 0.3	10.7 ± 1.3	250 ± 20	≥1,600	7.7 ± 0.5	7.7 ± 0.3
I	LASL	463 ± 7	633 ± 15	7.7 ± 1.0	7.6 ± 0.4	415 ± 10	434 ± 5	10.0 ± 0.6	9.8 ± 0.4
Cs	PNL	≥1,800	≥5,400	3,650 ± 390	≥1,530	930 ± 120	1,580 ± 720	7,670 ± 2,530	≥5,100
Ba	LASL	2,170 ± 26	3,320 ± 60	24 ± 1	25 ± 0.5	830 ± 15	845 ± 15	16.8 ± 0.8	15.7 ± 0.4
Ce	LASL	2,600 ± 1,140	14,000 ± 800	995 ± 58	400 ± 100	317 ± 92	1,270 ± 60	340 ± 20	120 ± 40
Eu	LASL	17,500 ± 510	20,200 ± 485	1,430 ± 105	490 ± 150	1,490 ± 65	1,670 ± 33	330 ± 12	84 ± 34
U	LASL	120 ± 35	7.2 ± 1.6	9,200 ± 760	5,730 ± 60	3.3 ± 1.4	1.44 ± 1.32	577 ± 25	240 ± 15
Np	PNL	440 ± 18	2,090 ± 260	75 ± 12	86 ± 2	77 ± 4	1,020 ± 400	1.8 ± 0.1	1.5 ± 0.2
Pu	PNL	5,750 ± 420	139 ± 5	450 ± 10	690 ± 180	620 ± 150	60 ± 2	350 ± 40	1,090 ± 50
Am*	LASL	21,200 ± 870	3,830 ± 30	1,840 ± 70	-	1,730 ± 55	609 ± 27	318 ± 5	-

*Data are preliminary and subject to change
-Data were not available at time of writing

experiments would be performed to verify batch results. Emphasis would be placed on those combinations of nuclides-sediment-ground waters that gave the highest mobility.

Interpretation of Outcrop Results

There are very few values for Se adsorption reported in the literature. From general chemistry principles, Se would be expected to be sensitive to pH and possibly Eh changes in the ground water. Over most of the Eh-pH domain, Se would be expected to be present as an anion (SeO^{2-}, SeO^{2-}, $HSeO^{2-}$) and thus potentially mobile. Experimental results show the adsorption of Se to be moderate from the Wilcox ground water and high from the salt brine. As the pH of these two solutions differed significantly, possible pH-dependent reactions are occurring instead of ionic strength-dependent reactions. There does not appear to be any large dependency on Eh and only a small dependency on geologic media. The higher than expected adsorption, assuming Se is present as an anion, might reflect adsorption on hydrous iron oxides in a manner similar to phosphate adsorption.

As expected, the Sr results show a significant dependence on ground-water ionic strength and very little dependence on oxygen conditions. There is little dependence on sediment type, based on these data. The comparison between PNL and LASL data is satisfactory.

The iodide adsorption results show some adsorption occurring. There is no clear dependency on ground-water type, sediment type, or oxygen conditions. Currently, the observed non-zero adsorption is unexplainable. Assuming I^- is the predominate species, one would expect Kd values <1.

The cesium data show that considerable adsorption occurs under any conditions, with no apparent dependencies. The agreement between PNL and LASL data is satisfactory.

Like Sr, Ba (Ra analog) shows a strong dependence on ground-water composition, with sorption decreasing as the salt content increases. The "aquifer" sediment appears to be more selective in Ba adsorption than the "aquitard" sediment.

The cerium and europium data show a large variability caused by the blank correction. Neither Eu nor Ce remains in solution at the neutral to basic pH under study. Adsorption is very high to moderate for all cases. There appears to be slight dependencies on ground-water composition (sorption decreases as salt content increases) and sediment type ("aquifer" greater adsorption than "aquitard").

The adsorption of U appears to be sensitive to ground-water type (higher adsorption from brine), oxygen condition (higher adsorption under oxidizing conditions), and sediment type ("aquifer" higher than "aquitard"). The higher mobility of U in the Wilcox water may result from soluble carbonate complexation. The relationship to oxygen conditions is dramatically opposed to trends in nature, where U is much less mobile under reducing conditions. Some of the discrepancy may have resulted from sorption of hydrous iron oxides and the blank correction methods of calculating Kd, but these results are unexpected.

Np sorption on the "aquifer" sediment is much larger than on the "aquitard" sample. As expected, Np appears to be more readily adsorbed under anoxic conditions with the "aquifer" sediment. Np adsorption appears to decrease significantly as the water increases in salt content. The oxygen sensitivity does not appear during adsorption onto the "aquitard."

The Pu results show moderate to strong adsorption. The expected trend of significantly enhanced adsorption under anoxic conditions is not observed, possibly because of blank correction. Very little Pu could be kept in solution in the blanks under anoxic conditions. Maximum observed Pu concentrations might be reported as well as Kd values when discussing Pu, as Pu concentrations are extremely small at solubility limit.

In general Am is readily adsorbed quite under all conditions, but all results were not available at the time of this writing.

Kd VALUES SELECTED FOR USE IN THE REFERENCE SITE ANALYSES

The laboratory determinations of Kd values for the outcrop samples provide a demonstration of the methods that would be used for an actual site evaluation. However, several factors led to a decision not to use the outcrop measured Kd values for this analysis:

- The outcrop samples were visibly weathered and contained visible organic particles. The clay and organic fractions would likely give erroneously high sorption measurements (i.e., error in the nonconservative direction).
- The sample associated with aquifers had more clay than that associated with aquitards.
- Experiments had to be performed in a very limited time frame, with minimal replication.

In addition, uncertainty exists with respect to the probable redox conditions of the ground waters and with respect to the ionic constituents of each ground water. For these reasons, to provide conservatively representative Kd data for the reference site analyses, the results of the sample characterization were used as the basis of selecting from the WRIT generic Kd data bank, Kd values associated with quartz in saline and bicarbonate solutions. Thus the Kd values shown in Table 11.7 were used in base case reference site assessments in lieu of the measurements on the outcrop samples.

These Kd values were selected by considering that the actual geologic media are similar to pure quartz, on which generic WRIT Kd data are available (Serne 1978; Relyea 1979) for a 0.03 N $NaHCO_3$ and 5.13 N NaCl waters. The bicarbonate solution is about twice the strength of the Wilcox aquifer, and the brine is about 25 times more salty than the proposed Hainesville recipe. However, this value more closely reflects the concentration later determined to be appropriate for the salt brine being dissolved from the breached salt dome. As it is not certain whether the probable redox conditions will be oxidizing or reducing, the lower Kd was chosen.

There are no WRIT generic Kd values for H, C, Se, Ra, Th, Pa, U, or Cm. Se, Ba(Ra) and U Kd values were the lowest values of those measured on the outcrop samples (Table 11.6). Barium is used as an analog for radium, based on the National Academy of Sciences publication on the radiochemistry of radium (Kirby and Salutsky 1964). It is assumed that ^3H and ^{14}C would be found

TABLE 11.7. Kd Values for the Reference Site Analyses* (ml/g)

Element	Ground-Water Type: Wilcox Aquifer	Ground-Water Type: Brine
H	0	0
C	0	0
Se	24 (21)	24 (21)
Sr	270 (250)	0
Tc	0	1.6 (0.7)
I	0	0
Cs	11 (18)	0
Ba(Ra)	15	15
Th	40	40
Pa	40	40
U	1.4 (1.1)	1.4 (1.1)
Np	6.6 (2.3)	0
Pu	73 (47)	250 (90)
Am	75 (68)	0
Cm	75 (68)	0

* The values in parentheses represent mean Kd values minus one standard deviation, as taken from the WRIT generic Kd data bank. These values, where they exist, were taken to be the lower bound on Kd values used in one of the consequence analyses.

as tritiated water and bicarbonate-carbonate anions, respectively, and thus these were given a Kd value of zero. For the ^{14}C, this approach ignores potential carbonate precipitation and thus could be conservative. The Kd for Th was from a literature value for sand (Nishiwaki et al. 1972). The chemistry of Pa and Cm were assumed to be similar enough to Th and Am, respectively, to use their data as analogs.

CHAPTER 12

EXTERNAL REVIEW OF WORKING DOCUMENT PNL-2955

This document was distributed to a number of individuals to provide a peer review of its contents before final publication. That working document of December 1979 was revised in response to the comments received. Chapter 12 is provided so that the reader can note key questions unresolved with respect to long-term effectiveness assessments, diverse opinions on some issues, technical and philosophical criticisms of this work. It should be understood that this report represents the first complete application of the AEGIS methodology (which is undergoing development), that there were insufficient data and time for the level of analysis that will be done for the later stages of site qualification and licensing, and that the intent of this work was to demonstrate the AEGIS and WRIT approaches to nuclear waste repository assessments. This report is not meant to be the final analysis of a nuclear waste repository located in a salt dome; however, the report does present the major areas of potential problems for salt dome repositories.

REQUEST FOR PEER REVIEW

The following is a copy of the letter sent to the external (outside PNL) reviewers of the working document of this report.

3 January 1980

AEGIS-80-010

Subject: Request for Peer Review of PNL-2955

Dear

The Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program is conducted at Battelle, Pacific Northwest Laboratory (PNL) under contract with the Office of Nuclear Waste Isolation (ONWI), which is managing nuclear waste isolation programs for the Department of Energy (DOE). The objective of AEGIS is to develop and apply methodology for evaluating the post-closure effectiveness of deep geologic isolation of nuclear waste. During FY-1979 the predecessor to AEGIS, the Waste Isolation Safety Assessment Program (WISAP), performed an initial assessment of a hypothetical nuclear waste repository in a reference salt dome. This preliminary reference site analysis is enclosed in a working document form as PNL-2955, Volumes 1 and 2.

This document represents the demonstration of the AEGIS methodology for a site taken to be representative of interior Gulf Coast salt domes. This report is the first part of an analysis which will include sensitivity evaluations of important parameters and assumptions. The complete AEGIS analysis is to be used as part of the safety assessment for the Preliminary Information Report (PIR) being assembled by ONWI. This PIR is analogous to a Preliminary Safety Assessment Report (PSAR) accompanying a license application except that it provides either example cases or methods for providing the information considered necessary for an actual PSAR. The amount of information available on the example site used in this study is considerably less than would be available for a true candidate dome proposed for licensing with the Nuclear Regulatory Commission.

The application described in PNL-2955 is intended to be a methodology demonstration. While many of the points of this study may have generic applicability to salt domes, this is not an actual site assessment. The application was performed to provide perspective on the performance of system barriers when the system is subjected to human intrusion. During the next several months, ONWI and PNL will be evaluating the sensitivity of the analysis to key assumptions concerning aspects of human activities in the future. In addition, engineered barrier concepts will be evaluated for any effect that they might have on the source term of radioisotopes being transported to the biosphere. In this context, the results of PNL-2955 will provide a base case to be used in later considerations of the effectiveness of engineered barriers and of the effects of institutional controls or passive information systems which could be employed.

PNL-2955 was first completed in August 1979, and in the subsequent months the report has been subjected to several reviews. These reviews have included consideration by all of the AEGIS staff, by management at PNL, DOE, and ONWI, and by a few consultants. Based on these reviews, the document was revised slightly to its current form to show more clearly the assumptions in the analysis. This working document is being sent to you and to others on the limited distribution list (attached) for the purpose of expanding the independent review of the work. We are especially seeking peer review of the overall methodology used and of the details of the reference site assessment, including the data, interpretations, and assumptions. Examples of specific areas of our report on which we are seeking comments are:

1. Is the overall approach in this report appropriate for evaluating the long-term effectiveness of a nuclear waste repository?

2. Were the potential natural breach scenarios treated adequately?

3. Is the human intrusion scenario credible?

4. Are the mining operation scenario assumptions appropriate? Are they conservative or nonconservative?

5. Have the draft EPA criteria* been interpreted correctly in the development of the scenario?

In addition, we are seeking comments on the broader framework for long-term assessments. Specifically, examples of questions for which we would like your comments are:

1. Is it appropriate to assume complete loss of institutional control or memory after 100 or 1000 years?

2. Is it appropriate to take no credit for the use of passive markers at the repository site?

3. Is it appropriate not to include engineered barriers in a base-case analysis?

4. Is it appropriate to assume no monitoring and/or discovery of radioactive materials by a future humanity which intrudes into the repository?

The salt dome analysis is the first exercise of the integrated AEGIS methodology. AEGIS is aware of a need for a scientific consensus of the adequacy of the methodology to be used in the licensing process. It is for this reason that we need a thorough review of our work at this stage of development. I request that you send any comments you might have to me prior to 15 March 1980.

In addition, we welcome suggestions of others who should be involved in this peer review process. This document will be revised as appropriate based on the comments of the reviewers.

Thank you for your consideration of this report.

Sincerely,

Albin Brandstetter, Ph.D.
Manager
Assessment of Effectiveness of Geologic Isolation Systems (AEGIS)

AB:jp
Attachments

*The draft EPA information used for PNL-2955 included:

EPA Background Report. Considerations of Environmental Protection Criteria for Radioactive Waste. February 1978.

EPA Criteria for Radioactive Wastes. Recommendations for Federal Radiation Guidance. 43 FR 53262. 15 November 1978.

EPA draft standards for the management, storage, and disposal of spent fuel and high-level waste. 29 June 1979.

EPA draft of Proposed Criteria for Radioactive Waste Disposal (Federal Radiation Guidance). 13 July 1979.

Distribution List for Working Document PNL-2955

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In addition to these reviewers, the Office of Nuclear Waste Isolation (ONWI), which manages the research, development, design, and selection of salt dome nuclear waste repositories for the U.S. Department of Energy and which is the sponsor for AEGIS, assembled an ad hoc group (ONWI Task Force) for the review of the working draft of PNL-2955. This group was led by Dr. C. Ping Chen, ONWI, Battelle Memorial Institute, 505 King Avenue, Columbus, OH 43201, and consisted of ONWI staff, contractors, and consultants.

EXTERNAL REVIEWERS' RESPONSES TO QUESTIONS

The comments from all the external reviewers were grouped according to the nine questions asked in the transmittal letter, and responses were prepared by AEGIS. In addition, many other general and technical comments were received, which are also summarized in the next section. Other comments not discussed below related to changes in the text that have been made for this final version or relate to very technical questions now are under consideration by AEGIS staff in the continued methodology development.

<u>Question 1</u>: Is the overall approach in this report appropriate for evaluating the long-term effectiveness of a nuclear waste repository?

Of the 22 comments received from the external reviewers, 16 either directly answered this question or the answer was inferred from the content of the overall response. Of those, 14 answered that the overall approach is appropriate, although many responses were qualified.

<u>Question 2</u>: Were the potential natural breach scenarios treated adequately?

Only eight commentors either specifically addressed this question, or had comments from which a position could be inferred. All eight answered yes, though again with some qualifications.

<u>Question 3</u>: Is the human intrusion scenario credible?

For this question, eight responses were yes; two were no.

<u>Question 4</u>: Are the mining operation scenario assumptions appropriate? Are they conservative or nonconservative?

For this question, seven answered yes; three answered no.

<u>Question 5</u>: Have the draft EPA criteria been interpreted correctly in the development of the scenario?

In evaluating this question, it should be understood that the regulations appliable to nuclear waste disposal are in the development stage. Thus, the drafts available to AEGIS at the time of this work have been supplanted by differing, more recent drafts.

The EPA (oral) response was that while the draft standards have changed in the interim, the interpretations AEGIS did of the contemporaneous standards were definitely appropriate.

Of the written comments received, only five addressed this question, four answering yes.

Question 6: Is it appropriate to assume complete loss of institutional control or memory after 100 or 1000 years?

This question received different answers for the two time periods. For 100 yr, seven responses were yes; five were no. For 1000 yr, eight were yes and three were no.

Question 7: Is it appropriate to take no credit for the use of passive markers at the repository site?

For this question, seven responded yes, three no. In addition, one reviewer said yes for 1000 years, but no for 100 years.

Question 8: Is it appropriate not to include engineered barriers in a base case analysis?

A total of eight reviewers responded yes to this question, four responded no.

Question 9: Is it appropriate to assume no monitoring and/or discovery of radioactive materials by a future humanity which intrudes into the repository?

This question resulted in fewer comments than the others. Six responded yes, four no.

SUMMARY TO QUESTION RESPONSES

The specific questions put to the reviewers provided a focus for their positions. Responses varied from as few as seven direct answers to as many as fifteen. The consistent pattern among those responding to the questions was support for the assumptions and approach used in this study. Only a single reviewer was consistently, strongly negative about the AEGIS approach and the specifics of the human intrusion analysis, but he was equally negative about the regulatory considerations and about having to worry about the nuclear waste at all once it was emplaced. This overall positive review must be tempered in that, as one reviewer said, the results of a Delphi process can be dependent on the particular experts involved, a similar situation exists for the peer review of a complex, multi-disciplinary work such as this one. Nevertheless, this peer review can be interpreted as an acceptance of the overall approach of the AEGIS program at its current state of development.

EXTERNAL REVIEWERS' ADDITIONAL COMMENTS

Most of the external reviewers provided comments in addition to those specifically pertaining to the questions addressed to them. Included in this section are summaries of these commments received. Comments relating to specific items that were changed from the review document to this final report and comments of a highly technical nature, which are undergoing further consid- eration by AEGIS staff, are not included in this section. Also not included here are comments pertaining to the DOE or ONWI programs beyond the scope of AEGIS or of this report.

The comments presented below are mostly verbatim from the commenters, although occasionally they represent summaries or paraphrases of the specific comments received. Responses to many of these comments have been provided by the AEGIS and WRIT staffs. The comments have been grouped according to topic area.

Topic - Human Intrusion Into A Nuclear Waste Repository Located In A Salt Dome

Comment

- As a general conclusion, the task force has determined that the PNL-2955 report does not represent a sufficiently rigorous technical justification for determining that solution mining intrusions inherently result in credible and unacceptable consequences. This justification awaits development. PNL-2955 does provide a highly conservative, first-cut, rough assessment, however. Had the results been acceptable, further consideration of solution mining intrusions would be unwarranted.

AEGIS Response

- The intent of the AEGIS analyses was to demonstrate current technology under development for the licensing process. Available site specific data and generally conservative assumptions were used to complete the analyses on schedule. We believe the work does successfully meet that intent. The numbers might vary with improved data. But, lacking total reliance on information transfer and/or on engineered barriers for extremely long periods of time into the future, the conclusion is sound that there is a potential for substantial adverse consequences from human intrusion by solution mining into a nuclear waste repository located in a salt dome. This potential is sufficiently high for human intrusion into a salt dome to be evaluated in the actual licensing process.

Comment

- We agree with the discussion of future alternative uses of salt domes. This generic characteristic of salt domes is one of the potentially adverse conditions identified in the drafts of NRC's Technical Criteria of 10 CFR 60 Subpart E. This should be considered in comparing salt domes against alternative media before a site is selected.

AEGIS Response

None.

Comment

- We agree with the statement that "the geology of the salt dome provides no barrier to the human intrusion scenario; indeed, salt domes are very localized, attractive resources, enhancing the likelihood of human intrusion." The protection offered by a multiple barrier approach is diminished by removing the natural barrier.

AEGIS Response

None.

Comment

- One of the geologists on the NAS-NRC panel that recommended nuclear waste disposal in bedded salt told me they did not consider human actions in their studies. Scenarios involving human actions, such as solution mining, are important contributions to the field of nuclear waste disposal.

AEGIS Response

None.

Comment

- It is reasonable to assume that markers can be emplaced at the repository that will communicate its hazard to subsequent generations. These markers could in some cases provide a basis for further controls.

AEGIS Response

- Such passive information concerning a site and its hazards should not be considered to be perfectly effective for the indefinite periods of time (hundreds of thousands to millions of years after closure), which would be needed before the consequences of an inadvertent human intrusion, such as the one presented in this report, could be not severely adverse to the general population. Secondly, credit for such information transfer was not taken into account in this study, since the influence of passive markers would be on the likelihood of intrusion, not on the consequences subsequent to the intrusion. This work did not include analysis of the probability of specific human intrusion scenarios, since there is little basis for such probability estimations. Rather, a qualitative decision was made as to whether or not a human intrusion scenario, exemplified by the particular scenario here, is plausible and credible.

Comment

- A solution mining intrusion of some type may be a credible event in the absence of controls to promote societal awareness and should be addressed in a safety analysis for a repository in salt.

AEGIS Response

- Even if controls exist to promote general societal awareness, human intrusion can still occur unless the site itself is under active control. Thus, although information may be in place in archives or elsewhere in the region of the repository as well as distributed throughout the world, for that information to preclude human intrusion into a repository located in a salt dome, there would have to be some degree of physical control at the site itself. Physical control itself acts as some information and would provide the incentive to seek further information before proceeding with an intrusive activity. However, consider the recent example of a Gulf Coast salt dome which had an oil well intercept a known and currently operating salt mine facility. The fact that this underground activity was intruded inadvertently by resource exploration activities provides a dramatic case in point of the non-transfer or non-use of information which was important, even though institutional controls were obviously in place at the time of this event.

An additional point pertinent to this and the previous comment is that as the apparent protective usefulness of information decreases overtime, the maintenance of that information or the reliance on it may well diminish. As an example, the information of what naturally-occurring plants are poisonous probably passed over many generations, even before the existence of written records and information systems, because such information was selectively advantageous and provided protection to the existing societies. Currently, however, in this country the knowledge of such plants is not widespread, as it rarely affects a society that consumes packaged food products and has developed widely available antidotes. As the apparent need for the information lessened, the information was lost in a practical sense for individuals in the society, although such information certainly exists in various, widely distributed locations, such as libraries. Similarly, as the time elapses over several generations after all nuclear wastes are disposed of and, therefore, are of no immediate threat, the value to societies of information about them will diminish.

Comment

- The interpretation of "loss of institutional control" as a complete loss of societal memory after only 100 yr is, in our opinion, unreasonably conservative and not consistent with the intent of EPA. This point needs to be considered and clarified further.

AEGIS Response

- The interpretation of "loss of institutional control" used was a correct interpretation of the EPA draft standards available at the time of the working document, according to EPA staff developing the standards. Subsequent EPA drafts refer to a less conservative position, where only active institutional controls of a site cannot be relied upon past a given time. However, this issue of active versus passive institutional controls remains unresolved currently. Should there be a prohibition against reliance on active institutional controls only (after 100 yr), it remains unclear what impact that would have on the AEGIS analyses, since there is no guidance on how much reliance could be placed on passive controls, or for how long. The comments and responses presented above are also germane.

Comment

- The solution mining scenario in this report may be bounding from an initiating event and single scenario occurrence view, but it is not bounding for long-term considerations. The results of the report indicate that at the end of the 50-yr operational solution mining scenario, about 95% of the nuclear waste remains unleached in the salt dome. In fact, this scenario exposes the waste and makes it more vulnerable to future release mechanisms. Repeated occurrences of solution mining or other activities would cause additional and potentially large releases and a hazard over a much longer time period. We conclude that assessments should consider cumulative releases from multiple or repeated scenarios over the 10,000-yr period.

AEGIS Response

- We agree with this comment, although time constraints prevented such analyses. Such analyses would be done if this were an actual nuclear waste repository site assessment.

Comment

- We disagree with the omission of analyses of the consequences of human intrusion other than solution mining. The unsupported conclusion that the solution mining scenario is both more plausible and consequential is insufficient justification for not assessing the probabilities and consequences of other types of human intrusion. Therefore, add additional human intrusion scenarios, e.g., the use of the salt dome for a hazardous chemical waste disposal facility, strategic petroleum reserve, or exploration for other natural resources.

AEGIS Response

- We do not propose that the specific human intrusion scenario is the most plausible such scenario that can occur for a salt dome repository. Other human intrusion scenarios might occur with greater frequency. Further, we do not believe that reasonable estimations can be made for particular human activities far into the future.

  The specific scenario presented here is not predicted necessarily to occur. Rather, the scenario is offered as being a reasonable-to-conservative representative of the class of human intrusions involving remote controlled removal of salt, at least part of which would be consumed by the general public. We believe that class of scenarios is very plausible, certainly enough so that it warrants consequence analyses.

  Also, that class of scenarios appears to be the most consequential, primarily because the vector of exposure to humans is essentially direct consumption of part of the nuclear waste. Other human intrusion scenarios would be further considered in an actual site assessment, including those involving remote removal of salt for purposes other than direct salt consumption, such as for storage of other materials in the mined cavity. However, we believe the analyzed scenario is, as a class, bounding to other human intrusion scenario classes, even though they are also very plausible classes. Certainly if the particular scenario class analyzed here could be precluded or the consequences mitigated to acceptable levels, then other human intrusion scenarios would have to be analyzed.

Comments

- Although other human intrusion scenarios appear not to be worst-cases, they should not be precluded from further investigation.

  It might be useful in future work to calculate the consequences for a range of human intrusion scenarios, so that a spread of outcomes is apparent even without relying on probabilities.

AEGIS Response

- See response to preceding comment.

Comment

- Similar scenarios, albeit based on different motivations, may be credible in other geologic media besides salt.

AEGIS Response

- Similar solution mining scenarios may be credible in geological media other than salt. However, the likelihood of occurrence in other media is significantly lower compared to that for salt domes, even for the other salt medium under consideration, bedded salt. This is because of the spatial distribution of bedded salt compared with salt domes. Bedded salt is relatively uniformly distributed in continuous formations over very extensive areas. The result is that intrusion into a bedded salt located at random has a low probability of intercepting a repository. That probability can be reduced considerably further if the bedded salt repository is located in an area of reduced resource value compared with the bedded salt region in general. By contrast, salt domes are essentially point sources over a region of very limited extent and number. Thus, regionally in the Gulf Coast, if one is to exploit a salt medium, there are only a few hundred such areas available, and even fewer with the characteristics inviting exploration (especially the rather shallow depth salt domes which coincide with those under consideration for nuclear waste repositories). Further, given that a salt dome containing a repository is to be exploited, the likelihood is very high of intercepting the repository itself; it would be difficult not to hit the repository considering its areal extent relative to the salt domes's size, and considering its depth.

The extent of a human intrusion solution mining breach into a non-salt medium would be significantly reduced or nonexistent, since the non-salt media under consideration are far less soluble than salt. And, importantly, the other geological media are not edible.

Scenarios not involving solution mining as the intrusion mechanism, in media other than salt, will likely be addressed in assessments of the effectiveness of repositories in those media but are beyond the scope of this document.

Comment

- In a report by Johnson and Gonzales (1978) it was stated that of 150 salt domes potentially suitable for a HLW repository in the Gulf Coast region, 95 have to date undergone industrial development. This means that in the approximately 100 yr of geotechnical activity, 66% have been drilled into. It follows that within 100 yr after the location of the repository is forgotten, the chances are about two out of three that our descendents will drill into the salt dome hosting a given repository. In 300 yr, the chances are 95% for a human activity which could jeopardize the integrity of this disposal site. Consequently, I urge DOE to abandon salt formations from its consideration as quickly as possible, before more funds, and even more importantly, more public confidence have been expended in nursing this non-viable option.

AEGIS Response

None.

Comment

- Exception is taken to the rationalization that the probabilities of human-induced repository breaches cannot be quantified. There is sufficient documented past experience with solution mining of salt domes that an estimate of the probabilities can be calculated.

AEGIS Response

- We do not feel that the probability of a specific scenario, for which consequence analyses are performed, can be estimated with any degree of certitude. On the other hand, the rate of use of salt domes in the Gulf Coast certainly suggests that human intrusion into a salt dome is highly plausible.

Comments

- The probability of human intrusion must equal one, since you cannot assume any other probability distribution, because you cannot defend any other probability distribution.

- A number of mechanisms exist that can reduce the likelihood and postulated consequences of the scenario. A defense-in-depth philosophy can be adopted.

AEGIS Response

- There is no disagreement with these statements, except that they should be qualified somewhat. Reduction of the likelihood of a human intrusion scenario may be realized by certain measures; however, it is very unlikely the probabilities can be reduced to the point where such human intrusion scenarios become both incredible and unreasonable and, therefore, do not have to be considered.

Comment

- It is an important assumption that no human mitigation is assumed or allowed. Why shouldn't one allow human mitigation?

AEGIS Response

- The possibility of some activities by the extant population mitigating the consequences of the human intrusion certainly exists. Such actions would require the population to be cognizant of the cause of recognized adverse health effects. If that were the case, then presumably the solution mining would cease, and perhaps some additional measures would be taken, such as to identify and dispose of contaminated inventories of salt, to decontaminate the facilities, to detoxify the population, and so on.

However, to assume that those activities would occur, in performing an analysis like this, is to rely upon the activities of a future population as providing a major barrier to the nuclear waste. This is inconsistent with the whole pupose of a nuclear waste repository, which is to isolate contemporary wastes so that distant generations will not have to be burdened with them. Such an assumption is also inconsistent with the requirement of nonreliance on institutional controls beyond the near term. Further, a population could reasonably have a technology capable of a solution mining intrusion but not be cognizant of the hazards of radioactivity. That such a society could exist is demonstrated by the fact that it did exist at the beginning of this century. In performing these kinds of analyses, reliance should not be placed on the future continuation of a technology that is very newly developed and may not persist, for a wide variety of possible reasons.

It should be recalled that calculations are presented in this report (although not in the working document, to which the comments referred) that indicate that the doses to the solution mine operators from inhalation and external exposure would not be high enough to cause early detection of the brine's hazard. It would seem likely, however, that if this scenario were to occur only 100 yr after closure, the dose burdens to the consumers of the culinary salt would be so high as possibly to lead to a recognition of the contaminant. In that case, mitigation by direct human actions would seem more likely. But it should be recognized that the mechanism triggering such human mitigation would be the severely adverse impacts on the health of a general population.

Comment

- The human intrusion analyses should be expanded to show health effects and monetary costs. My estimates are enclosed. For cost-benefit comparisons, using the OMB (NRC) value of $1,000/man-rem avoided gives estimates of up to $\$1.6 \times 10^{14}$, more than the value of the energy produced.

AEGIS Response

- It is outside the scope of AEGIS to determine cost-benefits or to determine specific health effects. AEGIS is designed to evaluate the plausible scenarios of nuclear waste repository disruptions, and the quantities and concentrations of radionuclides subsequently released to the accessible environment. This is in accord with the current versions of the regulations being developed by EPA and NRC. In addition, AEGIS does, where appropriate, evaluate the dose burdens which could be incurred by the population existing at the time of the release to the accessible environment. Those doses can be compared with natural background, to provide perspective on the severity of the consequences.

Comment

- Introduction of anomalous materials into the repository could, by several means, announce the hazard. Candidate materials can be identified, but further research on their performance is warranted. This approach should not be required, but is an option that is available.

AEGIS Response

- We agree that study should be given to the development of engineered factors which could cause the intruding population to terminate operations earlier than otherwise would be the case. On the other hand, reliance should not be placed on such alerting mechanisms, since predicting their reliability and predicting the specific response to be made by the intruders for the time frames for which human intrusion is dangerous (in the million-year-plus time frame) is fraught with great uncertainty. As with passive information systems designed to reduce the likelihood of intrusion in the first place, we believe these and similar measures would be useful measures to be taken <u>in addition</u> to the defense-in-depth approach to nuclear waste isolation. However, we do not believe such information measures could be demonstrably reliable for them to be considered barriers unto themselves.

A second point is that an anomalous material with respect to one use of the salt in a salt dome may not be cause for termination of use of the salt dome for another purpose. For example, noxious or strangely colored inclusions in the brine is an approach mentioned for this anomalous material notification system. That might cause an intruder not to use the brine for culinary purposes. On the other hand, an intruder who is solution mining to develop a cavity for petroleum storage, a common current practice, might be totally unconcerned about such a phenomenon. He might then proceed with the operation, merely dumping the unusual brine into surface water or aquifer systems, where other vectors could lead to the radionuclides coming in contact with the general population.

A third point is that such anomalous indicators could reasonably result in the piqued curiosity of the intruders, increasing the exploration of the salt dome.

Finally, the scenario analyzed in this report represents the bounding class of human intrusion scenarios, quantified in a conservatively representative way, in which contaminated salt is directly consumed by a general population. Other classes of scenarios exist which were not considered here but which would have to be addressed in an actual site assessment. Among those is the class where a human intrusion exists that degrades the integrity of the repository but does not necessarily immediately result in the release of radionuclides to the surface. Here, if an anomalous indicator were present, solution mining would have occurred, opening up pathways for subsequent ground-water intrusion into the soluble host medium, even if that solution mining were to cease upon recognition of the anomalous material. For salt domes currently existing that have had a previous history of some human exploration, these are now excluded from further consideration for use as a nuclear waste repository (cf. Patchick 1980), because the primary barrier (the salt dome) has been compromised. It would not seem reasonable to consider that a repository in a salt dome, which was briefly intruded but which intrusion terminated because of some anomalous indicator, would be considered acceptable as a repository for all times subsequently. In this sense, the indicators would become a barrier briefly, but at the expense of the primary barrier thereafter. It should be kept in mind that multiple intrusions over the first 10,000 yr, and obviously over the million years or so of hazard, are likely.

Topic - Solution Mining Scenario

Comments

- Solution mining technology has undergone rapid sophistication in the past two decades. For a solution mining intrusion that is high-production, long-duration (such as that posulated in PNL-2955), the technology required includes expertise in geologic investigations, rock mechanics, process chemistry, sophisticated instrumentation, metallurgy, fabrication processes, and materials science. This is not "unsophisticated" technology.
- The postulated solution cavern geometry is inconsistent with assumed production rates and operational periods. Conversely, the assumption of large production of salt over an extended period implies the need for the technology of present practice, namely, controlled production of elongated frustums of cones of controlled diameter. Adoption of an internally consistent set of assumptions will significantly limit the source term of the scenario.

AEGIS Response

- These two comments represent a valid criticism of the original AEGIS analysis in that the scope of the solution mining activity as presented in the working document seems to be inconsistent with the lack of sophisticated control over the cavern geometry. The presumption is that an intruder with the sophisticated technology required for such extensive salt brine extraction would be able to detect the existence of the nuclear waste repository, or, failing that, would develop a relatively narrow conical cavity which would intercept a smaller fraction of the nuclear waste repository.

  There are two separate aspects to this point, however. First, as the commenting group suggested, solution mining practices have markedly changed in the last several years. The logical extension of that fact is that the solution mining practices of 100 yr from now, 1000 yr from now, or far longer into the future, will be markedly changed from the current practices. Thus, developing a scenario which is rigidly linked to today's cavern development (as opposed to a considerably different such development of the 1950's, for instance) cannot be relied upon as providing protection from human intrusion far into the future.

  The AEGIS policy is, to the greatest extent possible, not to rely upon specific levels of sophistication of technologies to limit the occurrence or extent of a human intrusion event, but, rather, to limit such intrusions by the characteristics of the physical system itself. Thus, the question of the size and shape of the original solution mining cavity should not be "is that what current mining practices would do?" Rather, the question is "what geometry of cavity can the salt dome allow?" The bounding scenario should be based on the physical bounds, not on the current specific, controlled technologies. After all, even today not all cavities are governed by the state of the art in cavern geometry control. Thus, predicting the optimal (least interception of the repository) geometry, based on current controlled practices, into a future with totally uncertain technologies does not provide the requisite conservative analysis of human intrusion by solution mining into a salt dome. If it could be demonstrated that the size and shape of the original cavity proposed in this report could not physically occur, that would be adequate grounds for reducing that scenario.

The second point concerning these comments is that there is an appearance of an inconsistency between the scale of the solution mining operations and the assumptions about the population not necessarily having a sophisticated technology base. To address this inconsistency, this revised report indicated that an altered scenario, using the much more realistic assumption that most of the brine goes to culinary uses, could involve a greatly reduced scope of the solution mining operations. In this scenario, having all of the brine go to culinary uses would increase the dose burdens to the consuming individuals by 30-fold, since the original assumption was for only 3% of the brine to be consumed. That 3% value was based upon the total quantity of brine of all qualities produced in the U.S. divided into the total culinary salt consumed. However, practices at current culinary salt mines in salt domes are for most (80%-90%) of the salt to be consumed, since the salt domes are sources of very pure salt. Offsetting that increase and eliminating the inconsistency, the size of the solution mining could be reduced by 30-fold, resulting in precisely the same dose to individuals and populations as calculated in this report, with an operation whose scale could have readily been achieved with a technology far less sophisticated than currently used.

Comment

- Sophisticated analytical tools are currently available that predict solution cavern growth. These tools benefit from large amounts of empirical data, and are sufficiently flexible to allow modeling preferential dissolution of unconsolidated areas.

AEGIS Response

- The difficulty in using such cavern geometry models is that the results are intimately linked to the specifics of the mining activities (e.g., particular flow rates, relative positions of influent and effluent pipes, time and frequency of reversing the water flow) Solution mining technology has undergone significant alteration in the last several decades, suggesting that prediction now of very specific technical activities occurring in hundreds or thousands of years into the future is fraught with uncertainty. In an analysis of human intrusion, the consistent aim of AEGIS is to limit the nature of the breach by the constraints of the physical system, rather than to rely on a very specific set of technical activities.

Comment

- Solution mining is today in the U.S. a declining source of salt production, principally for economic reasons.

AEGIS Response

- The rate of utilization of salt domes by solution mining is on the increase, largely in providing storage cavities (cf. Griswold 1980). While a human intrusion by solution mining might be for reasons other than culinary salt (e.g., cavity production for storage of wastes or hydrocarbons, chlorine production), some of the resulting brine could still go to culinary use. Further, vectors exist for doses to humans other than by direct consumption. In any event, a solution mining intrusion would result in transport of the radioisotopes to the accessible environment.

Comment

- For normal drilling technology associated with starting a solution mining operation, it is doubtful that peculiar conditions in the repository (e.g., elevated temperatures) would be either noticed by or cause for alarm in the drilling crew. Put another way, the existence of the repository will not be obvious as a result of random drilling.

AEGIS Response

None.

Comment

- Domes that are relatively near the surface will be more prone to solution mining than domes that are deeper. Deep placement of the repository within a shallow dome may be just as effective, but further study is required.

AEGIS Response

None.

Comment

- The scenario does not consider dynamic processes going on inside the solution cavern. Specifically, deposition of anhydrite and other impurities (including spent fuel assemblies) will occur at the base of the cavern in a sump region. The phenomenon of reburial of exposed fuel by subsequent anhydrite deposition is not considered in the present form of the scenario. The effect of considering this phenomenon will be to limit the availability of nuclides to the brine solution for leaching. Once reburied in the sump, nuclide release will most likely be controlled by porous medium diffusion processes.

AEGIS Response

- Such near-field considerations were outside the scope of the program at the time of the analyses. However, calculations have shown that for the geometry of the cavern in the base case scenario, the layer of anhydrite at the bottom would not cover the nuclear wastes. For other cavern geometries, the anhydrites could provide at least a partial reduction in the surface area of the wastes available for dissolutioning. Even in that case, however, since the source term was based on a solubility limited situation, such a reduction in the surface area exposed for dissolutioning would have to be below a very small fraction (1.5%) of the potential surface area to begin to provide a reduction in the amounts of isotopes delivered to the accessible environment.

Comment

- For solution mining scenarios, one would have to indicate whether or not there is sufficient non-saline water there to allow the solution mining operation.

AEGIS Response

- The amount of water calculated in the original scenario development as being needed to deliver the assumed amount of salt produced is approximately 1400 gpm. This quantity is very small compared to the available water in the surface systems and near-surface aquifers at the Hainesville area. Further, even if that water were not available, seawater could be used (i.e., non-saline water is not required). Seawater is used in some solution mining operations, requiring somewhat greater volume because of its reduced efficiency in dissolving the salt dome. The insufficient availability of solution mining water might limit or preclude such activities in quite arid regions, far removed from large bodies of water. Such a situation does not apply to the salt domes under consideration for nuclear waste repositories.

Comment

- It seems too conservative to assume that the salt mine operates for 50 yr without detection of the radioactive wastes.

AEGIS Response

- The 50-yr period was chosen as being representative of the lifetime of salt mines in the U.S. Mines of longer and shorter duration frequently exist. Thus, the assumed value is somewhat arbitrary. That the lifetime of the salt mine could be realized before discovery of the mine as being a source of adverse health effects would be highly dependent on the nature of the monitoring technology extant during those 50 yr, the nature of the distribution systems, the nature of the social systems, and so on.

A key factor in this is the time after closure at which the human intrusion occurs. Should the event happen after only 100 yr, the health effects might be so severe that they could be traced to the solution mine, and the operations would terminate. At later times, however, the health effects might take considerably longer to become manifested, resulting in a greater degree of difficulty in identifying the source. Also, consider that the sources of most of today's cancer cannot be specifically identified, even in locales where the incidence of specific cancers greatly exceeds that of a national average. It is conservative to assume no detection of the contamination, but we do not believe it is excessively conservative.

Comment

- Technology is available today to measure impurities such as radionuclides at the ppm and ppb levels. Analysis of salt products is becoming increasingly sophisticated in response to consumer demands.

AEGIS Response

- To the best of AEGIS' determination, solution mining activities for salt today are not monitored routinely for radioactivity. It does not seem reasonable to rely on such monitoring indefinitely into the future as a means of mitigating the consequences of a human intrusion into a salt dome.

Comment

- It is too conservative to assume the solution mining cavity will be located primarily in the repository zone.

AEGIS Response

- The physical nature of salt domes limits the depths for solution mining activities. If the mine is too shallow, there is an insufficient dome above the cavity to support the weight of the overlying sediments, and collapse ensues. If it is too deep, the rates of salt creep make it very difficult to maintain a cavity. Thus, the depths of the solution mine are bounded by the same factors which control the placement of a nuclear waste repository. In addition, repositories in salt domes as currently envisioned cover a large part of the salt dome's areal extent, increasing the opportunity for intrusion into the repository when the salt dome is intruded.

A second point is that the effects of excavating the repository and the effects of the wastes having been in place for 100 yr, 1000 yr, or longer would suggest an increased proclivity for dissolutioning in the vicinity of the repository.

Also, as discussed above, there is no physical reason why the cavity could not occur as presented. Evidence has shown one salt dome in the Gulf Coast to have a solution-mined cavity of lens shape, similar to the one here.

Finally, it should be recalled that after exposing only about 1.5% of the spent fuel surface area in the repository, the quantity of radionuclides delivered to the surface does not increase upon exposing a greater surface area. (This is because of the assumptions of uranium solubility limits of 6 ppm and of congruent dissolutioning of the spent fuel particles.) Thus, the assumption of the cavity occurring in the repository zone does not have an impact on the dose burdens, after only a small portion of the spent fuel surface area is contacted by water.

<u>Comment</u>

- As the scenario is described in PNL-2955, the nuclides may not be affected at all if preferential dissolution of backfill occurs. The drifts should be affected first and these are separated from the nuclides.

AEGIS Response

- The AEGIS analyses did not rely on preferential dissolutioning; rather, to be conservative, the volume of rock affected by the solution mining operation was chosen to conform to the overall extent of the mined repository. Certainly a scenario could be envisioned in which the cavity never breaches the repository (although, because of depth considerations and the lateral extent of the repository in the salt dome, this is unlikely). By the same token, a scenario could be envisioned of intrusion into an adjacent salt dome that does not even have a nuclear waste repository. Neither case would be very instructive to the question of what are the consequences, based on a conservative analysis, of a human intrusion by solution mining into a nuclear waste repository located in a salt dome. Also, see the response to the previous comment.

Comment

- It is stated that only 61% of the repository would be exposed by the mining operation. It would seem to be much more realistic to expect that the incompletely homogenized passageways of the repository would channel the brine flow such that about 100% could be so exposed.

AEGIS Response

- Such near-field analyses of the specific channelization of the dissolutioning are beyond the scope allowed AEGIS in this analysis. However, as discussed above, exposing 100% versus 61% or even 1.5% of the surface area of the spent fuel would not result in any higher doses to the individuals consuming the salt.

Comment

- The solution mining scenario is not confined to salt domes. Solution mining is common in bedded salt today, and defending against such a scenario may be easier in domes that in bedded salt. This is balanced by the observation that the probability of occurrence may be higher in domes as they are readily identifiable geologic structures of limited extent.

AEGIS Response

- Solution mining in bedded salt formations will not lead to the complete utilization of those geological formations in any foreseeable length of time. On the other hand, solution mining in salt domes will lead to their complete exploitation in the next few centuries, based on current trends. Saying the "probability of occurrence may be higher in domes" is a considerable understatement.

  The key difference to keep in mind between salt domes and bedded salt are their spatial extents. Bedded salt extends continuously over large areas. Indeed, the Louann salt bed, from which the Hainesville and other Gulf Coast salt domes evolved, extends for tens of thousands of square miles. On the other hand, salt domes extend upward as a limited number of pinpoints on a landscape of that scale.

  Further, given that a salt dome is to be exploited, it is almost certain the repository would be intercepted. By contrast, given that a bedded salt basin is to be exploited, it is highly unlikely that a randomly located repository would be intercepted, and even less likely if a bedded salt repository were deliberately located to avoid resource utilization.

Comments

- Solution mining can also be used in salt beds, with very little change in other parts of the scenario. Accordingly it would be useful to slightly expand the sections dealing with human intrusion scenarios to include salt beds as well as salt domes.

AEGIS Response

- This analysis represents the first full reference site assessment of a geological medium under consideration for nuclear waste repositories. Salt domes were chosen because they were most advanced with respect to locating a site and with respect to data availability.

Other reference site analyses are being completed by AEGIS, including for basalt and bedded salt repositories. It is beyond the scope of this document to discuss those analyses.

Comment

- In the process of solution mining, a residual pocket of lower solubility material may accumulate in the bottom of the brine cavity. There is a very small but finite chance that criticality might develop.

AEGIS Response

- It is beyond the scope of AEGIS to consider criticality effects.

Comment

- A chemical analysis of the different halites in the salt dome would be useful, since concentrations of impurities may have important effects.

AEGIS Response

- Since this was a reference site analysis, such determinations were not made. If this were an actual site assessment, that information would be acquired, although by contractors other than AEGIS or WRIT.

Comment

- Domes with relatively high levels of anhydrite and other impurities will perform better than domes with low levels of impurities in terms of limiting nuclide release to the brine solution and be less likely used as a source of culinary salt.

AEGIS Response

- It seems unlikely that there would be present in a salt dome enough impurities that are highly sorptive that could significantly alter the concentration of radionuclides in the solubility-limited (for U) brine of the scenario. The likelihood of utilization of such a salt dome increases as time continues and as fewer nonutilized salt domes remain. However, highly impure salt could require additional processing which could inadvertently process out more of the radionuclides contaminating the brine before their distribution in culinary salt. Nevertheless, those removed radionuclides would still be in the accessible environment and subject to impacts on humans and the environment.

Comment

- The lack of sound information on possible near-field effects of the solution mining process is unfortunate. There was no discussion of possible thermal effects in a heat gradient from the repository.

AEGIS Response

- AEGIS was not provided with information concerning the near-field characteristics of the salt dome. AEGIS was excluded from considering the repository- and waste-induced effects.

Topic - Dose Calculations and Assumptions

Comments

- I found the inattention to the other 97% of the brine was worrisome; the argument for what happens to this should have been worked out a little further.

- Leaving 97% of the wastes dangling is not a good idea. If one finds such difficulty in 3% of the salt, then what sort of problems can one find with the rest.

- It should be stressed that the 3% limit for culinary consumption is quite arbitrary. A conservative assumption would be that all of the salt produced from that salt dome would be sold for this purpose, thus increasing the radiation exposure 33-fold.

- Is the 3% fraction true for each solution mining activity, or is this an average over the entire salt mining industry? Could one find solution mining where no salt was used for table purposes?

AEGIS Response

- In response to these four comments (and other similar ones received), we would have treated this parameter differently, were we to do the original analyses now. The 3% factor came from taking the total quantity of salt produced in the U.S. divided into the total quantity consumed as culinary salt. (This procedure was based on calculations presented in the CWMS 1980 document.) Direct ingestion of contaminated salt is the most obvious and consequential vector for health effects to a general public; hence, that vector was the one concentrated on. When it was apparent that the consequences from this vector could be so severe, and because of time constraints on the original analyses, evaluations of doses from other vectors were not performed.

  In an actual site assessment that would be done; however, such evaluations would be more tenuous than for the direct consumption vector, since they would relate to specific technologies or activities. For instance, the other 97% could go to chlorine production, to other chemical processes, to salt for highways for winter usage, and so on. Or it could be directly injected into aquifer systems for disposal, released uncontrolled to the land or to surface water systems, and so on. For that matter, the radionuclides consumed directly in culinary salt would be eliminated from the body and re-enter the accessible environment, possibly to other pathways to humans. The point is that there is high uncertainty in the quantification of such vectors, and pathway analysis is virtually unbounded. On the other hand, the dose vector of direct consumption is relatively well quantifiable, even far into the future, since the ingestion of salt is bounded by physiological needs. Even here cultural factors can alter the ingestion rates, such as changes in diet, in food preservation methods, and so on. Nevertheless, the consumption vector is reasonably well limited.

After the original analyses were done, it was determined that for a salt dome used for the production of culinary salt, the actual fraction used is much higher (80 to 90%). Considering this, a conservative assessment would have all of the salt brine being used for culinary salt production, linearly increasing the dose burdens over those presented here.

With respect to the last comment, solution mining in salt domes certainly could and does occur for reasons other than producing culinary salt (see Griswold 1980). However, analysis of such operations would not represent the bounding plausible consequences of human intrusion into a salt dome repository. If this were an actual site assessment, such scenarios would also be considered.

Comment

- Since no calculations were performed for isotopes entering the biosphere beyond 1000 yr after closure, this biases the results against the alpha-emitters and, therefore, underestimates the total dosage that would be incurred. However, the doses from the solution mining scenario are so great, one does not need to worry about underestimates.

AEGIS Response

- Unlike the working document to which the commenter responded, this revised report does show the effects of human intrusion into a nuclear waste repository located in a salt dome for periods up to one million years after closure.

Comment

- The assumptions concerning salt production, etc, are average values. It is not clear that this occurs at every solution site and especially at the site we are concerned with. Distances that salt is shipped are limited unless it is on a major river. The population ingesting salt may be limited in the future. All these uncertainties need to be spelled out so that one is not completely taken aback by the dosages incurred in these scenarios.

AEGIS Response

- See the response to the previous comments. In addition, it should be understood that the doses to individuals are not affected by the distribution system nor the limits on the population size in the future. The population doses were based upon how many people could consume the quantity of salt produced, not upon any particular demographic pattern or distribution system. This minimizes the cultural impacts on the population doses. It should also be noted here that the original consumption rates per year were based on the value in the CWMS (1980) of 1800 g/yr, or about 5 g/day. Subsequently, we have learned that an FDA report to be released estimates the actual culinary ingestion rate for salt in the U.S. is about three times the value we used. Changing the ingestion rate to reflect this would have no impact on the population dose, but 1/3 as many people would on average receive three times the dosage shown in the calculations here for individual doses.

  With respect to the final comment, the assumptions of this analysis are detailed in Chapter 2.

Comment

- How realistic is the use of a population of 15,000,000 for dose assessments, especially since the water path is dominant?

AEGIS Response

- See the response to the previous comments.

Comment

- The assumption that people eating contaminated salts do not discover it is somewhat unlikely since the doses are so high that the radiation effects should be almost immediately apparent.

AEGIS Response

- As discussed previously, this is a possibility, especially for an intrusion occurring after only 100 yr, since then the doses would be exceedingly high. However, the impacts then, and especially at later times, might not be recognized as having derived from a particular salt product. More importantly, relying on the severe, immediate effect from acute doses to a general public is not the optimal way of reducing population doses.

Similarly, in a case where there was enough radiation exposure to a group to cause, say, 500 deaths but there were only 100 individuals in the group, each individual cannot die five times over. The conclusion that the population dosage was mitigated by there only being 100 deaths misses the point that severe consequences were occurring for that popuation. (Please note these numbers are for example only; they do not represent the consequences of the scenario analyzed in this report.)

Comment

- The dose calculations are not put into perspective with respect to applicable standards.

AEGIS Response

- In the working document, the doses were not compared with anything. In the current document, comparisons are made with natural background to provide perspective. However, comparison cannot be made with applicable standards, since none now exist for nuclear waste disposal. The draft regulations being prepared by EPA, as of this writing, do not establish dose or health effects standards; rather, limits are placed on the quantities of radionuclides which would cumulatively enter the accessible environment, including underground sources of drinking water, over the 10,000-yr period following closure. Cumulative quantities are presented in this report for comparison with the standards set by the eventual regulations. These values do exceed the current EPA draft numerical limits for releases to the accessible environment.

Comment

- An EPA regulatory trend which should be considered in analyzing the consequences of release is the accessible environment, including ground water. The results of this analysis can be compared with the standards.

AEGIS Response

See the response to the previous comment. In addition, at the time of the geotransport consequence analyses, it was not clear to us that aquifers would be considered to be in the accessible environment nor that cumulative releases there would be the criterion. Thus, the geotransport analyses output concentrations of radionuclides entering the surface water systems and the cumulative quantity of such releases to the surface. If the draft regulations currently existing become promulgated with those provisions, then the AEGIS analyses can readily accommodate such output.

Comment

- The fact that no credit for the reduction of radioactivity was given for purification of salt from solution mining brine is considered to be a major defect in the scenario. A mining operation producing and marketing such a large volume of salt must be sophisticated enough to go through more than just a single stage crystallization process.

AEGIS Response

- As discussed in response to previous comments about the level of sophistication of the solution mining operation compared with its large-sized scale, the consequences of the human intrusion with respect to individual doses would be identical for a greatly reduced scale operation but which had a higher and more realistic fraction of its brine going to culinary salt. Thus, sophisticated technology need not be assumed.

Again in accordance with the AEGIS policy of deemphasizing technology and relying on the physical characteristics of the system, it should be noted that the salt in salt domes is rather pure. For most salt domes, no processing of the salt is necessary to yield directly edible salt. The best information we have suggests that salt dome brine needs just to precipitate out by drying to produce marketable salt. Additional purification may occur if excessive impurities exist, but that should not be relied on as providing a barrier to contact of nuclear waste with human populations.

The actual process of precipitation may result in the reduction of the concentration of some radioisotopes; similarly, it may result in the increase in the concentration of others. This would seem to increase the early time period doses, when the mostly highly soluble fission products dominate, and to decrease the later doses, when transuranics dominate. For an actual site assessment, this phenomenon would be further investigated.

Also, those radionuclides that were purified from the brine would still be in the accessible environment and could affect humans by vectors other than direct consumption.

Comment

- A more rigorous analysis will probably show consequences that are much less severe than currently indicated and quite possibly acceptable.

AEGIS Response

- Although improvements in data and other aspects could certainly be made, the AEGIS report does present a current analyses. Severely reduced consequences would require differing assumptions and perspectives. We believe, however, that choosing assumptions that would lead to severely reduced consequences, to the level where the health effects would be considered acceptable (definition needed), would not be consistent with the performance of conservative, though reasonable, analyses. If our analyses had been based strictly on conservative assumptions, with none of the reasonable nonconservative assumptions we used such as solubility limits, congruent dissolutioning, rates of salt production, and others, the consequences would have been considerably higher.

Using differing assumptions or more refined data would give differing numerical results. However, we believe the conclusions of these analyses would not change unless a series of quite nonconservative assumptions was contrived. We believe the basic conclusion is sound, that human intrusion into a nuclear waste repository located in a salt dome could reasonably lead to consequences that would be considered unacceptable by virtually any criterion. Further, the potential for such adverse impacts on future populations exists far beyond periods of reliable institutional control, information transfer, or engineered barriers, and far beyond the period for which the hazards of nuclear waste repositories are presumed to exceed that of natural ore bodies.

Topic - Geotransport Analyses

Comment

- Geotransport calculations in PNL-2955 assume the repository level at a depth coincident with a subsurface aquifer. In practice, this situation could be avoided.

AEGIS Response

- The Hainesville Salt Dome was analyzed as a reference site, representative of salt domes. Specific characteristics of the site might well be different for an actual proposed salt dome. Such characteristics would be determined based on site exploration, and the detail of information characterizing the site would be greater than presented here for the Hainesville site. Even if a major aquifer were not at the same depth as the repository, geotransport pathways could exist through aquifers of greater or lesser depths, depending on the specific aquifer systems and on repository- and waste-induced effects.

Comment

- Water of usable quality is an inexact term. Quality for differing uses varies (e.g., cooling towers at less than 200 ppm, human consumption at 0 to 1000 ppm, stock watering up to 10,000 ppm). It is suggested that a table with analyses for all aquifers be added to the text.

AEGIS Response

- Such information was not provided to AEGIS, although it would be for an actual site assessment. Current drafts of regulations affecting nuclear waste disposal refer to underground sources of drinking water as being a part of the accessible environment and, therefore, subject to numerical release limits. These current drafts set the water quality criterion, with some exceptions, as water with <10,000 ppm total dissolved solids. These draft regulations are, however, subject to change.

Comment

- The range of values for transmissivity, permeability, etc, makes one wonder how good it is to use average conditions.

AEGIS Response

- These parameters frequently have a wide range of values. AEGIS used the best information made available to us. We have the capability to use very complex sets of data, so that AEGIS models can handle as detailed and heterogeneous data as could be determined from site characterizations. In an actual site analysis, it would be expected that AEGIS would be provided more detailed information.

Comment

- While it may be true that pumping tests are point measurements, values of transmissivity and storage coefficients so derived are representative of the aquifer within the area of influence of the pumped well.

AEGIS Response

- The point made here is well taken. However, as was pointed out in the text, too few transmissivity measurements were made available to AEGIS to develop or draw a good contour map. Ideally, data need to be supplied at all the nodes in the ground-water model.

Comment

- It should be explained as to why model calibration of a 1600-acre/ft withdrawal simulated the depression resulting from an actual withdrawal of 3000-acre/feet.

AEGIS Response

- The data available from 1966 in the Broom (1969) article could not be correlated to the water levels taken from data measured in the period 1952 to 1977. An attempt was made to duplicate the potential contours provided to AEGIS drawn by geologists over these same well data.

Comment

- Can one have much confidence in the models when the potentials have differences of approximately 30 ft? What does this say about which direction the ground water will flow?

AEGIS Response

- As was pointed out in the text, the area modeled covers 10,000 mi^2, and ground-water elevations range from 200 ft in the south and east, to 500 ft in the west, and 450 ft in the northwest. The water levels were taken from historical data covering the period 1952 to 1977. Controls on the well casing elevations were generally taken from topographic maps. The point was made in the text that the model matched the well measurements nearly as well as the hand-drawn contours provided by the field hydrologists.

Comment

- It appears the effects of lower aquifers have been dismissed too quickly. If the text is accurate, then some of the lower aquifers are probably artesian near the dome. If the water is actually saline, not brine, then use of the water should not be ruled out and dissolution of the salt dome could occur if water from the aquifer is accidentally introduced through, for example, an improperly plugged exploration hole.

AEGIS Response

- The information provided to AEGIS concerning the lower aquifers was sparse and not highly reliable. If this were an actual site assessment, the data would be more extensive. If warranted, a scenario such as that proposed in the comment would be addressed.

Comment

- You indicate total salt dome dissolution has occurred within 15,000 yr after the breach. Can it be shown that the solubility limit of the intruding water was not exceeded to accomplish this?

AEGIS Response

- The calculation for the time of salt dome dissolutioning at and above the level of the repository was done by estimating the magnitude of the ground-water flow through the breach and assuming the water leaving the salt dome was essentially saturated with salt. Thus, the 15,000-yr figure is how long it would take for that quantity of salt to be carried away, given the estimated flow, for water near the solubility limit.

Comment

- There should be some indication of the aquifers' water chemistry and whether or not saline plumes have been found.

AEGIS Response

- The water chemistry of the major aquifers was simulated in the solutions used for Kd determinations (see Chapter 11). More complete characterizations were not provided to AEGIS, but would be in an actual site assessment. It is our understanding that saline plumes have been found near the Hainesville Salt Dome. However, our understanding is that the caprock of the Hainesville Salt Dome has been used as an area for pumping saline water underground. Therefore, the source of the saline plumes is uncertain for this salt dome.

Comment

- It is assumed that major solution collapse will reduce the inflow from 260 to 36 gpm (after 15,000 yr). For a conservative analysis, I would think that solution collapse might well be assumed to open up new pathways and increase the flow.

AEGIS Response

- The flow of 260 gpm actually is as conservative as could be used, considering the data available to us and considering that there was no information regarding the near-dome hydrology. That is because the 260 gpm is the calculated flow which is the maximum the Wilcox aquifer could accept, given the 50-ft head driving force. The reason for this reduction of the flow subsequent to the collapse around the original pathway, which was sealed through the overlying sediments and through the Wilcox formation from its top to the top of the salt dome, is that the latter area in the Wilcox would now be open for water from the Queen City to enter without passing over the waste. The total quantity of water entering the Wilcox would not change substantially after the collapse, but only a fraction of it would now contact the residual nuclear waste.

Comment

- Although I have not verified it, the salinity of the well-water pumped in the case of such a massive breach would appear to be so high as to preclude large-scale human consumption.

AEGIS Response

- As indicated in the text, the water in the salt plume resulting from the breach in the side of the salt dome would be nearly saturated with salt, as shown by AEGIS geotransport modeling for Na, and, thus, would not be consumable. However, current draft regulations would consider that water to be part of the accessible environment since it would be so designated before the breach and would remain so designated subsequent to a breach.

Comment

- Reasonable dose estimates can be calculated from contaminated wells. Along the edge of the salt plume will be contaminated water which will nevertheless be potable. No exact location would be necessary to produce useful information.

AEGIS Response

- The point is well taken. However, based on the current draft regulations, as discussed above, the numerical standards would apply even to the salt-saturated ground water. These draft standards do not require dose estimates or health effect estimates to be made.

Comment

- The report states that geotransport after 100-yr or 1000-yr breaches gives essentially equivalent consequences. If this, in fact, is true as a general proposition, then the proposed 10 CFR 60 requirement that no leakage be allowed for the first 1000 yr is ludicrous and a waste of time.

AEGIS Response

- The conclusion concerning a 100 yr or 1000 yr initiation time for geotransport is specific to this analysis and may or may not be applicable to other repository sites. The reason for this conclusion is that the ground-water travel time to the surface water systems is rather long, 15,000 yr. Thus, beginning at time 100 vs 1000 yr does not substantially affect the timing or concentrations of the radioisotopes reaching the surface, especially considering that most have retardation factors above zero, further delaying their release to the surface water systems. At other repository sites which might have much shorter geotransport times, the timing of the initial event becomes more important.

Another point is crucial here, however. The conclusion was made with respect to the time of entry to the surface water systems, not to the time of entry to the accessible environment as defined by current draft regulations. The latter includes underground sources of drinking water, perhaps modified somewhat to mean such sources beyond a minimum distance from the repository. Under that standard, the conclusion would be different, in that the Wilcox aquifer itself would constitute a part of the accessible environment. In that situation, the time of entry of 100 yr versus 1000 yr would make a considerable difference in terms of the quantity and types of radioisotopes released and subject to the draft numerical limits.

Similarly, for any scenario involving a direct pathway from the salt dome repository to the surface (e.g., the solution mining scenario) the timing of the initiation of the event has a marked impact on the results.

Topic - Natural Dissolutioning Scenario

Comments

- The statements of salt dome stability for tens of millions of years and of exceedingly slow dissolutioning rates and the clear implications of the impossibility of significant increase in the dissolutioning rate seem overly optimistic to me, for several reasons.

  One million years might not be realistic or conservative when considering the potential for preferential dissolutioning together with waste heat effects.

AEGIS Response

- The rates of dissolutioning were based on the best available far-field information provided to AEGIS. For an actual site assessment, AEGIS would require better data to reduce the large uncertainty in these estimates.

  Major factors might substantially affect the rates of natural dissolutioning, including the effects on the salt dome of the construction of the repository and the effects induced by the thermal and radioactive characteristics of the nuclear waste itself. AEGIS was excluded from considering these effects, so the conclusions presented in this document concerning the stability of the salt dome are tempered.

  Other factors that could significantly reduce the time for natural dissolutioning relate to the near-dome hydrology and to the details of the structure of the periphery of the salt dome and the immediately surrounding medium. The necessary information concerning this geohydrology of the near field was not provided to AEGIS. Such information would be needed for an actual site assessment.

Comment

- Assuming the caprock formed during the Carrizo-Wilcox deposition to the present gives a longer dissolution time and, therefore, a lower dissolutioning rate. Why not use a higher rate? Couldn't dissolutioning have occurred in a shorter period of time?

AEGIS Response

- The rate of formation of the caprock was only one method used to estimate the rate of natural dissolutioning down to the level of the repository. All estimates gave values many times longer than the one million year time for which AEGIS addressed natural breach scenarios. To be conservative and to compensate for the uncertainty in these calculations, AEGIS chose a natural dissolutioning scenario occurring at one million years as a scenario which would have to be analyzed for consequences. Such analyses were not performed because of time constraints and because the geotransport part of the human intrusion scenario provided a detailed example of how such analyses would be done.

For an actual site assessment, such consequence analysis would be performed. As discussed above, the time of initiation of that scenario would be better refined based on better data characterizing the site and on consideration of repository- and waste-induced effects.

Comment

- The best conditions and effects are often assumed when dealing with limited information or poorly understood processes. For example, the inner- or near-dome structure and hydrology were disregarded in determining credible scenarios. Near-field geologic and hydrologic conditions may significantly influence determining critial pathways, particularly for salt domes.

AEGIS Response

- As discussed above, AEGIS was excluded from considering repository- and waste-induced effects, and no information was provided to us concerning the near-field geologic and hydrologic systems.

Comment

- An unaddressed climatic consideration is whether change in climate could affect the forests in the area, which could change evapotranspiration, which could influence the ground-water travel times and direction.

AEGIS Response

- Considering the excess water available for recharge of the aquifers of concern but which leaves the area via surface runoff, it seems that any likely increase in the evapotranspiration rates would be offset by increased infiltration. Conversely, any decrease in the evapotranspiration rate would be accommodated by increase in surface runoff.

Comment

- Nuclear and non-nuclear explosions should be indicated. They could present a significant step initiating natural dissolutioning of the salt dome.

AEGIS Response

- These and other human activities which do not directly breach a repository but which enhance the natural forces which could breach a repository constitute a hybrid category of breach scenarios. That category is bounded by direct human intrusion and, hence, was not analyzed here. In an actual site assessment, that type of scenario would be addressed.

Topic - Engineered Barriers

Comment

- No credit was given to the canister and cladding as barriers to nuclide release, by direction from ONWI, as this study was intended to show where emphasis should be placed. This is an extreme case and does not, in fact, reflect reality as even a carbon steel canister would provide some protection based on recent data from ORNL. Similarly, zircalloy cladding, an integral part of spent fuel, and more advanced packaging and waste forms may totally eliminate the potential for release.

AEGIS Response

- This comment is valid for those times for which engineered barriers could provide total protection. It is beyond the scope of AEGIS to determine how long that period would be. Also, no information concerning engineered barriers was provided to AEGIS, and we were excluded from considering the effects of engineered barriers.

  An additional point concerning this is that in this revised report, it is now shown what the dose consequences would be for this scenario to occur as far into the future as one million years. It would seem unreasonable to expect engineered barriers would be totally reliable for that length of time, and beyond, which would be necessary for the consequences not to be severely adverse. Coupled with this is the consideration as discussed in the following comment, that the engineered barriers would have to reduce the available surface area effectively leaching radionuclides by a factor of 50 for the doses to even begin to be reduced.

Comments

- It is noted that if solubility limits the source term, then only 1.5% of the surface area of the original inventory is needed to saturate the system and give the doses reported. It is reasonable to assume that collapse of waste canisters or rock falls onto waste canisters caused by the solution mining process could cause exposure of 1.5% of the inventory. These results point out the severe vulnerability of engineered barriers to this scenario and set of assumptions and a possible need for a more conservative design specifically for this hazard.

  The incremental burdens applied to a waste package by a solution mining scenario are definable and not particularly severe.

AEGIS Response

- The AEGIS report does not state that the internal environment of the solution mining cavity would necessarily be severe. However, our calculations do show that only a small fraction (1.5%) of the surface area of the spent fuel would need to be exposed to leaching to result in the calculated severe consequences of the base case scenario. Whether or not the scenario would result in enough physical disruption to expose such a small surface area from otherwise intact engineered barriers is not resolved. An exposure of 1.5% is equally applicable to the consequences calculated for one million years after closure.

Comment

- For analyzing the effects of engineered barriers, specific barrier designs should be devised and their failure probabilities should be estimated.

AEGIS Response

- It is beyond the scope of AEGIS to make engineered barrier designs or evaluate their failure rates. However, the base case scenarios do provide the opportunity for AEGIS to evaluate the effectiveness of engineered designs provided to us in terms of altering the consequences of human intrusion into a salt dome repository.

Comment

- Improved waste forms and package designs, currently a major element of DOE programs, offer a good and perhaps the best mechanism to mitigate the consequences of the scenario.

AEGIS Response

- At ONWI's direction, engineered barriers were not included in this study, so that a baseline could be established of what level of protection, and for how long a period of time, such engineered barriers would have to provide. Calculations presented here suggest their efffectiveness would be needed for very long periods of time, and they would have to provide a very effective reduction (50-fold) in the surface area potentially available for leaching before any reduction in the consequences would ensue. That period of time considerably exceeds the period of fission product activity, the time for which engineered barriers are currently being designed. Indeed, that period of time extends into geologic time scales. While AEGIS cannot make a definitive conclusion until specific engineered barrier characteristics are provided, it would seem that relying on such thorough effectiveness for such long periods of time would be a very stringent requirement for engineered barriers.

  Another point is that there is not defense-in-depth to the scenario of human intrusion by solution mining in a repository located in a salt dome. The geological formation itself (the salt dome) is not a barrier to this scenario; in fact, it provides the attractant. Thus, either some information transfer mechanism must preclude the human intrusion itself, or the engineered systems alone must provide very effective mitigation of the consequences.

Topic - Source Term and Retardation Analyses

Comments

- Great importance is placed on the laboratory evidence of a solubility limit of 6 ppm for uranium from the dissolution of spent fuel elements. This solubility is crucial, I agree, but I believe the use of 6 ppm in the calculations is hardly a conservative assumption, in view of the data given. The effects of radiolysis at the surface of a large mass of waste will differ from those in the standard IAEA tests and conceivably could result in higher dissolutioning rates.

  Applying the nonconservative assumptions of an average uranium solubility limit and congruent dissolutioning moderates the results of the consequence analyses by lowering the doses.

AEGIS Response

- It is quite correct that a great deal of importance was placed on the phenomena of solubility limits and congruent dissolutioning for spent fuel. The initial calculations of the leaching of radionuclides from the spent fuel involved measured leach rates for a number of radionuclides. These rates were measured on a per surface area basis. Likewise, the surface area was directly measured for spent fuel (see the following comment). Simple extrapolation of the leach rates to the scale of surface area available in the repository resulted in predictions that the entire contents of the exposed repository would dissolve in a matter of a few decades.

  Based on this, calculations were made to see if the quantity of water delivered to the surface could carry that much of the radionuclides. These showed that the concentrations of the heavy metals would be very excessive, indicating that the limits on the quantity of radionuclides delivered to the surface would be imposed by the ability of the water to carry them, rather than by the leaching characteristics of the waste form. This severely reduced the critical role that the extent of exposure of the nuclear wastes would have made, since only a small fraction of the wastes need to be exposed to saturate the solution mining brine. And this now made the solubility limit chosen central to the source term.

We agree that the solubility limit chosen for 6 ppm is not conservative. At the time these source term calculations were made, that value was based on the only actual data available to us. The data WRIT has collected since that time indicate a higher solubility limit should be assumed. Currently the value chosen would probably be 18 ppm, based on the uranium concentrations actually analyzed by WRIT in their spent fuel leach tests, although even those data are not based on static tests, for which saturation could be expected.

In considering the effects of using different uranium solubility limits, the source term will change essentially linearly with the solubility limit. (This is not strictly true, because of the leaching which occurs before exposure of enough surface area to result in saturation, i.e., the first year or so of solution mining. However, the difference is not important.) Thus, raising the assumed solubility limit to 18 ppm would triple the dose burdens.

The assumption of congruent dissolutioning also is not conservative. The best data available at the time of the source term calculations, based on WRIT leaching of spent fuel, indicated that although the early stages of leaching show different leach rates for different radionuclides, after a year or so of leaching, the leach rates of all radionuclides approach that of uranium. This is consistent with the prediction of congruent dissolutioning, based on considering that most of the radionuclides in spent fuel are physically bound within the uranium oxide matrix. Thus, they can be released no faster than that matrix is released. More recent data from WRIT studies suggest that this constraint on the other radionuclides in spent fuel may not be so stringent, allowing an increased source term and increased doses.

With respect to radiolysis effects, recent data have shown that enhanced dissolution of UO_2 can be expected. However, what effect this would have on solubility limits and the degree of enhanced leaching has not yet been determined.

Comment

- According to Table 10.1, the spent fuel is highly fractured; over 3% has particle sizes <1 mm. Was the fraction intentionally crushed? What fraction of the radionuclides in the fuel pins was measured? Give references for this work.

AEGIS Response

- This work was done specifically for this reference site analysis; therefore, it is not published elsewhere.

The spent fuel was not crushed. The analyses were done by WRIT staff, taking spent fuel received from the HB Robinson II reactor. That spent fuel had been cut into short lengths before shipment to PNL. On receipt, WRIT staff photographed the exposed spent fuel surfaces to provide a control. Then the spent fuel was pushed out of the rods and sifted through a series of sieves, and the results were as recorded in the table in this report. A check with the photographs was made, assuring that the particle sizes measured are consistent with the condition of the spent fuel before being pushed out.

The results of the WRIT surface area determinations showed the surface area of the spent fuel to be almost five times the surface area of intact pellets. This fracturing occurs as a part of the fuel burnup, not as an artifact of measurement. The numbers were independently verified in the work done earlier for the CWMS (1980) document. There, actual hot cell measurements were not made. Rather, a number of photographs of cross sections of spent fuel was carefully analyzed to determine the particle sizes. These analyses also indicated a spent fuel surface area to intact fuel pellet surface area ratio of almost five.

Comment

- Implicit in the results are important effects from spent fuel rather than reprocessed waste as the source. These implied effects can be seen in Table 1.5, where the total curies of radioisotopes delivered to the surface after 50 yr of solution mining of a spent fuel repository is 2.98×10^7, 1.22×10^6, 3.4×10^5, and 1.5×10^5 for times 100, 1000, 10,000, and 30,000 yr, respectively. Crudely, my calculations show burying high-level reprocessed wastes would give curies on the order of 2.4×10^7, 2.0×10^4, 1.8×10^4, and 1.6×10^4. This gives some indications about the importance of waste form.

AEGIS Response

- The AEGIS analyses originally were done, by direction, only on a repository containing spent fuel. Recent calculations have been done on a repository located in the Hainesville Salt Dome, which contains reprocessed HLW in the quantity comparable to the spent fuel inventory used here. As of the writing of this report, those calculations have not yet been completed.

  One consideration in making such HLW dose calculations is that the source terms from HLW would not be uranium solubility limited. Also, congruent dissolutioning is not evident in the data available concerning leaching of HLW glass forms. This effectively removes a very important ceiling on the source term. On the other hand, the quantity of HLW waste in terms of volume and surface area is reduced from spent fuel, and the long-term inventory would be substantially different.

Comment

- The effects of pressure on the leach tests are not indicated. The McCarthy-type studies should be used instead of the open, nonpressurized tests. The doubts expressed about the state of knowledge are important and serious. However, it should be pointed out if limiting rate theory holds and if only one of the rates is zero, then the total flow within the system is zero. One could possibly engineer around some of these unresolved scientific problems.

AEGIS Response

- The effects of pressure are not indicated because there are none that can be detected within the errors of experimentation. Obviously, pressure was used at elevated temperatures (above 100°C) if leaching was to be conducted in a liquid phase. The elevated temperature tests were conducted by WRIT in an identical fashion to those of McCarthy, and in fact they agree very well with his results where similar samples, leachates, and temperatures were used.

  None of the WRIT tests were open, unpressurized tests. The IAEA test is one example of the tests used by WRIT. It is not open, but, rather, involves sealed systems. The pressure varied from atmospheric at room temperature to 2000 psi at temperatures above 100°C. There was no observable effect over this pressure range.

Comment

- The section on mineralogy is unacceptable and should be redone.

AEGIS Response

- This section was presented to demonstrate the types of analyses which would be done for an actual site assessment. The WRIT program is currently enhancing its capability in this area, and were those analyses to be done now, they would be substantially improved.

Comment

- The Kd determinations appears fraught with uncertainty. It certainly does not instill confidence in the ability to measure these parameters.

AEGIS Response

- The WRIT program has developed a very substantial expertise in measuring sorption and desorption processes. The large uncertainties apparent in this document reflect the presentation to WRIT of samples that are very nonrepresentative of the actual geological media of concern. Time constraints prevented better samples being provided to WRIT. Nevertheless, the sections dealing with the outcrop samples do demonstrate the types of analyses which would be performed for actual site assessments, for which appropriate samples would be available.

The secondary source of information, for those situations where actual samples are not available for WRIT analyses, involves the WRIT Kd data base, and the predictor equations WRIT has derived based on those data. That data base is quite extensive, and it covers a wide variety of radionuclides, geomedia, and ground waters. The predictor equations derived empirically continue to be improved in their predictive capabilities.

Comment

- It cannot be over-emphasized that the validity of using Kd values measured on crushed or even uncrushed material in short-term laboratory experiments to predict long-term in-situ migration is tenuous at best. The WRIT program has not solved this problem. Also, depending on the pathways through the host rock, the Kd values of the bulk material may not be at all appropriate for the weathered surfaces that the radionuclides may actually contact.

AEGIS Response

- The first statements reflect a purist viewpoint versus a more practical viewpoint. WRIT has not solved the aspects of nuclide sorption to the level of undeniable first principles, of course. But the predictors of nuclide sorption developed by WRIT are reasonably reliable and continue to be more so.

Comment

- The determination of the acid dissociation and electrolyte exchange constants of the sorbing surfaces through acid/base titrations can be useful in interpreting or predicting the variation of exchange capacity with pH and concentration of sorbing ions.

AEGIS Response

- This is a valid comment, but ion exchange is the key to only a few nuclides. Thus, it would add a lot of meticulous work for little net benefit.

Comment

- A statement is made that the rate of desorption in short-term laboratory studies is slower than the rate of adsorption for some elements. One explanation of this phenomenon is that the radionuclide is adsorbed in one form but must be desorbed in quite another form. For example, an oxygenated uranium solution containing UO_2^{+2} salts will be adsorbed by limestone. In this reaction, however, the $UO_2(CO_3)_3^{-4}$ complex is possibly formed. As a result of this complexation, the desorption Kd will probably not equal the adsorption Kd (the assumption used in mathematical transport models) because of the two (or maybe even more) separate uranium species involved in the adsorption/desorption process.

AEGIS Response

- This explanation is less likely than Neretnieks' concept that diffusion into the bulk rocks occurs when the radionuclides are absorbing under a large concentration gradient. It then takes longer to diffuse out on desorption when the concentration gradient is lower. Also, redox sorption/precipitation, such as Dhan Rai et al. (1980) of WRIT has shown for Pu(VI,V) → Pu(III,IV), holds onto the adsorbed radionuclides strongly.

Comment

- The importance of surface area and surface reactions has not been emphasized strongly enough. The concept of ion migration (in this case, radionuclide migration) in geological materials essentially involves both bulk and surface phenomena: the initial step in the mechanism of radionuclide adsorption by a mineral must involve a radionuclide/mineral interface followed by subsequent reactions with the bulk. The initial surface reaction will be heavily dependent on the amount of surface available as a reaction site. For example, quartz, a major component of several of the samples of oolitic limestone and argillaceous shale used in the WRIT program, has been shown to undergo reactions whose rates are severely dependent on the surface area. The surface areas for oolitic limestone and argillaceous shale (using the B.E.T. method on 20 to 50 mesh samples), however, are 0.75 and 20.7 m^2/g for the two samples, respectively.

AEGIS Response

- Whether surface area reactions should be stressed more is subjective. One could just as well argue that the allowable time of reaction in a real world geotransport situation is so long that the kinetic effect one observes in the laboratory would have gone to completion very long before the radionuclides would reach the surface. This point is basically a physical hydrology point, not a chemical problem.

Comment

- Assuming that one has the fracture surface area and the fracture volume are very big "ifs". You should reference the Stripa work. You should also point out that the laboratory studies give different results than field studies. One should be going to the field for corroboration.

AEGIS Response

- To the knowledge of the WRIT staff, there is no radionuclide migration work performed at Stripa to date. Laboratory studies do not necessarily give different results than field studies. See the KBS-110 study by Landstrom et al. (1978) for work at Studsvik. Within experimental and field uncertainties, Kd values for most elements agreed. The migration of radionuclides from OKLO also agree with thermodynamic calculations.

Topic - Site Characterization

Comments

- The chaper on site characterization contains sufficient information as a demonstration, but it is not put together in a thoughtful manner. I get the impression it is taken from an engineering report. The section reads like a commercial geology report and as such does not inspire confidence in the reader that a fundamental understanding of the geology of the region has been attained.

  Far-field characteristics are missing important types of information regarding the geologic, hydrologic, and geochemical characteristics of the site, the site's resource potential, and the source term. In many cases the boundaries of the geological and hydrological investigations are inappropriate since they do not coincide with the input needs of scenario and consequence analysis.

  The site characterization section omitted important types of data, including resources and extraction, reservoirs, salt dome stability and growth history, dissolution processes, hydrogeologic parameters and controlling factors, geochemistry of surrounding rock units, inner dome structure, permeability, and water content. A characterization better suited for this type of assessment report would be one which more directly supports the scenario and consequence analysis.

AEGIS Response

- Each of these comments, and other similar ones received, are quite valid. In an actual site assessment, the quality and depth of site characterization data would be considerably improved. As noted in the report, site characterization information is provided to AEGIS by other ONWI contractors. This reference site analysis provided useful experience in determining for AEGIS what types of data could be expected and for the site investigators what types of data AEGIS and WRIT require. The data being provided on the current reference site analysis in a different geological medium are considerably better attuned to the needs for scenario and consequence analyses.

Topic - Scenario Analysis Methodology

Comment

- Scenario anaysis should 1) identify all credible release scenarios, 2) conceptualize for each credible scenario the sequence of events leading from the initiating disruptive event to a release, 3) quantify this sequence of events, and 4) through modeling exercises, including sensitivity analysis, determine the initial and bounding detailed scenarios. The approach to scenario analysis in this report falls short of what is needed by only presenting final and bounding scenarios resulting from a Delphi/expert opinion and peer review process. Other important scenarios might be overlooked or unnecessarily deemphasized.

AEGIS Response

- The AEGIS scenario methodology is continuing to be developed. The direction of the approach is indicated in Appendix A, describing the computer-assisted methodology under development. That methodology is to provide an auditable, systematic way to identify credible scenarios, involving sequences of events and processes. However, the methodology was not in place at the time of scenario analysis for this reference salt dome assessment. In an actual site assessment, the AEGIS scenario analysis methodology should be fully developed.

  With respect to the elements of a scenario analysis, it should be understood that all possible, credible scenarios cannot be specified, quantified, and have their consequences analyzed, since there are an infinite number of such scenarios. Rather, credible scenarios will have to be grouped in a way appropriate for a particular geological medium and a particular repository site. Then for those groups of scenarios, realistic and upper and lower bounding specific scenarios should be determined, quantified, and analyzed. Sensitivity analyses should then be performed to identify the important parameters affecting the consequences of each scenario group.

The final point here is that the scenario analysis of this report determined what scenarios were plausible and eliminated others as being implausible. Among the plausible types of scenarios, the major type chosen for analysis represents a bounding class of scenarios, that of human intrusion by solution mining for culinary salt production. Within that bounding class of scenarios, a conservatively representative set of parameters was chosen quantifying the scenario; i.e., the most bounding parameters were not chosen. The approach in this report 1) provided an example of the types of scenario development and exclusion done by AEGIS, 2) provided an example of how a chosen scenario type would be quantified and analyzed, and 3) provided information on key scenario problems for locating a repository in a salt dome. We do not purport to have considered all scenario groups in the detail necessary for an actual site assessment.

Comment

- The solution mining scenario is somewhat similar to a loss-of-coolant accident in a nuclear reactor. A more thorough discussion of secondary effects is important. Sequences of several minor mishaps can, however, lead to similar major consequences, and it is crucial that the reader not be left with the impression that releases of waste from a repository would be most likely to occur in a single step.

AEGIS Response

- This is a valid comment. As discussed for the previous comment, the AEGIS scenario methodology is being developed to treat systematically sequences of events leading to a release to the accessible environment as well as single event releases.

Comment

- One troublesome feature of the scenario approach is the reliance on the Delphi method for identifying branch scenarios. Presumably the modified Delphi method will include a way to demonstrate convergence of opinion among several sets of "experts". If not, the procedure is questionable, since it will be totally dependent on selection of the "perfect" set of experts, a most unlikely event.

AEGIS Response

- It is apparent that an ideal set of experts is not attainable. However, AEGIS intends to optimize its expert opinion considerations by using a variety of experts in an auditable way, using the computer code to assist in scenario analysis, and subjecting its scenario analyses to extensive peer review.

Comment

- In the climate section, the possibility of human-induced changes (e.g., ozone layer and CO_2) in climate are excluded. Although there is much unknown about what could or will happen, it still seems essential to attempt a quantitative evaluation of those changes.

AEGIS Response

- The climate considerations are largely based on a very long geological record that indicates patterns and causal mechanisms for climatic changes and that bounds the probable climatic conditions over the next one million years. Cultural impacts on climate have an extremely short historical record, and extrapolation into the future based on that record cannot now be done beyond a few decades.

  Another point is that for this reference salt dome, climatic change is not a sensitive parameter with respect to affecting the integrity of the repository. For a different site for which climate was a major factor, an attempt would be made to address human-induced climatic changes insofar as possible.

Comment

- Appendix A, describing the methodology under development, employs basalt as an example problem. This is confusing and largely irrelevant.

AEGIS Response

- Basalt is used as the example because as of the date of writing this report, that is the only geological medium for which a scenario analysis computer code has been developed. AEGIS chose basalt for initial development because 1) it is a medium that has been under study for some time, so we know the most about it, 2) it is under serious consideration for a repository, and 3) its geological considerations are complex, so that use of a computer is most advantageous. If warranted for other geologic media, the code will be modified to be applicable for other media.

Comment

- In Appendix A a brute-force stochastic approach is outlined. Although this may give the appearance of greater objectivity than the opinion approach, it does not necessarily incorporate better source data, and the problem remains of deciding the level of improbability at which an event can be disregarded. It does possess the advantage of facilitating the handling of coupled or interactive events.

AEGIS Response

- This is a valid comment. The intent of the computer-assisted methodology is not to provide a sophisticated output which obscures a lack of understanding of the geological processes involved. Rather, the computer code is designed to provide an auditable way of treating the information, input from empirical data as well as from the subjective judgment of geoscientists, and tracing the scenario developed back to that input information. Additionally, it provides a way of treating the multiple interactions among the various processes and events.

  It also should be emphasized that the subjective judgment of experts is a major basis for AEGIS scenario analysis. Many of the phenomena of interest cannot be quantified explicitly to provide specific, reliable predictions as to the magnitude or timing of events. Hence, many phenomena are treated as probability distribution functions, which rely upon that subjective judgment. The interactive and user-determined nature of the AEGIS code optimizes the utilization of differing experts with differing judgments, thus providing a way to evaluate the sensitivity of the analysis to expert opinions.

Topic - Geotransport Analysis Methodology

Comment

- We have been concerned about model verification for some time. I think that model verification by means of field testing is very important and should be done as part of your program. The discussion about "conservative" assumptions is meaningless unless it can be shown that the models accurately reproduce reality. Model verification should precede sensitivity analysis.

AEGIS Response

- The AEGIS program is committed to developing as much independent verification of its geotransport models as possible. This includes a wide range of such verification, from simple benchmark comparisons of computer models against analytical solutions, and test cases of models to assure correct solution of particular computer runs, to more complex comparisons of computer model predictions against real world data on the specific processes being addressed, and finally to validations of computer model predictions for phenomena on the time, complexity, or spatial scales appropriate for geotransport analysis. It should be understood, however, that it may not be possible to validate some aspects of geotransport using empirical data, since there is no way to collect data for the next thousands of years.

With respect to the comment about conservative assumptions, we disagree that they are meaningless without final validation of models. The assumptions listed in this report largely can be evaluated as to their conservative or nonconservative quality without resorting to specific model predictions. Thus, for an assumption which involves, for example, a solubility limit on uranium placing a ceiling on the release of all radioisotopes below what could have been released under unrestricted leaching, it can confidently be stated that is a nonconservative assumption, because the contrary assumption would lead to increased doses.

Similarly, the assumption that all of the ground water flowing from the Queen City to the Wilcox occurs through a narrow, sealed pipe and passes directly over the exposed spent fuel is a conservative assumption, because if any part of the water passed into the Wilcox without dissolving some radionuclides, the dose values would be decreased. Both of these conservative versus nonconservative assessments, as well as a large number of other assumptions, are valid irrespective of the accuracy or precision of models of geotransport.

Finally, we do not agree that model verification should precede sensitivity analyses. Both represent needed aspects of consequence analysis, but they are not necessarily causally dependent. Thus, sensitivity analyses, which are much easier to perform, can be done while verification has not yet been completed.

In addition, sensitivity analyses can indicate the phenomena or parameters which make a major impact on calculated predictions, as well as those which have little effect on results. This can be useful information in designing and performing empirical validations of models, in indicating physical phenomena that need to be better understood, in assisting the design and conceptualization of the engineered repository system, in assisting the selection of criteria for site selection, and so on.

Comment

- It is not clear why the finite difference model was used instead of using 3DFEGW throughout, since the far-field geometry is still difficult.

AEGIS Response

- AEGIS geotransport methodology is based on having a number of interactive computer models, ranging from simple, analytical one-dimensional models to the complex three-dimensional models capable of handling heterogeneities over time and space. The use of particular models is determined by the specific application as well as the complexity of the available data. For the far-field analyses, the data did not warrant using the three-dimensional model, so two-dimensional flow was simulated by using multiple, simultaneous analyses of one-dimensional tubes flow. On the other hand, the near-dome hydrology provided an opportunity to demonstrate the capability of the 3DFEGW model.

Comment

- Is the one-dimensional transport model conservative? If so, by how much?

AEGIS Response

- By most definitions, a conservative model will consistently overestimate concentration or flux levels within the flow pathway, and especially at the entry of the radionuclides into the accessible environment. Note that here the accessible environment may include an entire aquifer.

  Restriction of the entire dissolved contaminant mass to a tube flow (hypothetical 1-D system with cross-sectional dimensions) representing the most direct convective flow path seems to provide conservative estimates, at least within the specified tube flow. However, concentration levels outside the tube flow are not conservative, because they are zero (i.e., not estimated). For the salt dome geotransport simulation, the exit rate to the surface water system, however, was the emphasized quantity. The outflow is reported in terms of exit concentration, based on the water velocity.

The quantitative degree of conservatism cannot be assessed without simulating the actual three-dimensional system, for which data were insufficient. An approximate 3-D system composed of multiple flow tubes could be used to study this question in the future. However, it seems reasonable to assume that concentration or flux levels established by transverse (lateral) dispersive effects within the actual system would never exceed those modeled in a flow tube connecting the repository and preselected observation locations.

In terms of contaminant arrival time along a flow tube, it is not certain if the shortest travel time for the actual system is predicted. But this uncertainty is unavoidable without additional real data, and is the basis for using an effective dispersion parameter.

Comment

- What is the justification for the statement that effective dispersion was assumed to dominate the transport?

AEGIS Response

- Present research seems to indicate that megascopic dispersion effects can be related to the velocity variation or flow uncertainity in a ground-water system. The dispersion parameter for that length scale is typically orders of magnitude greater than that constituted by a local hydrodynamic dispersion coefficient, which is usually determined on media samples. Megascopic dispersion is a result of global variations and is a characteristic of a particular flow system, whereas true hydrodynamic dispersion is viewed as an intrinsic property of local hydrogeologic media. In principle, if complete information on flow was obtainable at a megascopic scale, then fluid velocity and a hydrodynamic dispersion coefficient (in general, a tensor) would suffice to characterize dispersive transport. However, fluid velocity is always measured on realized systems, as an average quantity. The velocity variation from that average is ultimately responsible for dispersive behavior that can not be explained by an average velocity and a locally measured hydrodynamic dispersion coefficient as used in the classical transport equation. Thus, the insufficiency of data and uncertainty about the actual flow system compel introduction of a megascopic dispersion phenomenon, and hence of an effective dispersion coefficient.

In the application in this report, the velocity streamlines obtained from hydrologic modeling defining a flow tube were taken to be equally probable as transport pathways. Then the flow velocity variation (travel time variation) over streamlines was identified with the megascopic spatial dispersion variance, $2D^*T$. Independent simulations for each component streamline with equally divided released contaminants, would achieve the same total simulation objective, but not as efficiently as a single flow tube representation employing the effective dispersion parameter D^*. A theoretical basis for this approach is discussed in Simmons (1980).

Comment

- I am confused by the discussion in Chapter 8 which attempts (without success) to dismiss the need for two-dimensional transport and the presentation of Appendix D which appears to discuss a two-dimensional simulation. Note in this regard that the uncertainty arguments used to dismiss the need for sophisticated transport model in Chapter 8 also hold for flow calcuations. I find the entire discussion of transport unacceptable.

AEGIS Response

- The introductory discussion on transport was not meant to dismiss the need for two-dimensional transport analysis. It indicates instead the difficulty with proceeding beyond one-dimension with an inadequate basis of information. Without a reasonable estimate of the dispersion tensor components applicable to the required megascopic scale, it does not seem appropriate to proceed with the pretense of complete knowledge suggested by a solution for the two- or three-dimensional convective-dispersion equation. Moreover, at this time the very foundation for applying that classical transport equation to the scale of an aquifer is being questioned. As interested and serious researchers in the subject, we are also disappointed in the failed opportunity to perform a higher dimensional analysis of the system. The transport by convective flow could have been simulated directly. But in a laminar flow system without lateral dispersive exchange between streamlines, the accumulated one-dimensional transport along individual streamlines should represent the same results. Furthermore, only the streamlines intercepting the release region would need to be included in any such convective flow system. An attempt, however, was made to reintroduce the effects of lateral dispersion by allowing the random exchange of solute between streamlines containing a megascopic flow tube. Effects of lateral dispersion as represented by the cross-sectional dimensions of the flow tube were thereby included in an effective (forward) dispersion parameter. It is emphasized for this method that the one-dimensional transport algorithm, however, is not altered; a dispersion parameter with a different physical origin is employed. The objective is estimation of a biosphere entry flux, and an exact calculation of solute concentration within the region was not required.

Appendix D describes both the general 2-D MMT-DPRW transport model and some more specific details used in the 1-D version. There should be nothing unusual in describing the general features of the model and the sèlected restriction of application to a 1-D case. Appendix D was extracted from a Battelle report (Washburn et al. 1980), and it is a continuation of the subject begun in Ahlstrom et al. (1977). The commenter should have received copies of those reports.

We believe the reviewer's comment that the uncertainty restrictions placed on transport modeling apply as well to the water flow modeling to be absolutely incorrect. The nature of these problems is entirely different. Ground-water modeling of the system (Chapter 7) included relatively detailed information on transmissivities and the potential field. The associated flow velocity field (streamlines) is the backbone of the transport process, regardless of the dimensionality of the transport representation. It is generally accepted that water flow in a steady or quasi-steady flow state is adequately described at aquifer scale by hydraulic properties averaged over large subregional elements, although an important current research topic is the influence of uncertainty or spatial variability of parameters (Neuman 1979; Sagar 1978). On the other hand, averaged quantities may not correctly describe the dispersive details of an advancing solute front, which is sensitive to detailed flow variations about the average. In particular, current transport research indicates there is more than mere uncertainty of input parameters such as dispersivity. Indeed, the validity of Ficks' law and the classical transport equation applied at megascopic scale are under question (Matheron and DeMarsily 1980; Smith and Schwartz 1980). The indicated concepts employed in this report's admittedly simplified transport analysis is discussed at length in another report (Simmons 1980).

In summary, we do not wish to dismiss the need for more sophisticated transport modeling. No sincere scientist should avoid using the best available mathematical models for so important an application as a nuclear waste repository analysis. However, we do object to applying a higher dimensional model without the necessary valid input parameters.

Comment

- I could write a book on why the discussion on mass transport is unacceptable: to summarize let me point out...

  1. the method developed by Pinder and Cooper attempts to solve the transport equation

  2. the particles are injected to trace the characteristic curves

  3. this approach may conserve mass but this is only a necessary not sufficient condition to assure one has solved the transport equation

4. the method as proposed does not purport to solve the transport equation (at least I have never seen any proof to that effect)

5. I abandoned the particle approach 10 yr ago because one could not obtain an error estimate; i.e., one could not demonstrate rigorously either consistency or convergence. The method presented suffers from the same limitation. I see no mathematical foundation to this approach.

6. Inasmush as one does not explicitly solve the transport equation but rather try and represent the physics by analogy, why bother with all the preceding discussion devoted to developing and explaining the transport equation?

7. One of the classic problems with this approach arises in a divergent flow regime, e.g., near an injection well. The particles move further and further apart until the solution within a cell becomes meaningless. To add particles is to add mass, thus a dilemma arises.

8. In my opinion, many of the steps taken to obtain a solution using this approach are closer to witchcraft than science, e.g., the location of new parcels as on D-23.

AEGIS Response

1. The one-dimensional MMT model as it now stands, based on discrete parcels of mass, does solve the classical convective-diffusion equation. A design was developed that emphasizes calculation of exit solute flux, although the spatial concentration distribution is obtained also with somewhat less accuracy and efficiency. Comparison runs with an analytical model were described elsewhere (Washburn et al. 1980). Comparison tests have also been made (not reported) using the velocity ensemble development reported by Simmons (1980), and agreement was very good.

2. It seems obvious that particles will trace characteristic curves (streamlines) when assumed a priori that solute is carried without deviation by the fluid stream. This is the very basis for

representing 3-D convective transport as a finite number of 1-D systems. If a particle transfer mechanism is known between streamlines, the transport is still representable by a collection (ensemble) of pathways through the system. The classical or Fickian dispersion mechanism is described stochastically by a random walk relative to a coordinate frame moving along characteristic curves with the water velocity.

3. This statement is true in any context--mass should be conserved. But the condition does not guarantee a solution to any particular phenomenological (dynamic) transport equation.

4. The method employed here is a direct extension of a fundamental theorem on stochastic processes describing the relationship between a stochastic differential equation of the Wiener process (Brownian motion) and the diffusion equation (Fokker-Plank). A book by Cox and Miller (1965) is an excellent reference to fundamental literature, and the classical work in Wax (1954) is basic.

5. The method used here is not that applied by Pinder and Cooper (1970). Rigorous statements of consistency (defined how?) and convergence are found in the realm of stochastic processes, not in finite element or difference mathematics. Limitations on attainment of theoretical results, however, are imposed by approximations required by computer codes. But all mathematical methods suffer the same problem. A random walk approach allows for a more fundamental error estimate based on sampling a stochastic process which is perceived as an analog of the actual physical system, rather than based on convergence of a series approximation.

   A random walk simulation generates one possible realization of a continuum system actually composed of particles, whereas a solution of the classical equation represents the ensemble average. Note that it is not claimed that the particles need actually be atoms nor that a random walk is the microscopic movement process within the real fluid system. In some cases, the random walk particle model may appear to be more like the actual system. When observing an actual system composed of clouds of particles, one is more likely to observe only one member of the concentration distribution ensemble than its average. This is a main reason why measurements seldom match theoretical limits at various physical scales, excluding of course effects of instrument measurement error.

The accuracy and convergence of the MMT-DPRW model can be tested in a way similar to other numerical models. Convergence is tested by increasing the number of parcels and by refinement of the movement time step. Finite difference or finite element methods do not solve the transport equation exactly either. All methods implemented by computer codes produce approximations.

6. The discussion in Appendix D was meant only to contrast the usual equation-based approach and the direct simulation approach.

7. The dilemma of sampling concentration in a divergent flow can be resolved by injecting more particles of smaller mass at initialization of the simulation. If it is known at the beginning that concentration is to be sampled in a given cell, then the model itself can be applied to estimate how many particles must be released to achieve an accurate estimate. Indeed, if statistically independent simulations are accumulated within any cell and averaged, the desired accuracy could be attained. This approach is usually very inefficient with computer time, but it will work. Admittedly, the random walk approach is currently slower than other equation-solving methods, but new generations of parallel processing computers may change the situation. An outstanding attribute of the direct simulation

approach is its application flexibility. In this salt dome application, a simple alteration of the code allowed retardation of radionuclides to be controlled by the presence or absence of a dissolved salt plume. The approach easily solves an advancing front problem, whereas the other methods suffer numerical difficulty.

8. Certainly a weakness in the MMT 1-D model is its lack of theoretical verification for describing transport subject to chain decay and chemical absorption. But direct comparisons with exact analytic solutions have shown that basic mechanisms are accounted for. We do not consider kinematics with respect to a moving reference frame as witchcraft. Equation 17 on page D-22 is based on the relative motions of both parent and daughter radionuclides. If the time steps were made sufficiently small, then consideration of such relative motions could be eliminated. However, Equation 17 is employed to allow larger, more efficient time steps.

Comment

- Many of the graphs in Appendix G illustrate rather unusual curves. I assume the behavior to be real rather than numerical, and I think a discussion of these curves would be in order. Consider, for example, G-20, G-22, G-28, G-38, G-40, and G-90.

AEGIS Response

- The graphs in Appendix G are the result of applying a running average time series filter (smoothing) to the MMT 1-D flux estimation output. The residual statistical fluctuations are evident as smaller period variations on the overall graph, and are statistical artifacts. Such variations could have been further smoothed, but with the cost of possibly altering the overall curve. Random fluctuations are a normal and correct feature of the random walk approach, but similar behavior in a numerical finite element or finite difference equation represents a failure of the algorithm.

For example, all features shown on G-16 for carbon-14 are real behavior. G-19 was not smoothed properly and should have looked like G-18. The top of G-20 should be nearly flat, and an enlarged smoothing based on more points shows this in G-21. Difficulty in reading such curves does present a problem in some cases. However, it was not the objective of these simulations to obtain precise curve shapes, but only approximate estimates of peak values within ranges of time for dose calculations. Cases with borderline results can be decided by further simulation.

Comment

- The statement that the dispersion caused by velocity variation between streamlines usually dominates the porous media longitudinal dispersion, which is a microscopic phenomenon seems to suggest that transverse dispersion is greater than longitudinal--contrary to observation and established theory.

AEGIS Response

- On the contrary, the flow tube model is based on a relatively large longitudinal and small transverse dispersion coefficient. Transverse dispersion is represented by spreading within cross-sectional dimensions during a transversing of the flow tube length (a travel time).

Comment

- What is the meaning of D+D* (end of Chapter 8)?

AEGIS Response

- The meaning of D+D* is the sum of both dispersion coefficients for global and local variations in velocity.

Comment

- I disagree with the statement that the level of complexity of a model used for simulating actual release consequences is not justified beyond the complexity and quality of the input data. You need the complexity necessary to describe the physics to the degree required to answer whatever question is being posed. Then you obtain the best estimate of the required parameters.

AEGIS Response

- We agree with the reviewers' comment about the need entirely to describe the physics. However, when related parameters are not available or are even of questionable validity, it may be better to elimate a physical process such as lateral dispersion temporarily until further information becomes available. The judgmental process of including or excluding parameters from a physical model seems to depend on predictive objectives. In this application the objective was to emphasize a bounding case of movement of radiocontaminants toward specified environmental entry points. The conservative judgment was to minimize solute dilution by removing the effects of lateral dispersion. Such a choice seems to warrant selection of a one-dimensional, simplified model transporting directly between release and observation locations. The dispersion parameter used for the longitudinal direction was selected to represent an extreme of variation in the flow direction. If the objective had been instead to simulate a worst case dispersal throughout the aquifer region, then a two-dimensional simulation using a greatest possible lateral dispersion parameter based on flow direction uncertainty would seem to be called for. A 2-D simulation could not be avoided then.

REFERENCES TO VOLUME 1

Ahlstrom, S. W., et al. 1977. Multiple Component Mass Transport Model: Theory and Numerical Implementation (Discrete - Parcel - Random - Walk - Version). PNL-2127, Pacific Northwest Laboratory, Richland, Washington.

Barton, D. E. 1933. "Mechanics of Formation of Salt Domes with Special Reference to Gulf Coast Salt Domes of Texas and Louisiana." Bull. AAPG v. 17, no. 9, pp. 1025-1083.

Bates, R. C. 1969. Geology of Industrial Rocks and Minerals. Dover Publications, New York.

Brandstetter, A. et al. 1979. Waste Isolation Safety Assessment Program Technical Progress Report for FY-1978. PNL-2874, Pacific Northwest Laboratory, Richland, Washington.

Broom, M. E. 1969. "Ground-Water Resources of Gregg and Upshur Counties, Texas." Rept. No. 101, Texas Water Devel. Board.

Brown, E., et al. 1970. Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases. Book 5, Laboratory Analysis. U.S. Government Printing Office, Washington DC.

Burkholder, H. C. et al. 1979. Waste Isolation Safety Assessment Program Technical Progress Report for FY-1977. PNL-2642, Pacific Northwest Laboratory, Richland, Washington.

Centanni, R. A. M., and M. A. DeSesa. 1956. "Flourometric Determination of Uranium." Anal. Chem. 28(11):1651-1657.

Claiborne, H. C. and F. Gera. 1974. Potential Containment Failure Mechanisms and Their Consequence at a Radioactive Waste Repository in Bedded Salt in New Mexico. ORNL-TM-4639. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Cox, D. R., and H. D. Miller. 1965. The Theory of Stochastic Processes. John Wiley & Sons Inc., New York.

CRRD. 1979. Conceptual Reference Repository Description. Prepared for Battelle Memorial Institute, Office of Nuclear Waste Isolation by Bechtel National, Inc., San Francisco, California.

CWMS. 1980. Final Environmental Impact Statement, Management of Commercially Generated Radioactive Waste. DOE/EIS-0046F, U.S. Dept. of Energy, Washington D.C.

Davis, S. N. 1980. Hydrogeologic Effects of Natural Disruptive Events on Nuclear Repositories. PNL 2858, Pacific Northwest Laboratory, Richland, Washington.

Davis, S. N. and R. J. M. DeWiest. 1966. Hydrogeology. John Wiley & Sons, New York.

Dillard, J. W. 1963. "Availability and Quality of Groundwater in Smith County, Texas." Texas Water Comm. Bull. 6302.

Dosch, R. G., and A. W. Lynch. 1978. Interaction of Radionuclides with Geomedia Associated with the Waste Isolation Pilot Plant (WIPP) Site in New Mexico. SAND 78-0297, Sandia Laboratories, Albuquerque, New Mexico.

Erdal, B. R., et al. 1979. Laboratory Studies of Radionuclide Distribution Between Selected Groundwaters and Geologic Media. Quarterly Technical Progress Report, Oct. 1-Dec. 31, 1978, LA-7638-PR, Los Alamos Laboratory, Los Alamos, New Mexico.

Etter, E. M., ed. 1978. Field Trip to Damon Mound. Houston Geological Society Guidebook, Houston, Texas.

Finston, H. L. 1961. The Radiochemistry of Cesium. NAS-NA 3035, Nuclear Sciences Series.

Francis, C. W., et al. 1979. "Chromatographic Kd Values of Radionuclides and the Effect of Redox Potentials on Sorption of Radionuclides by Geologic Media." In: WISAP Task 4 Second Constructor Meeting Proceedings, ed. R. J. Serne, PNL-SA-7352, Pacific Northwest Laboratory, Richland, Washington.

Gary, M., K. McAfee, Jr. and C. L. Wolf, eds. 1974. Glossary of Geology, American Geological Institute, Washington, D.C.

Grandstaff, D. E. 1976. "A Kinetic Study of the Dissolution of Uraninite." Econ. Geol. 71:1493.

Griswold, G. B. 1980. Solution Mining in Salt Domes of the Gulf Coast Embayment. PNL-3190, Pacific Northwest Laboratory, Richland, Washington.

Halbouty, Michel T., and George C Hardin, Jr. 1956. "Genesis of Salt Domes of Gulf Coastal Plain," Bull., AAPG, v. 40, no. 4, pp. 737-746.

Halbouty, Michel T. 1967. Salt Domes Gulf Region-United States and Mexico. Gulf Publishing Company, Houston, Texas.

Hartmann, W. K. 1978. "Long-Term Meteorite Hazards to Buried Nuclear Waste Materials." In A Summary of FY-1978 Consultant Input for Scenario Methodology Development. ed. Scott et al., PNL-2851, Pacific Northwest Laboratory, Richland, Washington.

Hawkins, M. E., and C. J. Jirik. 1966. "Salt Domes in Texas, Louisiana, Mississippi, Alabama, and Offshore Tidelands, A Survey." Info. Circ. 8313, U.S. Bureau of Mines.

Hespe, E. D., ed. 1971. "Leach Testing of Immobilized Radioactive Waste Solids, A Proposal for a Standard Method." Atomic Energy Review, 9:1.

Holland, H. D., and L. H. Brush. 1978. "Uranium Oxides in Ores and Spent Fuels." In Proceedings of High Level Radioactive Solid Waste Forms, ed. L. A. Casey, NUREG/CP-0005, p 597. Denver, Colorado.

ICRP (International Commission on Radiological Protection). 1959. Report of Committee II on Permissible Dose for Internal Radiation. ICRP Publication 2, Pergamon Press, New York.

Johnson, K. S., and S. Gonzales. 1978. Salt Deposits in the U.S. and Regional Geologic Characteristics Important for Storage of Radioactive Waste. OWI/SUB-7414/1.

Joint Committee on Powder Diffraction Standards. 1980. Mineral Powder Diffraction File. Joint Committe on Powder Diffraction Standards, Swarthmore, Pennsylvania.

Kehle, R. O. 1980. Assessment of Tectonic Hazards to Waste Storage in Interior-Basin Salt Domes. PNL-2864, Pacific Northwest Laboratory, Richland, Washington.

Kirby, H. W., and M. L. Salutsky. 1964. The Radiochemistry of Radium. NAS-NS-3057.

Koltoft, I. M., and P. J. Elving. 1966. Treatise on Analytical Chemistry. Part II, Volume 4, Intersciences Publishers, Inc., New York.

Kupfer, D. H. 1974. "Shear Zones in the Gulf Coast Salt Delineate Spines of Movement." Transactions - Gulf Coast Association of Geological Societies, v. XXIV.

Kukla, G. 1978. "Probability of Expected Climate Stresses in North America in the Next One Million Years." In A Sumary of FY-1978 Consultant Input for Scenario Methodology Development. ed. Scott et al., PNL-2851 Pacific Northwest Laboratory, Richland, Washington.

Landstrom, O. 1978. "In-Situ Experiments on Nuclide Migration in Fractured Crystalline Rocks." KBS Technical Report 110, Stockholm, Sweden.

Law Engineering Testing Company. 1979a. Gulf Coast Salt Dome Geothermal Study. Marietta, Georgia.

Law Engineering Testing Company. 1979b. Preliminary Report on the Geology and Hydrology of the Hainesville Dome, Wood County, Texas. Marietta, Georgia.

Loocke, J. E. 1978. Growth History of the Hainesville Salt Dome, Wood County, Texas. Masters Thesis, Univ. Texas. Austin, Texas.

Mara, S. J. 1980. Geologic Factors in the Isolation of Nuclear Waste: Evaluation of Long Term Geomorphic Processes and Catastrophic Events. PNL-2854, Pacific Northwest Laboratory, Richland, Washington.

Matherson, G., and G. De Marsily. 1980. "Is Transport in Porous Media Always Diffusive?" Water Res. Research 16:901-917.

Meyer, R. E.. et al. 1978. "Systematic Study of Nuclide Sorption on Select Geologic Media." In WISAP Task 4 Contractor Meeting Proceedings, ed. R. J. Serne, PNL-SA-6957, Pacific Northwest Laboratory, Richland, Washington.

Millot, G. 1970. Geology of Clays. Springer-Verlag Publishing, Berlin, Germany.

Moore, F. L. 1957. Anal. Chem., 29:1767.

Napier, B. A. et al. 1980. PABLM-A Computer Program to Calculate Accumulated Radiation Doses From Radionuclides in the Environment. PNL-3209, Pacific Northwest Laboratory, Richland, Washington.

Netherland, Sewell, and Associates, Inc. 1976. Geologic Study of the Interior Salt Domes of Northeast Texas Salt Dome Basin to Investigate Their Suitability for Possible Storage of Radioactive Waste Material as of May, 1976. Prep. for Office of Waste Isolation, Union Carbide Corp., Nuclear Div., Energy Res. Devel. Admin., Oak Ridge, Tennessee.

Nettleton, L. L. 1934. "Fluid Mechanics of Salt Dome." Bull., AAPG, v. 18, no. 9, pp. 1175-1204.

Neuman, S. P. 1979. "Statistical Characterization of Aquifer Heterogenetics: An Overview." In Symposium on Recent Trends in Hydrogeology Honoring P. A. Witherspoon's Sixtieth Birthday. Geological Society of America, New York.

Nishiwaki, Y., et al. 1972. "Behavior and Distribution of Radioactive Substances in Coastal and Estuarine Waters." In Radioactive Contamination of the Marine Environment. IAEA-SM-158/11, pp. 177-193.

O'Keefe, J. D., and T. J. Ahrons. 1977. "Impact-Induced Energy Partitioning, Melting and Vaporization on Terrestrial Planets." In Proceedings Lunar Science Conference, 8:3357.

Patchick, P. F. 1980. The Suitability of Palestine Salt Dome, Anderson Co., Texas for Disposal of High-Level Radioactive Waste. ONWI-74, Office of Nuclear Waste Isolation, Columbus, Ohio.

Pinder, G. F., and H. H. Cooper, Jr. 1970. "A Numerical Technique for Calculating the Transient Postion of the Saltwater Front." Water Resources Research, 6(3), pp. 875-882.

Price, G. R., G. R. Ferreti, and S. Swartz. 1953. "Flourophometric Determination of Uranium." Anal. Chem., 25(2):322-331.

Rai, D., R. J. Serne and D. A. Moore. 1980. Interactions of Plutonyl (VI) with Soil Minerals. PNL-SA-8448, Pacific Northwest Laboratory, Richland, Washington.

Raymond, J. R., et al. 1980. Test Case Release Consequence Analysis for a Spent Fuel Geologic Repository. PNL-2782, Pacific Northwest Laboratory, Richland, Washington.

Relyea, J. F. 1979. Sorption Behavior of ^{85}Sr, ^{137}Cs and ^{95m}Tc Under Normal Atmospheric and Reduced Oxygen Levels. PNL-SA-7928, Pacific Northwest Laboratory, Richland, Washington.

Sagar, B. 1978. "Galerkin Finite Element Procedure for Analyzing Flow Through Random Media." Water Resour. Res. 14(6):1035-1044.

Scott, B. L., G. L. Benson, and M. A. Harwell. 1979. A Summary of FY-1978 Consultant Input for Scenario Methodology Development. PNL-2851, Pacific Northwest Laboratory, Richland, Washington.

Seitz, M. G., et al. 1979. "Transport Properties of Nuclear Waste in Geologic Media." In WISAP Task 4 Second Constructor Meeting Proceedings, ed. R. J. Serne, PNL-SA-7352, Pacific Northwest Laboratory, Richland, Washington.

Serne, R. J., ed. 1978. Waste Isolation Safety Assessment Program Task 4 Contractor Information Meeting Proceedings. PNL-SA-6957, Pacific Northwest Laboratory, Richland, Washington.

Simmons, C. 1980. Relationships of Dispersive Mass Transport and Stochastic Convective Flow Through Hydrologic Systems. PNL-3300, Pacific Northwest Laboratory, Richland, Washington.

Smith, L., and F. W. Schwartz. 1980. "Mass Transport I: A Stochastic Analysis of Macroscopic Dispersion." Water Res. Research, 16:303-313.

Strickert, R. G., et al. 1979. ARDISC: Computer Programs to Calculate the Distribution of Trace Element Migration in Partially Equilibrating Media. ANL-79-25, Argonne National Laboratory, Argonne, Illinois.

USGS. 1959. "Western Gulf of Mexico Basins." United States Geological Survey Water Suppply Paper.

Washburn, J. F., et al. 1980. Multicomponent Mass Transport Model: A Model Simulating Migration of Radionuclides in Ground Water. PNL-3179, Pacific Northwest Laboratory, Richland, Washington.

Wax, N. 1954. Selected Papers on Noise and Stochastic Processes. Dover Pub., New York.

Wight, L. H. 1978. "Analysis of the Seismic Hazard to an Underground Waste Repository. In A Summary of FY-1978 Consultant Input for Scenario Methodology Development, ed. Scott et al., PNL-2851, Pacific Northwest Laboratory, Richland, Washington.

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PREFACE

The Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program presents in this report methodology demonstration applied as an initial assessment of a reference site for a salt dome nuclear waste repository. The information in this document was designed to support the Preliminary Information Report (PIR) being assembled by the Office of Nuclear Waste Isolation (ONWI).

This report presents an exercise of the AEGIS methodology as applied to a hypothetical repository located in a reference salt dome site. It is not an actual site assessment. The salt dome considered in this assessment has been excluded from consideration as a repository for nuclear waste.

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This research was supported by the Waste Isolation Safety Assessment Program conducted by Pacific Northwest Laboratory. This program was sponsored by the Office of Nuclear Waste Isolation, which is managed by Battelle Memorial Institute under contract DE-AC06-76RLO 1830 with the Department of Energy. On 1 October 1979, WISAP became the Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program and the Waste/Rock Interaction Technology (WRIT) Program. This report is issued by AEGIS.

The contents of this report are the culmination of the efforts of many individuals. The contributions of the authors include the following lead personnel: M. A. Harwell and A. Brandstetter, coordination and integration; G. L. Benson, scenario analyses and external coordination; J. R. Raymond, consequence analysis; D. J. Bradley, leach rate data; R. J. Serne, sorption data; J. K. Soldat, dose analyses. The other authors are listed alphabetically, including their roles: C. R. Cole, transport modeling; W. J. Deutsch, solubility limits; S. K. Gupta, near-dome simulations; C. C. Harwell, human intrusion and report coordination; B. A. Napier, dose calculations; A. E. Reisenauer regional hydrologic simulations; L. S. Prater, scenario development and report coordination; C. S. Simmons, radionuclide transport modeling; D. L. Strenge, dose calculations; J. F. Washburn, transport modeling; and J. T. Zellmer, scenario methodology.

In addition to the authors, contributions from other AEGIS and WRIT staff at PNL included the following individuals: L. L. Ames, C. O. Harvey, D. D. Hostetler, F. E. Kaszeta, Y. B. Katayama, J. W. Lindberg, W. J. Martin, R. W. Nelson, C. A. Newbill, G. M. Petrie, W. M. Phillips, J. F. Relyea, D. J. Silviera, J. A. Stottlemyre, R. P. Turcotte, R. W. Wallace, C. D. Washburne, K. M. Wilson, and J. T. Zuck. Contributions from LASL staff were headed by B. R. Erdal.

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This effort could not have been completed without the cooperation and assistance of the Law Engineering Testing Company, the NUS Corporation, and the Texas Bureau of Economic Geology. Finally, we wish to acknowledge the external reviewers who provided valuable feedback based on the working document of this report. Many of their comments and suggestions have been incorporated into this revised report and into the ongoing technology development of the AEGIS and WRIT programs.

Revisions two, three and four of the working draft of PNL-2955 were completed with M.A. Harwell retained as an AEGIS consultant under contract B-93866-A-U. Completion dates for the working draft revisions were as follows:

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31 August 1979
Revision 1: December 1979
Revision 2: January 1981
Revision 3: August 1981
Revision 4: March 1982

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APPENDIX A

RELEASE SCENARIO METHODOLOGY UNDER DEVELOPMENT

APPENDIX A

RELEASE SCENARIO METHODOLOGY UNDER DEVELOPMENT

Long-term safety analyses for underground nuclear waste repositories rely on two basic components: 1) release scenario analyses, and 2) consequence analyses. The objective of the release scenario analysis is to identify, quantify, and characterize potential breaches of the repository as input into the consequence analyses models. The objective of the consequence analysis is to assess the fate of any radionuclides that might be released into the geosphere by a breach of the repository. Consequence analysis is accomplished through the application of sophisticated geohydrological transport models that simulate the movement of radionuclides through the hydrologic system and determine the potential time and amount of radionuclide release into the accessible environment. These models use the initial breach conditions defined by the release scenario analysis.

Numerous methods have been used in the past to develop release scenarios. Traditionally these methods have been based on event/fault tree or Delphi/expert opinion approaches. Such approaches are limited by their inherent inability to quantitatively bound the uncertainties and complexities characteristic of geologic systems. This weakness is compounded by the long (10^6-yr) time frame over which quantitative release scenarios are to be developed.

Geologic systems tend to be highly complex, and in many respects inadequately understood. Consequently, the science of geology often tends to be qualitative, and as such, lacks the ability quantitatively to provide long-term predictions of the future states of geologic systems. In addition, geologic systems are dynamical over the time frame under consideration, making fault tree analysis insufficient for scenario development. However, based on the past geologic record and the present state of the geologic systems, it may be possible to bound the future geologic system states with some degree of confidence. This involves assessments of numerous disruptive geologic and related phenomena. These phenomena must be addressed not simply as discrete occurrences but also in the context of potential phenomena synergisms. Such a task will be difficult at best because of the complex, dynamic nature of the geologic system.

The methodology being developed by AEGIS attempts to bound the future geologic system states and provide a measure of the uncertainties inherent in release scenario analysis. The uncertainties tend to increase dramatically as the time frame of the analysis and the complexity of the geologic system increase.

Because release scenario analysis provides the initial geologic conditions for use by the consequence analysis transport models, it is necessary that the initial conditions or ranges of initial conditions be realistic, defensible, and based on state-of-the-art knowledge and practices. The AEGIS methodology being developed to deal with these challenging problems of release scenario analysis will be discussed in the remainder of this appendix.

METHODOLOGY UNDER DEVELOPMENT

The scenario analysis methodology under development is a brute-force, stochastic approach incorporating Monte Carlo Simulation, qualitative event/fault tree, and Delphi/expert opinion components. The objectives of the program are three-fold: 1) to develop and apply a methodology to analyze how disruptive events may, alone or in concert, affect a waste repository, 2) to identify the perturbations or sequence of perturbations, resulting in the breach of a waste repository, and 3) to describe the state of the geologic system at the time of breach as initial conditions for consequence analysis. The current scope of the AEGIS program is to address only far-field/non waste-induced parameters. Near-field/waste-induced phenomena will be integrated into future release scenario methodology efforts.

The Repository Simulation Model will ultimately be used as a decision-making tool in the repository licensing process. As such the methodology must be designed to incorporate the wide range of criteria that will be imposed upon it. Some of these criteria are: 1) auditability, 2) ability to accommodate objective and subjective input, 3) facilitation of parametric and sensitivity studies, 4) facilitation or assistance in describing breach scenarios and frequencies, 5) establishment of limits and/or initial conditions for input into the consequence analysis transport models, and 6) flexibility to accommodate an increasing data base. The incorporation of such criteria will assist in the development of the Repository Simulation Model and enhance its use as a generic methodology for repository licensing.

Any methodology developed for use in formulating disruptive release scenarios must address the problem acknowledging certain geological and hydrological system restraints. The identification, understanding, and bounding of these restraints are primary goals of release scenario development. Some of the important restraints that must be considered are: 1) significant phenomena synergisms and event couplings, 2) time dependence of geological and hydrological processes and events, 3) limited data base for postulating future system states, and 4) the high degree of quantitative and qualitative system uncertainties. Such restraints tend to be inherent in any geological or hydrological study because of the complex nature and inadequate understanding of most geologic systems. Consequently, release scenario analysis necessarily relies on state-of-the-art knowledge as well as sound geologic input from experts.

The Repository Simulation Model being developed by AEGIS to meet these many requirements has several basic components. These include: 1) characterization of individual disruptive phenomena, 2) identification of system synergisms, 3) characterization of the layered earth model (LEM), 4) development of system response rules, 5) simulation and layered earth model evolution, and 6) characterization of potential breach scenarios. These components provide a logical framework within which the user may develop sequences of events and processes leading to Type 1 and 2 repository breaches. This framework also provides a method of assessing the effects of perturbations to the geologic system and setting hydrological system bounds on these effects so that they may be used as input to the consequence analysis transport models.

Because of the complexity of geologic systems and the large amount of data that must be manipulated, the Repository Simulation Model is a computerized methodology. It is composed of several submodels (e.g., climate, faulting) and is being designed to work in two simulation models: 1) user interactive and 2) a stochastic multiple simulation. When in the interactive mode, the user can pick the input parameters, select a set of system response rules, and highlight particular submodels for a single simulation run. In this fashion, the geoscientist users will be able to use the model as both a stochastic and a deterministic tool to facilitate understanding of the geological system surrounding the repository. The interactive mode will also be used to analyze specific breach scenarios developed during the multiple simulation operation. In this manner, the sensitive components of the geological and hydrological system can be identified for additional parametric and sensitivity analysis.

The multiple simulation (Monte Carlo) mode will allow a large number of independent simulations to be analyzed while choosing geological parameters from probability distributions and density functions. In this manner, the potential system response space that results from long term interaction of the various geological phenomena can be mapped. Within this response space, potential repository breaches can be catagorized into appropriate scenarios for use as input into the consequence analysis hydrologic transport and data models.

An example of the methodology under development is taken from the model being developed for repositories located in layered basalt. This simulation model is composed of eleven submodels, each of which addresses a class of disruptive phenomena. These submodels are: 1) climate, 2) continental glaciation, 3) hydrology, 4) sea level fluctuations, 5) geomorphic events, 6) deformation, 7) sub-basalt basement faulting, 8) shaft seal failure, 9) undetected features, 10) magmatic activity, and 11) meteorite impact. These submodels address the disruptive natural phenomena that may, alone or in concert, affect the safety of a waste repository located in a layered basalt geologic system during a period of one million years. The submodels chosen for this example are continental and alpine glaciation (Figures A.1 and A.2).

To estimate the recurrence frequency of glacial activity over the next 10^6 years or so, three separate theories were explored and ultimately combined to result in a time dependent driving function for glaciation. Results from the Milankovitch theory of orbital physics (solar insolation impinging upon the earth's surface), and harmonic analyses of past glacial activity and intense volcanic activity were combined to estimate the frequency of future episodes of glacial activity.

To address the impact on the repository of any given episode as provided by the glacial driving function, it is necessary to become somewhat site specific. For illustrative purposes, the PNL laboratory in Richland, Washington, was chosen as the example site. The following discussions are strictly to demonstrate the form of the methodology and do not indicate actual scenarios for this site.

Data on past glacial activity resulted in the approximate curves shown in Figure A.3. The first curve gives an average rate of ice advancement rate in km/yr. The second curve shows the minimum distance from the edge of the continental ice sheets to the chosen site at the time of maximum ice advancement. A similar distribution is given for some recharge areas of deep confined aquifers.

During major episodes of continental glaciation, there is only a 10^{-7}/yr probability of the repository site being covered by ice. The cumulative probability is on the order of 0.1 for 10^6 yr and the maximum ice thickness is estimated at 200-300 m. Should the basin area be glaciated, however, a vertical recharge pressure of up to 27 bars (0.09 bars/m of ice) might be expected. Furthermore, under a wet based glacier, a perpetual supply of liquid water might be expected.

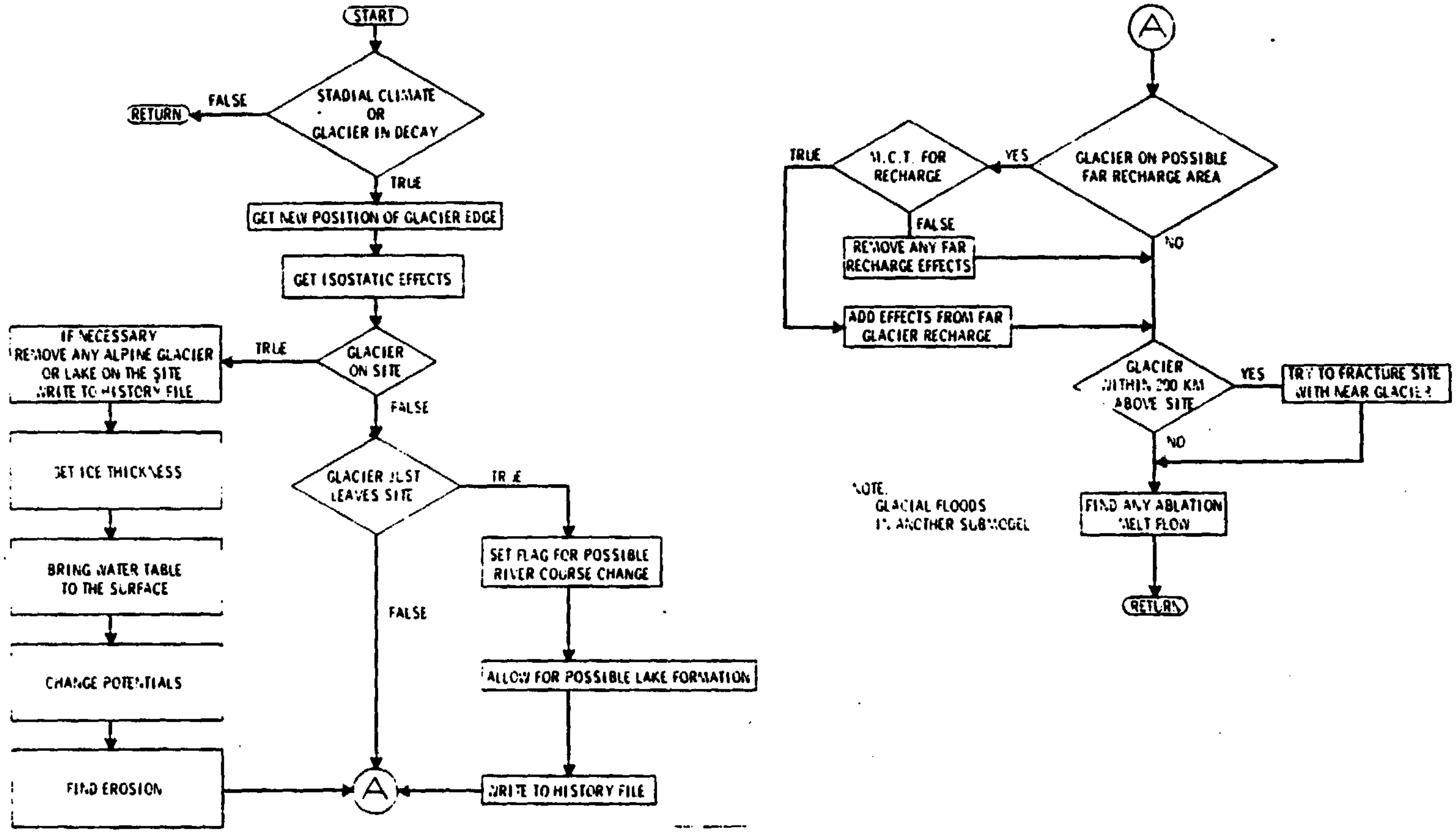


FIGURE A.1. Continental Glaciation Logic Flow Chart

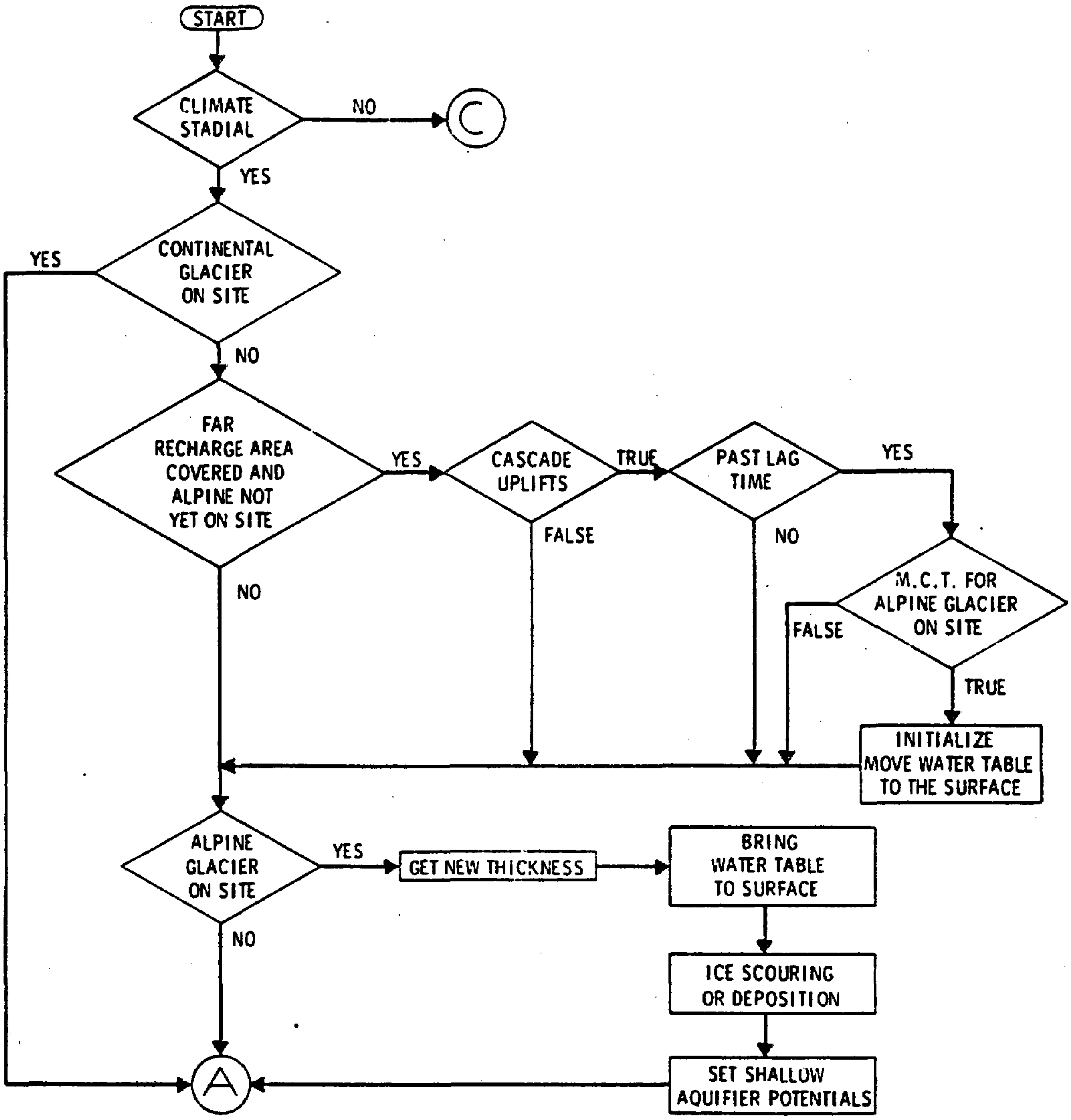


FIGURE A.2. Alpine Glaciation Logic Flow Chart

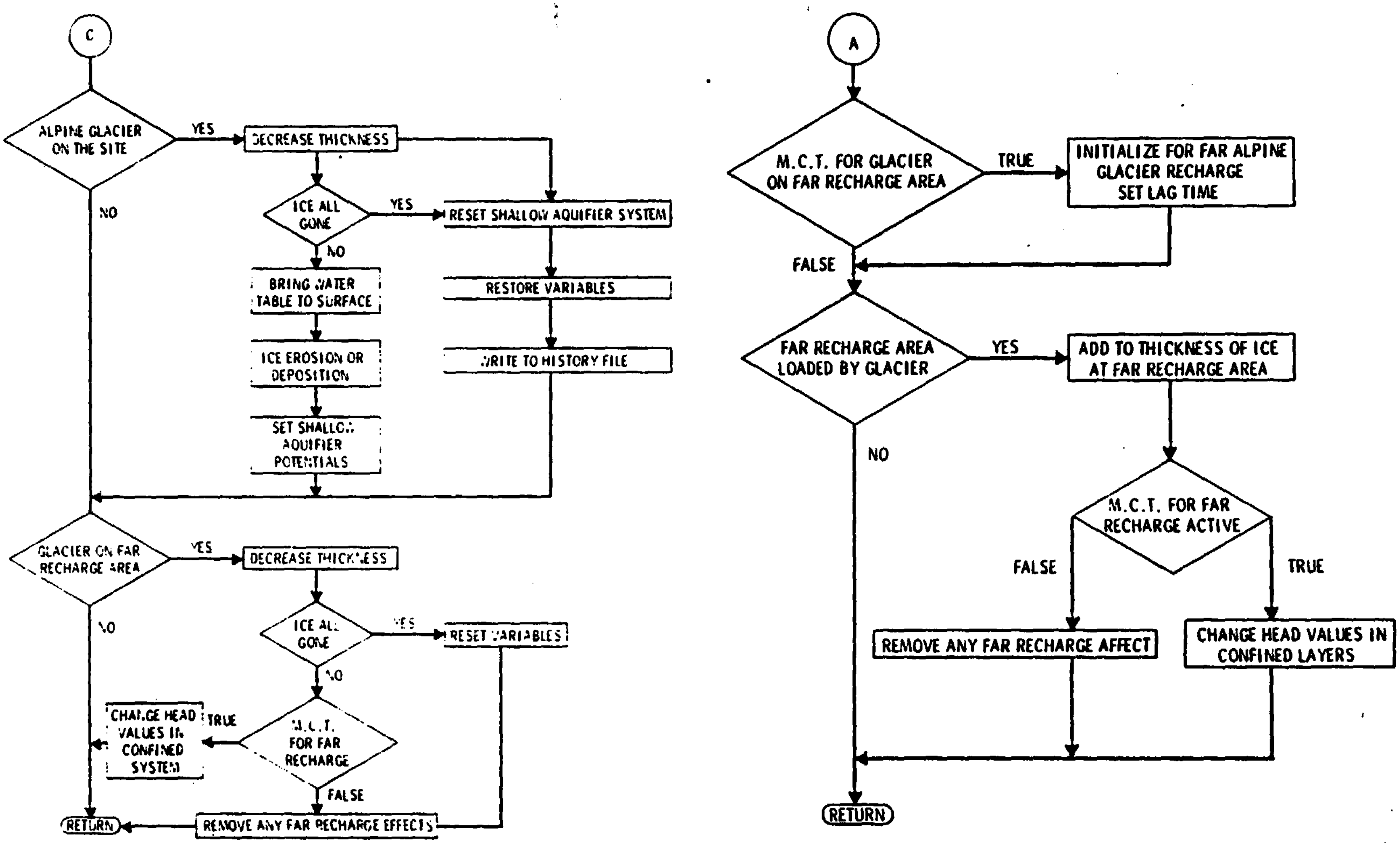
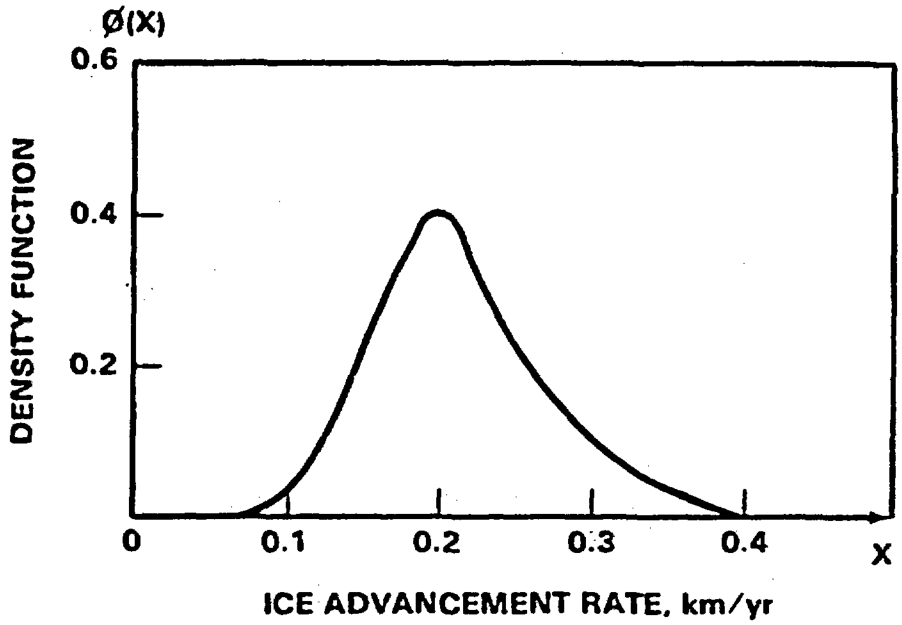


FIGURE A.2. (contd)



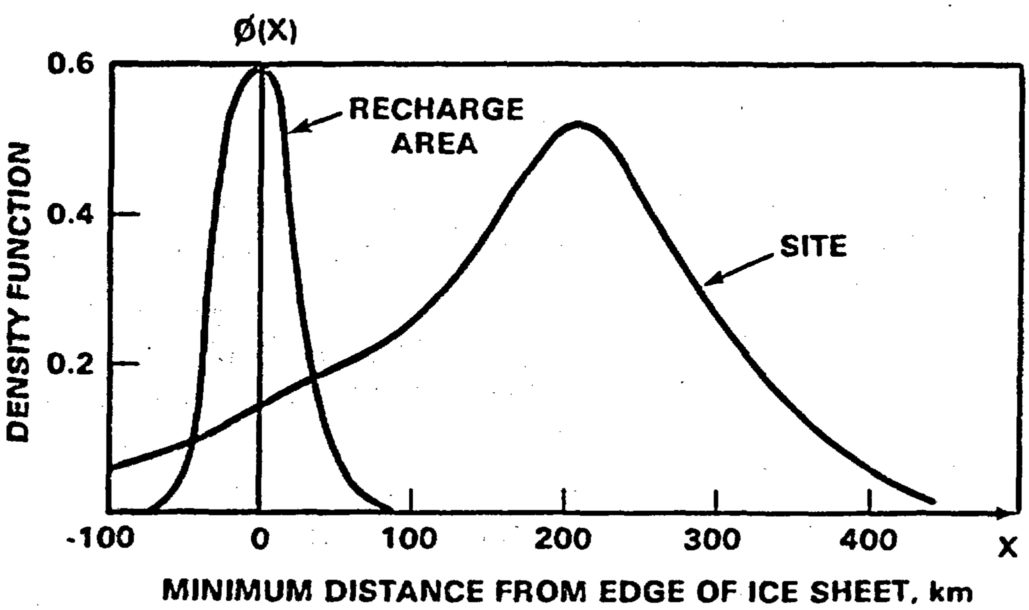


FIGURE A.3. Example Data Distributions

Glacial loading of the deep aquifer recharge areas, on the other hand, supports a 10^{-5} yr^{-1} probability and a cumulative figure approaching 1.0 in 10^6 yr. Maximum ice thickness in this case is estimated at 500-1000 meters and the recharge factor is also 0.09 bars m^{-1}. Figure A.4 is an artist's conceptualization of these two potentially independent glacial phenomena.

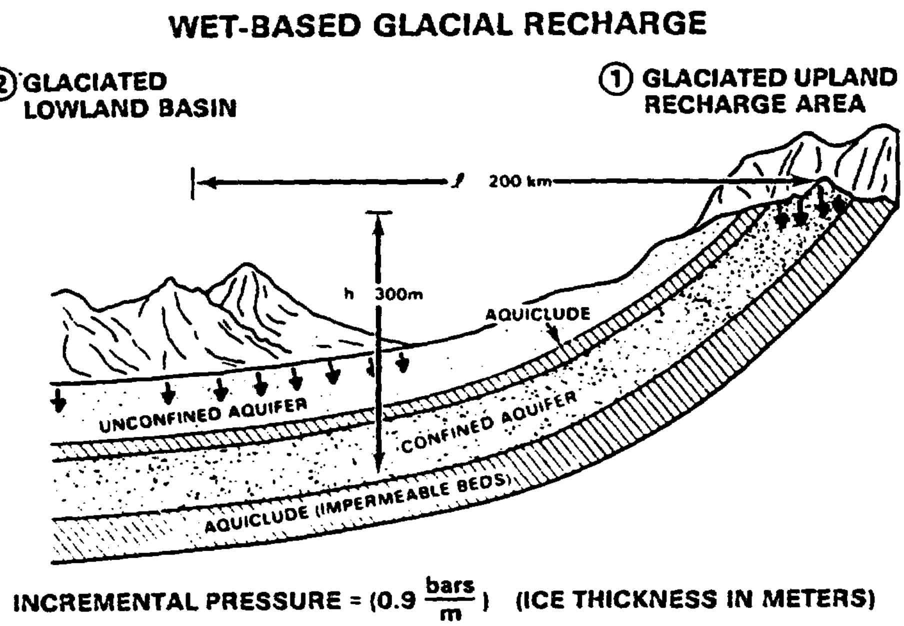


FIGURE A.4. Conceptualization of Glacial Recharge

The response of the confined aquifer system will depend primarily on its hydrological properties such as conductivity and storage potential. However, regardless of how the heads and/or volumetric flows are perturbed, the repository (embedded in a relatively impermeable zone) should not be affected unless a pathway exists or is created between aquifers supporting differing potentials. Such a pathway might be associated with fault rupture, but for the moment the discussion will be restricted to the possibility of surficial fracturing beyond the edge of large continental ice sheets.

Given an ice sheet 3 km thick at its centerpoint and 1450 km in radius, overlaying a 37 km elastic crustal shell superimposed on a viscous liquid interior, it is possible to compute the radial, tangential, and shear stresses that might exist beneath and just beyond the edge of the ice sheet. Beyond the edge of the ice sheet, tensional stresses on the order of 10-30 bars might conceivably exist. These stresses appear to be sufficient to cause surface cracking (Peltier and Andrews 1976). Such fracturing may be responsible for the initiation of the Great Lakes and Finger Lakes, and other lakes marginal to the Laurentide ice sheet (Bull 1978). Faults along the coast of Maine, probably initiated by ice sheet margin stresses, are still active, because of isostatic rebound (Rand and Gerber 1976).

Other possible results associated with large scale glaciation are high levels of meltwater runoff and even catastrophic flooding such as occurred several times in the state of Washington. Seven to nine massive Missoula-type floods are anticipated in southeast Washington in the next 10^6 years (Tubbs 1978). At the hypothetical site in question, a tem- porary lake upwards of 300-350 m in depth would be associated with each flood. Recharge pressure to the unconfined aquifer zone would be on the order of 0.11 bars m^{-1} of lake depth.

Ice scouring and selective stream erosion are also distinct possibilities. Average denudation might be on the order of 15 to 110 m per 10^6 yr at the area in question. Deep selective stream erosion might vary from zero to 0.15 mm yr^{-1} if anticlinal uplift is not occurring. With such uplift, the erosion rate could be from 0.2 to 0.7 mm yr^{-1}.

Finally, there is a possibility for sub-basal ground-water flow from beneath the ice sheet to the edge of the ice sheet. Such flow could, on the average, be under 0.25 bar km^{-1} horizontal gradient and water might be forced upwards at the edge of the ice sheets. It is also possible to relate sea level fluctuations to glacial episodes. In general, a $\pm$ 100 m variation is estimated (Schwartz 1978).

The above is a brief example of the application of the continental and alpine glaciation submodels to a layered basalt medium. However, in actual use the Repository Simulation Model will make use of all eleven submodels. The model assesses the potential effects of each submodel as well as the effects of interrelationships that may exist among the various submodels during the entire one-million-year time frame of the model run. These effects are determined, updated, and recorded at the end of each 100-year time step. In this way, time histories of the evolution of the geologic system are developed. Analyses of these time histories provide a method of determining the events or sequences of events that may ultimately lead to breaching of the repository. Consequently, the primary goal of the Repository Simulation Model is to identify and estimate the probabilities associated with disruptive events which, alone or in concert, might compromise the isolation status of a nuclear waste repository and to describe the possible geological and hydrological system states at the time of a breach. Such information can then be supplied as initial conditions to the release consequence transport models by developing plausible scenarios and identifying the bounds to be used in the parameters of the transport models.

The current status of the AEGIS release scenario analysis model is a second generation computer model that has been developed for a basalt repository. This model is currently being revised, with additional statistical capabilities being incorporated. The models for salt dome and bedded salt media are still in the conceptualization phase.

The methodology being developed is not being designed to predict the future geologic and hydrologic system. Instead, its objective is to attempt to bound, in a logical and auditable fashion, the set of potential future system states that could result in a repository breach. In addition to describing potential repository breaches, the output from this methodology will assist in describing the bounds for parametric and sensitivity analyses for the geohydrologic transport models. Thus, the consequence of potential repository breaches and the ultimate release of radionuclides to the accessible environment can be systematically analyzed.

APPENDIX B

FINITE ELEMENT, THREE-DIMENSIONAL GROUND WATER (FE3DGW) FLOW MODEL

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FINITE ELEMENT, THREE-DIMENSIONAL GROUND WATER (FE3DGW) FLOW MODEL

The objective of transport modeling for the AEGIS Program is to develop an integrated modeling system to predict, in the event of a breach, the movement of radioactive contaminants from a nuclear waste repository located in geologic media through the geosphere to the accessible environment. Prediction of radioisotope transport requires an estimation of water movement, because water is the primary driving force for waste movement in a hydrogeologic system. Hydrologic models define water flow paths and travel times from the input data provided by repository release scenario analysis. Four levels of the hydrologic models have been categorized (Raymond 1977) to handle varying complexities and availability of input parameters. The first level is for the simplest one-dimensional models having analytical solutions; the second level includes idealized analytic or hybrid analytic models for single aquifer systems with scanty input data; the third level deals with more complex single or quasi-multilayered systems; and the fourth level is for complex multilayered systems.

The three-dimensional, finite element, ground water model described in this report falls within the fourth level of AEGIS hydrologic models. This model is capable of simulating single-layered systems having variable thickness or multilayered systems, where thickness and the number of layers can be changed to agree with the vertical geologic section. Also, spacing of the model nodes can be varied as required. The source or sink terms can be defined at a given point (e.g., at a well), along a given line (e.g., rivers, streams), or for a given region (variable surface infiltration from natural precipitation or irrigation). Pumping stresses in each layer of the subregion can be defined as a function of time. The geologic input data for such complex multilayered systems are reduced to well-log descriptions at each surface node and to subdivisions of the entire region into two-dimensional elements. Supportive programs have been developed to plot grid values, contour maps, and three-dimensional charts of both the input data used in simulation and the results obtained.

NEED FOR A THREE-DIMENSIONAL, FINITE ELEMENT MODEL

Geohydrologic systems and surface water bodies (e.g., lakes, rivers) usually have irregular boundaries, and the finite element method provides a powerful tool for space and boundary definition. The spacing of the nodes near the repository, pumping wells, or surface water bodies can be narrowed, and the hydraulic conductivities can change abruptly from element to element so that fault zones and confining layers are represented.

GALERKIN FINITE ELEMENT FORMULATION OF THREE-DIMENSIONAL FLOW

Three-dimensional, non-steady flow is defined by the following equation (Jacob 1950):

$$\frac{\partial}{\partial x}\left(K_x \frac{\partial h}{\partial x}\right) + \frac{\partial}{\partial y}\left(K_y \frac{\partial h}{\partial y}\right) + \frac{\partial}{\partial z}\left(K_z \frac{\partial h}{\partial z}\right) - Q = S_s \frac{\partial h}{\partial t} \qquad (1)$$

S_s = specific storage L^{-1}

$= \rho g \left(\alpha_p + \theta \beta_p\right)$

g = gravity field strength, $L\ T^{-2}$

h = head above common datum, L

$$= z + \frac{1}{g} \int_{p_0}^{p} \frac{dp}{(p)}$$

K_x, K_y, K_z = represents hydraulic conductivity of the saturated flow in the x, y, and z direction, $L\ T^{-1}$

p = fluid pressure, $M\ L^{-1}\ T^{-2}$

Q = strength of sink function defined by T^{-1}

$$= \sum_{i=1}^{n} Q_w(x_i, y_i, z_i, t) \quad (x-x_i)\ (y-y_i)\ (z-z_i)$$

Q_w = the well discharge from the aquifer, $L^3\ T^{-1}$

δ = Dirac delta function

t = time, T

z = elevation above given datum, L

θ = porosity of medium, dimensionless

α_p = compressibility of medium, $LT^2\ M^{-1}$

β_p = compressibility of liquid, $LT^2\ M^{-1}$

ρ = density of fluid, $M\ L^{-3}$

GALERKIN APPROXIMATION

Equation (1) can be rewritten in a more compact form as:

$$L(h) = \frac{\partial}{\partial x_\alpha} \left(K\alpha\beta \frac{\partial h}{\partial x\beta}\right) - Q - S_s \frac{\partial h}{\partial t} = 0 \tag{2}$$

$\alpha, \beta = 1, 2, 3$

In the above equation and in subsequent equations, subscripts α and β are used to describe the three-dimensional flow equation in condensed form.

To solve $L(h) = 0$ by the Galerkin method, a trial solution of the following form is assumed:

$$h(x_\alpha, t) \approx h'(x_\alpha, t) = \sum_{i=1}^{n} H_i(t)\ V_i(x_\alpha) \tag{3}$$

where $V_i(x_\alpha)$ (i=1, 2...n) is a system of functions (basis functions or bases) chosen beforehand and satisfying the essential boundary conditions imposed on Equation (1). The functions $V_i(x_\alpha)$ (i=1, 2...n) are assumed to be linearly independent and to represent the first n functions of some system of functions that is complete in the given region. The functions $H_i(t)$ are undetermined coefficients that, as shown later, are the solution of Equation (1) at specified points (or nodes) in region .

The approximating function $h'(x\ ,t)$ will be an exact solution to Equation (1) only if $L(h')$ is equal to zero. This can be best achieved in a variational sense using the definition of orthogonal functions. The orthogonality of expression $L(h')$ is required to all the basis functions $V_i(x\ )$ $(i=1, 2...n)$ or:

$$\iiint_\Omega L(h'[x_\alpha,t])\ V_i(x_\alpha)\ d\Omega = 0 \tag{4}$$

$i=1,\ 2...n$

Because only n basis functions have been selected, there are n undetermined coefficients $H_i(t)$ $(i=1, 2...n)$ and therefore only n conditions of orthogonality can be satisfied. These conditions are stated as:

$$\iiint_\Omega L(h'[x_\alpha,t])\ V_i(x_\alpha)\ d\Omega = \iiint_\Omega L(\sum_{j=1}^{n} H_j[t]\ V_j[x_\alpha])\ V_i(x_\alpha)\ d\Omega = 0 \tag{4a}$$

$i=1,\ 2...n$

Assuming that the appropriate integrations can be performed, the desired solution of Equation (2) is obtained by substituting the values of $H_i(t)$ into Equation (3).

The above-mentioned formulation of the Galerkin equation was applied by Pinder and Frind (1972) to ground-water simulation. This was also applied to three-dimensional ground-water flow by Gupta, Tanji and Luthin (1975).

BASIS FUNCTION

The suitability of the Galerkin approximation for computer application is largely based on the choice of basis functions $V_i(x_\alpha)$. Efficient numerical schemes can be developed when continuous piecewise polynomial functions are used (e.g., Price, Cavendish and Varga 1968, Cavendish, Price and Varga 1968, and Culham and Varga 1970). In selecting these functions a series of nodes is chosen in the domain, and basis functions are defined such that $V_i(x)$ is unity at node i and zero at all other nodes. When functions are chosen with these constraints, the undetermined coefficients $H_i(t)$ (i=1, 2...n) are then the required function h'(x ,t) at the n points.

The three-dimensional mixed basis functions (Gupta, Tanji and Luthin 1975) are given below.

Corner Nodes

$$V_i(\xi, \eta, \zeta) = \alpha_i \beta_i$$

where

$$\alpha_i = \frac{1}{8} (1 + \xi\xi_i) (1 + \eta\eta_i) (1 + \zeta\zeta_i)$$

$$\beta_i = \beta_\xi + \beta_\eta + \beta_\zeta$$

Values of β_ξ, β_η and β_ζ are determined by the order of the element sides ($\zeta = \pm 1$, $\eta = \pm 1$), ($\zeta = \pm 1$, $\xi = \pm 1$) and ($\xi = \pm 1$, $\eta = \pm 1$), respectively, in conjunction with information from Table 1.

Nodes Along the Sides of Elements

A typical midside node of a quadratic side:

$$V_i = \frac{1}{4} (1 - \xi^2) (1 + \eta\eta_i) (1 + \zeta\zeta_i) \text{ for } \xi_i = 0, \eta_i = \pm 1, \zeta_i = \pm 1$$

TABLE 1. Parameters of β_ξ, β_η and β_ζ for Mixed Corner

Order of Side	β_ξ	β_η	β_ζ
Linear	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$
Quadratic	$\xi\xi_i - \frac{2}{3}$	$\eta\eta_i - \frac{2}{3}$	$\zeta\zeta_i - \frac{2}{3}$
Cubic	$\frac{9}{8}\xi^2 - \frac{19}{24}$	$\frac{9}{8}\eta^2 - \frac{19}{24}$	$\frac{9}{8}\zeta^2 - \frac{19}{24}$

$$V_i = \frac{1}{4}(1 + \xi_i\xi)(1 - \eta^2)(1 + \zeta\zeta_i) \text{ for } \xi_i = \pm 1, \eta_i = 0, \zeta_i = \pm 1$$

$$V_i = \frac{1}{4}(1 + \xi_i\xi)(1 + \eta\eta_i)(1 - \zeta^2) \text{ for } \xi_i = \pm 1, \eta_i = \pm 1, \zeta_i = 0$$

A <u>typical midside node</u> of a cubic side:

$$V_i = \frac{9}{64}(1-\xi^2)(1+9\xi\xi_i)(1+\eta\eta_i)(1+\zeta\zeta_i) \text{ for } \xi_i = \pm\frac{1}{3}, \eta_i = \pm 1, \zeta_i = \pm 1$$

$$V_i = \frac{9}{64}(1+\xi\xi_i)(1-\eta^2)(1+9\eta\eta_i)(1+\zeta\zeta_i) \text{ for } \xi_i = \pm 1, \eta_i = \pm\frac{1}{3}, \zeta_i = \pm 1$$

$$V_i = \frac{9}{64}(1+\xi\xi_i)(1+\eta\eta_i)(1-\zeta^2)(1+9\zeta\zeta_i) \text{ for } \xi_i = \pm 1, \eta_i = \pm 1, \zeta = \pm\frac{1}{3}$$

A convenient method of establishing the coordinate transformations from Cartesian to local ξ, η, ζ, space is to use the basis functions given above. The points with coordinates, x, y, z, will lie at corresponding point, ξ, η, ζ, in the element as given by the general definitions of the basis functions. By these relationships, each set of local coordinates will correspond to a set of global Cartesian coordinates and in general to only one such set. Non-uniqueness arises only with violent element distortions.

GALERKIN APPROXIMATION FOR GROUND-WATER FLOW EQUATION

After generating the appropriate basis function for each node in domain Ω, it is necessary to solve Equation (4) for the undetermined coefficients $H_i(t)$. By substituting Equations (2) and (3) in Equation (4a) along with the assumption that the principal components of the hydraulic conductivity tensor are co-linear with x, y and z, the following is obtained for three dimensions:

$$\iiint_\Omega \left\{ \frac{\partial}{\partial x_\alpha} \left(K_{\alpha\beta} \frac{\partial}{\partial x_\beta} \sum_{j=1}^{n} H_j V_j\right) - S_s \frac{\partial}{\partial t} \sum_{j=1}^{n} H_j V_j - Q \right\} V_i \, d\Omega = 0 \qquad (4b)$$

$i=1, 2 \ldots n$

where the domain Ω is composed of all elements over which the i^{th} basis function is defined.

To eliminate the second derivatives in Equation (4b), Green's theorem in the following form can be used:

$$\iiint_{\Omega} \left[\psi \frac{\partial^2 \phi}{\partial x_{\alpha}^2}\right] d\Omega = -\iiint_{\Omega} \frac{\partial \phi}{\partial x_{\alpha}} \frac{\partial \psi}{\partial x_{\alpha}} \, d\Omega + \iint_{\lambda} \psi \frac{\partial \phi}{\partial x_{\alpha}} \ell_{\alpha} \, d\lambda \tag{5}$$

Assuming $K_{\alpha\beta}$ to be constant over each domain of integration and noting that H_j is a function of time only, and using Green's theorem Equation (5), Equation (4b) can be written as:

$$\iiint_{\Omega} \sum_{j=1}^{n} \left(K_{\alpha\beta} \frac{\partial V_i}{\partial x_{\alpha}} \frac{\partial V_j}{\partial x_{\beta}}\right) H_j \, d\Omega + \iiint_{\Omega} S_s \, V_i \sum_{j=1}^{n} V_j \frac{\partial H_j}{\partial t} \, d\Omega$$

$$+ \overset{T}{\iiint_{\Omega}} QV_i \, d\Omega - \iint_{\lambda} V_i \sum_{j=1}^{n} \left(K_{\alpha\beta} \frac{\partial V_j}{\partial x_{\beta}} \ell_{\alpha}\right) H_j \, d\lambda = 0 \tag{6}$$

1=1, 2...n

The n Equations in (6) can be written in the matrix form as:

$$[P] \{H\} + [R] \{dH/dt\} + \{U\} = 0 \tag{7}$$

where $[P]$ and $[R]$ are n x n matrices in which:

$$P_{ij} = \iiint_{\Omega} \left(K_{\alpha\beta} \frac{\partial V_i}{\partial x_{\alpha}} \frac{\partial V_j}{\partial x_{\beta}}\right) d\Omega$$

$$R_{ij} = \iiint_{\Omega} S_s \, V_i V_j \, d\Omega$$

and $\{U\}$ is a vector in which:

$$U_i = \iiint_\lambda QV_i \, d\Omega - \iint_\lambda V_i \sum_{j=1}^{n} \left(K_{\alpha\beta} \frac{\partial V_j}{\partial x_\beta} \ell_\alpha\right) H_j \, d\lambda \tag{8}$$

The last term in Equation (8) incorporates the Neumann boundary condition:

$$- K_{\alpha\beta} \frac{\partial h}{\partial x} \ell_\alpha = q_n$$

where q_n is the flux of water per unit area of boundary S, L/T. This last term is formed only when q_n is nonzero, in which case it takes the form of:

$$\iint_\lambda V_i \, q_n \, d\lambda$$

Under these conditions, the flux prescribed along the boundary can be integrated, and the weighted average value for each node of total outward flux used for the specific node under consideration. At nodes where a Dirichlet or constant-head boundary condition is encountered, Equation (6) is not generated. The matrices of Equation (7) are partitioned to account for these passive nodes to minimize the number of operations required for solution.

INTEGRATION OF APPROXIMATING EQUATIONS

The finite element process converges if integration is sufficient to evaluate exactly the volume of the elements. The Gaussian quadrature scheme is generally used for numerical integration. Numerically integrated finite elements provide greater versatility than those employing analytical integration. For a general class of problems, the matrices are always of the same form in terms of the shape function and its derivatives. In the computer program, the shape functions and their derivatives are specified, along with the order of integration (number of Gaussian points). The use of universal shape function routines has a unique practical advantage in that, once the routine is checked decisively for errors, the computer works efficiently in dealing with any new situation or problem.

Numerical approximation is carried out with respect to the nodal values, and each node is described in terms of shape factor V_i given in local coordinates; thus, we have the following relationships considering each element as a domain:

$$x = \sum_{i=1}^{n} V_i(\xi, \eta, \zeta)\ x_i \tag{9}$$

$$y = \sum_{i=1}^{n} V_i(\xi, \eta, \zeta)\ y_i \tag{10}$$

$$z = \sum_{i=1}^{n} V_i(\xi, \eta, \zeta)\ z_i \tag{11}$$

$$h' = \sum_{i=1}^{n} V_i(\xi, \eta, \zeta)\ H_i \tag{12}$$

where x_i, y_i, and z_i are actual values of nodal Cartesian coordinates and n is the number of nodes in the element under consideration. H_i (as defined earlier) is the actual value of the required function $h'(x, y, z, t)$.

Considering the set of local coordinates ξ, η, and ζ and a corresponding set of global coordinates x, y, and z, by usual rules of partial differentiation, we can write, for instance, the ξ derivatives as:

$$\frac{\partial V_i}{\partial \varepsilon} = \frac{\partial V_i}{\partial x}\frac{\partial x}{\partial \varepsilon} + \frac{\partial V_i}{\partial y}\frac{\partial y}{\partial \varepsilon} + \frac{\partial V_i}{\partial z}\frac{\partial z}{\partial \varepsilon} \tag{13}$$

Performing the same differentiation with respect to the other two coordinates and writing in matrix form we have:

$$\begin{bmatrix} \frac{\partial V_i}{\partial \xi} \\ \frac{\partial V_i}{\partial \eta} \\ \frac{\partial V_i}{\partial \zeta} \end{bmatrix} = \begin{bmatrix} \frac{\partial x}{\partial \xi}, & \frac{\partial y}{\partial \xi}, & \frac{\partial z}{\partial \xi} \\ \frac{\partial x}{\partial \eta}, & \frac{\partial y}{\partial \eta}, & \frac{\partial z}{\partial \eta} \\ \frac{\partial x}{\partial \zeta}, & \frac{\partial y}{\partial \zeta}, & \frac{\partial z}{\partial \zeta} \end{bmatrix} \begin{Bmatrix} \frac{\partial V_i}{\partial x} \\ \frac{\partial V_i}{\partial y} \\ \frac{\partial V_i}{\partial z} \end{Bmatrix} = [J] \begin{Bmatrix} \frac{\partial V_i}{\partial x} \\ \frac{\partial V_i}{\partial y} \\ \frac{\partial V_i}{\partial z} \end{Bmatrix} \tag{14}$$

In the above, the left-hand side can be evaluated because the functions V_i are specified in local coordinates. Furthermore, x, y, and z are explicitly given by the relation defining the curvilinear coordinates [Equations (9), (10), and (11)]. The matrix [J] can be formed explicitly in terms of local coordinates. This matrix is known as the Jacobian matrix.

To find the global derivatives, we invert [J] and write

$$\begin{Bmatrix} \frac{\partial V_i}{\partial x} \\ \frac{\partial V_i}{\partial y} \\ \frac{\partial V_i}{\partial z} \end{Bmatrix} = [J]^{-1} \begin{Bmatrix} \frac{\partial V_i}{\partial \xi} \\ \frac{\partial V_i}{\partial \eta} \\ \frac{\partial V_i}{\partial \zeta} \end{Bmatrix} \tag{15}$$

In terms of the shape function defining the coordinate transformation [V'], which are identical with the shape functions [V] when isoparametric formulation is used, we have:

$$[J] = \begin{bmatrix} \sum \frac{\partial V_i}{\partial \xi} x_i, & \sum \frac{\partial V_i}{\partial \xi} y_i, & \sum \frac{\partial V_i}{\partial \xi} z_i \\ \sum \frac{\partial V_i}{\partial \eta} x_i, & \sum \frac{\partial V_i}{\partial \eta} y_i, & \sum \frac{\partial V_i}{\partial \eta} z_i \\ \sum \frac{\partial V_i}{\partial \zeta} x_i, & \sum \frac{\partial V_i}{\partial \zeta} y_i, & \sum \frac{\partial V_i}{\partial \zeta} z_i \end{bmatrix}$$

The transformation of the variables and region, with respect to which integration is made, is achieved by the following:

$$dx\,dy\,dz = \det\,[J]\;d\xi\,d\eta\,d\zeta$$

which is valid irrespective of the number of coordinates used. Assuming that the inverse of [J] can be found, by transformation we have

$$P_{ij} = \int_{-1}^{1}\int_{-1}^{1}\int_{-1}^{1} \left((K_x \frac{\partial V_i}{\partial x}\frac{\partial V_j}{\partial x} + K_y \frac{\partial V_i}{\partial y}\frac{\partial V_j}{\partial y} + K_z \frac{\partial V_i}{\partial z}\frac{\partial V_j}{\partial z} \right) \det\,[J]\;d\xi\,d\eta\,d\zeta \qquad (16)$$

Similar expressions are developed for the remaining terms of Equation (8).

To perform an integration of the form indicated in Equation (16), a Gaussian quadrature scheme is used. In this technique a polynomial f(x) of degree 2N-1 may be integrated exactly as the weighted mean of its N particular values of specified points (Gaussian points). Examining in detail the form of Jacobian determinant (expressed in terms of shape function derivatives), and its order, the number of Gaussian points required for exact integration can be determined. Zienkiewicz and Cheung (1965) give a concise discussion of Gaussian quadrature and tables of required coefficients (Table 2). Zienkiewicz (1971) summarizes that if only a few elements are used to represent a region, more than a minimum number of Gaussian points is advised.. If a large number of elements has to be used, the lowest necessary order of integration is economical. It is also reported that considerable improvement results from using a minimum integrating order. The computer program written has a choice of the use of 2, 3, or 5 Gaussian integration points in each dimension.

FORMATION OF MATRICES

Once the matrices of Equation (7) have been developed, the task is to solve for the undetermined coefficients $H_i(t)$ (i=1, 2...n). To eliminate the term dH/dt associated with the P matrices, a backward finite-difference approximation for the time is generally used with given initial values:

TABLE 2. Abscissae and Weight Coefficients of the Gaussian Quadrature Formula

$$\int_{-1}^{1} f(x)\, dx = \sum_{j=1}^{n} H_i\, f(a_j),$$

$\pm a$		H
	n = 2	
0.57735 02691 89626		1.00000 00000 00000
	n = 3	
0.77459 66692 41483		0.55555 55555 55556
0.00000 00000 00000		0.88888 88888 88889
	n = 4	
0.86113 63115 94053		0.34785 48451 37454
0.33998 10435 84856		0.65214 51548 62546
	n = 5	
0.90617 98459 38664		0.23692 68850 56189
0.53846 93101 05683		0.47862 86704 99366
0.00000 00000 00000		0.56888 88888 88889
	n = 6	
0.93246 95142 03152		0.17132 44923 79170
0.66120 93864 66265		0.36076 15730 48139
0.23861 91860 83197		0.46791 39345 72691
	n = 7	
0.94910 79123 42759		0.12948 49661 68870
0.74153 11855 99394		0.27970 53914 89277
0.40584 51513 77397		0.38183 00505 05119
0.00000 00000 00000		0.41795 91836 73469
	n = 8	
0.96028 98564 97536		0.10122 85362 90376
0.79666 64774 13627		0.22238 10344 53374
0.52553 24099 16329		0.31370 66458 77887
0.18343 64624 95650		0.36268 37833 78362
	n = 9	
0.96816 02395 07626		0.08127 43883 61574
0.83603 11073 26636		0.18064 81606 94857
0.61337 14327 00590		0.26061 06964 02935
0.32425 34234 03809		0.31234 70770 40003
0.00000 00000 00000		0.33023 93550 01260
	n = 10	
0.97390 65285 17172		0.06667 13443 08688
0.86506 33666 88985		0.14945 13491 50581
0.67940 95682 99024		0.21908 63625 15982
0.43339 53941 29247		0.26926 67193 09996
0.14887 43389 81631		0.29552 42247 14753

$$[P]\ \{H\}_{t+\Delta t} + [R]\ (\{H\}_{t+\Delta t} - \{H\}_t)/\Delta t + \{U\} = 0$$

or

$$([P] + [R]/\Delta t)\ \{H\}_{t+\Delta t} = [R]/\Delta t\ \{H\}_t - \{U\} \tag{17}$$

where values occurring on the right-hand side are known.

For finite difference in time, the Crank-Nicolson or central-difference scheme can be used after the first initial step. In past versions of the model, backward difference was used for the initial time step, but in the present model, rather than simulation of H, the computer program has been modified to simulate changes during the time step.

COMPUTATIONAL ORGANIZATION OF THE PROGRAM FOR REDUCING CORE STORAGE REQUIREMENTS AND EXECUTION TIME

The three-dimensional, finite element method has the major limitations of requiring large organization and programming efforts and considerable core storage, limiting the size of problems handled on a given computer. In DAVIS-FE (Gupta et al. 1975) the core storage requirements and cost of computation for a three-dimensional ground-water flow were reduced by use of small independent subprograms, storing intermediate results which are needed repeatedly, and use of a partially compressed matrix for storing and solution of the sparse and unbanded system of equations. Further improvements of the DAVIS-FE and equation solver were made for application to multilayered ground-water systems beneath Long Island, New York (Gupta and Pinder 1978).

Under AEGIS, additional modifications were carried out and a new version, FE3DGW (Finite-Element 3-Dimensional Ground Water), was developed to simulate multilayered systems on a small computer (PDP-11/45 having maximum core storage of 32 K for 16-bit words). This section gives a brief description of the organization of the computer program.

PROGRAM ORGANIZATION TO REDUCE MEMORY REQUIREMENTS

Input Data

Reduction of core storage can be achieved by using a disk, provided the data are sequentially written and retrieved. Therefore, the input data for the finite element simulation were grouped into two major categories:

Data Used at Random

Data related to material properties, nodal coordinates and boundary conditions are needed at random, as per the nodes of the given elements. Therefore, this information is stored in the core memory of the given subroutine whenever possible. For simulation on a small computer, if all the nodal coordinates cannot be accommodated in core storage, they are read in as multiples of 256 integer (128 real) words, the equivalent of one record of disk block.

Data Used in Sequential Form

Element-related information forms the bulk of storage requirements. Because numerical integration is carried out sequentially element by element, the element-related information is handled through disks.

System Matrix

For a natural basin involving many layers of three-dimensional elements, the system stiffness matrix is large, sparse, and unbanded. The number of unknowns in a natural multiaquifer system may be as high as 1000 or more, whereas nonzero coefficients for linear, quadratic, and cubic order three-dimensional elements are respectively only 27, 81, and 135. If mixed degree three-dimensional isoparametric elements are used, in general the number of unknowns in a given row is 40 to 60.

The use of two arrays, one for storing the nonzero elements and the other for column identifications, has been found to be very efficient in reducing the memory requirement for large sparse, unbanded and asymmetric systems of equations (Gupta and Tanji 1977). Because provision must be made for the longest row of nonzero coefficients, storage of a limited number of zeros is required in some of the rows, resulting in partially packed arrays. Such a storage scheme is economical if the longest row after elimination process contains less than 50% nonzero elements.

REDUCTION OF PROCESSOR TIME

Storage of Intermediate Results Needed Repeatedly for Transient or Steady-State Solution

Numerical approximation is carried out with respect to the nodal values, and each node is described in terms of shape factor V_i, given in local coordinates. Details of the steps involved in numerical integration have been given in the section on the Galerkin finite element formulation of three-dimensional flow. Various components of Equation (17) are estimated in the following manner:

a. For a linear element a minimum of two Gaussian points in each direction are required, which warrants estimation of shape function V_i,

$$\frac{\partial V_i}{\partial \xi}, \frac{\partial V_i}{\partial \eta}, \frac{\partial V_i}{\partial \zeta}$$

and the matrix Jacobian [J], eight times for each element. For a quadratic or cubic order element, the minimum is 27.

b. In Equation (6), the only parameters required are:

$$\frac{\partial V_i}{\partial \xi}\frac{\partial V_j}{\partial \xi} \det [J], \frac{\partial V_i}{\partial \eta}\frac{\partial V_j}{\partial \eta} \det [J], \frac{\partial V_i}{\partial \zeta}\frac{\partial V_j}{\partial \zeta} \det [J], V_iV_j \det [J] \text{ and}$$

V_i det [J], respectively called FIFJ, GIGJ, HIHJ, XIXJOB, and XIJCOB. The values of these parameters are estimated at each Gaussian point and summed up for the given element before writing to disk. These parameters are functions of the x, y, and z coordinates of each node of the element and remain constant for steady-state and confined transient cases. The economy achieved by storing intermediate steps can be evident from the fact that Gaussian numerical integration requires 8 or 27 times estimations (depending on the order of the element) of the shape function, V_i, and its derivatives for each node of the element for every solution. For each quadratic or cubic order element this amounts to 1188 times estimations of each of the integration parameters called FIFJ, GIGJ, HIHG, XIXJOB, and XIJCOB.

c. The element stiffness matrix is formed by rewriting Equation (17) in the following form:

$$P_{ij} = FIFJ \times K_{xx} = GIGJ \times K_{yy} + HIHJ \times K_{zz}$$
$$R_{ij} = \rho g\ (\alpha_p + \phi\beta_p) \times XIXJOB$$
$$U_i = Q \times XIJCOB$$

For each transient or steady-state problem, the stiffness matrix of the region is developed by reading the summed-up values of FIFJ, GIGJ, HIHJ, XIXJOB, and XIJCOB for each node of the given element.

Solution of System Matrix with Minimal Arithmetic Operation

In finite element formulation, the subroutine for the solution of simultaneous equations constitutes another major influence on computational cost. The computer program uses EQSOLV (Gupta and Tanji 1977) in which: 1) the row with the minimum number of nonzero elements is selected as the pivot row and to avoid instability, the largest absolute element in the pivotal row is used as the pivotal column; 2) the coefficients matrix is decomposed to the upper triangle, and sequential operations and coefficients for right-hand constant vector are stored such that, for constant time steps, repeated solutions are obtained by back substitution without decomposing the system matrix again; 3) the bulk of the program centers on a search of the partially packed column matrix to locate elements to be operated on, and thus actual arithmetic operations are minimal.

DIVISION OF THE MODEL INTO INDEPENDENT SUBPROGRAMS

For efficient handling of the input data for providing checks at various stages of simulations, the computer model has been subdivided into the following five independent subprograms.

1. PROG1 - This program reads the input data, assigns a new number to each node for internal estimation, generates a three-dimensional mesh, estimates the number of unknowns and generates File-Q[a] disk files for data processing in other subsequent programs.

(a) File-Q is a set of FORTRAN callable direct I/O subroutines written for use on PDP 11/45. The File-Q file structure for disk volumes is designed to minimize the overhead associated with direct access file operations. Once File-Q has been opened, only basic read-write limits are checked for each I/O operation and all direct access I/O transfers are started at the beginning of a physical (256 word) disk block boundary.

By making this program independent, the modeler is provided with a means of critically examining the input data before proceeding with execution of the other programs. In other programs, reduction of memory requirement is achieved by retrieval of only relevant information.

The computer output from large basins may run to several pages that may be needed only for the initial run and not for further additional minor modifications. Therefore, the computer program has varied options from no output to complete listing of various details.

2. PROG2 - This program calculates the integration parameters (described in Reduction of Processor Time Section) needed repeatedly but which remain constant for the given x, y, z coordinates. These integration parameters are stored sequentially for each element and are retrieved for transient or steady-state solutions with different boundary conditions or hydraulic properties.

3. BAND - Simulation of ground-water basins involves a large, sparse and unbanded system of equations. The equation solver uses partially packed arrays by storing only nonzero elements in one matrix and their column identification in another matrix. Initially as well as during decomposition of the system matrix into upper triangular form, the nonzero columns of each row are arranged in ascending order, reducing processor time by conducting the search for specific elements until the column identification of the row being searched, is exceeded.

   Through subprogram BAND, the preassigned locations of elements for initial formation of system matrix are calculated. This reduces considerably the computational efforts necessary in rearranging the columns during repeated formations of the system matrix.

4. PROG3I - For a given problem it is usually desired to simulate potentials with different time steps, recharge rates and pumping stresses. PROG3I has been structured to read or to redefine these values for each simulation run. Thus PROG1, PROG2 and BAND are executed only once. Through PROG3I and PROG3, simulation for various combinations of time steps and boundary values are carried out.

5. PROG3 - This is the main program, which calculates the potential head using File-Q disk data generated by PROG1, PROG2, BAND, and PROG3I.

   Maximum efforts in computation of head are involved in formation of element matrices, the system matrix and decomposition of the system matrix into an upper triangular form. For a constant time step simulation, the coefficients of the system matrix are invariant. PROG3 has been structured to decompose the system matrix only at changes of time step magnitude. For constant time steps, the solution is achieved by recalculating the right-hand constant vector as a function of boundary conditions, prescribed flux rates and pumping stresses, followed by back substitution into the decomposed upper triangular matrix.

MAIN FEATURES PROVIDED IN THE MODEL FOR CONVENIENT MATHEMATICAL DESCRIPTION OF A GIVEN GROUND-WATER SYSTEM

In contrast to surface-water supplies, ground-water reservoirs are interconnected over large areas, and their definition and analysis require difficult and extensive geologic investigations. Geologists and geohydrologists usually define various layering patterns by a few typical well logs (defining the vertical geologic section), interpreted cross sections and contour maps showing top elevation, bottom elevation, and/or thickness of each identified hydrogeologic unit in the given region.

To simplify the input data preparation, the model is structured on the basis of two-dimensional surface elements and well logs at each node. Three-dimensional finite elements, describing geologic stratification, are generated by the model. Development of three-dimensional elements by the model ensures the continuity. Any discontinuity in adjoining three-dimensional elements results mathematically in an insulated, no flux, layer.

Characteristics of input data structure and steps involved in mathematical representation of the given ground-water system follow:

1. Discontinuities, major breaks in slope or thickness, and fault zones of the hydrogeologic units are some of the controlling parameters affecting the ground-water flow regime. To define the geologic stratification for a given ground-water basin, these controlling parameters are identified by discrete nodes on each of the hydrogeologic units and then combined at the surface.

2. For proper presentation of the unknown function (head), increase in nodal concentration is necessary. This is done by placing additional nodes along surface water bodies (lakes, rivers, seashore), at important recharge or pumping wells, and for further subdidivsion of large uniform region (for defining variable infiltration or pumping stresses).

3. At each surface node, well logs are prepared by using contour maps of hydrogeologic units. The depth increments are defined either in elevation above a given datum or in actual thickness of each material.

4. According to the geologic and surface water boundaries, the nodes are joined by straight (linear) or curved (quadratic or cubic) lines to subdivide a given region into isoparametric, two-dimensional, mixed-order elements. Mixed-order, isoparametric elements enable a mathematical description of straight, curved, or meandering boundaries with a minimum number of nodes.

5. Using two-dimensional surface elements and well log details at each node, three-dimensional elements are generated by the computer program.

6. Some of the stress conditions encountered in a ground-water system are:
   - potential boundary conditions; e.g., given water-level elevation of lakes, ponds, seashore
   - vertical infiltration at the top of the ground-water surface
   - pumping (or recharge) at given well locations (node)
   - pumping (or recharge) for a given subregion (element) from a given layer.

This model has the provision of defining steady state and transient 1) potential boundary conditions, 2) vertical infiltration rate at the surface and 3) pumping or recharge rate at a given location or element.

SUPPORTIVE PROGRAMS DEVELOPED TO VERIFY THE INPUT DATA USED IN SIMULATION

Digital finite element models provide a flexible means of defining a complex ground-water system. However, the probability of input errors always exists in computer simulations. When dealing with a large number of nodes, manual checking becomes tedious and time-consuming, and results are not guaranteed to be free of errors. Some means of editing the input data before simulation is essential.

Realizing the above needs as well as the fact that tabular output data are not adequate, the following supportive plotting programs have been developed. The input data deck initially designed for simulation is used in all plotting programs.

Plotting of Node Locations, Elements, and Vertical Logs

The subprogram (PLOTEL) has been developed to plot the locations of each node, two-dimensional surface elements, and the vertical log at each location. Finite element solution of the governing partial differential is obtained by Gaussian integration of each element. Any error in description of an element (by defining the wrong node number or sequence of the nodes of an element) results in an erroneous integration. Through this plotting package, the user achieves a positive check on correctness of geometry of nodes and finite elements.

The logs that describe the geologic section on which the three-dimensional elements are generated by the program are another place where errors can occur. To provide a visual check for the modeler and hydrogeologist, geologic sections are drawn at each node location. A horizontal tick mark is placed at the interface of two hydrogeologic units on the section. The material between these tick marks (representing thickness of the hydrogeologic unit) is identified by an integer number assigned to the material (Figure B.1). By knowing the local stratigraphy, hydrogeologists can review these sections for errors. At locations where adequate data are not available, solutions can be obtained by redefining the geologic sections with alternative interpretations. Because three-dimensional elements are developed by the computer program itself, another formulation of the given ground-water system is easily obtained by changing vertical sections at disputed locations.

From the vertical sections and the element demarcations plotted by PLOTEL, fence diagrams can easily be developed.

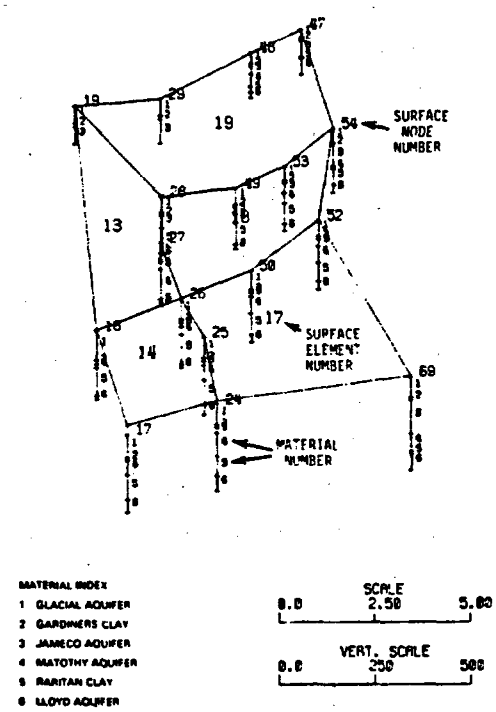


FIGURE B.1. Illustrative Sample Plot of Vertical Stratification in Part of Western Subregion of Long Island. (This plot is made by supportive program PLOTEl to check nodal geometry, element delineation, and vertical section defined at each node.)

Contour and Three-Dimensional Plotting of Initial Head, Top Elevation, and Thickness of Materials

When dealing with large multilayered reservoirs, it becomes difficult to evaluate errors from the tabulated printer output only. Contours and three-dimensional plots of initial head, top elevation, and/or thickness of each hydrogeologic unit provide a useful tool for proper verifications of input and interpretation of the results. Most of the available computer graphics packages are, however, applicable only to regular grid values, while irregular grids usually are involved in finite element methods. To estimate the regular grid values, the reference plane is divided into linear elements. Using the principles of basis functions and search techniques, program GRIDIT finds the element associated with each grid and its local coordinate values. For a given basin, this program is executed only once to generate a binary output disk file, used by GRIDIN and GRIDH. Program GRIDIN estimates grid values of the parameter of interest (top elevation or thickness of any material) from the input data file and prepares a regular grid file that can be contoured or plotted three-dimensionally by the normal available graphics packages.

Plotting Held Potential and Prescribed Flux Boundary Conditions

Ground-water simulation is a boundary value problem, and, therefore, the results are functions of the held potential boundary conditions, as well as the flux stresses prescribed for the surface, nodes, and elements. Program PLOTBC plots the locations and values of held potential boundary conditions. PLFLUX plots the stresses prescribed for ground surface and in each element of each hydrogeologic unit. Because surface infiltration is usually described in terms of fraction of precipitation, the units of input are rate per unit area, while withdrawal and recharge from each element are in units of volume per unit time for that subregion.

Display of Results

Program GRIDIN was developed to estimate the head values at regular grid spacing for any given plane (at the surface or bottom of a hydrogeologic unit). From the data retrieved by GRIDH, contour maps, grid display, and/or three-dimensional plotting can be accomplished. Program DIFH estimates the difference between a given set of potentials (measured or prescribed) to model-predicted potentials.

APPENDIX C

VARIABLE THICKNESS TRANSIENT (VTT)
GROUND-WATER HYDROLOGIC MODEL

APPENDIX C

VARIABLE THICKNESS TRANSIENT (VTT) GROUND-WATER HYDROLOGIC MODEL

Any modeling effort requires some simplifying assumptions to bridge the gap between reality and our current knowledge or understanding of the system being modeled. In most modeling fields certain basic simplifying assumptions are routinely accepted, whereas others require justification based on data gathered and observations made on the real-world system being modeled. In the set of equations in this appendix, a large amount of the modeling effort and associated assumptions have already been made (cf., Bear 1972). The set of assumptions and modeling effort discussed in Chapter 4 of Bear's report go from the complex world of porous media particles and the associated tortuous flow paths for ground water to the regime of representative elementary volumes and the fluid flow continuum. These assumptions are generally accepted in the field of ground-water hydrology and are complex enough that they will not be presented here. The equations we write to describe an aquifer system will be for a fluid flow continuum in porous media. However, it is not sufficient for a mathematical model to be based on a sound set of equations that describe the physical system. The model must also be based on technically sound hydrologic information and reasonable simplifying assumptions regarding these hydrologic interpretations. The advent of high-speed digital computers has paved the way for making computer simulation of complex ground-water systems a practical reality.

The digital computer model is designed to simulate the hydraulic head response to natural and man-made aquifer stresses in a multi-layered two-dimensional aquifer system. The real ground-water system is, of course, a three-dimensional system, consisting of precipitation percolating from the surface through unsaturated soil into the uppermost aquifer. In some cases along rivers or streams or at the base of lakes and ponds, the aquifers are discharging into or being recharged from these surface-water bodies. These conditions formulate one type of boundary condition for our mathematical model. The units we call separate aquifers are really water saturated layers in the soil and rock matrix, that make up the earth's crust. These units are generally more permeable than the geologic units directly below them and sometimes more permeable than those above. As a result, the water in an aquifer tends to flow in a horizontal direction along the bedding plane of the more permeable geologic formation because the resistance to flow is less. The less permeable (aquitard) or sometimes impermeable (aquiclude) layers below, and sometimes above, the aquifer materials retard or completely block the vertical flow. These less permeable layers are designated as the base and top of the aquifer unit. When a more permeable layer exists below the upper aquifer unit's base, another aquifer may exist. When the aquitard material between aquifers is somewhat permeable, there can be water transfer between the aquifer units, depending on the water potential or pressure in the units. For most regional ground-water models that are currently being used, a simplifying assumption is made that transforms this three-dimensional system to a layered two-dimensional system with interaquifer transfer via a potential-driven leakage term. The mathematical model that uses this set of simplifying assumptions is the multi-aquifer formulation of the Boussinesq equations.

MATHEMATICAL FORMULATION FOR THE VARIABLE THICKNESS TRANSIENT (VTT) MODEL

Often an exact solution of the general, three-dimensional, saturated flow equation and free-surface boundary condition is not required to obtain useful results. VTT uses the Dupuit-Forchhiemer or Boussinesq approximate method, which assumes a simplified, two-dimensional horizontal view of the ground-water system. This allows the free-surface boundary condition and the flow equation to be combined into a single equation amenable to practical numerical solution techniques. For simplicity we will refer to this method as the Boussinesq Flow Model.

Let x, y, z be the coordinates of a fluid particle, then dx/dt, dy/dt and dz/dt are the components of "pore velocity," and the Darcian seepage velocities are:

$$V_x = n_e \frac{dx}{dt} \quad (1)$$

$$V_y = n_e \frac{dy}{dt} \quad (2)$$

$$V_z = n_e \frac{dz}{dt} \quad (3)$$

where:

n_e = effective porosity.

Now, if we let $z = h(x, y, t)$ represent the coordinate of the free surface and formally differentiate with respect to time, we have:

$$\frac{dz}{dt} = \frac{\partial h}{\partial x}\frac{dx}{dt} + \frac{\partial h}{\partial y}\frac{dy}{dt} + \frac{\partial h}{\partial t} \quad (4)$$

Substituting the Darcian velocities and rearranging we have:

$$n_e \frac{\partial h}{\partial t} + V_x \frac{\partial h}{\partial x} + V_y \frac{\partial h}{\partial y} - V_z(h) = 0 \quad (5)$$

The Dupuit assumptions used in this model may be simply stated as: $\Phi(x, y, z, t) \approx \Phi(x, y, \bar{z}, t)$ where $\bar{z}$ = average height of the water particles above reference datum. This is equivalent to stating that flow is essentially horizontal, so that vertical flow components can be neglected and that the slope of the water table surface is slight (<5°). Darcy's law can be rewritten as:

$$V_x = -\bar{K} \frac{\partial h}{\partial x} \quad (6)$$

$$V_y = -\bar{K} \frac{\partial h}{\partial y} \quad (7)$$

where:

$K(x, y)$ = vertically averaged value of hydraulic conductivity at location (x, y)

Substituting Equations (6) and (7) into (5) we have:

$$n_e \frac{\partial h}{\partial t} - \overline{K} \left[\left(\frac{\partial h}{\partial x}\right)^2 + \left(\frac{\partial h}{\partial y}\right)^2\right] - V_z \ (h) = 0 \tag{8}$$

Now replacing V_z (h) with the expression obtained from substituting the results of Equations (6) and (7) into Equation (8):

$$n_e \frac{\partial h}{\partial t} - \overline{K} \left[\left(\frac{\partial h}{\partial x}\right)^2 + \left(\frac{\partial h}{\partial y}\right)^2\right] - h \ \frac{\partial}{\partial x} \left[\left(\frac{\overline{K}\partial h}{\partial x}\right) + \frac{\partial}{\partial y}\left(\frac{\overline{K}\partial h}{y}\right)\right] = 0 \tag{9}$$

Rearranging Equation (9) yields:

$$n_e \frac{\partial h}{\partial t} - \frac{\partial}{\partial x} \left(\frac{\overline{K}h\partial h}{\partial x}\right) - \frac{\partial}{\partial y} \left(\frac{\overline{K}h\partial h}{\partial y}\right) = 0 \tag{10}$$

or in gradient vector notation:

$$n_e \frac{\partial h}{\partial t} - \nabla \cdot (\overline{K}h\nabla h) = 0 \tag{11}$$

Equation (10) is termed the Boussinesq equation. To this point for simplicity of development we did not include source terms and have assumed that the aquifer base elevation is the zero reference elevation. To expand Equations (10) or (11) to handle an aquifer with varying bottom elevation h_b (x, y), and to include source/sink or accretion terms, we must do the following:

- assume that the bottom slope is slight, as we did for the free-surface slope
- replace h in Equations (10) or (11), which was a result of integrating from z = 0 to z = h by $h-h_b$, because our integration is now done from $z = h_b$ to z = h
- add the accretion term, N.

The resulting equation is the Boussinesq equation for unsteady flow:

$$\overline{n}_e \frac{h}{t} = \nabla \cdot \overline{K} \, (h-h_b) \, \nabla \, h + N \tag{12}$$

where:

n_e (x, y) = vertical average of the effective porosity of the aquifer (dimensionless)

h (x, y) = elevation of the free surface from some reference elevation (L)

h_b (x, y) = elevation of the aquifer bottom from the reference elevation (L)

N (x, y) = accretion rate (LT^{-1})

K (x, y) = vertically averaged value for hydraulic conductivity at point (x, y) (LT^{-1})

ASSUMPTIONS

The basic assumptions of the Boussinesq flow model for describing saturated unconfined flow are:

- Flow is by an incompressible fluid that saturates a rigid, porous soil matrix.
- Compressibility effects of the fluid and soil matrix can be neglected under conditions of unconfined or free-surface flow; however, they are incorporated into the storage term for confined flow.
- Hydraulic conductivity and effective porosity can be represented by the vertical average values and are isotropic but inhomogeneous throughout the region.
- The free-surface slope and the aquifer bottom slope are both assumed to be slight (<5°).
- Vertical velocities are assumed to be small and therefore can be neglected.

- Coefficient distributions and dependent variables are assumed continuous over the simulation region.
- Flow in the capillary fringe is neglected.
- Seepage surfaces cannot be handled and are therefore neglected.

The Boussinesq formulation as presented above allows one to approximate the elevation of the free surface in a single unconfined aquifer at every (x, y) location. Many times in a real system one wishes to simulate a multi-aquifer system, in which one or more of the aquifers are confined, although these confined aquifers may be unconfined in some places. Also there may be transfer of water between the aquifers. This kind of a multi-aquifer system can be handled by a multi-aquifer set of Boussinesq equations with potential driven interaquifer tranfer or leakage terms. For a multilayered system the equations would be:

$$S^{i} \frac{\partial h^{i}}{\partial t} = \frac{\partial}{\partial x}\left(T^{i} \frac{\partial h^{i}}{\partial x}\right) + \frac{\partial}{\partial y}\left(T^{i} \frac{\partial h^{i}}{\partial y}\right) + N^{i} + \sum_{j=1}^{-1} C_{j\to i}\,(h^{j} - h^{i})$$

$$+ \sum_{j=i+1}^{n} C_{j\to i}\,(h^{j} - h^{i}) \tag{13}$$

where:

i = 1, 2, ... n

n = number of layers

$C_{i\to j} = C_{j\to i}$ = interaquifer transfer coefficient between layer i and j

$S^{i} = n_e^{i}$ for unconfined system or storage coefficient for the confined system

T^{i} = transmissivity for a confined system is K^{i} times the thickness of aquifer or $K^{i}(h^{i} - h_{j})$ for an unconfined or water table aquifer

N^{i} = the flux or stress term applied to layer i

As with any mathematical model there are specific data requirements, boundary conditions, and initial conditions that must be specified. Equation (13) as presented is the transient equation. When the left-hand side of Equation (13) is replaced by zero, the steady-state equation results. As mentioned previously, the transient equation allows one to investigate the effects of seasonal fluctuations and rates of change, whereas the steady-state equation allows one to investigate the ultimate effect of any water use policy. Use of the transient model requires that the storage coefficient distribution be known, whereas the steady-state model does not require this distribution.

SPECIFIC DATA REQUIREMENTS FOR THE PHYSICAL PARAMETERS

The following are the specific data requirements:

- hydraulic conductivity ($K=k/\mu$, where k = intrinic permeability and = fluid viscosity); transmissivity ($T=Kb$, where b = saturated thickness of the aquifer material)

  The Boussinesq flow model requires as an input the saturated hydraulic conductivity or transmissivity distribution throughout the region being modeled and for each aquifer being modeled. The values required by the Boussinesq model must represent the vertical average of the K or T of the saturated thickness of the aquifer.

  Hydraulic conductivity or transmissivity reflects the ability of the rock and soil matrix to allow water transmission. The K or T distribution is usually determined via appropriately conducted pumping tests, where the well is fully penetrating and perforated throughout saturated aquifer material. Data from these type of field measurements are expensive to obtain, and therefore the K or T distribution is extrapolated from a small number of these measurements. This initial distribution is further modified during the model calibration phase to obtain better agreement between model-predicted potentials and observed potentials. Hydraulic conductivity can also be estimated from laboratory studies of aquifer material samples, lithologic data, and inverse mathematical modeling methods.

- storage coefficient (or effective porosity n_e and vertical compressibility of the soil matrix [α])

  The transient form of the Boussinesq equation requires the distribution of the vertical averaged value of the storage coefficient for each aquifer throughout the region being modeled. This parameter controls the rate at which the water and disturbances in the potential surface propogate throughout the ground-water system. In the case of an unconfined system, the storage coefficient is dominated by the effective porosity of the aquifer's soil matrix. Contributions to the storage coefficient based on soil matrix compressibility and water compressibility are ignored. In the case of confined systems, the storage is a function of the aquifer soil matrix compressibility (α), effective porosity (n_e), with storage $= \rho g(\alpha + n_e\beta)$.

  Storage or effective porosity can be determined via pumping tests with observations wells, lithologic data from core samples, and laboratory or in-situ measurement techniques. In addition, storage coefficients can be determined during model calibration when adequate transient data on potentials exist.

- interaquifer transfer coefficients ($C_{j\to i}$).

  The multiaquifer Boussinesq Flow Model requires an interaquifer transfer coefficient, which is a measure of the hydraulic interconnection between aquifer systems. This value is a function of the thickness and hydraulic conductivity of the aquitard separating the aquifer systems; it must be determined at each (x, y) location where an aquitard exists between the aquifers. This value arises naturally in the other three-dimensional formulations in the form of (x,y,z) hydraulic conductivity distributions. It is generally obtained via model calibration of inverse modeling techniques.

Initial Conditions

The Boussinesq flow model requires initial conditions. The Boussinesq flow model requires one average potential value for each aquifer for each (x, y) grid location throughout the region being modeled.

Boundary Conditions

Like other mathematical models, the Boussinesq model requires that boundary conditions be specified. Boundary conditions are difficult to formulate and result from interpretations of potential data, well logs, and lithologic data. The physical extent of the aquifer and or aquifers is defined. This includes a geometrical description of the positions in space of the aquifer materials such as:

- the lateral boundaries of the aquifer or aquifer systems
- contour maps of the base and top of the aquifer or aquifer systems.

Along each of the lateral boundaries, the conditions that describe the physical situation that exists must be determined. These include:

- Lateral Flow Boundary

  This results from not extending the model to the geologic boundaries of the aquifer or aquifer systems. At these boundaries the rate that water is flowing into or out of the aquifer or aquifer system must be specified.

- No Flow Boundaries

  These occur when the model has been extended to the geologic boundaries of the aquifer where the aquifer materials and impermeable barriers meet.

- Held or Time-Varying Potential Boundaries

  These occur at large lakes and rivers, where the saturated aquifer materials are in contact with large bodies of water whose water surface elevations are essentially unaffected by aquifer potentials.

RECHARGE - DISCHARGE LOCATIONS AND RATES

Typically, when modeling an aquifer system that extends to the major recharge areas of the aquifer, the following types of data are used to estimate aquifer recharge:

- precipitation records
- surface slope
- temperature record

- surface soil types
- vegetation cover and land use
- evapotranspiration data.

Human caused recharge or discharge must also be accounted for by determining:

- location of pumping and recharge wells
- use of water and infiltration mechanisms (e.g., septic tanks, irrigation infiltrations, settling ponds).

Along flow boundaries where the area being modeled does not extend to geologic boundaries, the flow across this boundary must be determined via pump test and geologic studies conducted along this boundary.

Figure C.1 illustrates graphically the phenomena that must be considered in calculating the distribution of aquifer stress values throughout the region being modeled.

NUMERICAL FORMULATION OF THE SYSTEM EQUATIONS

For numerical formulation, a horizontal x-y coordinate grid system was adopted with uniform nodal spacing. R represents the region of flow and r_{ij} the sub-area associated with node ij (Figure C.2).

The differential equation, Equation (8), is then converted to finite difference form by integrating around the node area r_{ij}. Now:

$$\int_r \int_{ij} \left[\underline{\nabla} \cdot K(h - h^b)\underline{\nabla}h - n_e\frac{\partial h}{\partial t} + N\right] dxdy = 0 \tag{14}$$

By Green's theorem in the first form (Kellogg 1954):

$$\int_r \int_{ij} \underline{\nabla} \cdot K(h - h^b)\underline{\nabla}h dxdy = \oint_{\Gamma_{ij}} K(h - h^b) \frac{\partial h}{\partial n} ds \tag{15}$$

where n denotes the outward pointing normal to the curve Γ which bounds the area r_{ij}. The line integral is taken in the anticlockwise direction. Using Equation (15), Equation (14) reduces to:

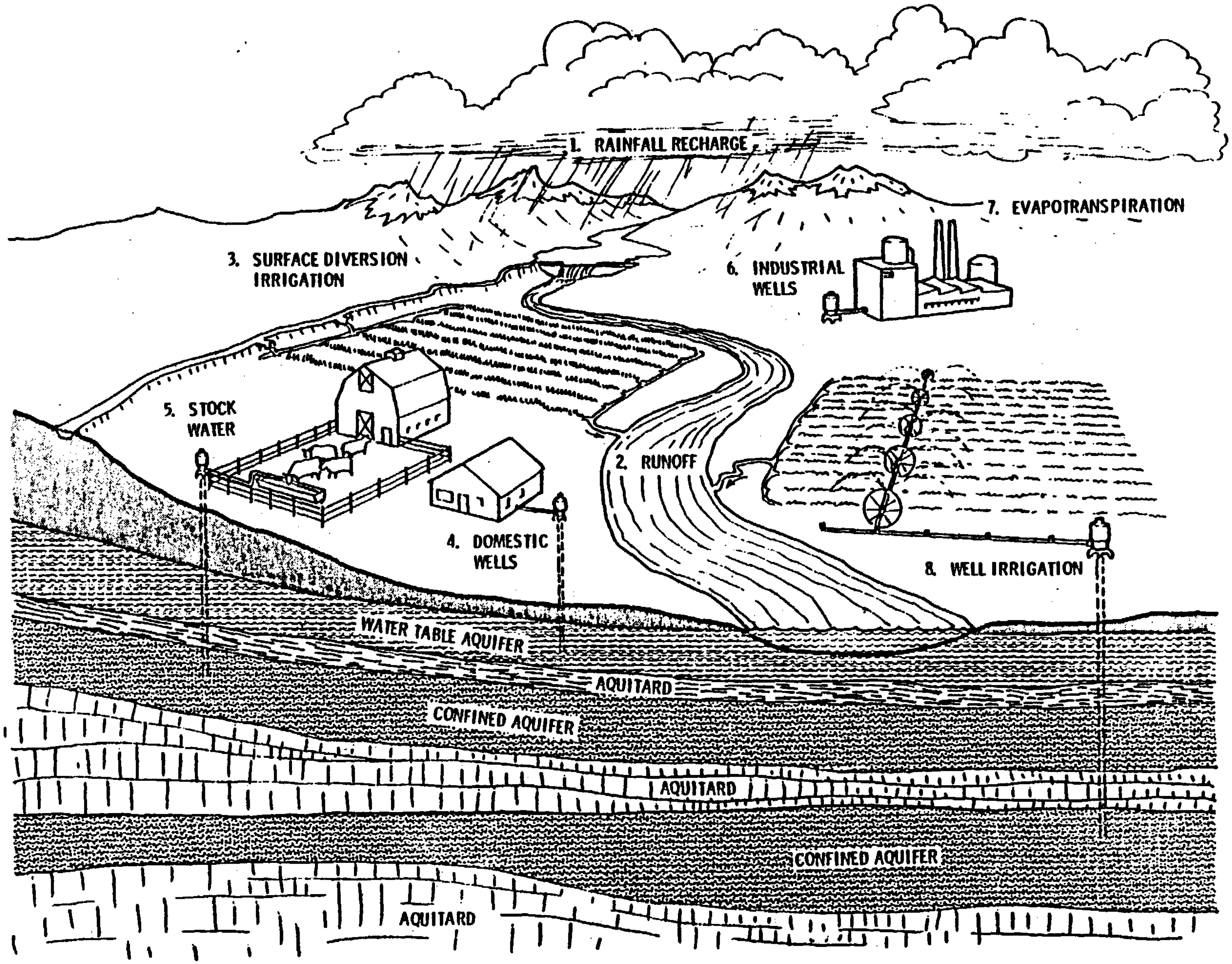


FIGURE C.1. Nodal Recharge/Withdrawal Phemomena

$$\oint_{\Gamma_{ij}} K(h - h^b) \frac{\partial h}{\partial n} ds - \int_r \int_{ij} (n_e \frac{\partial h}{\partial t} - N) dxdy = 0 \qquad (16)$$

In Figure C.2 the corner points of the node area are at (i-1/2, j-1/2), (i+1/2, j-1/2), (i+1/2, j+1/2), and (i-1/2, j+1/2). The area of r_{ij} is $\Delta x \Delta y$. The integrals of Equation 16 are approximated as follows, with the integral along Γ_{ij} divided into the integrals along the four sides of r_{ij}:

$$\int_{i-1/2,\ j-1/2}^{i+1/2,\ j-1/2} K(h - h^b) \frac{\partial h}{\partial n} dx \approx (K\Delta h)_{i,j-1/2} \frac{h_{ij} - h_{i,j-1}}{-\Delta y} \Delta x \qquad (17a)$$

$$\int_{i+1/2,\ j-1/2}^{i+1/2,\ j+1/2} K(h - h^b) \frac{\partial h}{\partial n} dy \approx (K\Delta h)_{i+1/2,\ j} \frac{h_{i+1,\ j} - h_{ij}}{\Delta x} \Delta y \qquad (17b)$$

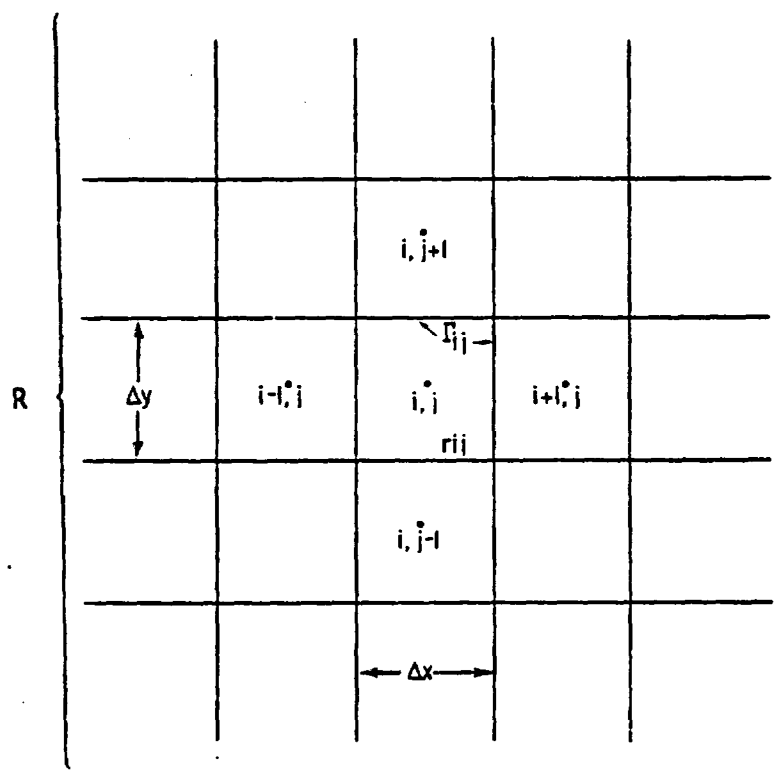


FIGURE C.2. The Finite Difference Grid with the Nodal Numbering System

$$\int_{i+1/2,\ j+1/2}^{i-1/2,\ j+1/2} K(h - h^b)\frac{\partial h}{\partial n}dx \approx (K\Delta h)_{i,\ j+1/2} \frac{h_{i,\ j+1} - h_{ij}}{\Delta y}\Delta x \tag{17c}$$

$$\int_{i-1/2,\ j+1/2}^{i-1/2,\ j-1/2} K(h - h^b)\frac{\partial h}{\partial n}dy \approx (K\Delta h)_{i-1/2,\ j} \frac{h_{ij} - h_{i-1,j}}{-\Delta x}\Delta y \tag{17d}$$

$$\iint_{r_{ij}} (n_e\frac{h}{t} - N)dxdy \quad n_{e_{ij}} \frac{h_{ij}^{k} - h_{ij}^{k-1}}{\Delta t}\Delta x\Delta y - N_{ij}\Delta x\Delta y \tag{17e}$$

where the superscript k denotes the iteration number

and where the $K\Delta h$ half way between node center in the j-1 direction is:

$$(K\Delta h)_{i,j-1/2} = 1/2\left[K_{ij}(h_{ij}^k - h_{ij}^b) + K_{i,j-1}\ (h_{i,j-1}^k - h_{ij}^b)\right]$$

A fully implicit representation of the time derivative has been used in Equation (17e). Combining the above approximations results in the finite difference approximation to the Boussinesq equation for a square grid system, $\Delta x = \Delta y$:

$$-(K\Delta h)_{i-1/2,j}\ h_{i-1,j}^k + \Big[(K\Delta h)_{i-1/2,j}+(K\Delta h)_{i+1/2,j}+(K\Delta h)_{i,j-1/2}$$

$$+(K\Delta h)_{i,j+1/2}+n_{e_{ij}}\frac{(\Delta x)^2}{\Delta t}\Big]\ h_{ij}^k-(K\Delta h)_{i+1/2,j}\ h_{i+1,j}^k$$

$$= (K\Delta h)_{i,j-1/2}\ h_{i,j-1}^k+(K\Delta h)_{i,j+1/2}\ h_{i,j+1}^k+n_{e_{ij}}\ \frac{(\Delta x)^2}{\Delta t}\ h_{ij}^{k-1}+N_{ij}^{k-1}\ (\Delta x)^2 \tag{18}$$

For node on boundaries along which the hydraulic potential is specified in time and space (and therefore no calculation is needed):

$$h_{ij}^k = H_{ij}^k$$

The impermeable boundaries of the region must be approximated in the grid system by shapes selected from Figure C.3. This avoids right angles, which cause stagnation points and singularities in the mathematical solution of the ground-water flow equation.

The boundary conditions are put into finite difference form by applying the technique described above to a node area at the boundary of the region R. The boundary types are illustrated in Figure C.3. The associated nodal area r_{ij} can be either inside or outside the octagon. The finite difference equations are derived by setting the appropriate portions of the integral on $_{ij}$ in Equation (15) to zero when the segment is impermeable. In finite difference form, 24 different equations correspond to each of the different boundary point subregions illustrated in Figure C.3. Either a specified flux or no flow can be imposed by each of the 24 equations. The accretion term,

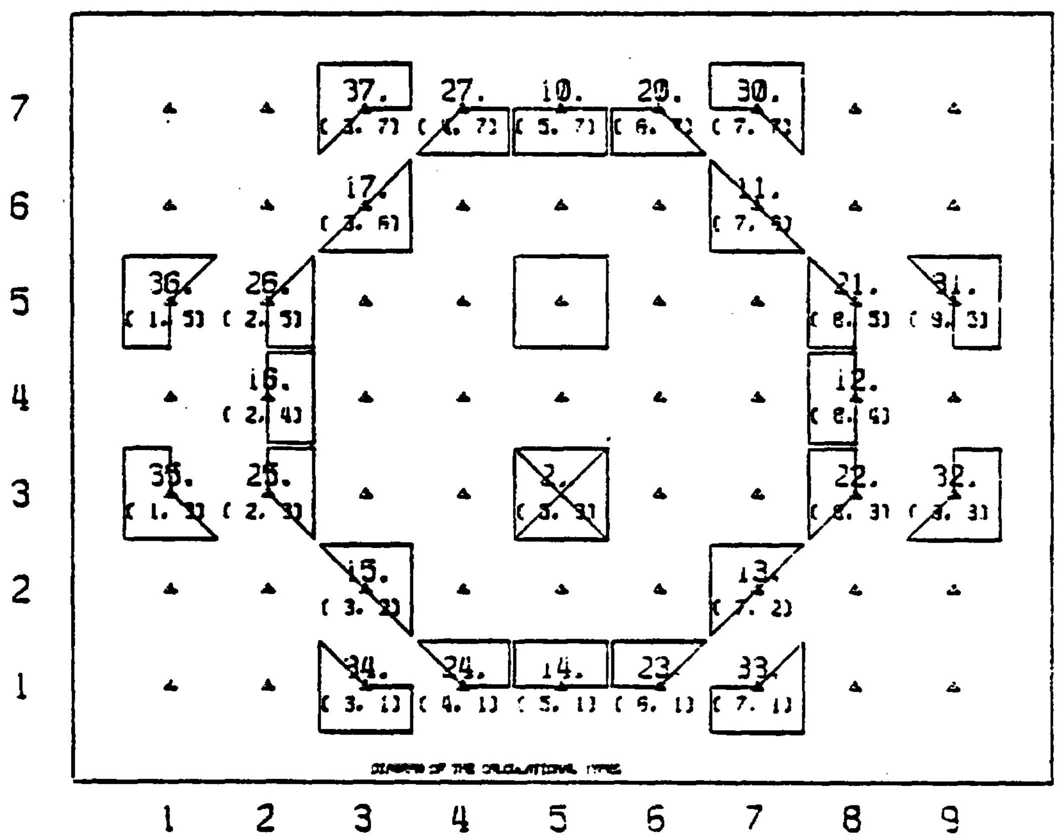


FIGURE C.3. Schematic Showing Shapes and Rotation of Available Boundary Condition Types whether infiltration or withdrawal, in finite difference form becomes $N_{ij} = q_{ij}(\Delta x)^2$ (units L^3/T) to be specified at each node. Accretion at the fractional boundary nodes must have the nodal area properly reduced from $(\Delta x)^2$.

The partial differential equation and boundary conditions subsequently become a set of $\hat{N}$ finite difference equations, one for each node of the region R being modeled. The boundary conditions have been effectively absorbed into the equations for their respective boundary nodes.

The finite difference equations can be derived in the same form by other techniques, such as Taylor series expansion. The equations for nodes on impermeable boundaries are equivalent to those obtained by introduction of a point external to the region for purposes of forming the normal derivative.

Boundary Definitions

To simulate the system, a model depends on segmenting the physical continuum into a discrete grid. Each grid segment is then represented by a single node within the model. The VTT Model uses a finite difference algorithm with a uniform grid and requires that each node within the Cartesian coordinate system be marked with a calculation type as:

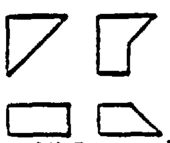
- within the aquifer
- external to the aquifer
- a water or held potential boundary node [$h = H(x,y,t)$]
- an impermeable boundary for the aquifer with $q = 0$. (Aquifer boundary nodes, where the flux is known, are treated as the mathematical equivalent to an impermeable boundary node with the appropriate accretion term; i.e., $q \neq 0$.)

To facilitate the marking of calculational boundary types to avoid right angles along no-flow boundaries, and to simplify representation of complex boundaries, a systematic method of representing interior, exterior, and boundary nodes was adopted. Figure C.3 illustrates the different kinds of nodal types used in the VTT code. There are basically four nodal types; others simply arise to handle the various shapes and orientations of the impermeable boundaries.

⊠ is a water boundary, i.e., held potential boundary node [$h = H(x,y,t)$].

△ is an external node outside of the aquifer.

□ is an internal or nonboundary node which lies within the aquifer.



with all their possible rotations, are used to represent the 24 kinds and shapes of impermeable boundary nodes.

Solution Techniques

Three different solution techniques were selected to solve essentially the same set of equations, thus resulting in three separate versions of the same model. Each of these is designed for use in specific problems. These will be described in general to avoid lengthy mathematical discussions.

The VTT version of the model solves the transient form of the system of finite difference equations by using the successive line overrelaxation technique. For transient problems the solution is stable and convergent with sufficient speed to make solution of large matrices practical.

The VTTSS3 version of the model solves the steady-state system of finite difference equations resulting from the integration of Equation (15) when the transient term $n_e \frac{\partial h}{\partial t}$ is set to zero. This set of equations is solved by using a Newton iteration technique (Kellogg 1954). This version is primarily used for a system of aquifers in which one is unconfined and, therefore, the equations are nonlinear. Convergence of this method is quadratic in nature and for most ground-water problems the solution is reached in four to five iterations.

The VTTSSZ version of the model solves the same system of steady-state equations discussed in the preceding paragraph, except that it uses a Colesky decomposition method (Kellogg 1954). This version is used when all the aquifers being simulated are confined. This method is many times faster than the Newton version, and because the system of equations will be linear, no iteration is required.

APPENDIX D

DEVELOPMENT AND DESCRIPTION OF THE MULTICOMPNENT MASS TRANSPORT (MMT) MODEL

APPENDIX D

DEVELOPMENT AND DESCRIPTION OF THE MULTICOMPONENT MASS TRANSPORT (MMT) MODEL

To date, mass transport modeling in a given physico-chemical system has been approached in two fundamental ways. One method is to describe the system with an appropriate mathematical equation and then solve the equation with initial and boundary conditions that characterize the system. The other approach is to attempt to define numerical structures that represent specific constituents or physical structures of the system and allow these numerical representations to interact with the system as determined by the physico-chemical driving forces that are active within the system, thereby creating a more direct simulation.

The first approach will be termed the "model-equation" method and usually leads to a complex set of partial-differential equations that are typically solved numerically by finite-difference or finite-element techniques, and more recently by integrated-finite-difference techniques (Narasimhan and Witherspoon 1976). The second or "direct-simulation" approach requires an efficient bookkeeping structure to control the numerical representations so that the initial conditions, boundary conditions, and other physical or chemical constraints are satisfied.

For AEGIS, the initial step was to review several ground-water mass transport models that used each of these funamental approaches and weigh their respective advantages and disadvantages with respect to consequence analysis of deep geologic repositories (Raymond 1977). The model-equation approach using finite difference or finite element techniques suffered from numerical dispersion, which could be exaggerated by the required long simulation times ($\sim 10^6$). Another disadvantage was a greater development time because all models would have required modification to take care of decay chains. The model developed by Pinder and Cooper (1970) using the method of characteristics was investigated. It suffered less from numerical dispersion; however, it had some stability and mass conservation problems.

The approach chosen was a direct simulation technique similar to that of Pinder and Cooper, except that the particles had mass associated with them instead of concentration, and the dispersion process was handled as a random process rather than solving finite-difference equations representing the diffusion equation. This method was adapted from a direct-simulation heat transport analog developed by Eliason and Foote (1972). The primary advantages of the subsequent model are:

- always mass conservative
- no cumulative numerical dispersion
- inherent numerical stability
- facilitiates handling of multicomponent systems.

The following is the conceptual development of both the model-equation and direct-simulation approaches. The direct-simulation method is actually derived from the differential equations. This will provide a basis for comparison of both methods.

MODEL EQUATION APPROACH

Equations of mass transfer are extensions of the continuity equation for a specific chemical species. Stated in non-mathematical terms for a given control volume:

Net rate of mass efflux of species A from control volume	+	Net rate of accumulation of A within control volume	-	Rate of chemical production of A within the control volume	=	0

A general continuity equation developed by Gray (1975) for multiphase transport of species α is written for porous media as:

$$\varepsilon \frac{\partial \langle\rho\alpha\rangle}{\partial t} + \langle\rho\alpha\rangle \frac{\partial \varepsilon}{\partial t} + \nabla \cdot (\langle V\rangle \langle\rho\alpha\rangle) + \nabla \cdot \langle\hat{\rho}\alpha\hat{V}\rangle$$

$$+ \frac{1}{V} \underset{A_{fs(t)}}{\quad} \rho\alpha\,(V - W) \cdot \eta\alpha dA = - \nabla \cdot \langle J\alpha\rangle -$$

$$\frac{1}{V} \underset{A_{fs(t)}}{\quad} J\alpha \cdot \eta\alpha dA + \varepsilon \langle R\alpha\rangle^{f} \tag{D.1}$$

where

$\rho\alpha$ = Mass concentration of α in the fluid

V = Fluid pore velocity

W = Velocity of the interface

ε = Porosity

$J\alpha$ = Diffusive flux of α with respect to the fluid pore velocity

$R\alpha$ = Rate of production of α in the fluid phase

$n\alpha$ = Unit vector normal to the fluid-solid interface

$\langle\rangle$ = Indicates the average of the quantity enclosed

$\hat{}$ = The local fluctuations of the quantity.

The first term in the above equation is the accumulation term. The next term accounts for concentration changes caused by changes in porosity which is useful for unsaturated conditions. The third term accounts for convection of species α by movement of the fluid. The following term is the divergence of the average of the product of the local fluctuations of the mass concentration and pore velocity. This represents hydrodynamic dispersion as defined by Bear (1972). The last term on the lefthand side and the first term on the right in Equation (D.1) relate to the effect of geometry on diffusive flux (tortuosity) and the diffusive flux, respectively. The last two terms relate to interphase mass transport and chemical production respectively.

Simplifying Assumptions

Equation (D.1) represents a completely general transport equation; however, not all the terms in (D.1) are easily quantified given present technology. Several simplifying assumptions are necessary to obtain a usable formulation. Other justifications for simplifying Equation (D.1) include:

- The level of complexity of a model used for simulating actual release consequences is not justified beyond the complexity and quality of the input data.

- Reasonable computation time and economical constraints, based on present computing hardware capabilities, limit the level of complexity that can be considered by a model. The simplifying assumptions will be denoted with italics where they appear in the following text.

It is assumed that the effects of changing atmospheric pressure are negligible. This assumption should be valid for most situations to be considered.

A velocity field is required for input to the model. These data can be obtained from a flow model or from analysis of data produced from a field study program. In any case, the flow field is calculated before computing the mass transport simulation. Inherent in this procedure is the assumption that *the flow patterns are independent of the chemical composition or temperature of the ground-water solution.* This assumption is sound, providing the system is nearly isothermal and all solutes are at relatively low concentration. The concentrations of the solutes must be low enough to not significantly affect the viscosity of density of the solution. For many cases this assumption will be valid, but for instances concerning salt water intrusion or dissolution of salts from salt domes or bedded salt formations, this assumption is invalid.

The result of the above assumption is to allow decoupling the mass transport equations from the flow equations and heat transport equations, thus enabling simulation of each phenomenon separately rather than simultaneously. In near surface aquifers where diurnal temperature fluctuations may be important or in cases where heat sources are available, (such as a nuclear waste repository), this assumption may not be valid.

Resolution of the flow patterns below a certain scale in a regional aquifer is usually not feasible, if not impossible. This small scale uncertainty in the flow field results in the term called mechanical or hydrodynamic dispersion (Bear 1972).

Schwartz (1977) subdivided hydrodynamic dispersion by scale and called it microscopic, macroscopic, or megascopic dispersion. Each term represents the scale of heterogeneity in the ground-water system. At the microscopic scale, dispersion occurs because the complex network of interconnected passages that comprise the soil structure causes continuous division and re-division of the flowing fluid. On the macro-scale local variations in lithologic units are responsible for dispersion. Regional variations in lithology account for megascopic dispersion. In any case, the variation in hydraulic conductivity accounts for dispersion.

Harleman, Melhorn and Rumer (1963) correlated the dimensionless ratio of longitudinal dispersion to the kinematic viscosity with a grain-size Reynolds number and a permeability Reynolds number. The grain-size Reynolds number was calculated with d_{50}, the 50% grain size, and the permeability Reynolds number was calculated with the square root of the intrinsic permeability. For sand they found:

$$\frac{D_L}{\nu} = 0.90\ R_{d_{50}}^{1.2}$$

and

$$\frac{D_L}{\nu} = 88\ R_k^{1.2}$$

where D_L/ν is the inverse Schmidt number for longitudinal dispersion. Unfortunately, dispersion has been quantified primarily in laboratory column experiments, and a paucity of field dispersion experiments exists because of measurement difficulties.

The two larger scale dispersions are made of microscopic dispersion and have results similar to molecular diffusion. In fact, Bear (1972) concluded that after a sufficiently long period of time, hydrodynamic dispersion could be *modeled as molecular diffusion. Therefore, for the MMT model, it was assumed that hydrodynamic dispersion processes can be included with molecular diffusion in the relative flux term. Furthermore, it is assumed that the relative mass flux can be adequately described by expressions of the form of Fick's First Law.* Thus,

$$J_\alpha = -\rho \bar{\bar{D}}_\alpha \nabla W_\alpha$$

where

ρ = total mass density of the solution
$\bar{\bar{D}}_\alpha$ = hydrodynamic dispersion tensor
W_α = mass fraction of species $\alpha\,(\rho_\alpha/\alpha)$

Incorporating this assumption into Equation (D.1) results in:

$$\varepsilon \frac{\partial \langle \rho\alpha \rangle}{\partial t} + \langle \rho_\alpha \rangle \frac{\partial \varepsilon}{\partial t} + \nabla \cdot (\langle V \rangle \langle \rho_\alpha \rangle) =$$

$$\nabla \cdot (\rho \bar{\bar{D}}_\alpha \cdot \nabla W_\alpha) + \varepsilon (R_\alpha)^f \qquad \text{(D.2)}$$

Incorporated into Fick's First Law are the assumptions that the mixture is an ideal solution and that only binary interactions at the molecular level are significant.

The dispersivity tensor, $\bar{\bar{D}}_\alpha$, is a function of both space and time. *If dispersion is assumed to be isotropic in the directions longitudinal and transverse to the direction of flow,* then the components of $\bar{\bar{D}}_\alpha$ can be represented by:

$$D^\alpha_{xx} = D^\alpha_L \cos^2\theta \cos\phi + D^\alpha_T (\sin^2\phi + \sin^2\theta \cos^2\phi)$$
$$D^\alpha_{xy} = (D^\alpha_L\ D^\alpha_T) \sin\phi \cos\phi \cos^2\theta$$
$$D^\alpha_{xz} = (D^\alpha_T - D^\alpha_L) \sin\theta \cos\theta \cos\phi$$
$$D^\alpha_{yx} = D^\alpha_{xy}$$
$$D^\alpha_{yy} = D^\alpha_L \cos^2\theta \sin^2\phi + D^\alpha_T (\cos^2\phi + \sin^2\theta \sin^2\phi)$$
$$D^\alpha_{yz} = (D^\alpha_T - D^\alpha_L) \cos\theta \sin\theta \sin\phi$$
$$D^\alpha_{zx} = D^\alpha_{xz}$$
$$D^\alpha_{zy} = D^\alpha_{yz}$$
$$D^\alpha_{zz} = D^\alpha_L \sin^2\theta + D^\alpha_T \cos^2\theta$$

where

ϕ = angle between the direction of flow and the (X,Y,Z) coordinate system in the X-Y plane measured from the X axis (see Figure III-2).

θ = vertical angle between the direction of flow and the X-Y plane, measured from the X-Y plane.

D^α_L = dispersion coefficient in the direction of flow L^2/T

D_T = dispersion coefficient in the direction transverse to flow L^2/T

D_L and D_T *are commonly (Boersma, Lindstrom and Saxena 1973) assumed to be represented by:*

$$D_L = a_L|\bar{v}|$$
$$D_T = a_T|\bar{v}| \tag{D.3}$$

where a_L and a_T are longitudinal and transverse dispersivities as defined by Bear (1972), which are functions of only a given porous medium. The implication is that $\bar{\bar{D}}$ is a function only of soil type, not of species α. The assumption made in Equation (D.3) is that the contribution of molecular diffusion is negligible or constant for all species.

The convective term can be expanded giving:

$$\nabla \cdot \rho_\alpha V = \rho_\alpha(\nabla \cdot V) + (V \cdot \nabla\rho_\alpha) \tag{D.4}$$

The pore velocity, V, can be expressed as q/Φ where q is the seepage (or Darcy) velocity and Φ is the volumetric moisture content or porosity for saturated flow. The assumption here is that *Darcy's Law holds for the description of saturated ground-water flow.* This should be a valid assumption for cases where pore sizes are greater than 20 µm. However, as Boersma, Lindstrom and Saxina (1973) point out for pore sizes less than 20 µm, there is a significant deviation from Darcy's law.

Expanding Equation (D.3) results in:

$$\nabla \cdot \rho_\alpha V = \rho_\alpha \frac{q}{\phi^2} + \frac{\rho_\alpha}{\phi}(\nabla \cdot q) + V \cdot \nabla\rho_\alpha \tag{D.5}$$

If the transporting medium is assumed incompressible, which is valid except near the boiling point of water, then:

$$\nabla \cdot q = 0 \qquad \text{for saturated systems} \tag{D.6}$$

and

$$\nabla \cdot q = - \frac{\partial \phi}{\partial t} \quad \text{for saturated systems.} \tag{D.7}$$

For AEGIS applications the only region that would invalidate the above assumption would be near a nuclear waste repository and then only a relatively short time after implacement of the waste.

Incorporating the preceding assumptions and *assuming that the total mass density of the mixture is relatively constant*, Equation (D.1) becomes:

$$\frac{\partial \rho_\alpha}{\partial t} - \rho_\alpha \frac{V}{\phi} (\nabla \phi) + V \cdot \nabla \rho_\alpha = \nabla \cdot \bar{\bar{D}} \nabla \rho_\alpha + r_\alpha \tag{D.8}$$

for saturated systems.

In ground-water systems the production term, r_α, is usually a complex function of several variables including soil or rock type, temperature, pressure, and concentration of all species found at any point in the system. This function is normally represented by a complex rate expression. However, for most problems of practical interest these expressions are not known; and because of very difficult experimental problems, these expressions are not likely to be obtained before a waste repository is put into operation. Fortunately, most ground water moves slowly, and reaction kinetics are rapid with *respect to the flow velocity to enable the assumption that most ground-water systems are at or near chemical equilibrium at all times*. Thus, at the end of each numerical time step, all species are constrained to be in equilibrium with each other.

Ground water has many constituents. Some of the species exist at concentrations high enough to affect the chemistry of other species in solution. These are called macroions. *It is assumed that the radionuclides leached from a repository or naturally occurring exist only in minute quantities compared to macroions and do not appreciably affect the chemistry of other constituents in solution*. These are referred to as microions. This assumption will be important in a later section dealing with how MMT handles the production term.

The equations that describe the current computerized versions of MMT are:

$$\frac{\partial \rho_\alpha}{\partial t} + V \frac{\partial \rho_\alpha}{\partial x} = D \frac{\partial^2 \rho_\alpha}{\partial x^2} + r_\alpha \qquad (D.9)$$

for the one-dimensional model, and a vertically-averaged equation

$$\frac{\partial \rho_\alpha}{t} + V \cdot \nabla \rho_\alpha = \nabla \cdot \bar{\bar{D}} \nabla \rho_\alpha + r \qquad (D.10)$$

represents the 2-D version.

THE DIRECT SIMULATION APPROACH

The intent of the direct-simulation approach is to create a numerical analog that directly represents the physical behavior of a system. The model must satisfy the principle of mass conservation and it must account for all important physical constraints and driving forces present in the system. A direct simulation approach applicable to AEGIS ground-water transport is outlined in the following text. All assumptions will again be indicated by italics.

Particles of Mass

The first step in creating an analog of a mass transport system is to define a numerical construct that represents the chemical species of interest. It has proven useful to view material systems as comprising a number of discrete particles. Pinder and Cooper (1970), Bredehoeft and Pinder (1973), and Konikow and Bredehoeft (1974) chose to have these particles represent concentration. In Ahlstrom et al. (1977), these particles represent mass or radioactivity. The latter was chosen for the MMT models. Carried to the atomic or molecular scale, this concept has been established as a reliable description of the nature of matter.

It is not computationally feasible to consider molecular scale particles; however, the same concept can be used to create a satisfactory analog. The following assumptions apply to MMT:

- Material that is in solution in ground water can be represented by an ensemble of a finite number of discrete particles of mass.
- Water that is carrying the material is assumed to be a continuum, subject only to laminar flow.
- All particles are assumed to move with the continuum and at its velocity.
- All particles are independent of one another.
- Particle motion is governed by Newtonian rather than relativistic mechanics.

Because of computational restrictions, the number of particles is usually restricted to something on the order of 10^4 - 10^5. The fourth assumption is valid only for dilute solutions, but is true for all except highly concentrated solutions. By definition the particles occupy zero volume.

Convective Transport

Convection of the particles is controlled by the motion of the host medium. *It is assumed that the number or tyupe of particles does not significantly alter the flow properties of the host medium.* This implies that the momentum and mass transport equations are decoupled and that the motion of the particles is governed by the physical properties of the fluid and the geometry of the system.

The flow of water in a ground-water system is usually represented by a matrix of velocity components. This matrix must represent a mass conservative flow field to simulate correctly mass transport in subsurface flow systems. The flow field can be obtained by several methods, but most often it is obtained from a ground-water flow model. In the AEGIS suite of models these flow simulations can be made by PATHS, VTT, or FAST. Each particle is allowed to move for a time interval, Δt, as determined by its location in the flow field. The time step is restricted so that the maximum distance a particle can travel is no larger than one grid spacing of the grid upon which the velocity field is defined.

Dispersive Transport

This transport process, usually called diffusion or dispersion, results in a net flux relative to the ambient convective transport. A qualitative discussion of dispersion was previously presented. Here again this effect has been handled by different methods. Pinder and Cooper (1970), using the method of characteristics, obtained intermediate concentrations after convecting the particles and then solved an isotropic diffusion equation using those concentrations by finite differences. Ahlstrom et al. (1977) *assumed the particles of mass are subject to various dispersive mechanisms which cause statistically random displacements.* Justification for this approach is presented in Ahlstrom et al. (1977).

Total Particle Movement

To summarize particle movement, a particle of mass is defined that is assumed to be subject to displacements resulting from both convective and dispersive mechanisms during a given time step. If a large number of particles are released at a concentrated location after several time steps, an ellipsoidal cloud will result with a center point moving with the average flow velocity and the major semi-axis coincident with the direction of flow.

Based upon the assumptions presented above, the motion of a particle is dependent only on the nature of the flow system and not on the type of species being transported. This suggests that each particle can be tagged with more than one mass quantity, each representing a different species. By computing the movement of one set of particles, the transport of several species can be simulated simultaneously with considerable savings in computer time. However, for the AEGIS versions, to minimize run time and handle decay chains, it is more convenient to allow each species to have its own set of particles.

Concentration Distribution

At the end of any desired time step, the solution can be halted and the amount of mass residing within any defined volume can be tabulated, yielding an average concentration value for the volume. The solution can then continue transporting each particle from where it was halted, stopping again to compute another concentration distribution when desired. This procedure is completely mass conservative as opposed to some earlier Lagrangian solution techniques such as the PIC method (Pinder and Cooper 1970), which tags each particle with a concen- tration rather than a mass. Averaging a set of concentrations to calculate an overall cell concentration can often lead to serious mass conservation problems.

Source/Sink Terms

Injection or withdrawal of contaminants from a system is easily simulated by adding or removing particles at appropriate locations. Other types of source/sink mechanisms, such as radioactive decay or chemical reaction, require that the mass quantities with each particle be adjusted or redistributed. This applies to AEGIS applications except when reversible sorption and decay are the only source/sink terms. It is then possible to alter the velocity field by a retardation coefficient. This will be explained later in the text. The current soil-waste reaction chemical model used in the two-dimensional MMT is explained by Routson and Serne (1972).

Boundary Conditions

The boundary conditions for the direct approach model can be specified quite easily. Two distinct types can be identified:

1. Free flow boundary - Any particle transported out of the system across this type of boundary is assumed to have exited from the system. New particles with appropriate mass are created at inflow boundaries.
2. Reflecting or no-flow boundary - Any particle encountering this type of boundary is reflected back into the system.

ADVANTAGES OF THE DIRECT SIMULATION APPROACH

The direct approach to model development has been found to have the following significant advantages over more traditional model-equation based approaches:

- Always Mass Conservative - The fundamental approach of the algorithm is inherently mass conservative, in contrast to the somewhat similar PIC technique.

- <u>Inherent Stability</u> - The response of this numerical analog is inherently stable, with respect to time step size and other model parameters such as the dispersion coefficient and the magnitude of the velocity (see Trent 1975).

- <u>No Cumulative Numerical Dispersion</u> - Most of the numerical smearing problems often found in other numerical schemes are eliminated (see Trent 1975). The main reason for this is the Lagrangian approach to advection computation. Many of the stability and numerical dispersion problems of Eulerian methods arise from the approximations made to the advective term. This property was one of the primary motivating factors for development of the direct approach. The only numerical dispersion in this approach occurs when concentrations are computed. This results from calculating an average concentration for each grid cell. However, this numerical dispersion is not carried forward in time because particle positions and associated masses are not affected by this averaging process.

- <u>Ease of Control of Solution Accuracy</u> - The accuracy of the solution can be easily controlled by specifying the number of particles to be used in the simulation. This allows a rough preliminary debugging solution to be computed for the full length of a simulation using only a few particles at a substantial reduction in cost compared to a more accurate run using a large number particles (see Ahlstrom, et al. 1977).

- <u>Solution Stacking</u> - If nonlinear source/sink terms are not present in a given simulation (based upon the previously stated assumption, this is the only way nonlinearity can enter the problem), the results of one solution for a given problem may be averaged with subsequent solutions of the same case to give more accurate results. For instance, suppose that after computing a simulation it was apparent that too few particles had been used, the entire simulation need not be re-computed using more particles. Instead, an additional run of the same simulation can be computed (making sure the pseudo-random number generator continues where it left off) and its results averaged with the previous run. This process effectively increases the particle density in each cell and can be repeated as many times as necessary to achieve the desired solution accuracy.

- Adaptability to Small, Economical Computer System - The fact that each particle is independent of any other makes this solution technique particularly easy to program for small computers with limited addressable memory but with fairly large mass storage (disk) resources. Only a few sets of particle data need to be in memory at any one time, with the remainder of the data residing on disk. The smaller machines, although somewhat slower than most larger systems, are usually much more cost effective and allow real-time user interaction. The independence of the particle trajectory calculations also makes this model attractive for use on computers designed with a high degree of parallelism.

- Ease to Coupling New Source/Sink Models - The capability of being able to simply redistribute particle mass as a means of responding to an externally defined reaction scheme and the simplicity of adding or removing particles to simulate injection or withdrawal allow a great deal of flexibility.

- Complicated Mathematical Structures are Avoided - The direct, discrete-particle solution approach is basically simple. The entire scheme can be described with a few algebraic expressions. The main task in implementing this algorithm is concerned with creating an efficient bookkeeping structure for keeping track of particles. This type of code is much easier for nonprofessional computer technicians to understand than complex numerical solution schemes necessary for solving the differential equations upon which models are usually based. This allows more rapid program development and debugging as well as making the resulting code easier to maintain and modify.

- Easy to Use for Three-Dimensional Applications - Assuming the accuracy is to remain constant, computation time increases linearly with the number of vertical levels used. This is a much less rapid increase in computation time than is the case with other methods. Also, problems that often arise from very high aspect ratios (the ratio of the horizontal size of a system to its vertical extent) are nonexistent.

- Complex Boundaries are Easily Handled - All that is necessary to account for boundaries is a knowledge of the coordinates of the boundaries and the location of each particle. When a boundary is encountered by a particle, appropriate action, as discussed above, is taken based on the boundary type.

DISADVANTAGES OF THE DIRECT SIMULATION APPROACH

In addition to these advantages, three primary disadvantages of the discrete particles method have been noted:

- Computation Speed - The primary drawback of the particle-based method outlined above is the computational speed. For circumstances where model parameters have values that are within the stability range of a finite-difference or finite-element solution schemes, these types of algorithms are usually faster for a given decree of accuracy, except perhaps for some three-dimensional cases. This problem is most acute when high accuracy solutions are required and nonlinear terms are present. The convergence of the discrete particle scheme improves only as the square root of computation time. (For example, four times as many particles must be used to double the accuracy.) When the problem is nonlinear, the entire solution set of particles must be brought forward in time before the next time step can be computed. This eliminates many of the advantages gained from the assumed independence of each particle.

  The relatively large computation times are partially offset by the reliability of the algorithm for any combination of values of model parameters and by the compatibility of this method with small economical computer systems. However, this approach very likely is not the best method to use for problems requiring a solution with a very high degree of accuracy. Fortunately, most environmental simulation problems are not of this type. For most large-scale environmental simulations, the required input data are usually not known within an accuracy of better than a few percent. Consequently, a simulation using a relatively small number of particles is usually acceptable.

- Presence of Random Noise - A certain amount of statistical random noise is always present in solutions computed with the direct simulation scheme. As more particles are added, the amplitude of the noise decreases; but because of the statistical nature of the random walk analog, it is always present to some degree. The random noise portion of the solution can be reduced, quite markedly in some instances, by post-processing the results with various smoothing or filtering methods.

- Number of Particles - A general criterion has yet to be developed for selecting the number of particles needed to obtain acceptable solution accuracy. Although the solution stacking procedure can be helpful in this regard, much depends on the experience of the user.

Although the discrete particle approach has been shown to have several advantages and commendable properties, it should not be viewed as the best method for all problems. The possible applications of this scheme are quite broad, but it probably should not be used when the computed solution accuracy must be with 5% of the true value. However, for environmental simulations, where predictions that might be in error by a few percent are totally acceptable, this method holds a great deal of promise.

NUMERICAL IMPLEMENTATION

The numerical scheme resulting from the direct simulation approach is termed the Discrete-Parcel-Random-Walk (DPRW) method. The basic device or numerical tool employed by this procedure is a hypothetical entity referred to as a computational parcel. The term "parcel" was chosen to distinguish the numerical tool from the more general but slightly vague "particles" referred to in the previous section. The continuum of dissolved or suspended matter to be modeled is represented as consisting of a finite ensemble of these parcels. The parcels have, by definition, zero size, but each has associated with it a set of Cartesian spatial coordinates $(x_p^n, y_p^n, z_p^n)_k$ and a set of discrete quantities of mass $\varepsilon^{k,n}$, where:

p = the parcel index ($p = 1,2,3...N_p$) where N_p is the total number of parcels used to represent a given quantity of matter

k = the transported species index (k = 1,2,3...K) where K is the total number of constituents present in the system

n = the time level index (n = 1,2,3...N_t) where N_t is the number of time increments to be computed.

For example, the location of parcel 3 after five time steps is (x_3^5, x_3^5, z_3^5). If the problem is concerned with five constituents, this process would be repeated for all the parcels associated with each constitutent.

During a given time step a new location for each parcel is computed as determined by advective and dispersive mechanisms, and the weights associated with each parcel are adjusted to account for any source/sink processes. The sequence of these computations is as follows:

1. First, the new location as determined by convective motion is calculated.
2. This new location is then modified by a random step to simulate dispersion.
3. Parcel weights are adjusted to account for first-order source/sink mechanisms such as decay.
4. The masses of all the parcels in each cell are added to obtain the total mass of each constituent in each cell.
5. Source/sink mechanisms such as radionuclide decay chains are then taken into account.
6. In the case of decay chains, parcels of daughters are then created.

Each of these steps is more fully explained in the following subsections.

Convection Component

The MMT-DPRW models require as input a mass conservative velocity field. At present the one-dimensional version requires a single constant velocity as its input, while the current 2-D version allows for spatially and time variant velocity fields. The components must be arranged on a regularly-spaced grid that remains stationary with time. One or two velocity components as required by the dimensionality of the problem are defined at each nodal point of the flow field. In the case of a spatially variant problem, the velocity field is linearly interpolated at points away from the node locations.

As defined in Pinder and Cooper (1970), for two dimensions the convective characteristic equations of Equation (D.7) are:

$$\frac{dx}{dt} = u \text{ and } \frac{dy}{dt} = v \tag{D.11}$$

where

u = velocity component in the x-direction

v = velocity component in the y-direction

The convective transport contribution is therefore calculated by:

$$x_p^* = x_p^n + \Delta t^n \; u^n \tag{D.12}$$

$$y_p^* = y_p^n + \Delta t^n \; v^n \tag{D.13}$$

where

Δt = the computational time step

x_p = the x location of parcel, p, at the end of the nth time step

$*$ = indicates an intermediate value of the new parcel location.

Dispersive Component

A dispersive transport component is then calculated for each parcel by assuming that the ensemble of parcels is subject to Brownian-like random motion resulting from the tortuous path that the host fluid takes through a complex medium such as soil. The equation that represents dispersion along the direction of flow is:

$$x_p' = 24 D_L \Delta t \; (0.5 - [R]_0^1) \tag{D.14}$$

This equation is sufficient for one-dimensional simulations, while dispersion in the direction normal to the direction of flow is represented by:

$$y'_p = 24D_T\Delta t\ (0.5 - [R]_0^1) \tag{D.15}$$

where

x'_p = the location of parcel, p, along the X'-axis oriented in the direction of flow

y'_p = the location of parcel, p, along the y'-axis oriented normal to the direction of flow

D_L = longitudinal dispersion coefficient

D_T = transverse dispersion coefficient.

These equations are derived in Ahlstrom et al. (1977).

The remaining computation is to transform the dispersive components from the (x', y') coordinate system to the (x,y) coordinate system and add the dispersive contribution to the convective contribution to obtain the location of the parcel at the end of the current time step. The new location is calculated by:

$$X_p^{n+1} = X_p^* + X'_p \cos\phi - y'_p \sin\phi \tag{D.16}$$

$$y_p^{n+1} = y_p^* + X'_p \sin\phi + y'_p \cos\phi \tag{D.17}$$

where ϕ is the angle between the (x', y') coordinate system and the (x, y) coordinate system. Equation (D.16) is sufficient for one-dimensional systems where $\phi = 0$.

Conversion to Intensive Values

When the advective and dispersive computations have been completed for every parcel in the system, a grid network can be superimposed upon the spatially-distributed ensemble of parcels. The nodal points of the grid are labeled with i, j indices, as appropriate to the problem, where

$i = 1,2,3\ldots I$ $\quad I$ = number of nodal points in x-direction

$j = 1,2,3\ldots J$ $\quad J$ = number of nodal points in y-direction

The nodal points form the vertices for $(I-1) \times (J-1)$ rectangles which are referred to as cells. The dimensions of cell (i,j) are Δx_i by Δy_j by:

where

$$\Delta x_i = x_{i+1} - x_i \tag{D.18}$$

$$\Delta y_j = y_{j+1} - y_j \tag{D.19}$$

Parcel "p" is said to lie within cell (i,j) if:

$$x_i \leq x^{k,n+1} < x_{i+1} \tag{D.20}$$

$$y_j \leq y^{k,n+1} < y_{j+1} \tag{D.21}$$

$$z_z \leq z^{k,n+1} < y_{z+1} \tag{D.22}$$

The total amount of mass of each species within a cell (as defined above) is computed by summing the mass quantitites associated with each parcel within that cell. If concentration is needed for calculation of a source/sink term, the total mass within each cell is divided by the volume of water within each cell. Thus, concentration within each cell for each species k is calculated by

$$C^*_{ij} = \frac{G\,\varepsilon_{ij}}{V_{ij}\,\phi_{ij}} \tag{D.23}$$

where

$G_{\varepsilon ij}$= a conversion factor from model distance units to those desired by the user (e.g., converting from Ci/ft^3 to pCi/ml)

V_{ij} = volume of cell i,j

ϕ_{ij} = pososity or volumetric water content of cell i,j

ε_{ij} = the intermediate concentration of species α in cell i,j

This intermediate concentration is now used for source/sink calculations requiring concentration (e.g., cases where concentration differences provide the driving force).

Source/Sink Contribution

The source/sink phenomena accounted for by AEGIS versions of MMT are first order decay, radionuclide decay chains, and sorption.

Radioactive Decay Losses of Contributions

First-order decay is handled easily by adjusting each parcel's associated mass by

$$\varepsilon_{\alpha,\rho}^{n+1} = \varepsilon_{\alpha,\rho}^{n} e^{-\lambda_\alpha \Delta t} \tag{D.24}$$

where λ_α is the first-order decay constant of species α, and Δt is the time step. In the case of decay chains all current parcel weights are decayed by the above equation. In the case of chains, concentration is not required. The mass sums are then adjusted by analytically solving the appropriate set of simultaneous ordinary differential equations that describe the decay losses and additions for the chain of interest over the last time step. Because the current parcel weights have been first order decayed, the amount of a daughter to be created is the difference between the first order decayed weight sum, and the weight sum adjusted by the analytical solution describing the decay chain. The operation is described by:

$$\Delta\varepsilon_\alpha = \varepsilon_{\alpha,\rho}^{n+1} - \varepsilon_{\alpha,\rho}^{*,n+1} e^{-\lambda\alpha \Delta t} \tag{D.25}$$

where, $\Delta\xi$, is the amount of α to be created, and * indicates the intermediate weight sum before adjustment by decay chain mechanism. $\Delta\xi_\alpha$ is then divided by the number of parcels the user desires to create to obtain the weight of the new parcels of α created by parents of α.

The remaining problem is to locate the created parcels in the system relative to the parents creating the parcel. This is done as a random time event relative to the center of mass within a cell of the parent nuclide. While summing the weights in a given cell, a center of mass for the parents is calculated by

$$x_{\alpha,c} = \frac{\sum_{m=1}^{m} X_\alpha \, \varepsilon^{n}_{\alpha,m}}{\sum_{m=1}^{m} \varepsilon^{n}_{\alpha,m}} \tag{D.26}$$

where X_α is the X-location of the parcel and $X_{\alpha,c}$ is the X-location of the center of mass in cell i,j. During the time step the center of mass of the parcels has moved a distance ΔX_p, while a postulated center of mass of daughter parcels starting from the same location would have moved a distance ΔX_d. Each created parcel is assumed to be created at some random time $[R_0^1]$ during the time step, and is convected and dispersed during the remaining fraction of the time step after it was created. Thus, the location of a given parcel is calculated by

$$x_d^{n+1} = x^n_{p,c} + r\Delta x_p + \frac{V}{R_d}(1-r)\ \Delta t + \sqrt{24D_L(1-r)\Delta t}(0.5-[R]_0) \tag{D.27}$$

where

x^{n+1} = the X-location of the created daughter parcel after current time step

$X_{p,c}$ = the X-location of center of mass of the parent from the previous time step

r = $[R]_0^1$ which is the fraction of the current time step when the daughter parcel was created

R_d = retardation coefficient of the daughter

$[R]_0^1$ = random walk dispersion movement random number.

Thus the new parcels are created and located as above. This operation is repeated for each cell containing parcels and every time step. When a parcel decays to a zero weight within the accuracy of the machine, it is eliminated from further consideration.

Sorption

When considering sorption of the radionuclides by the porous media through which the radionuclides and water are flowing, Equation (D.8) becomes for one-dimension and first-order decay:

$$\frac{\partial \rho\alpha}{\partial t} + \frac{B_d}{\phi}\frac{\partial S_\alpha}{\partial t} = D\,\frac{\partial^2 \rho\alpha}{\partial X^2} - V\,\frac{\partial \rho\alpha}{\partial x} - \lambda_\alpha\,(\rho_\alpha + \frac{B_d}{\phi} S) \tag{D.28}$$

where

B_d = bulk density of the media
S = mass concentration of α sorbed to the porous media
λ_α = decay constant

Since the concentration of radionuclides is assumed to be small, the sorption equilibrium curve should be nearly linear and is described by

$$S_\alpha = K_d \rho_\alpha \tag{D.29}$$

where, K_d is the distribution coefficient. Thus, by substituting equation (D.29), the last term in equation (D.28) becomes $\lambda_\alpha(1 + \frac{B_d}{\phi} S)\rho_\alpha$. Because sorption is assumed to occur rapidly with respect to ground-water movement, equation (D.29) becomes

$$\frac{\partial S\alpha}{\partial t} = Kd\,\frac{\partial \rho_\alpha}{\partial t} \tag{D.30}$$

when differentiated with respect to time. This is only true when sorption occurs rapidly relative to the movement of the ground water or when the ground water is at or near equilibrium at all times. Thus, Equation (D.28) becomes

$$R_\alpha \frac{\partial \rho_\alpha}{dt} = D\,\frac{\partial^2 \rho\alpha}{\partial x^2} - V\,\frac{\partial \rho_\alpha}{\partial x} - R_\alpha \lambda_\alpha \rho_\alpha \tag{D.31}$$

after substituting Equation (D.30); where R_α is the retardation coefficient equal to $1 + \frac{Bd}{\phi} Kd$. For decay chain migration Equation (D.31) becomes

$$R_1 \frac{\partial N_1}{\partial t} = D \frac{\partial^2 N_1}{\partial X^2} - V \frac{\partial N_1}{\partial X} - \lambda_1 R_1 N_1$$

$$R_2 \frac{\partial N_2}{\partial t} = D \frac{\partial^2 N_2}{\partial X^2} - V \frac{\partial N_2}{\partial X} - \lambda_2 R_2 N_2 + \lambda_2 R_1 N_1 \qquad \text{(D.32)}$$

$$\vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots$$

$$R_n \frac{\partial N_n}{\partial t} = D \frac{\partial^2 N_n}{\partial X^2} - V \frac{\partial N_n}{\partial X} - \lambda_n R_n N_n + \lambda_n R_{n-1} N_{n-1} \qquad \text{(D.32)}$$

for linear chains, where N indicates activity concentration usually expressed in curies. Thus, the characteristic convection equations are

$$\frac{dX}{dt} = \frac{V_x}{R_\alpha} \quad \text{and} \quad \frac{dy}{dt} = \frac{V_y}{R_\alpha} \qquad \text{(D.33)}$$

The retardation of nuclide migration is accounted for by dividing the velocity and dispersion coefficient by the retardation coefficient. This gives an accurate result at the output of the ground water to the surface.

APPENDIX E

DOSE MODELS

APPENDIX E

DOSE MODELS

The radiation doses calculated for the reference site analysis used the computer program PABLM. This program permits the calculation of the accumulated radiation dose to humans resulting from radioactive materials released to the accessible environment. Radiation doses from the chronic ingestion of salt and prepared foods containing salt that contain radionuclides are calculated. Selection of this dose methodology is specific to the scenario selected for analysis.

In addition to direct ingestion, for actual site analyses a total of 18 other ingestion pathways (or food products) may be selected with corresponding consumption rates, growing periods, and air or water concentrations and deposition rates. A total of four external exposure pathways may also be selected, with corresponding exposure times and soil or water concentrations. For all exposure pathways chosen, radionuclides may continue to be deposited and built up in the soil for the life of the releasing source. After the source is no longer emitting, the nuclides are assumed to remain in the soil and to be removed only by radioactive decay.

In any single case the program can be used to calculate accumulated radiation doses to a maximum of five possible body organs or tissues for up to a maximum of 100 radionuclides.

The computer output consists of summaries of radiation doses to the chosen organs listed by exposure pathway and by radionuclide. Dose summaries may also be obtained for all terrestrial food pathways combined and for all aquatic food pathways combined. In addition, an option exists for a complete listing of dose contribution by radionuclide by pathway. The complete listing includes the calculated radionuclide concentrations in all ingested plant and animal material.

TERRESTRIAL FOODS

The model for estimating the transfer of radionuclides (except for ^{3}H and ^{14}C) from air or irrigation water to plants through both leaves and soil to food products was derived for a study of the potential doses to people from a nuclear power complex in the year 2000 (Fletcher and Dotson 1971; Baker, Hoenes and Soldat 1976).

The source of contamination on farm land or crops may be from either airborne or waterborne radionuclide releases or from residual environmental contamination after an acute or chronic release. In the absence of specific data for sites where irrigation is used, sprinkler irrigation is normally assumed, rather than ditch or flooding irrigation, because the sprinklers spray contaminated water directly onto plant surfaces, resulting in higher radionuclide concentrations in the plants. Other types of irrigation systems can be simulated, if desired, by setting the foliar retention factor in the program to zero.

For atmospheric contamination, a deposition velocity is assumed for the airborne radionuclides onto the plant foliage and ground. If the "initial" deposition mode is selected, the foliar contamination terms are automatically set equal to zero, and plant concentrations are derived from the soil concentrations using plant/soil concentration ratios.

The concentrations of radionuclides in animal feed crops and animal drinking water are used to calculate the concentrations in animal products such as milk, meat, or eggs. The calculation involves multiplying the total daily radionuclide intake by the animal by a transfer factor.

The radionuclides ^{3}H and ^{14}C are handled separately when calculating concentrations in terrestrial foods. They are assumed to be in equilibrium with their surroundings. Thus, the concentration of tritium or ^{14}C in the hydrogen or carbon in environmental exposure media (soil, plants, and animal products) is assumed to have the same specific activity as in the contaminating medium (air or water). The fractional content of hydrogen or carbon in a plant or animal product is then used to compute the concentration of tritium or ^{14}C in the food product under consideration (Baker, Hoenes and Soldat 1976).

AQUATIC FOODS

Radionuclide concentrations in aquatic food products are based on the radionuclide concentrations in the contaminated water. They are calculated using equilibrium concentration ratios between the food and the water, called bioaccumulation factors. The water concentration is based on the release rate of radionuclides from the source and the characteristics of the receiving water body. Formulae for the three most common reconcentration situations for receiving water bodies are included in the computer program (Soldat et al. 1974).

A simple model is used to predict the radionuclide concentrations in sediments of a river or lake. The model is based on the assumption that there is a constant water concentration during the release period. The deposition rate to the sediment is assumed to be dependent only on the water concentration. The only removal mechanism assumed for radionuclides in sediment is radioactive decay.

EXTERNAL DOSES

External doses from radionuclides deposited in farm fields are calculated assuming an infinite flat plane source model. A factor of 0.5 is included for shielding and scattering caused by surface roughness. For a person standing on the shoreline of a body of contaminated water, the dose from radionuclides deposited in the sediment is calculated using the same model as for a farm field, modified to include a factor that corrects for the fact that the shoreline is not an infinitely wide source (Soldat et al. 1974).

The dose from swimming in contaminated water is calculated using the assumption that the body of water is large enough to be considered an "infinite medium" relative to the range of emitted radiations. Persons boating on the water are assumed to be exposed to a dose rate half that of swimmers.

INTERNAL DOSES

Internal doses are calculated as a function of radionuclide concentration in food products, as described above, ingestion rates, and a radionuclide-specific dose commitment factor. The concentration in foods varies with time, release rate, and buildup and decay in the soil. The dietary level (i.e., kg/yr) is assumed to be constant. The dose commitment factors are calculated for each year of intake, to the end of the dose period, based on the model of ICRP Publication 2 (ICRP 1959). For purposes of this analysis, internal doses were based solely on direct consumption of salt.

A first year committed dose is calcuated as well as the accumulated dose for a selected number of years. The accumulated dose is the sum of a series of annual dose commitments from the time of ingestion to the end of the dose period. Doses may be calculted for either a maximum-exposed individual or for a population group. The doses calculated are accumulated doses from continuous, chronic exposure.

APPENDIX F

MODEL INPUT PARAMETERS AND DATA USED

APPENDIX F.1: VTT MODEL PARAMETERS AND INPUT DATA

TABLE F.1A. VTT Model Input Control File

```
PIR RUN 1 EAST TEXAS PUMPING AND 260 GPM INJECTION AT DOME
PIR1,POT                   POT
PIR1,BOT                    BOT
NONE                       TOP
PIR1,HYC                HYC
PIR1CAL,TYP              CAL TYP
NONE                 STORAGE
PIR1,TCF             INTER AQ XFER
NONE                OCEAN XFER
2,60,65,YNO,1300.,10560.,1000.,
0.,0.,
0,0,,,
0,0,1,50,50,9.0E-03,1,25
1990,5,1,0,0
1990,9,31,23,59
0,1,0,0,
1990,9,31,23,59,1,4
1,65,1,      TOP
1,1,E-12
1,65,1,
1,1,E-12
1,65,1,      STORAGE AQ1
1,.0001
1,65,1,
1,.0001
1,65,1,       OCEAN XFER
1,0,
1,65,1,
1,0,
```

TABLE F.1B. Streambed Transfer Coefficients

DP1:[4,27]PIRITCF.AD1
60 45

LINE= 1									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 2									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 3									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 4									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 5									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 6									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 7									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 8									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 9									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE F.1B. (contd)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.5320E-04
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000
LINE= 10									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04
0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000	0.5320E-04	0.0000	0.0000	0.0000
LINE= 11									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04
0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000
LINE= 12									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 13									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 14									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000
0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000
LINE= 15									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04
0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000
LINE= 16									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 17									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 18									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.0000

TABLE F.1B. (contd)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.0000
0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000
LINE= 20									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04	0.5320E-04
0.5320E-04	0.5320E-04	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000
LINE= 21									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000
LINE= 22									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000
LINE= 23									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.5320E-04	0.0000	0.5320E-04	0.0000	0.0000
LINE= 24									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.6726E-04	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04	0.0000	0.5320E-04	0.0000
LINE= 25									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.6726E-04	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000
0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.5320E-04	0.0000
LINE= 26									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.6726E-04	0.6726E-04	0.6726E-04	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04
0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.5320E-04	0.0000
LINE= 27									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.6726E-04	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.5320E-04	0.0000
LINE= 28									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE F.1B. (contd)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.6726E-04	0.6726E-04	0.5320E-04	0.5320E-04	0.0000	0.0000	0.5320E-04
0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000
LINE= 29									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04
0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000
LINE= 30									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000
0.0000	0.0000	0.5320E-04	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 31									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.8071E-04	0.8071E-04	0.8071E-04	0.8071E-04	0.7174E-04	0.6726E-04	0.0000	0.5320E-04
0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 32									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.8071E-04	0.8071E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 33									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 34									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 35									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 36									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04
0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000
LINE= 37									
0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE F.1B. (contd)

LINE= 38									
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 39									
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.3507E-04	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 40									
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.5320E-04
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000
LINE= 41									
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.5320E-04
0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000
LINE= 42									
0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 43									
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000
0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 44									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 45									
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.0000
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 46									
0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000	0.0000	0.5320E-04	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 47									
0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE F.1B. (contd)

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 48										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 49										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 50										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04
	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 51										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.5320E-04	0.0000
	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 52										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.5320E-04
	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 53										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 54										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	5933.	5933.	5933.	5933.	0.0000
	0.0000	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 55										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04
	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 56										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE F.1B. (contd)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 57									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 58									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 59									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 60									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 61									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04
0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 62									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.5320E-04
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 63									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.5320E-04	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 64									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LINE= 65									
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MAXIMUM VALUE= 5932.523 MINIMUM VALUE= 3.5070064E-05

TABLE F.1C. Well Location and Ground Water Elevation File

LOCATION AND WATER ELEVATION OF WELLS

X LOC.	Y LOC.	WATER ELEV.	YEAR
11395.7	8707.0	279.0	57
4063.1	13173.3	346.0	58
13717.1	55876.8	280.0	71
12558.7	61420.1	284.0	71
13923.0	86561.0	292.0	71
11933.4	89873.0	276.0	71
30268.1	87807.3	235.0	71
31914.4	76255.5	178.0	69
35820.6	57147.6	256.0	71
46951.5	29243.7	257.0	59
43676.7	28389.1	267.0	57
53407.7	33180.1	247.0	62
55418.4	34785.8	242.0	71
76940.8	54085.9	252.0	60
49458.4	62459.6	220.0	56
56824.1	79850.1	209.0	71
77813.0	66447.0	240.0	71
38990.3	3612.3	400.0	58
78131.5	60732.0	219.0	60
2413.3	94792.4	287.0	71
17620.4	106668.0	203.0	60
12095.2	150698.0	257.0	71
19623.0	159636.8	280.0	64
20589.2	159767.0	318.0	71
9466.8	165856.4	250.0	60
8489.2	168416.2	237.0	71
1848.4	169312.7	240.0	71
17031.4	171310.8	426.0	71
29384.9	176953.5	350.0	64
42157.0	178268.7	290.0	71
66705.4	177868.6	295.0	71
38825.5	161063.4	260.0	71
40468.5	160187.7	260.0	71
48632.7	157826.6	286.0	71
27225.7	150926.5	315.0	71
28825.1	150428.9	311.0	56
29344.1	146984.4	307.0	71
44146.2	135488.6	250.0	53
57404.8	141099.1	300.0	71
54188.7	126326.3	255.0	67
60628.6	124210.0	263.0	76
32122.2	106477.4	240.0	71
46829.1	107506.7	235.0	71
42635.4	105261.2	225.0	71
64702.9	105102.8	229.0	71
65321.9	97917.9	266.0	64
72747.2	91392.5	239.0	71
3630.1	184283.6	257.0	65
8986.1	191603.0	256.0	71
11036.3	202052.6	286.0	71
23247.5	196892.5	355.0	71
15599.8	214809.0	389.0	71
10353.0	214491.2	298.0	69
2949.2	215930.8	257.0	66
1918.6	222945.8	271.0	71
6536.1	232380.6	285.0	71
19238.1	240294.5	285.0	71
17472.0	250374.7	322.0	71
12325.1	254850.3	324.0	71
2741.4	264813.1	292.0	71

TABLE F.1C. (contd)

38033.7	271528.2	323.0	71
34555.7	265746.9	365.0	71
41398.7	257790.0	302.0	71
39309.4	254880.9	210.0	66
34809.3	255534.3	200.0	68
48838.0	257863.6	322.0	71
51909.2	257204.2	308.0	71
45549.9	250241.9	426.0	71
35435.6	246626.1	265.0	68
33103.4	241530.3	317.0	69
19874.2	229407.6	313.0	71
24186.8	222662.1	423.0	71
39515.2	226258.0	360.0	71
32536.9	216603.0	400.0	71
35619.8	213169.5	297.0	71
47858.7	211372.1	296.0	71
48201.9	209734.3	315.0	71
53396.7	184116.8	295.0	71
56131.9	203169.0	372.0	71
62666.6	208408.7	322.0	71
65947.7	207792.2	318.0	71
65296.8	202703.5	306.0	71
72678.7	198485.6	303.0	71
77486.9	192625.7	315.0	67
60145.8	218023.3	323.0	71
71746.8	217988.6	319.0	71
64889.0	229434.1	321.0	71
53803.3	236784.7	306.0	71
48106.1	242182.5	315.0	71
60874.5	244380.5	386.0	71
66513.5	262562.3	225.0	66
69048.7	269340.2	403.0	71
63912.5	271293.8	324.0	71
45562.5	257177.2	424.0	71
8969.3	273035.8	358.0	68
8499.2	274841.2	350.0	67
23805.6	273267.0	325.0	69
13883.6	283732.8	383.0	71
6626.5	290217.0	328.0	71
10893.7	294942.7	365.0	67
21519.2	296963.3	348.0	69
13873.0	300809.8	343.0	71
1878.0	309741.7	338.0	69
41689.4	308061.4	515.0	71
50191.5	305323.5	493.0	71
51794.0	294191.8	385.0	71
48699.8	290395.8	359.0	71
47236.2	288624.2	395.0	68
46829.6	285386.0	401.0	63
50173.8	279810.0	351.0	71
49468.1	277747.4	365.0	71
33873.2	277975.3	468.0	71
62872.5	278645.0	342.0	71
70597.4	280737.4	379.0	71
76575.1	298374.2	364.0	71
78296.5	308721.4	403.0	71
59643.3	306582.6	432.0	71
18456.7	315360.3	469.0	71
8492.3	316032.5	417.0	71
16995.7	322877.8	431.0	53
20862.3	328148.4	491.0	71
3710.5	333497.5	446.0	71
2938.7	337066.9	433.0	71
2217.2	338703.2	425.0	58
2192.8	344461.4	461.0	71

TABLE F.1C. (contd)

22469.5	340386.4	527.0	71
13786.8	355943.3	470.0	71
2804.5	358754.8	447.0	71
18274.5	358232.2	446.0	71
19022.7	360210.8	476.0	71
26936.0	357554.5	467.0	71
45927.1	359274.4	587.0	71
38611.9	349786.1	558.0	71
36139.2	348094.3	462.0	71
31426.4	339415.7	498.0	71
31524.0	326344.2	572.0	71
34060.1	313114.9	466.0	71
45755.9	320436.1	453.0	71
43125.5	326183.3	530.0	71
53552.4	335390.6	431.0	71
54939.0	335480.6	416.0	71
46051.5	339898.2	551.0	71
45120.4	341407.4	552.0	71
73759.8	357501.3	522.0	71
73020.2	343627.6	469.0	71
64866.6	333589.3	275.0	68
4300.6	372673.8	441.0	71
5470.8	374234.0	463.0	71
10378.3	386528.2	443.0	71
13624.4	394149.8	447.0	71
11843.2	398215.9	461.0	71
26132.2	398322.0	453.0	71
43542.6	396168.3	450.0	71
22750.8	402763.1	455.0	65
30895.2	405400.3	525.0	71
35972.8	407022.5	540.0	71
34744.8	409160.8	437.0	68
22005.2	410073.5	517.0	71
29335.5	416031.2	484.0	71
31210.1	419990.1	503.0	71
50546.1	419694.0	452.0	71
33136.8	431473.0	484.0	71
32512.4	430041.3	487.0	71
31589.8	429533.0	479.0	71
14707.9	426014.5	494.0	71
43370.7	446521.9	423.0	71
51575.5	444539.3	399.0	71
46191.3	435563.5	408.0	71
43302.1	432987.3	435.0	71
43730.3	431139.8	415.0	71
42320.5	426594.3	442.0	71
62607.1	430085.1	399.0	71
62363.5	428066.5	334.0	67
64043.7	428325.8	327.0	71
71594.5	431846.6	358.0	71
75397.6	427071.1	423.0	71
56204.6	425416.8	411.0	71
55371.6	421605.9	399.0	71
60311.8	416330.9	432.0	71
50747.8	411792.8	440.0	71
50910.0	407376.3	420.0	67
63280.2	400287.3	414.0	71
70692.3	396872.2	421.0	71
70157.0	394263.9	444.0	71
74980.5	386760.7	418.0	71
69100.8	385642.8	418.0	71
71883.2	383679.2	418.0	71
68017.8	383326.5	450.0	71
63941.8	383057.0	458.0	71
59607.1	384341.6	460.0	60

TABLE F.1C. (contd)

39407.8	389972.0	421.0	71
38447.7	388412.8	423.0	71
42879.7	384018.3	396.0	61
44196.3	380829.5	410.0	64
36077.4	372514.6	417.0	64
33306.2	371830.4	556.0	71
19773.9	391149.6	444.0	66
14958.7	386799.8	474.0	68
20688.1	383713.8	490.0	71
18640.8	380846.9	481.0	71
19615.9	378875.6	474.0	71
19379.8	375091.7	458.0	71
20700.9	370810.1	453.0	67
14373.7	366201.7	450.0	60
44016.8	373599.2	444.0	68
44114.0	370531.3	523.0	71
42780.7	367751.5	528.0	71
54438.3	374169.9	522.0	71
64343.7	367633.0	421.0	68
75608.7	367512.7	514.0	71
76774.9	370039.6	530.0	71
78230.3	373744.6	579.0	71
78962.5	399261.1	466.0	71
69137.9	406575.0	455.0	71
65568.0	415806.8	474.0	71
65727.5	417825.0	468.0	71
73714.2	417698.8	475.0	71
72713.8	415711.1	463.0	71
78268.6	424057.1	307.0	71
75758.7	432999.2	402.0	71
75846.3	440187.0	452.0	71
65079.3	441780.5	344.0	71
70318.2	445333.4	363.0	63
55371.9	451196.4	417.0	71
54212.6	456949.9	378.0	71
63915.8	468297.8	354.0	71
67239.4	477474.8	439.0	68
67440.6	479577.3	407.0	66
54240.1	480151.7	407.0	71
54852.0	484525.6	433.0	71
60589.7	489383.7	423.0	71
73496.3	508521.1	463.0	71
75818.1	525932.1	400.0	71
126181.8	573180.0	462.0	73
99251.0	560548.0	428.0	76
139268.4	549949.9	410.0	73
118226.9	537335.1	432.0	73
87413.5	533304.1	443.0	71
88466.4	534773.5	427.0	71
95526.0	533800.4	455.0	71
103713.4	528320.4	405.0	71
105093.4	523611.1	402.0	71
114343.5	526119.1	370.0	71
115857.1	526495.1	368.0	71
132162.0	524831.8	466.0	65
146065.8	519599.5	396.0	71
132447.7	519115.4	452.0	65
133621.3	516970.2	378.0	60
131814.4	517225.0	367.0	65
123029.4	516607.6	400.0	71
127391.6	516633.0	342.0	65
148859.2	504380.9	373.0	65
105582.2	513145.1	378.0	71
104274.3	509742.7	378.0	71
100924.7	510321.6	407.0	66

TABLE F.1C. (contd)

133078,5	491039,0	348,0	65
154587,3	484198,4	370,0	65
151849,8	480419,8	357,0	65
155627,3	477009,9	351,0	65
144153,6	477153,0	370,0	56
135269,4	466322,6	449,0	71
138953,0	456272,2	365,0	65
113605,9	453872,1	363,0	65
107048,2	453125,3	403,0	71
122791,4	469493,3	370,0	65
114972,4	468412,2	357,0	65
113793,4	466984,9	361,0	57
103373,1	464933,7	403,0	71
97955,5	471715,7	417,0	71
103902,2	480561,3	416,0	71
103278,3	498032,5	404,0	71
94707,6	492188,7	492,0	71
88202,1	498250,6	398,0	71
83495,0	498383,7	470,0	71
84940,6	509603,3	442,0	60
102293,9	506383,3	376,0	71
89432,3	477612,5	455,0	71
89003,6	471939,1	376,0	71
100963,1	459228,6	380,0	71
87129,6	455256,4	348,0	71
109686,4	446648,9	353,0	71
80389,9	445179,3	411,0	71
88705,7	441132,3	360,0	71
115183,8	440966,8	340,0	65
95382,1	436919,4	355,0	71
86630,6	430586,0	326,0	71
80989,8	424584,2	279,0	71
86074,2	423820,1	285,0	71
122004,1	448774,1	425,0	71
113617,3	433235,8	350,0	67
104142,7	421103,4	367,0	71
99638,9	416613,0	365,0	71
85120,6	404278,0	399,0	71
89142,9	395908,2	430,0	71
100752,3	402195,4	373,0	68
90937,0	386995,4	434,0	71
84348,2	365276,1	517,0	71
90156,1	370563,2	511,0	71
96221,3	379380,3	534,0	71
95561,0	387534,9	442,0	71
100829,5	397572,1	441,0	71
107939,4	402268,8	438,0	71
108252,6	415045,2	421,0	71
107413,2	387517,3	414,0	71
109681,3	386585,2	489,0	71
121325,0	387664,8	418,0	71
113627,1	383221,1	425,0	64
113073,9	370598,8	440,0	71
119164,9	376446,2	456,0	71
103901,9	372097,8	500,0	71
103174,4	363356,8	465,0	71
110909,8	364185,9	494,0	71
111494,3	362125,7	458,0	63
111086,0	370195,8	489,0	71
139373,4	371372,8	489,0	71
130228,0	382818,2	396,0	59
109183,5	419288,7	360,0	71
129448,9	395932,5	373,0	62
129943,9	389585,3	410,0	59
130066,8	387441,7	460,0	59

<u>TABLE F.1C.</u> (contd)

126336.5	422751.7	346.0	71
144457.0	426759.6	340.0	65
151176.8	423471.3	333.0	60
148839.6	434528.5	376.0	65
136833.3	444002.8	359.0	65
131037.0	446491.1	428.0	65
97750.0	361557.7	436.0	71
131371.2	360162.8	486.0	62
128499.4	350836.6	402.0	71
114083.4	350858.0	400.0	71
93097.9	342105.1	482.0	65
94653.5	342481.0	506.0	71
116804.4	315171.3	362.0	71
96707.6	310535.8	355.0	66
104604.9	307708.2	358.0	71
89721.5	304325.9	384.0	71
81608.3	303245.2	362.0	71
124811.6	301457.9	332.0	71
131031.6	301238.5	353.0	71
148721.6	298354.3	375.0	71
121096.1	290073.5	332.0	61
98655.5	292040.1	255.0	61
79938.4	282527.3	338.0	71
108062.4	286898.6	301.0	71
145384.6	287137.4	312.0	71
144788.5	284658.7	341.0	71
130650.0	270683.9	315.0	71
121395.5	265191.8	394.0	71
113699.3	261967.8	314.0	71
80925.6	268067.8	375.0	71
93369.9	242201.4	293.0	71
104044.7	241765.3	340.0	71
136338.9	247013.0	314.0	71
88862.3	235105.2	310.0	71
121879.0	222825.7	313.0	71
112954.8	213382.4	316.0	71
100924.9	206927.8	313.0	71
133686.7	221169.1	135.0	71
134061.5	218856.9	171.0	71
133169.5	212511.8	230.0	71
127908.9	207812.4	200.0	71
83325.8	214477.1	305.0	71
90266.1	189837.7	270.0	63
98544.1	188648.6	210.0	61
95687.6	189661.6	325.0	71
155679.3	200500.1	194.0	71
155802.5	198566.6	217.0	71
148273.6	194753.1	262.0	67
148465.2	182270.2	280.0	69
137019.1	172704.5	296.0	71
108328.9	154968.8	300.0	69
83805.0	140883.4	281.0	71
92247.4	137172.3	435.0	76
114657.4	142855.0	264.0	71
140033.7	136597.0	275.0	60
145039.6	111288.0	255.0	71
132973.8	108994.4	279.0	72
120112.4	108677.2	267.0	71
106406.4	105629.4	232.8	71
84321.7	120876.7	308.0	70
105086.7	94283.5	231.0	71
107734.1	93965.4	162.0	58
113123.0	100197.7	250.0	71
116555.2	90652.0	231.0	60
125626.9	87528.4	193.0	64

TABLE F.1C. (contd)

91370.4	84343.0	330.0	71
115957.7	84516.6	300.0	66
118437.6	84597.0	236.0	71
131550.7	84619.6	319.0	58
134492.5	84489.1	248.0	64
151821.3	64793.8	215.0	68
113950.6	63084.7	244.0	69
111967.4	57834.0	237.0	71
100740.3	54278.2	218.0	71
96242.4	53738.5	236.0	60
80954.2	60738.0	241.0	71
82806.1	62542.6	188.0	71
81083.7	63049.5	259.0	71
83783.1	12820.6	200.0	71
83528.9	11476.1	200.0	71
85365.3	2773.3	200.0	71
87168.5	38.8	229.0	71
89877.1	12643.5	220.0	71
90551.9	14281.6	220.0	71
106255.3	3835.1	244.0	63
125945.0	45666.9	240.0	71
133468.2	45613.7	238.0	71
128953.2	5272.4	229.0	71
151391.1	1456.5	200.0	63
229511.5	50178.4	200.0	71
199795.4	45276.4	247.0	55
165364.7	43212.7	240.0	71
169907.3	45517.6	231.0	71
164277.7	47081.0	234.0	71
162387.6	47924.4	273.0	66
164995.1	49055.3	237.0	71
175271.4	91615.6	258.0	56
158956.4	114797.8	253.0	71
159276.3	132113.4	251.0	71
160582.6	134381.0	260.0	56
160551.5	170063.8	280.0	68
186659.5	147077.1	262.0	55
186741.5	145648.0	235.0	71
192518.0	129794.5	240.0	69
209745.9	98793.4	239.0	71
213234.3	98788.3	244.0	71
220187.5	111176.5	247.0	71
204275.9	151211.9	211.0	77
231106.8	162267.8	115.0	71
222957.7	165263.9	176.0	54
193624.6	195820.6	250.0	68
159235.0	189189.0	345.0	55
159995.9	192129.9	270.0	67
173453.9	197994.0	253.0	71
166355.9	201324.8	279.0	71
166792.2	212125.7	254.0	69
166584.3	213639.1	244.0	71
160806.3	228463.9	279.0	71
216113.4	227645.3	279.0	66
158593.4	230364.0	298.0	71
158539.6	250706.2	312.0	71
215832.3	263412.5	312.0	62
233384.6	252711.1	288.0	66
224948.1	260372.9	312.0	62
180578.7	269390.9	313.0	62
177512.2	270488.3	330.0	59
219042.1	273957.1	285.0	62
196362.5	284792.2	286.0	62
211544.0	290821.9	296.0	64
179200.9	275529.3	377.0	71

TABLE F.1C. (contd)

162458.4	293836.0	334.0	71
164192.1	300937.1	323.0	71
173810.0	296341.7	313.0	55
195371.1	296435.8	304.0	62
195163.3	298075.2	318.0	62
201714.9	294703.1	318.0	62
216766.4	290127.2	322.0	62
220676.8	294256.2	326.0	62
211013.5	301582.1	316.0	62
209549.7	306417.7	322.0	64
221318.1	306568.3	314.0	62
213713.8	308554.9	312.0	62
208250.3	308773.2	307.0	62
199428.9	311988.5	320.0	62
206452.3	314996.2	311.0	62
184717.1	310909.6	313.0	62
188223.8	323176.9	352.0	62
165605.9	347335.1	349.0	62
187859.5	359954.1	295.0	62
191919.1	349313.5	260.0	68
196148.1	338589.8	287.0	62
211203.9	316586.3	288.0	64
230076.9	346146.7	327.0	60
227105.2	354514.9	277.0	71
185769.7	368782.1	307.0	62
184213.6	368070.0	289.0	62
180579.1	382953.7	320.0	59
178072.5	393128.4	336.0	71
163664.8	398697.7	341.0	62
162362.6	399203.9	343.0	62
160817.8	406141.1	315.0	65
159367.6	420180.9	318.0	71
186346.9	417829.3	344.0	65
198450.2	417138.8	310.0	65
208437.7	406700.8	330.0	65
214698.6	400345.2	310.0	65
229776.8	427137.3	329.0	65
190756.1	443586.6	346.0	76
158243.5	455655.2	336.0	65
157825.8	457421.0	381.0	65
171039.2	468371.0	326.0	65
173437.8	470342.8	342.0	65
158697.0	478056.0	348.0	71
158033.1	483857.0	390.0	65
170504.9	504853.1	383.0	76
159249.2	510291.6	413.0	71
176340.0	500179.2	395.0	65
176855.3	507533.6	407.0	71
176320.8	515561.9	464.0	65
179861.9	522701.6	428.0	65
176086.3	527456.4	462.0	71
193105.6	525750.1	462.0	65
198607.9	523388.3	415.0	65
185213.0	503402.3	405.0	65
195449.2	490694.3	403.0	65
190606.5	485742.0	398.0	65
185312.0	485161.4	420.0	62
191851.4	473635.8	335.0	71
201906.9	480723.8	352.0	65
224261.4	477370.3	380.0	65
223508.0	479472.9	373.0	65
215832.4	518403.3	401.0	65
213953.2	526517.7	411.0	65
218381.9	527321.5	424.0	65
222194.0	528606.9	438.0	63

TABLE F.1C. (contd)

226160.6	542008.3	412.0	71
162989.6	538487.6	455.0	73
187388.8	553497.8	464.0	73
160390.5	571358.2	462.0	73
190962.0	582324.4	511.0	76
204071.6	649138.7	326.0	71
305557.6	626957.4	330.0	71
281785.2	612198.6	377.0	76
279582.3	597743.7	361.0	76
306230.2	598712.8	308.0	71
283383.2	553397.3	322.0	71
273142.7	534919.7	346.0	71
291747.9	525729.8	322.0	71
292542.8	523248.8	311.0	71
260728.5	524430.8	429.0	65
239505.2	525387.0	410.0	65
260271.1	499424.2	386.0	65
259599.1	493667.3	375.0	65
301851.6	508651.0	295.0	71
292295.7	498368.0	320.0	66
289015.0	496691.7	322.0	67
279832.5	454802.3	327.0	66
287476.4	451176.4	318.0	67
297502.4	438426.7	284.0	71
266207.8	421577.4	325.0	66
251009.0	402518.7	317.0	59
247345.5	399245.9	277.0	65
261045.5	398174.8	300.0	65
263027.6	374425.4	293.0	62
267102.2	372906.4	295.0	62
270044.3	372944.0	285.0	62
269159.1	371222.2	290.0	62
253144.6	370237.2	294.0	62
204098.0	363315.8	308.0	62
312987.4	394063.0	250.0	66
258886.2	359259.1	225.0	56
274087.5	351671.3	297.0	62
276442.0	350869.3	251.0	71
293549.3	351894.5	320.0	60
290044.6	340846.1	265.0	62
276470.7	341874.9	296.0	62
268188.5	340248.1	270.0	54
254866.0	340772.2	293.0	62
253982.3	339975.0	292.0	62
253855.8	338757.5	290.0	62
252003.3	337540.3	286.0	62
255489.5	336022.0	260.0	71
283977.6	330894.2	315.0	56
276529.2	324642.9	272.0	62
278370.0	318966.3	271.0	62
249224.7	306106.6	260.0	59
249313.3	309132.6	247.0	71
244788.5	290520.4	305.0	62
252187.6	291812.3	325.0	60
294825.0	303853.4	262.0	62
298645.0	302040.5	237.0	62
295660.2	301582.6	293.0	62
296918.8	300025.7	285.0	62
294095.7	295196.5	311.0	62
291777.5	290786.3	310.0	62
293950.1	282083.6	250.0	69
242394.9	263583.3	264.0	62
247185.2	262861.6	287.0	62
278455.2	263109.4	342.0	52
295478.4	264050.8	243.0	62

TABLE F.1C. (contd)

303538.0	257818.5	280.0	56
243373.5	261700.3	278.0	62
289546.9	260403.1	215.0	65
280287.4	251590.8	260.0	60
286089.5	252969.1	287.0	60
285958.3	249564.9	285.0	56
296343.9	252533.6	278.0	62
274233.2	250212.8	333.0	62
266200.8	246988.4	338.0	62
258745.4	235987.9	321.0	62
256895.2	235402.2	329.0	62
265342.7	235179.5	336.0	62
271938.6	233362.5	356.0	62
271516.4	232102.2	278.0	62
267182.1	226494.2	338.0	66
271083.7	223739.1	335.0	71
238704.4	212355.2	265.0	61
252656.6	211325.8	291.0	71
280227.3	211074.7	280.0	69
297893.5	220505.1	298.0	54
306716.8	218558.6	367.0	71
298334.9	206382.6	305.0	71
309870.8	190521.7	371.0	71
282120.1	183753.0	341.0	71
273906.7	200156.6	263.0	67
279045.2	207504.0	296.0	71
266434.1	205925.6	304.0	69
256845.7	202073.2	290.0	71
272984.1	173175.2	275.0	77
286346.7	171432.2	279.0	71
285588.3	170130.4	270.0	62
315073.7	158275.3	299.0	56
312577.3	146091.7	377.0	71
309867.5	132604.4	277.0	71
304396.3	127653.1	257.0	71
297031.7	121233.5	265.0	71
293729.8	105351.4	288.0	71
297619.5	92526.8	240.0	77
273093.7	105424.1	221.0	71
272847.6	109543.3	248.0	65
278664.0	110849.4	282.0	71
268557.0	107069.9	228.0	71
264231.7	109598.1	225.0	71
265535.7	110310.7	229.0	71
257505.8	108767.5	221.0	61
240977.2	129596.5	252.0	71
269867.3	139431.6	259.0	71
277772.7	143033.2	290.0	71
251655.4	159799.6	220.0	64
283668.3	122514.2	279.0	71
250749.4	67384.7	225.0	71
266157.3	76056.0	270.0	64
289580.9	56729.9	206.0	71
289956.6	55048.1	212.0	71
291089.1	53449.4	203.0	71
281294.3	52119.0	232.0	71
252168.1	46740.4	206.0	71
246866.8	48345.4	206.0	71
79124.7	498852.5	512.0	71
23633.1	150177.1	289.0	71
356213.1	25195.9	150.0	61
350929.3	37933.6	134.0	68
366155.8	53973.3	215.0	57
355652.1	56419.8	193.0	69
342793.1	56599.2	190.0	67

TABLE F.1C. (contd)

352797.1	59279.9	213.0	64
367514.2	69520.8	207.0	71
343728.8	69415.5	180.0	68
350297.4	84118.0	265.0	65
381482.0	87788.7	260.0	66
391964.1	108539.1	437.0	69
366879.5	112469.3	237.0	69
340071.5	115938.7	232.0	72
369930.2	141042.6	358.0	76
324645.4	159908.8	338.0	76
387233.5	177125.6	352.0	76
349169.5	187748.9	322.0	72
336357.8	193895.5	292.0	76
370735.8	197143.2	302.0	72
387419.1	197002.5	286.0	72
361830.7	201437.4	431.0	72
357763.1	211358.5	362.0	72
375918.0	212183.1	342.0	72
393200.5	224732.9	238.0	72
380097.6	234199.7	143.0	72
333111.2	229534.3	318.0	72
329135.6	240448.3	258.0	72
369736.3	255304.6	427.0	72
391599.6	268018.5	374.0	72
334667.9	279540.8	149.0	72
373659.6	272572.8	378.0	72
345938.8	289280.4	269.0	72
340100.6	292773.5	253.0	72
369400.3	303421.8	270.0	76
351803.9	316590.5	237.0	66
352478.1	318607.0	247.0	66
355463.1	320117.3	134.0	66
350505.6	321592.5	179.0	66
346932.9	320755.1	189.0	66
345589.6	322395.2	244.0	64
335038.5	318748.4	220.0	66
338278.6	323662.3	235.0	71
339246.9	325678.6	220.0	66
377026.0	325687.5	253.0	66
388162.9	326434.2	260.0	63
372669.9	341954.4	232.0	66
360395.2	337636.7	243.0	71
356614.7	339489.1	238.0	60
339763.1	339251.7	241.0	66
329175.9	342454.8	216.0	71
327283.6	341027.7	219.0	66
377717.9	347959.3	234.0	66
360115.1	353732.0	221.0	66
334315.7	357074.4	230.0	66
360919.2	360076.8	219.0	66
373107.3	361579.0	316.0	66
359955.3	363145.4	200.0	66
359073.9	364406.9	240.0	66
354410.3	365503.6	131.0	61
364718.7	375412.1	172.0	66
357065.1	373863.9	240.0	66
346347.9	372528.5	209.0	66
328363.3	374225.3	251.0	66
331727.2	376449.5	252.0	66
324964.0	380321.6	254.0	64
321981.3	380534.4	256.0	66
340057.9	387872.6	244.0	71
344971.1	383834.1	295.0	66
375991.9	392463.7	250.0	66
376163.1	395951.5	245.0	66

TABLE F.1C. (contd)

352936.1	409587,4	174,0	67
334151.8	409814,0	218,0	66
344208.3	424471,4	230,0	64
345386.3	426025,2	232,0	63
366360.3	430965,6	248,0	71
331991.1	437803,6	180,0	71
331947.4	435912,6	182,0	71
329808.6	440873,2	170,0	66
329055.5	444698,0	181,0	66
327123.1	445498,1	193,0	64
316028.1	444583,3	237,0	67
333431.4	450997,7	178,0	66
334694.3	453349,9	183,0	66
319039.3	475938,2	364,0	71
328465.7	490966,3	272,0	71
328272.2	509919,1	290,0	71
316053.8	521788,4	371,0	71
323388.7	538709,4	330,0	71
321112.8	540266,3	220,0	71
339440.4	546301,6	264,0	70
381261.7	555384,1	275,0	71
373543.9	571948,1	289,0	71
395549.8	555497,6	387,0	75
315239.6	599650,6	277,0	71
327788.5	629224,1	450,0	71
353029.5	611972,4	369,0	71
367400.6	610867,2	429,0	71
376481.9	615776,0	365,0	71
374769.7	628048,3	314,0	71
408761.8	622429,4	272,0	71
345275.9	635596,4	385,0	71
346875.3	638494,6	352,0	71
353268.8	645296,8	299,0	71
323580.1	670242,8	297,0	71
346816.1	666818,5	270,0	71
392021.7	653541,4	221,0	71
468363.8	626053,8	205,0	68
376439.9	615776,0	365,0	71
421400.6	610777,8	320,0	67
422203.1	615441,7	346,0	60
426314.9	607957,9	308,0	60
452284.5	606884,6	288,0	67
441036.8	575544,9	287,0	71
373375.6	571788,1	289,0	71
381177.6	555258,1	275,0	71
430124.5	543448,6	281,0	67
432224.4	542017,9	257,0	67
401733.0	514183,1	216,0	71
399552.0	471111,0	268,0	71
445106.0	471701,4	239,0	64
468581.1	453400,6	225,0	68
453700.2	448202,7	242,0	60
437922.4	426490,4	244,0	64
441072.6	424764,7	238,0	71
403340.7	382732,3	255,0	65
461529.6	367174,6	267,0	71
430011.9	353021,8	352,0	60
399321.3	346115,8	252,0	71
421095.0	345716,9	251,0	64
455137.6	339799,8	319,0	71
402408.2	320976,0	256,0	66
426826.3	316623,3	246,0	66
428594.2	319227,8	254,0	63
443434.0	320853,2	241,0	71
436900.0	301145,0	260,0	72

TABLE F.1C. (contd)

426005.8	293505.0	350.0	72
433401.3	290723.7	278.0	72
466108.0	294602.0	231.0	72
441198.4	268143.7	230.0	72
469989.1	264795.7	250.0	77
419660.9	251076.2	123.0	76
439445.5	236913.4	320.0	67
409757.5	224751.4	413.0	72
397039.9	204425.3	360.0	66
430836.9	201086.2	287.0	77
450131.3	201868.3	288.0	77
408836.4	184188.7	278.0	72
419805.8	182454.9	334.0	72
458384.2	172204.0	328.0	71
416458.1	153874.4	352.0	76
461435.9	154462.4	365.0	76
406139.5	132656.5	537.0	76
419070.8	116334.8	465.0	69
426510.8	116075.6	449.0	61
400815.4	103279.3	408.0	69
396516.6	91429.5	277.0	69
421068.8	95441.6	275.0	69
463149.5	99563.3	378.0	66
462641.6	95864.8	320.0	65
466463.8	92750.6	150.0	66
429417.6	78367.6	315.2	71
437616.3	80419.6	253.0	71
439925.9	77979.4	310.0	67
464343.3	72828.1	300.0	65
426088.9	70005.8	290.0	69
406456.2	67376.2	188.0	65
441640.0	68099.6	225.0	69
425652.1	52561.8	277.0	63
436036.0	53897.1	265.0	53
446038.0	51575.8	273.0	52
466505.2	47563.1	212.0	71
418660.2	37646.1	530.0	71
422823.2	39239.4	88.0	80
421937.6	36255.8	870.0	71
403813.0	28202.3	310.0	71
416714.0	24280.8	24.0	80
415195.7	18859.8	71.2	68
413216.5	15204.6	71.2	68
414559.1	12471.1	48.0	30
411739.5	9068.9	71.2	80
421950.6	5444.3	63.0	20
464421.4	22092.0	139.0	64
462511.8	3810.0	450.0	71
468741.6	635207.6	274.0	67
468441.9	629449.1	385.0	60
470998.6	621502.1	189.0	68
477388.8	622504.9	170.0	68
478441.0	624731.8	143.0	68
478991.0	627631.6	163.0	68
493479.2	613031.9	267.0	71
511093.1	614444.4	219.0	65
513446.1	613433.4	227.0	67
513541.1	624992.9	286.0	67
513843.0	633945.9	237.0	68
543348.5	630408.9	192.0	68
513339.5	545084.9	201.0	68
510478.0	542565.5	192.0	68
524779.8	507789.2	163.0	62
544623.2	510923.1	180.0	60
510265.8	495066.3	229.0	68

TABLE F.1C. (contd)

523530,0	475213,4	155,0	68
470089,1	459669,0	230,0	67
509390,0	457950,5	183,0	60
515226,0	453615,3	189,0	71
517308,7	430536,3	234,0	71
529788,5	425732,5	262,0	60
517174,0	421456,9	270,0	59
510814,7	415700,3	230,0	64
514054,0	412338,3	225,0	60
516449,7	411117,0	238,0	64
518969,9	409096,9	254,0	64
474777,5	394594,6	261,0	63
510363,5	376065,8	295,0	64
514861,8	376565,9	290,0	71
507164,5	371487,0	351,0	58
507414,6	369132,8	289,0	60
498332,4	366409,1	281,0	64
523723,4	360444,8	284,0	64
494871,7	350313,8	278,0	71
513664,0	354540,8	323,0	71
535901,9	356159,2	283,0	60
514873,9	344997,8	311,0	71
541650,2	345014,5	274,0	58
536008,4	335477,9	260,0	64
536342,3	332913,5	260,0	64
511240,9	325833,3	293,0	60
516487,6	322087,3	281,0	60
519981,2	322714,5	235,0	60
523510,1	320609,4	230,0	64
527964,6	319386,2	243,0	64
526369,6	321825,7	238,0	64
531834,0	320266,0	266,0	64
531276,1	309589,0	245,0	71
518597,7	282110,2	217,0	71
482186,7	272728,8	262,0	71
547151,4	250473,0	282,0	71
473451,0	236292,8	293,0	77
471597,8	232343,3	237,0	71
503298,5	239207,1	239,0	77
509179,2	234787,8	218,0	71
520029,3	240242,1	232,0	71
539854,0	222107,2	282,0	77
506764,2	214613,4	145,0	73
492917,8	196761,7	263,0	77
530374,9	201055,9	214,0	71
534280,2	196806,7	240,0	71
520402,4	190178,3	244,0	71
495337,4	177171,2	213,0	71
481524,6	150324,0	339,0	71
503127,4	147024,9	264,0	71
507081,3	149753,5	259,0	71
519819,6	151633,0	270,0	71
511604,0	131800,3	315,0	71
481625,8	123968,1	298,0	71
482210,3	119680,0	286,0	69
476409,3	119475,3	260,0	69
475398,2	117164,4	388,0	71
505583,7	121885,8	367,0	71
512009,2	115700,6	392,0	71
503219,1	110622,7	298,0	71
489213,3	101934,7	250,0	67
473533,3	100814,6	302,0	68
486497,0	74278,4	247,0	71
491263,7	47539,7	235,0	56
483904,3	44099,8	261,0	71

TABLE F.1C. (contd)

477423.1	35783.1	285.0	71
500815.0	27136.3	252.0	69
476528.0	22711.1	135.0	71
510353.0	8849.7	225.0	62
519634.2	-112.5	158.0	68
533674.6	672.9	190.0	71
538302.5	2858.3	191.0	71
597589.6	647191.9	200.0	71
567110.3	598334.3	142.0	67
588965.4	595161.0	259.0	71
572018.1	587442.6	133.0	61
570208.3	584964.3	100.0	68
603965.4	588337.2	193.0	64
560675.3	549832.1	206.0	68
580048.6	544895.8	247.0	71
598397.2	523062.4	143.0	67
565054.1	513089.6	71.0	80
559332.0	507378.3	152.0	65
553819.6	501204.3	154.0	67
548732.5	500284.4	149.0	68
559745.9	500568.2	154.0	68
579341.3	508158.0	115.0	67
583378.3	509835.6	108.0	67
568507.9	475885.5	177.0	68
558660.8	464293.2	178.0	71
565462.8	456216.1	164.0	58
549681.6	437021.1	180.0	60
570823.2	434941.4	109.0	60
578600.1	435438.5	172.0	60
567077.1	424648.6	147.0	64
568248.2	423510.4	200.0	55
571273.9	422666.8	202.0	71
567362.6	420484.7	192.0	63
566813.8	417879.1	220.0	71
531012.3	421803.2	185.0	60
591916.4	426220.3	173.0	64
589048.5	416092.6	203.0	64
595802.1	401332.0	216.0	60
589368.1	398479.7	270.0	64
582181.9	400252.0	225.0	71
605915.7	383499.7	230.0	64
579093.3	379111.4	310.0	60
593915.8	362283.5	185.0	60
596941.1	361145.7	157.0	57
580756.5	359773.8	196.0	60
564944.1	352138.4	354.0	60
549092.4	347235.3	291.0	71
548963.7	344503.2	302.0	71
579066.9	351116.3	237.0	64
604126.3	358154.4	176.0	60
605553.6	356135.4	163.0	64
604408.1	344997.3	228.0	64
586753.9	345476.3	239.0	71
590021.5	333703.5	245.0	60
600825.5	334786.2	268.0	64
588961.0	323490.0	348.0	60
591988.1	320033.6	329.0	60
590220.1	321387.1	339.0	64
605986.3	324735.0	316.0	64
568483.6	316657.7	321.0	64
594917.9	310789.9	284.0	71
596849.5	308602.3	254.0	71
567418.0	301021.8	313.0	65
569300.5	291520.1	331.0	71
560363.6	264416.1	227.0	71

TABLE F.1C. (contd)

599740.4	254122.4	240.0	73
582569.2	231816.1	229.0	77
577471.5	219632.9	213.0	71
587295.7	207813.1	240.0	71
554581.4	195148.2	287.0	71
568513.9	170670.8	176.0	71
601064.1	142350.6	212.0	71
606273.9	139697.5	181.0	72
603702.5	132007.6	247.0	71
554125.1	112550.2	341.0	71
567363.4	109763.4	310.0	71
595141.7	102675.4	255.0	71
577207.1	73267.9	391.0	71
620029.1	61879.4	307.0	71
619298.8	35985.3	265.0	71
596670.9	30458.1	357.0	71
591117.5	25419.2	371.0	71
621461.0	19463.6	360.0	71

TABLE F.1D. Digitized Potentials Before Model Calibration (Actual Elevation = Value - 1300)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	1	2	3	4	5	6	7	8	9	10	11	12
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1750.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1750.000	1750.000	1749.490	1745.242
53	0.000	0.000	0.000	0.000	0.000	0.000	1750.000	1750.000	1745.166	1740.029	1736.923	1733.674
52	0.000	0.000	0.000	0.000	0.000	1750.000	1746.000	1740.324	1734.159	1728.474	1724.143	1721.228
51	0.000	0.000	0.000	0.000	1750.000	1747.544	1740.895	1731.907	1723.874	1716.346	1711.232	1708.428
50	0.000	0.000	0.000	0.000	1750.000	1741.219	1734.218	1725.967	1716.807	1707.569	1699.224	1694.342
49	0.000	0.000	0.000	1750.000	1742.910	1732.820	1726.933	1722.188	1714.303	1705.322	1694.812	1682.761
48	0.000	0.000	0.000	1750.000	1733.588	1722.108	1718.087	1715.744	1712.648	1707.734	1701.032	1687.276
47	0.000	0.000	1750.000	1744.201	1721.892	1707.564	1705.899	1705.782	1704.674	1704.481	1705.135	1698.858
46	0.000	0.000	1750.000	1739.767	1710.751	1687.795	1681.985	1684.346	1686.199	1690.919	1698.965	1697.852
45	0.000	0.000	1750.000	1740.258	1709.821	1668.881	1657.210	1654.829	1650.713	1666.935	1678.847	1682.526
44	0.000	0.000	1750.000	1746.175	1719.361	1692.734	1672.239	1662.127	1654.824	1651.388	1656.264	1662.664
43	0.000	0.000	0.000	1750.000	1732.395	1711.674	1694.498	1683.479	1673.305	1660.880	1651.861	1649.997
42	0.000	0.000	0.000	0.000	1749.823	1730.613	1715.768	1703.519	1688.467	1674.212	1667.152	1658.148
41	0.000	0.000	0.000	0.000	0.000	1750.000	1734.427	1714.729	1693.799	1683.535	1685.878	1679.446
40	0.000	0.000	0.000	0.000	0.000	1750.000	1741.979	1730.843	1718.146	1698.814	1718.661	1706.922
39	0.000	0.000	0.000	0.000	1750.000	1751.974	1750.576	1743.973	1732.554	1728.338	1738.269	1726.488
38	0.000	0.000	0.000	1750.000	1756.890	1761.806	1763.546	1762.990	1762.488	1765.848	1769.835	1749.123
37	0.000	0.000	0.000	1756.000	1765.000	1779.334	1786.786	1792.257	1799.499	1800.000	1800.000	1765.430
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1800.000	1780.123	1756.547
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1800.000	1800.000	1774.328	1745.104	1730.245
34	0.000	0.000	0.000	0.000	0.000	0.000	1800.000	1779.009	1763.233	1733.728	1703.111	1697.241
33	0.000	0.000	0.000	0.000	0.000	1800.000	1775.159	1756.803	1736.803	1707.848	1689.147	1684.049
32	0.000	0.000	0.000	0.000	1800.000	1781.234	1760.361	1739.332	1717.677	1692.925	1680.289	1673.360
31	0.000	0.000	0.000	1753.289	1766.721	1759.831	1744.416	1724.417	1702.128	1679.841	1669.867	1662.834
30	0.000	0.000	0.000	1713.804	1718.282	1729.633	1719.465	1703.394	1679.197	1661.294	1653.419	1649.840
29	0.000	0.000	0.000	0.000	1684.942	1687.391	1684.774	1673.734	1657.373	1645.918	1648.988	1636.447
28	0.000	0.000	0.000	0.000	0.000	1666.984	1658.499	1651.198	1644.158	1638.077	1633.229	1630.465
27	0.000	0.000	0.000	0.000	0.000	0.000	1643.599	1640.738	1636.985	1632.177	1627.702	1624.447
26	0.000	0.000	0.000	0.000	0.000	0.000	1635.488	1633.383	1631.863	1627.129	1623.166	1619.638
25	0.000	0.000	0.000	0.000	0.000	0.000	1630.082	1627.497	1625.574	1622.737	1619.140	1615.760
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1622.701	1620.485	1618.621	1615.466	1612.114
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1616.198	1614.224	1611.841	1608.547
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1609.357	1607.774	1604.759
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1604.116	1602.914	1599.796
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1598.001	1596.541	1592.956
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1592.631	1591.057	1587.928
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1588.351	1586.885	1584.262
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1583.617	1582.532	1580.183
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1578.732	1577.778	1576.005
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1574.574	1572.838	1571.888
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1567.496	1567.117
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1562.728	1562.106
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1558.383	1557.095
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1552.862
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1548.817
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1500.000

	13	14	15	16	17	18	19	20	21	22	23	24
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1750.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1750.000	1744.041
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1750.000	1732.146
55	1750.000	1750.000	1750.000	0.000	0.000	0.000	0.000	0.000	0.000	1750.000	1737.009	1721.159
54	1742.617	1741.419	1743.295	1750.000	0.000	0.000	0.000	0.000	1750.000	1741.969	1720.906	1711.005
53	1731.055	1730.047	1733.190	1741.190	1750.000	0.000	0.000	1750.000	1744.490	1733.041	1719.190	1703.039
52	1719.060	1718.403	1721.307	1720.691	1739.145	1750.000	1750.000	1741.522	1734.350	1724.016	1711.171	1697.225
51	1706.647	1706.417	1707.340	1714.253	1723.963	1729.394	1731.303	1730.312	1723.436	1714.401	1703.256	1692.149
50	1691.400	1690.710	1691.259	1699.425	1700.239	1712.690	1716.415	1710.912	1712.919	1704.326	1695.419	1687.440
49	1674.458	1672.597	1675.945	1685.345	1692.251	1696.669	1702.449	1707.522	1701.732	1693.190	1686.903	1681.250
48	1666.156	1656.621	1661.349	1670.540	1676.706	1681.151	1686.896	1690.371	1684.345	1679.616	1677.799	1673.294
47	1670.139	1651.285	1650.003	1656.276	1661.512	1665.227	1666.404	1663.004	1661.050	1665.692	1667.010	1664.377
46	1677.695	1660.798	1650.408	1648.061	1648.681	1649.211	1640.378	1646.672	1647.000	1652.926	1656.350	1654.305
45	1677.003	1667.954	1659.908	1651.005	1645.120	1642.977	1641.553	1640.038	1641.026	1643.909	1645.660	1644.195
44	1665.620	1665.943	1663.217	1655.390	1646.480	1640.703	1636.382	1634.354	1635.516	1637.194	1638.066	1637.013
43	1652.735	1656.063	1658.619	1653.919	1645.613	1639.013	1633.465	1629.340	1629.547	1630.407	1630.738	1630.072
42	1648.554	1647.069	1650.206	1647.235	1641.643	1635.624	1630.038	1625.397	1623.401	1623.472	1623.339	1622.046
41	1650.383	1646.636	1643.204	1640.834	1636.453	1631.135	1625.640	1620.004	1617.521	1616.567	1616.009	1615.469
40	1676.737	1654.671	1645.019	1639.492	1635.105	1629.944	1623.754	1617.897	1613.275	1610.251	1608.748	1608.004
39	1692.463	1669.818	1659.074	1646.771	1640.544	1631.612	1622.019	1613.275	1607.113	1603.514	1601.610	1600.730
38	1714.378	1686.569	1674.322	1666.450	1654.333	1633.884	1617.474	1605.619	1598.950	1596.302	1594.010	1593.667
37	1733.566	1700.190	1695.689	1687.300	1667.559	1634.711	1608.608	1598.386	1594.459	1591.031	1589.949	1588.460
36	1741.414	1725.002	1716.906	1705.763	1674.037	1631.415	1600.953	1594.533	1591.276	1588.200	1585.007	1583.976
35	1722.242	1716.502	1711.960	1701.350	1667.025	1625.126	1590.960	1593.003	1589.013	1585.629	1582.603	1580.300
34	1696.164	1694.958	1691.463	1680.030	1657.434	1622.421	1599.645	1593.074	1590.393	1586.774	1583.004	1579.790
33	1683.301	1682.925	1680.652	1673.496	1661.229	1640.188	1611.310	1597.255	1592.944	1589.192	1585.796	1582.373
32	1671.750	1671.367	1670.777	1660.453	1664.063	1654.440	1631.330	1603.370	1595.942	1592.611	1589.353	1585.900
31	1660.138	1659.433	1659.182	1650.191	1655.736	1649.320	1631.710	1614.463	1601.440	1597.060	1593.610	1590.556
30	1646.995	1645.972	1645.893	1644.185	1639.528	1631.887	1622.407	1615.223	1609.207	1604.155	1599.041	1596.172
29	1635.973	1634.306	1633.167	1630.853	1626.528	1619.646	1611.054	1605.159	1603.509	1602.730	1602.140	1601.792
28	1628.818	1626.069	1624.424	1622.064	1618.476	1613.090	1605.574	1598.727	1596.413	1595.697	1595.104	1594.467
27	1622.037	1620.003	1618.223	1616.091	1613.467	1610.184	1606.215	1602.370	1598.701	1595.837	1592.646	1589.694
26	1617.246	1615.096	1613.202	1611.190	1609.150	1607.120	1604.407	1601.953	1600.442	1599.030	1597.662	1595.629
25	1613.009	1610.703	1608.409	1606.021	1603.211	1600.773	1596.041	1592.524	1592.029	1593.731	1596.000	1600.413
24	1609.057	1606.315	1602.896	1598.453	1590.104	1584.972	1581.769	1580.531	1581.033	1585.301	1590.803	1598.199
23	1605.016	1600.835	1593.535	1583.420	1572.840	1567.261	1566.905	1569.419	1573.837	1578.553	1585.085	1593.631
22	1600.135	1591.718	1592.075	1576.176	1557.093	1551.543	1553.800	1560.952	1566.147	1571.799	1578.206	1586.756
21	1592.945	1584.409	1575.141	1564.318	1552.604	1548.388	1549.002	1553.852	1558.962	1563.317	1569.709	1576.624
20	1587.492	1580.461	1572.689	1564.700	1556.172	1549.335	1547.424	1548.901	1550.540	1553.100	1557.466	1564.903
19	1583.613	1578.255	1572.190	1565.672	1558.764	1551.627	1547.732	1546.642	1547.207	1548.101	1549.385	1552.753
18	1580.780	1576.023	1571.624	1566.066	1560.002	1553.680	1540.300	1545.601	1544.732	1545.282	1546.070	1547.035
17	1576.922	1573.171	1568.955	1564.191	1559.019	1553.196	1547.008	1544.755	1542.747	1542.619	1543.471	1544.969
16	1572.933	1569.060	1564.001	1560.411	1555.515	1550.922	1546.226	1543.270	1541.190	1540.776	1542.124	1543.915
15	1569.397	1565.528	1561.154	1556.449	1551.785	1547.241	1543.667	1540.909	1539.351	1540.493	1542.736	1545.260
14	1566.037	1562.856	1558.405	1553.290	1547.678	1543.331	1540.146	1538.040	1537.634	1540.010	1543.530	1547.921
13	1561.467	1559.970	1556.507	1551.513	1545.093	1539.765	1536.005	1534.297	1535.122	1538.031	1542.722	1549.149
12	1556.531	1555.603	1553.512	1549.731	1542.706	1536.463	1531.987	1530.840	1531.030	1533.576	1537.770	1542.085
11	1551.540	1550.494	1548.344	1544.685	1539.202	1532.388	1527.053	1524.980	1525.347	1527.826	1530.947	1535.975
10	1546.462	1545.063	1542.649	1539.026	1534.161	1528.235	1523.302	1520.936	1520.006	1521.741	1525.065	1530.337
9	1542.585	1540.380	1537.676	1533.937	1529.209	1524.339	1520.591	1517.641	1516.494	1517.045	1520.904	1525.427
8	0.000	1536.557	1533.509	1529.703	1525.[illegible]	1521.099	1517.705	1514.610	1512.065	1513.019	1516.005	1519.977
7	0.000	0.000	1529.400	1526.030	1521.012	1517.944	1514.447	1511.354	1509.258	1509.151	1510.116	1513.060
6	0.000	0.000	1525.604	1522.289	1518.247	1514.942	1511.051	1507.847	1505.330	1504.075	1503.032	1505.257
5	0.000	0.000	1521.662	1517.921	1514.178	1510.559	1507.304	1504.140	1500.000	1500.000	0.000	1500.000
4	0.000	0.000	0.000	1512.721	1509.642	1506.136	1503.142	1500.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	1508.128	1504.742	1500.000	1500.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	25	26	27	28	29	30	31	32	33	34	35	36
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1545.091	1513.810
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1594.354	1580.148	1565.064	1549.210
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1668.475	1626.428	1600.726	1585.481	1572.391
62	0.000	0.000	0.000	1750.000	1750.000	1750.000	1707.670	1693.493	1669.229	1647.748	1616.385	1596.724
61	0.000	0.000	1750.000	1723.677	1683.422	1663.536	1666.726	1695.604	1682.645	1667.964	1655.131	1642.955
60	0.000	1750.000	1727.368	1689.321	1653.696	1631.694	1641.203	1662.311	1670.368	1669.657	1665.071	1654.075
59	1750.000	1736.668	1700.320	1670.265	1636.928	1611.687	1607.935	1623.786	1647.446	1656.608	1659.071	1656.602
58	1742.564	1716.107	1685.467	1658.845	1625.363	1600.293	1595.257	1598.635	1608.368	1625.973	1637.781	1641.012
57	1727.112	1701.478	1673.614	1643.878	1617.569	1598.072	1592.450	1592.549	1595.431	1600.649	1611.688	1619.086
56	1713.599	1690.359	1662.953	1636.409	1615.864	1598.143	1591.790	1588.667	1589.726	1592.068	1595.761	1599.328
55	1702.031	1688.066	1654.594	1632.529	1615.268	1599.068	1592.022	1586.077	1584.037	1585.729	1587.036	1588.188
54	1693.818	1675.484	1651.421	1631.968	1616.615	1602.578	1593.494	1587.134	1581.812	1579.744	1579.178	1578.490
53	1687.143	1669.957	1651.630	1633.781	1620.800	1607.281	1596.850	1588.567	1581.741	1575.734	1572.889	1569.453
52	1683.260	1668.830	1653.649	1637.197	1624.416	1612.372	1600.929	1591.271	1583.144	1575.041	1567.411	1561.508
51	1680.756	1668.698	1655.953	1640.964	1628.774	1617.250	1605.984	1594.647	1585.074	1575.504	1565.603	1556.477
50	1678.101	1667.865	1656.739	1643.100	1631.531	1620.511	1609.171	1596.665	1566.344	1576.018	1565.537	1556.301
49	1673.014	1664.896	1655.031	1642.472	1631.374	1628.362	1609.108	1597.000	1566.047	1577.072	1568.719	1560.775
48	1667.547	1660.895	1651.031	1640.028	1630.075	1619.934	1609.476	1597.502	1566.711	1579.396	1572.310	1565.483
47	1659.287	1653.187	1644.466	1636.883	1628.107	1619.655	1611.845	1601.343	1585.534	1576.379	1571.111	1567.255
46	1648.978	1645.478	1637.098	1630.141	1622.944	1615.723	1608.152	1597.637	1577.881	1560.125	1564.058	1561.600
45	1640.371	1635.194	1629.076	1622.658	1616.021	1609.387	1599.100	1577.930	1561.871	1553.928	1552.701	1552.257
44	1633.396	1628.188	1621.418	1614.707	1607.698	1597.569	1572.145	1551.418	1544.498	1541.914	1541.167	1540.021
43	1627.476	1622.742	1616.103	1607.551	1593.179	1569.878	1549.271	1542.816	1536.778	1536.469	1534.893	1532.920
42	1621.928	1616.698	1612.759	1604.284	1584.474	1558.076	1543.935	1538.601	1535.817	1533.682	1531.046	1526.335
41	1615.192	1614.285	1610.318	1602.773	1584.842	1562.605	1546.866	1539.231	1535.532	1533.150	1531.275	1529.578
40	1608.068	1607.832	1605.788	1599.605	1583.666	1567.485	1552.659	1541.916	1536.490	1533.630	1532.866	1534.635
39	1600.797	1600.675	1597.762	1592.097	1581.679	1578.384	1556.057	1546.936	1538.238	1533.018	1531.843	1536.312
38	1593.026	1592.292	1589.999	1585.017	1579.313	1571.178	1562.649	1553.587	1540.028	1529.463	1525.195	1531.026
37	1587.250	1585.947	1583.597	1579.884	1574.597	1567.934	1560.428	1551.861	1536.687	1521.196	1511.609	1521.088
36	1582.201	1580.336	1577.477	1573.547	1568.484	1562.345	1554.621	1543.647	1529.199	1513.098	1506.593	1515.617
35	1578.229	1575.790	1572.429	1568.003	1562.764	1556.490	1547.887	1537.097	1524.801	1511.579	1505.008	1513.012
34	1576.436	1573.100	1569.060	1564.278	1558.508	1551.394	1542.502	1533.445	1523.682	1514.141	1510.654	1519.075
33	1578.990	1575.432	1570.891	1565.062	1557.968	1549.277	1540.747	1532.691	1525.288	1521.141	1521.069	1528.978
32	1582.985	1579.386	1574.565	1568.244	1560.928	1552.907	1544.181	1536.537	1530.216	1529.332	1532.748	1539.682
31	1588.032	1584.613	1579.227	1572.367	1564.706	1556.881	1547.978	1540.453	1535.524	1536.967	1541.967	1551.291
30	1593.761	1589.438	1582.185	1574.566	1567.149	1558.954	1550.428	1543.185	1541.400	1545.069	1552.166	1570.035
29	1600.399	1593.319	1581.906	1571.490	1563.393	1555.644	1547.961	1544.296	1547.792	1557.303	1572.773	1596.041
28	1592.785	1587.910	1577.716	1565.991	1555.759	1549.577	1546.229	1548.616	1550.057	1572.600	1592.985	1631.282
27	1586.537	1582.881	1575.089	1565.105	1552.114	1548.919	1558.323	1557.311	1569.173	1585.353	1614.487	1651.084
26	1593.156	1589.297	1584.002	1575.960	1566.210	1561.535	1563.484	1568.838	1578.275	1594.666	1632.834	1656.190
25	1601.003	1600.170	1598.067	1592.949	1585.708	1579.795	1578.696	1579.481	1585.241	1599.598	1633.094	1652.120
24	1602.784	1604.355	1605.033	1604.648	1601.979	1597.590	1594.435	1592.518	1594.291	1607.593	1627.452	1640.346
23	1601.800	1605.417	1607.614	1609.149	1609.856	1610.413	1610.738	1610.337	1612.711	1621.963	1629.550	1634.178
22	1596.834	1603.902	1608.025	1611.289	1614.425	1618.115	1622.940	1629.644	1635.921	1643.570	1644.842	1644.089
21	1587.234	1600.292	1607.315	1611.981	1616.691	1622.339	1630.896	1646.482	1651.507	1653.900	1655.389	1657.332
20	1576.885	1592.191	1604.534	1610.917	1616.411	1621.969	1630.001	1643.205	1650.029	1651.618	1654.574	1661.161
19	1564.196	1580.479	1599.713	1608.230	1612.985	1617.783	1625.075	1637.611	1642.297	1643.974	1647.483	1654.257
18	1551.391	1565.941	1586.191	1600.605	1605.861	1611.135	1622.806	1631.610	1636.438	1639.302	1642.696	1646.117
17	1546.919	1551.743	1568.133	1583.763	1593.067	1601.389	1614.221	1624.998	1631.399	1635.605	1639.760	1643.139
16	1545.969	1549.143	1560.043	1573.290	1582.677	1591.420	1603.493	1616.576	1623.731	1630.311	1636.025	1642.905
15	1548.360	1553.336	1561.884	1570.034	1577.428	1585.810	1593.675	1601.134	1610.381	1620.177	1631.395	1642.816
14	1553.040	1558.185	1562.443	1566.886	1571.907	1579.259	1586.085	1591.814	1595.447	1601.005	1618.224	1638.996
13	1552.740	1553.799	1554.481	1556.294	1565.280	1572.982	1574.964	1582.777	1586.658	1591.084	1599.864	1625.337
12	1545.573	1546.466	1547.464	1552.093	1559.938	1566.956	1571.129	1574.495	1578.305	1562.549	1588.172	1601.815
11	1539.297	1541.187	1543.777	1548.067	1554.748	1559.736	1562.632	1566.082	1569.665	1574.817	1579.806	1585.545
10	1534.001	1536.743	1540.472	1543.796	1547.232	1551.182	1553.901	1557.156	1560.750	1564.548	1566.450	1573.016
9	1529.561	1531.015	1536.515	1538.085	1539.184	1539.918	1540.899	1544.812	1549.367	1552.805	1554.254	1556.185
8	1524.935	1528.772	1531.213	1531.583	1530.731	1528.387	1524.869	1523.959	1523.584	1523.117	1522.551	1500.000
7	1517.765	1522.868	1524.820	1523.908	1520.100	1514.854	1509.271	1502.431	1500.000	1500.000	1500.000	0.000
6	1508.470	1511.887	1513.456	1511.721	1507.172	1500.000	1500.000	0.000	0.000	0.000	0.000	0.000
5	1500.000	1500.000	1500.000	1500.000	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	37	38	39	40	41	42	43	44	45	46	47	48
65	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	1522.670	1500.000	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	1554.120	1531.923	1516.101	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	1578.734	1563.406	1540.517	1529.177	1500.000	1500.000	0.000	0.000	0.000	0.000	0.000	0.000
61	1609.054	1580.092	1572.049	1560.310	1550.357	1529.502	1500.000	1500.000	0.000	0.000	0.000	0.000
60	1645.570	1616.700	1594.911	1580.604	1570.236	1557.160	1536.241	1511.620	1500.000	0.000	0.000	0.000
59	1649.940	1630.542	1612.519	1596.402	1583.607	1571.000	1555.520	1529.351	1509.963	1500.000	0.000	0.000
58	1637.223	1629.626	1619.102	1607.440	1593.042	1570.656	1562.134	1541.481	1522.749	1510.201	1500.000	0.000
57	1620.630	1619.015	1617.756	1611.330	1600.059	1583.924	1560.263	1552.358	1534.095	1521.409	1511.440	1500.000
56	1603.455	1605.969	1600.057	1606.900	1599.060	1585.617	1571.666	1550.119	1543.044	1530.776	1520.045	1509.903
55	1589.629	1591.202	1594.614	1595.904	1592.631	1583.066	1573.209	1561.703	1549.634	1535.566	1522.332	1513.403
54	1577.645	1577.003	1579.941	1581.193	1581.045	1578.454	1571.871	1561.303	1550.293	1536.042	1523.070	1515.037
53	1566.476	1560.495	1565.139	1566.676	1560.496	1560.703	1544.770	1556.950	1546.063	1534.981	1523.022	1515.729
52	1556.328	1551.720	1551.179	1553.138	1556.278	1557.079	1556.048	1550.062	1542.090	1532.990	1522.773	1516.194
51	1549.513	1546.349	1545.061	1545.446	1546.531	1547.255	1545.354	1541.478	1536.826	1529.994	1522.020	1515.092
50	1549.002	1545.230	1542.104	1540.727	1539.916	1538.912	1536.002	1532.927	1529.356	1525.340	1520.009	1514.704
49	1553.010	1547.000	1543.238	1538.078	1534.056	1531.476	1528.239	1524.070	1522.679	1520.676	1517.203	1512.994
48	1559.113	1553.012	1546.191	1539.626	1532.932	1526.516	1523.062	1520.667	1518.914	1517.238	1514.599	1510.055
47	1562.865	1557.317	1550.044	1541.007	1532.237	1524.312	1520.713	1518.115	1515.080	1514.020	1511.543	1508.474
46	1560.207	1558.430	1553.610	1543.807	1532.117	1523.530	1519.736	1516.949	1513.897	1511.943	1509.490	1506.329
45	1552.583	1558.293	1550.242	1541.305	1530.756	1523.046	1519.372	1516.727	1515.146	1513.004	1509.799	1505.200
44	1540.795	1538.900	1534.978	1527.620	1523.007	1521.896	1519.734	1519.004	1518.023	1515.003	1511.025	1505.611
43	1529.956	1526.440	1524.570	1523.009	1522.051	1522.060	1522.909	1523.179	1522.954	1521.330	1517.755	1512.021
42	1525.019	1525.021	1525.318	1525.032	1526.007	1529.365	1530.459	1531.616	1531.679	1530.513	1527.702	1523.790
41	1531.062	1534.754	1537.124	1538.846	1539.657	1540.506	1541.057	1541.467	1541.374	1540.462	1538.497	1536.500
40	1540.351	1547.492	1550.349	1551.447	1551.700	1551.020	1551.993	1552.237	1552.593	1552.307	1550.094	1549.440
39	1547.700	1554.945	1556.448	1557.516	1558.002	1558.343	1558.946	1559.909	1561.392	1563.055	1563.920	1563.619
38	1544.205	1553.004	1557.007	1559.760	1561.319	1562.024	1562.049	1564.265	1566.707	1570.022	1575.523	1576.200
37	1534.769	1544.028	1553.423	1558.908	1561.491	1563.721	1564.055	1566.331	1569.044	1574.639	1582.377	1586.029
36	1527.486	1538.165	1548.049	1557.140	1561.174	1563.496	1565.270	1566.029	1569.027	1573.497	1581.050	1590.091
35	1524.900	1536.090	1547.299	1556.959	1560.961	1562.026	1564.302	1566.017	1567.901	1571.095	1577.912	1586.164
34	1529.290	1539.505	1549.516	1558.111	1560.940	1561.570	1562.435	1563.600	1565.262	1567.327	1571.024	1578.672
33	1538.093	1547.540	1556.555	1560.766	1560.670	1558.055	1557.501	1558.299	1559.510	1560.002	1561.000	1566.347
32	1549.243	1558.928	1563.100	1564.372	1560.200	1551.326	1549.201	1549.150	1549.416	1549.814	1550.794	1553.130
31	1564.058	1569.161	1570.631	1571.723	1567.872	1558.591	1553.205	1550.909	1549.349	1547.021	1546.340	1546.534
30	1582.535	1583.095	1583.361	1580.050	1587.959	1583.204	1578.029	1571.910	1563.053	1555.621	1550.170	1547.300
29	1616.609	1617.171	1616.502	1627.900	1643.063	1642.645	1623.725	1592.076	1576.759	1567.136	1559.593	1551.036
28	1651.205	1654.669	1653.437	1652.061	1650.274	1644.929	1623.623	1594.201	1581.079	1572.963	1562.993	1552.656
27	1663.580	1666.006	1650.936	1646.961	1620.079	1602.349	1595.098	1587.746	1580.130	1570.999	1561.073	1551.262
26	1664.006	1665.492	1652.555	1616.300	1597.095	1591.400	1587.076	1582.993	1576.243	1567.712	1558.224	1549.497
25	1657.001	1659.006	1650.572	1609.351	1597.001	1592.900	1589.709	1584.693	1577.341	1567.992	1557.601	1548.068
24	1646.013	1650.155	1658.038	1644.924	1620.659	1603.704	1597.771	1590.423	1580.704	1569.120	1558.266	1548.969
23	1630.253	1639.472	1644.963	1651.706	1640.322	1635.333	1614.045	1595.016	1582.741	1570.933	1559.175	1549.352
22	1645.745	1645.121	1646.020	1653.020	1652.526	1640.924	1604.364	1591.356	1581.356	1570.305	1559.064	1549.464
21	1657.794	1650.590	1650.095	1653.016	1642.944	1607.349	1593.799	1586.523	1578.600	1569.495	1559.716	1550.127
20	1660.400	1665.917	1650.090	1637.893	1610.702	1595.210	1589.232	1583.726	1579.563	1573.312	1564.709	1559.755
19	1660.325	1660.105	1651.129	1625.011	1598.923	1591.003	1590.134	1589.476	1587.335	1582.000	1574.106	1563.713
18	1649.219	1649.706	1641.013	1619.646	1599.475	1596.037	1598.006	1599.435	1598.040	1593.911	1585.005	1574.122
17	1645.395	1645.052	1641.945	1631.535	1618.400	1617.522	1620.644	1620.065	1618.964	1610.590	1600.306	1585.159
16	1640.421	1652.921	1655.005	1654.273	1653.022	1650.771	1647.074	1643.326	1637.340	1626.301	1611.000	1592.310
15	1656.007	1672.926	1687.120	1697.322	1693.347	1684.013	1673.519	1663.026	1649.715	1631.950	1613.140	1594.909
14	1660.006	1710.716	1751.050	1777.960	1750.694	1725.175	1696.829	1675.200	1651.970	1628.037	1605.200	1592.342
13	1674.125	1731.400	1781.024	1797.601	1782.207	1753.409	1717.597	1683.422	1651.512	1620.492	1594.031	1580.902
12	1653.085	1717.942	1758.034	1754.152	1747.029	1735.000	1714.630	1682.720	1647.546	1613.159	1584.440	1570.639
11	1600.232	1649.426	1700.251	1691.299	1671.675	1680.064	1684.421	1668.939	1636.736	1601.203	1569.660	1559.392
10	1579.197	1594.343	1601.594	1594.504	1601.182	1634.700	1653.325	1650.390	1625.372	1589.419	1558.336	1545.000
9	1558.634	1562.147	1564.753	1566.774	1581.017	1609.221	1624.903	1629.642	1610.955	1589.472	1559.177	1544.870
8	1500.000	1500.000	1500.000	1534.433	1563.341	1584.240	1596.509	1604.712	1605.637	1587.597	1561.361	1544.754
7	0.000	0.000	0.000	1500.000	1545.503	1560.221	1577.358	1580.508	1581.475	1576.429	1560.119	1544.455
6	0.000	0.000	0.000	0.000	1509.005	1540.012	1555.511	1555.493	1555.802	1557.463	1552.944	1541.309
5	0.000	0.000	0.000	0.000	0.000	1500.000	1500.000	1500.000	1500.000	1529.422	1534.405	1531.704
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1500.000	1515.743	1519.196
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1500.000	1507.447
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1500.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1500.000

	49	50	51	52	53	54	55	56	57	58	59	60
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	1506.032	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	1507.765	1500.704	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	1509.108	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	1509.966	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	1509.925	1504.096	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	1509.306	1503.024	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	1508.030	1502.966	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	1506.463	1501.604	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	1504.695	1500.442	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	1502.715	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	1507.504	1500.000	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	1521.079	1518.972	1515.136	1500.000	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	1535.013	1532.946	1529.499	1523.583	1515.116	1500.000	1500.000	1500.000	0.000	0.000	0.000	0.000
40	1546.789	1547.071	1544.349	1539.951	1533.639	1526.300	1519.637	1514.466	1500.000	1500.000	1500.000	0.000
39	1562.121	1560.560	1558.192	1555.303	1552.198	1540.699	1540.632	1534.368	1527.746	1520.610	1513.564	1503.105
38	1574.666	1572.746	1569.267	1565.321	1562.052	1559.314	1555.419	1550.968	1541.649	1526.128	1513.809	1500.000
37	1590.284	1588.012	1581.550	1574.609	1570.869	1567.653	1562.232	1555.977	1545.389	1500.000	1500.000	0.000
36	1597.007	1599.623	1591.778	1584.361	1579.543	1574.698	1562.692	1548.935	1500.000	0.000	0.000	0.000
35	1590.964	1601.111	1595.155	1588.602	1583.349	1576.540	1560.927	1538.298	1515.432	0.000	0.000	0.000
34	1585.489	1589.741	1587.395	1582.916	1578.269	1569.243	1554.374	1535.476	1518.321	1500.000	0.000	0.000
33	1571.627	1574.348	1573.110	1568.043	1562.010	1550.006	1541.072	1532.019	1520.040	1509.899	1500.000	0.000
32	1556.717	1559.275	1557.563	1551.595	1546.683	1540.973	1535.650	1529.304	1522.107	1514.740	1507.462	1506.000
31	1547.258	1547.886	1547.159	1544.193	1540.671	1536.698	1532.324	1527.736	1522.700	1517.343	1512.024	1507.391
30	1544.520	1543.201	1542.311	1540.097	1537.106	1533.846	1530.388	1526.742	1522.928	1518.088	1514.934	1511.467
29	1545.579	1541.736	1539.239	1537.158	1534.761	1532.047	1529.131	1526.079	1523.013	1519.942	1516.959	1514.226
28	1546.251	1541.996	1538.267	1535.860	1532.962	1530.694	1528.232	1525.677	1523.146	1520.733	1518.376	1516.208
27	1545.960	1542.105	1538.454	1534.999	1531.099	1529.710	1527.576	1525.428	1523.312	1521.322	1519.419	1517.660
26	1545.352	1541.856	1538.401	1535.244	1532.156	1529.355	1527.160	1525.277	1523.515	1521.790	1520.213	1518.787
25	1544.953	1541.655	1538.490	1535.470	1532.875	1529.832	1527.349	1525.304	1523.663	1522.195	1520.842	1519.615
24	1545.155	1541.987	1538.947	1536.031	1533.257	1530.650	1528.219	1526.018	1524.869	1522.674	1521.443	1520.311
23	1545.585	1542.333	1539.600	1536.829	1534.197	1531.722	1529.582	1527.640	1525.976	1524.456	1523.070	1521.942
22	1545.857	1542.975	1540.222	1537.798	1535.504	1533.323	1531.467	1529.793	1528.099	1526.567	1525.331	1524.274
21	1546.488	1544.119	1541.740	1539.366	1537.212	1535.351	1533.378	1531.828	1530.177	1528.826	1527.636	1526.561
20	1548.429	1545.609	1543.295	1541.154	1539.262	1537.457	1535.397	1533.830	1532.308	1531.103	1530.027	0.000
19	1551.872	1547.286	1545.100	1543.280	1541.323	1539.403	1537.359	1536.015	1534.650	1533.350	1532.270	0.000
18	1559.930	1550.390	1547.154	1545.227	1543.237	1541.316	1539.673	1538.252	1536.880	1535.567	1534.526	0.000
17	1573.267	1561.452	1550.919	1547.084	1545.108	1543.372	1541.695	1540.472	1539.079	1537.791	1536.770	0.000
16	1581.865	1573.648	1562.010	1550.906	1547.128	1545.573	1544.104	1542.653	1541.264	1540.022	1538.966	0.000
15	1584.511	1585.010	1576.422	1564.106	1552.164	1547.771	1546.276	1544.882	1543.470	1542.235	1541.247	0.000
14	1598.459	1601.913	1596.102	1586.068	1573.034	1554.708	1549.568	1546.982	1545.665	1544.361	1543.202	0.000
13	1603.865	1618.492	1611.856	1608.337	1601.637	1585.942	1566.858	1552.488	1547.028	1546.765	0.000	0.000
12	1597.217	1611.743	1621.303	1623.445	1621.062	1613.956	1600.530	1578.131	1555.686	1551.519	0.000	0.000
11	1571.973	1601.585	1618.801	1630.405	1636.873	1636.573	1630.811	1616.023	1594.456	1572.709	0.000	0.000
10	1551.283	1577.999	1607.420	1626.539	1643.560	1656.673	1661.325	1656.176	1640.060	0.000	0.000	0.000
9	1543.632	1553.097	1566.653	1610.309	1637.670	1663.030	1670.007	1662.670	1667.176	0.000	0.000	0.000
8	1539.028	1544.771	1559.457	1590.728	1618.596	1648.265	1674.880	1663.724	1664.222	0.000	0.000	0.000
7	1537.639	1539.442	1547.568	1566.618	1593.870	1620.863	1648.126	1649.737	1647.556	0.000	0.000	0.000
6	1534.859	1535.399	1542.443	1554.624	1575.979	1594.580	1617.130	1637.712	0.000	0.000	0.000	0.000
5	1528.704	1530.833	1537.843	1546.748	1563.676	1570.965	1593.813	1611.936	0.000	0.000	0.000	0.000
4	1521.850	1524.971	1530.072	1538.237	1552.006	1566.615	1575.224	0.000	0.000	0.000	0.000	0.000
3	1513.238	1516.816	1520.210	1525.034	1535.606	1540.869	1559.843	0.000	0.000	0.000	0.000	0.000
2	1505.567	1506.989	1507.956	1509.981	1512.970	1515.771	0.000	0.000	0.000	0.000	0.000	0.000
1	1500.000	1500.000	1500.000	1500.000	1500.000	1500.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1500.000

	61	62	63	64	65	66	67	68	69	70	71	72
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1739.000
52	0.000	0.000	0.000	0.000	1740.000	0.000	0.000	1710.000	0.000	1720.000	0.000	1724.000
51	0.000	1704.600	0.000	0.000	0.000	1733.300	0.000	0.000	1715.000	0.000	0.000	1707.000
50	0.000	1700.000	0.000	0.000	0.000	0.000	1726.700	1720.000	1713.300	1706.700	1700.000	0.000
49	0.000	1675.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1700.000	1693.300
48	0.000	1690.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	0.000	1686.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	1681.700	1677.100	0.000	0.000	1670.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	1672.500	1667.900	1663.300	0.000	0.000	1654.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1665.000	1658.400	1654.200	1652.000	0.000
43	0.000	0.000	0.000	0.000	0.000	1665.000	1665.000	0.000	0.000	0.000	1649.600	1645.000
42	0.000	0.000	0.000	1690.000	1675.000	1670.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	0.000	0.000	1685.000	0.000	0.000	0.000	1650.000	1647.000	1643.000
40	0.000	0.000	0.000	0.000	0.000	1690.000	0.000	0.000	0.000	1660.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	1700.000	0.000	0.000	1690.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	1704.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	1700.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	73	74	75	76	77	78	79	80	81	82	83	84
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	1646.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	1660.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	1673.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	1640.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	85	86	87	88	89	90	91	92	93	94	95	96
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1581.000	1579.500	1577.200	1574.900	1572.700
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1570.400
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	1600.500	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1601.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1595.100	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1588.500	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	1590.900	1586.300	1581.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1577.300	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1572.700	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1568.200	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1563.400
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1585.000	1590.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1610.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	97	98	99	100	101	102	103	104	105	106	107	108
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	1570.400	1564.100	0.000	1563.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	1565.000	1563.560	1561.200	1559.000	1559.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	1559.100	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	0.000	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	0.000	0.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	0.000	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1550.000	1550.000	1525.000	1521.000	1518.000
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	1548.000	1544.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	1548.000	1544.000	1540.000	1536.000	1532.000	1528.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1590.000	1580.000	1570.000	1560.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	1600.000	0.000	0.000	0.000	0.000	1545.000
26	0.000	0.000	0.000	0.000	1625.000	1620.000	1610.000	0.000	0.000	0.000	0.000	1540.000
25	0.000	0.000	0.000	0.000	0.000	1624.000	0.000	0.000	0.000	0.000	1555.000	0.000
24	0.000	0.000	0.000	0.000	1620.000	0.000	0.000	0.000	0.000	1570.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1565.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1600.000	0.000	0.000	0.000	0.000
21	0.000	1683.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	1677.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1565.000	0.000	0.000
19	1670.000	1673.000	1660.000	0.000	1660.000	1630.000	1600.000	1575.000	1565.000	1565.000	1565.000	1550.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	1695.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	1618.000	1640.000	1665.000	1685.000	0.000	0.000	0.000	0.000	0.000	1595.000	0.000	0.000
13	1625.000	1645.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1585.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1582.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1578.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1574.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1560.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1551.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1548.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1D. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	109	110	111	112	113	114	115	116	117	118	119	120
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	1505.000	0.000	0.000	0.000	1510.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1520.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	1535.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	1600.000	0.000	0.000	0.000	1600.000	1586.000	1569.000	1551.000	1534.000	1517.000	1500.000
35	0.000	0.000	1583.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	1570.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	1558.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	1545.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	1530.000	0.000	0.000	1580.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	1524.000	0.000	0.000	0.000	1565.000	0.000	1610.000	0.000	0.000	0.000	0.000	0.000
29	0.000	1520.000	0.000	0.000	1548.000	0.000	0.000	1600.000	1605.000	0.000	0.000	0.000
28	0.000	1516.000	0.000	1525.000	0.000	0.000	0.000	0.000	1595.000	0.000	0.000	0.000
27	1530.000	1520.000	1512.000	0.000	0.000	0.000	0.000	0.000	1580.000	0.000	1580.000	0.000
26	1525.000	1517.000	1508.000	1504.000	1500.000	0.000	0.000	0.000	1560.000	0.000	1560.000	0.000
25	0.000	0.000	0.000	0.000	1499.000	0.000	0.000	0.000	1548.000	0.000	1548.000	0.000
24	0.000	0.000	0.000	0.000	0.000	1498.000	0.000	0.000	1536.000	0.000	1534.000	0.000
23	0.000	0.000	0.000	0.000	0.000	1497.000	0.000	1524.000	0.000	1504.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	1494.000	0.000	0.000	1512.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	1500.000	1495.000	0.000	0.000	1500.000	0.000	0.000	0.000
20	1548.000	1536.000	1524.000	1512.000	0.000	1493.000	0.000	0.000	1495.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	1491.000	1490.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	1513.000	1500.000	1495.000	1489.000	1486.000	1483.000	1480.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1477.000
16	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	1570.000	1565.000	1555.000	1538.000	1528.000	1517.000	1503.000	1501.000	0.000	0.000	0.000
14	0.000	0.000	0.000	1560.000	0.000	0.000	0.000	0.000	0.000	1495.000	1490.000	0.000
13	0.000	0.000	1570.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1480.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1510.000	0.000
11	0.000	1595.000	0.000	0.000	1560.000	0.000	0.000	0.000	0.000	1535.000	0.000	0.000
10	0.000	1575.000	0.000	0.000	0.000	1550.000	1540.000	0.000	1544.000	0.000	0.000	0.000
9	0.000	1565.000	1575.000	0.000	0.000	0.000	0.000	1546.000	0.000	0.000	0.000	0.000
8	1551.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1E. Held Elevation of Streams in the Model (Elevation = Value - 1300)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	61	62	63	64	65	66	67	68	69	70	71	72
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1730.000
52	0.000	0.000	0.000	0.000	1740.000	0.000	0.000	1710.000	0.000	1720.000	0.000	1724.000
51	0.000	1704.600	0.000	0.000	0.000	1733.300	0.000	0.000	1715.000	0.000	0.000	1707.000
50	0.000	1700.000	0.000	0.000	0.000	0.000	1726.700	1720.000	1713.300	1706.700	1700.000	0.000
49	0.000	1695.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1700.000	1693.300
48	0.000	1690.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	0.000	1686.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	1681.700	1677.100	0.000	0.000	1670.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	1672.500	1667.900	1663.300	0.000	0.000	1654.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1665.000	1658.000	1654.200	1652.000	0.000
43	0.000	0.000	0.000	0.000	0.000	1665.000	1665.000	0.000	0.000	0.000	1649.600	1645.000
42	0.000	0.000	0.000	1690.000	1675.000	1670.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	0.000	0.000	1665.000	0.000	0.000	0.000	1658.000	1647.000	1643.000
40	0.000	0.000	0.000	0.000	0.000	1690.000	0.000	0.000	0.000	1660.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	1700.000	0.000	0.000	1690.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	1704.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	1700.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1E. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	73	74	75	76	77	78	79	80	81	82	83	84
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	1686.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	1689.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	1673.390	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	1649.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1E. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1500.000

	85	86	87	88	89	90	91	92	93	94	95	96
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1581.000	1579.500	1577.200	1574.900	1572.700
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1570.400
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	1600.500	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1601.600	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1595.100	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1588.500	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	1590.900	1586.300	1581.800	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1577.300	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1572.700	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1568.200	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1563.600
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1565.000	1590.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1610.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1E. (contd)

POTENTIAL SOLUTION (FT) BIAS= 1300.000

	97	98	99	100	101	102	103	104	105	106	107	108
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	1570.400	1560.100	0.000	1563.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	1565.000	1563.560	1561.200	1559.000	1559.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	1559.100	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	0.000	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	0.000	0.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	0.000	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	1550.000	1550.000	0.000	0.000	0.000	0.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1550.000	1550.000	1525.000	1521.000	1518.000
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	1540.000	1544.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	1540.000	1544.000	1540.000	1536.000	1532.000	1528.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1590.000	1580.000	1570.000	1560.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	1600.000	0.000	0.000	0.000	0.000	1545.000
26	0.000	0.000	0.000	0.000	1625.000	1620.000	1610.000	0.000	0.000	0.000	0.000	1540.000
25	0.000	0.000	0.000	0.000	0.000	1620.000	0.000	0.000	0.000	0.000	1555.000	0.000
24	0.000	0.000	0.000	0.000	1620.000	0.000	0.000	0.000	0.000	1570.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1595.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1600.000	0.000	0.000	0.000	0.000
21	0.000	1683.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	1677.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1565.000	0.000	0.000
19	1670.000	1674.000	1600.000	0.000	1660.000	1630.000	1600.000	1575.000	1565.000	1565.000	1565.000	1550.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	1695.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	1610.000	1640.000	1665.000	1685.000	0.000	0.000	0.000	0.000	0.000	1595.000	0.000	0.000
13	1625.000	1645.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1585.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1582.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1578.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1574.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1560.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1551.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1540.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1E. (contd)

POTENTIAL SOLUTION (FT) DIAS= 1300.000

	109	110	111	112	113	114	115	116	117	118	119	120
65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	0.000	0.000	0.000	1505.000	0.000	0.000	0.000	1510.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1520.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	1535.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	1600.000	0.000	0.000	0.000	1600.000	1566.000	1569.000	1551.000	1534.000	1517.000	1500.000
35	0.000	0.000	1583.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	1570.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	1550.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	1545.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	1530.000	0.000	0.000	1560.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	1524.000	0.000	0.000	0.000	1565.000	0.000	1610.000	0.000	0.000	0.000	0.000	0.000
29	0.000	1520.000	0.000	0.000	1546.000	0.000	0.000	1600.000	1605.000	0.000	0.000	0.000
28	0.000	1516.000	0.000	1525.000	0.000	0.000	0.000	0.000	1595.000	0.000	0.000	0.000
27	1530.000	1520.000	1512.000	0.000	0.000	0.000	0.000	0.000	1580.000	0.000	1560.000	0.000
26	1585.000	1517.000	1500.000	1504.000	1504.000	0.000	0.000	0.000	1560.000	0.000	1560.000	0.000
25	0.000	0.000	0.000	0.000	1499.000	0.000	0.000	0.000	1548.000	0.000	1548.000	0.000
24	0.000	0.000	0.000	0.000	0.000	1498.000	0.000	0.000	1536.000	0.000	1536.000	0.000
23	0.000	0.000	0.000	0.000	0.000	1497.000	0.000	1524.000	0.000	1524.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	1496.000	0.000	0.000	1512.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	1500.000	1495.000	0.000	0.000	1500.000	0.000	0.000	0.000
20	1548.000	1536.000	1524.000	1512.000	0.000	1493.000	0.000	0.000	1495.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	1491.000	1490.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	1513.000	1500.000	1495.000	1489.000	1486.000	1483.000	1480.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1477.000
16	1500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	1570.000	1565.000	1555.000	1534.000	1528.000	1517.000	1503.000	1501.000	0.000	0.000	0.000
14	0.000	0.000	0.000	1560.000	0.000	0.000	0.000	0.000	0.000	1495.000	1490.000	0.000
13	0.000	0.000	1570.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1480.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1510.000	0.000
11	0.000	1595.000	0.000	0.000	1560.000	0.000	0.000	0.000	0.000	1535.000	0.000	0.000
10	0.000	1575.000	0.000	0.000	0.000	1550.000	1546.000	0.000	1544.000	0.000	0.000	0.000
9	0.000	1565.000	1575.000	0.000	0.000	0.000	0.000	1546.000	0.000	0.000	0.000	0.000
8	1551.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE F.1F. Interaquifer Transfer (ft^3/day)

INTERAQUIFER TRANS. (CFD)

	1	2	3	4	5	6	7	8	9	10	11	12
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
54	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-6093.
52	0.	0.	0.	0.	0.	0.	0.	-27630.	0.	-12651.	0.	-2340.
51	0.	0.	0.	0.	0.	-12121.	0.	0.	-11264.	0.	0.	-18395.
50	0.	0.	0.	0.	0.	0.	-9351.	-8775.	-10426.	-16566.	-29333.	0.
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-17120.	-33850.
48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	-46622.	-35760.	0.	0.	-43076.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	-28863.	-24881.	-31718.	0.	0.	-45902.	0.
44	0.	0.	0.	0.	0.	0.	0.	-16443.	-31960.	-36544.	-32186.	0.
43	0.	0.	0.	0.	0.	-29215.	-22420.	0.	0.	0.	-33170.	-54976.
42	0.	0.	0.	0.	0.	-50451.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	-45019.	-35120.	-57837.
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	-13879.	0.	0.
39	0.	0.	0.	0.	0.	-42261.	0.	0.	-60850.	0.	0.	0.
38	0.	0.	0.	0.	0.	-50003.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1F. (contd)

INTERAQUIFER TRANS. (CFD)

	13	14	15	16	17	18	19	20	21	22	23	24
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
54	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	-31640.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	-24405.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	-30266.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	-75730.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1F. (contd)

INTERAQUIFER TRANS. (CFD)

	25	26	27	28	29	30	31	32	33	34	35	36
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	0.	0.	0.	0.	0.	0.	0.	-33901.	-50926.	-50070.	-29819.	10949.
62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-55041.
61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	-91530.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	-75003.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	-71315.	0.	0.	0.	0.
56	0.	0.	0.	0.	0.	0.	0.	-67798.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.	-116736.	-79153.	-69270.	0.	0.	0.	0.
54	0.	0.	0.	0.	0.	0.	0.	0.	-61397.	0.	0.	0.
53	0.	0.	0.	0.	0.	0.	0.	0.	0.	-41054.	0.	0.
52	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-27718.	0.
51	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-18100.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-23240.	-51313.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	30215.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1F. (contd)

INTERAQUIFER TRANS. (CFD)

	37	38	39	40	41	42	43	44	45	46	47	48
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	-10665.	28341.	0.	125966.	0.	0.	0.	0.	0.	0.	0.	0.
61	0.	0.	-20629.	5933.	51087.	66509.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
54	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	-9602.	-24463.	-12105.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	-24696.	-9259.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	0.	0.	-18956.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	-17789.	-5987.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	-18877.	-2297.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	-96.	7813.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	11525.	86447.	-29271.	-18686.	4961.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.	-16817.	-33740.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	-30332.	-34763.	-47419.	-56643.	-71404.	-69244.
30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	6668.	-1813.	-5789.	-7610.	0.
27	0.	0.	0.	0.	0.	0.	-5277.	0.	0.	0.	0.	-18484.
26	0.	0.	0.	0.	35419.	31396.	28616.	0.	0.	0.	0.	-53191.
25	0.	0.	0.	0.	0.	17317.	0.	0.	0.	0.	-58094.	0.
24	0.	0.	0.	0.	11197.	0.	0.	0.	0.	-26085.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.	0.	-1857.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	21723.	0.	0.	0.	0.
21	0.	102428.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	55689.	0.	0.	0.	0.	0.	0.	0.	-55786.	0.	0.
19	47441.	44524.	99893.	0.	90946.	7772.	-63787.	-117967.	-101953.	-48896.	-15653.	-59976.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	129569.	0.	0.	0.	0.	0.	0.	0.
14	-42104.	-4815.	34348.	85927.	0.	0.	0.	0.	0.	-36303.	0.	0.
13	26641.	51202.	0.	0.	0.	0.	0.	0.	0.	-68724.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-51799.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-47446.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-37772.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-63137.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-61115.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-36755.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1F. (contd)

INTERAQUIFER TRANS. (CFD)

	49	50	51	52	53	54	55	56	57	58	59	60
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
54	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	-45249.	0.	0.	0.	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	0.	0.	-20307.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.	0.	-67917.	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	0.	30750.	0.	0.	0.	12324.	6302.	41644.	0.	0.	0.	0.
35	0.	0.	-19700.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	-33922.	0.	0.	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	-46446.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	-71009.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	0.	-89796.	0.	0.	35390.	0.	0.	0.	0.	0.	0.	0.
30	-80668.	0.	0.	0.	-6027.	0.	109233.	0.	0.	0.	0.	0.
29	0.	-71303.	0.	0.	-50987.	0.	0.	100002.	169240.	0.	0.	0.
28	0.	-53395.	0.	-92341.	0.	0.	0.	0.	127600.	0.	0.	0.
27	-18570.	-21739.	-67379.	0.	0.	0.	0.	0.	80020.	0.	76622.	0.
26	-62661.	-40533.	-60457.	-90015.	-100663.	0.	0.	0.	17265.	0.	5720.	0.
25	0.	0.	0.	0.	-113001.	0.	0.	0.	-2726.	0.	-14997.	0.
24	0.	0.	0.	0.	0.	-119730.	0.	0.	-26025.	0.	-39979.	0.
23	0.	0.	0.	0.	0.	-79765.	0.	-35731.	0.	-62939.	0.	0.
22	0.	0.	0.	0.	0.	-50700.	0.	0.	-62052.	0.	0.	0.
21	0.	0.	0.	0.	-57072.	-43400.	0.	0.	-59953.	0.	0.	0.
20	-45514.	-69599.	-72005.	-63560.	0.	-51907.	0.	0.	-43210.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	-41434.	-35093.	0.	0.	0.	0.
18	0.	0.	0.	0.	-54001.	-50177.	-34287.	-39436.	-44733.	-55416.	-35190.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	13390.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	-32776.	-14969.	-17472.	-47600.	-49011.	-54130.	-73003.	-65114.	0.	0.	0.
14	0.	0.	0.	-44992.	0.	0.	0.	0.	0.	-101441.	-34703.	0.
13	0.	0.	-62657.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	12363.	0.	0.	-79011.	0.	0.	0.	0.	-46977.	0.	0.
10	0.	-36234.	0.	0.	0.	-60492.	-74631.	0.	-54930.	0.	0.	0.
9	0.	-44747.	-16411.	0.	0.	0.	0.	-97929.	0.	0.	0.	0.
8	-70544.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1G. Transmissivity Distribution for East Texas Oil Field Discharge Case (gallons/day - ft)

TRANSMISSIVITY GAL/DAY-FT

	1	2	3	4	5	6	7	8	9	10	11	12
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2367.
54	0.	0.	0.	0.	0.	0.	0.	0.	2986.	2978.	2763.	2787.
53	0.	0.	0.	0.	0.	0.	1953.	2280.	2031.	1984.	2258.	2954.
52	0.	0.	0.	0.	0.	656.	944.	1556.	1654.	2921.	3935.	4737.
51	0.	0.	0.	0.	1630.	906.	946.	2239.	3616.	6280.	4955.	10206.
50	0.	0.	0.	0.	2825.	2509.	3417.	7065.	11565.	19852.	21953.	22560.
49	0.	0.	0.	4006.	4492.	5556.	9675.	17047.	19465.	22819.	23248.	25471.
48	0.	0.	0.	3603.	4972.	6626.	9815.	16542.	13709.	18296.	14241.	20472.
47	0.	0.	8930.	2660.	3502.	5695.	7438.	10182.	7559.	6567.	7864.	12654.
46	0.	0.	3046.	1934.	2618.	5536.	7063.	9983.	9707.	6892.	6535.	10180.
45	0.	0.	2793.	1640.	2342.	5491.	9603.	16631.	21474.	19270.	12673.	13546.
44	0.	0.	2418.	1080.	1989.	4086.	6697.	18640.	23686.	24977.	22636.	22973.
43	0.	0.	0.	2179.	1992.	2073.	3735.	9839.	15683.	20552.	22460.	25496.
42	0.	0.	0.	0.	2227.	2069.	2266.	5006.	7362.	9491.	12536.	20300.
41	0.	0.	0.	0.	0.	2639.	2478.	6366.	5230.	5467.	6707.	14992.
40	0.	0.	0.	0.	0.	2639.	2470.	4342.	5024.	5117.	6061.	13696.
39	0.	0.	0.	0.	2305.	2664.	2131.	3073.	4584.	4567.	5010.	9724.
38	0.	0.	0.	3092.	2449.	1953.	2033.	2873.	3096.	3010.	6733.	9950.
37	0.	0.	0.	3538.	3258.	3083.	3189.	6732.	6845.	6632.	7107.	8603.
36	0.	0.	0.	0.	0.	0.	0.	0.	0.	12985.	10286.	9351.
35	0.	0.	0.	0.	0.	0.	0.	13783.	14315.	12938.	11629.	12875.
34	0.	0.	0.	0.	0.	0.	9351.	13354.	16832.	9125.	8446.	11934.
33	0.	0.	0.	0.	0.	4666.	5966.	7514.	9232.	10795.	10458.	13359.
32	0.	0.	0.	0.	5936.	5461.	6783.	7908.	8941.	11358.	13463.	17631.
31	0.	0.	0.	17125.	12889.	12497.	13646.	15109.	15693.	16443.	20299.	27635.
30	0.	0.	0.	26681.	30591.	31404.	33116.	35283.	37034.	37201.	42577.	49163.
29	0.	0.	0.	0.	36721.	36366.	42636.	45287.	47037.	47579.	52456.	56032.
28	0.	0.	0.	0.	0.	38347.	41126.	46516.	49351.	44604.	54018.	50851.
27	0.	0.	0.	0.	0.	0.	43349.	49462.	53352.	51851.	51831.	50510.
26	0.	0.	0.	0.	0.	0.	46610.	54319.	57687.	58354.	60021.	57687.
25	0.	0.	0.	0.	0.	0.	51351.	54853.	57167.	60186.	61600.	62355.
24	0.	0.	0.	0.	0.	0.	0.	52685.	55519.	62188.	62609.	63522.
23	0.	0.	0.	0.	0.	0.	0.	0.	59354.	65189.	67190.	67457.
22	0.	0.	0.	0.	0.	0.	0.	0.	0.	65949.	69691.	73192.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	68617.	72136.	74026.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	73433.	74637.	70525.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	77212.	75137.	66357.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	76990.	71136.	61821.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	77286.	70003.	60186.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	79865.	74526.	64523.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	79695.	77527.	69850.
14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	79650.	72692.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	84474.	76582.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	85808.	79750.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	81762.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	73537.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1G. (contd)

TRANSMISSIVITY
GAL/DAY-FT

	13	14	15	16	17	18	19	20	21	22	23	24
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4530.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5154.	5347.
56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5079.	5005.
55	3296.	3044.	7434.	0.	0.	0.	0.	0.	0.	4505.	4100.	4109.
54	4914.	5727.	9760.	9900.	0.	0.	0.	0.	4309.	4031.	3052.	3711.
53	5506.	6516.	11032.	10110.	9900.	0.	0.	4221.	4550.	4467.	3795.	4633.
52	6417.	6930.	11069.	11564.	10540.	8916.	9067.	4070.	7163.	8950.	7992.	7706.
51	10605.	10733.	10246.	10246.	10171.	15977.	9955.	7040.	9143.	11256.	10036.	9600.
50	22612.	22612.	30441.	39007.	41259.	30373.	29603.	15773.	15274.	15769.	14629.	14510.
49	26363.	26363.	45101.	47736.	56019.	56553.	41325.	26030.	26075.	25240.	24468.	23143.
48	25725.	26676.	49633.	47034.	55581.	60062.	63565.	53133.	57259.	57373.	54375.	44974.
47	22973.	26339.	45510.	49317.	55036.	60074.	60413.	60340.	50145.	53149.	65367.	64034.
46	22299.	26596.	20510.	33349.	36013.	41101.	49104.	54533.	61370.	55909.	54705.	45098.
45	22973.	26673.	29010.	33912.	30347.	43015.	49517.	55053.	60521.	54120.	51160.	42933.
44	26336.	20510.	30344.	33045.	36013.	40601.	40104.	54352.	56120.	51160.	40234.	41264.
43	20343.	31044.	33512.	32345.	33178.	30513.	47517.	52105.	46016.	39601.	38513.	35346.
42	20167.	32011.	35346.	36346.	39014.	41049.	47050.	47350.	38513.	32511.	32170.	20677.
41	30793.	35043.	37600.	41401.	40104.	50510.	52510.	46350.	35046.	29677.	26676.	22341.
40	32511.	40320.	39047.	43602.	51510.	55019.	53052.	46603.	39014.	32670.	25042.	22000.
39	25700.	40356.	41609.	42064.	51605.	55186.	47603.	30100.	32345.	29044.	27009.	27009.
38	13959.	30048.	30496.	39730.	40661.	52105.	39047.	31511.	31511.	36346.	36600.	34512.
37	9530.	15551.	26109.	30979.	44006.	49591.	39306.	31511.	37513.	42101.	36179.	30344.
36	9351.	11222.	12501.	17640.	39453.	40507.	36292.	36046.	46350.	49051.	43015.	36179.
35	11010.	12730.	11761.	20796.	44224.	51430.	39014.	40514.	40050.	46603.	30600.	34679.
34	25235.	30600.	26256.	31003.	40006.	40200.	30346.	39007.	45102.	40347.	35512.	34512.
33	27061.	35044.	39164.	46654.	55551.	44949.	30345.	41040.	44015.	39047.	37513.	34512.
32	31157.	34616.	40004.	50700.	50520.	45349.	35679.	42340.	40101.	35012.	31670.	29177.
31	40660.	41494.	43015.	51351.	55521.	52910.	42340.	45016.	30513.	32345.	29677.	29010.
30	56105.	54106.	47016.	43602.	49517.	52052.	40104.	50010.	42340.	36600.	35346.	35012.
29	61100.	60600.	51010.	39601.	41101.	52105.	56520.	57107.	49517.	42515.	39347.	30100.
28	53519.	57520.	56353.	47603.	41014.	40050.	60521.	62022.	52052.	40517.	44602.	43515.
27	49104.	50051.	57052.	54053.	49351.	40017.	56520.	56607.	44102.	41014.	44015.	47050.
26	52352.	50510.	51351.	53605.	55519.	54106.	57107.	55021.	40604.	42101.	46350.	47016.
25	55521.	57353.	56106.	51510.	53052.	57353.	56607.	50520.	54053.	47016.	51010.	47517.
24	63109.	62609.	61600.	52105.	50051.	56106.	50607.	60521.	61021.	52352.	54019.	48517.
23	65109.	64056.	64109.	53052.	47604.	53352.	60600.	63356.	63356.	54019.	55019.	51010.
22	68191.	65356.	63056.	57107.	53352.	53052.	62022.	67023.	65023.	54519.	56520.	56242.
21	69029.	67524.	62100.	50520.	60521.	63356.	60524.	70350.	66357.	55019.	57353.	50740.
20	65023.	69524.	60055.	55519.	60100.	69691.	70529.	65523.	65056.	57353.	60521.	61416.
19	59600.	60024.	60100.	52010.	56353.	67023.	65670.	60021.	60024.	61021.	65523.	66190.
18	55519.	64056.	60055.	55053.	60354.	70025.	71025.	64022.	66057.	57520.	65670.	70191.
17	56607.	66357.	65023.	61021.	61021.	66670.	75193.	75693.	80195.	70027.	81062.	79695.
16	62609.	68357.	61355.	52010.	52010.	60055.	75360.	80520.	84063.	85030.	81362.	73526.
15	67190.	66523.	57054.	49104.	53105.	61055.	73492.	77061.	79520.	80026.	70361.	60302.
14	66670.	63056.	55521.	54352.	57353.	62100.	60024.	71350.	72025.	73360.	80750.	67670.
13	66523.	66670.	60024.	64523.	63056.	65023.	66357.	71192.	70691.	74637.	76414.	52074.
12	69350.	71192.	74359.	71350.	73026.	71350.	71692.	70061.	75193.	79750.	79472.	50510.
11	76516.	76160.	77494.	75560.	84496.	77461.	73659.	80495.	77260.	85030.	87664.	50332.
10	60391.	67992.	70300.	60557.	70327.	60291.	60309.	71625.	71125.	76449.	74370.	41367.
9	67757.	66083.	60060.	70247.	70070.	69750.	69624.	77494.	77094.	70472.	71313.	35494.
8	0.	55642.	50101.	60021.	89072.	82029.	82562.	85096.	81226.	76516.	65317.	32623.
7	0.	0.	33790.	42356.	60602.	86030.	85763.	84696.	82779.	76537.	59190.	29211.
6	0.	0.	29600.	29633.	47039.	69002.	77930.	75342.	78179.	71930.	51560.	29409.
5	0.	0.	29433.	27759.	33637.	40926.	67200.	59326.	63509.	64714.	0.	30705.
4	0.	0.	0.	20139.	30036.	42065.	66033.	61650.	0.	0.	0.	0.
3	0.	0.	0.	20109.	32215.	43035.	62199.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	34545.	0.	0.	0.	0.	0.	0.	0.
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1G. (contd)

TRANSMISSIVITY GAL/DAY-FT

	25	26	27	28	29	30	31	32	33	34	35	36
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	16006.	16006.
64	0.	0.	0.	0.	0.	0.	0.	0.	12740.	17262.	19656.	19999.
63	0.	0.	0.	0.	0.	0.	0.	5130.	6653.	6758.	9588.	10959.
62	0.	0.	0.	3898.	3816.	3723.	3222.	4515.	5134.	5467.	5467.	5940.
61	0.	0.	5071.	5366.	5710.	5374.	4156.	5035.	5065.	5130.	5130.	5130.
60	0.	4840.	5629.	6418.	6600.	6461.	6398.	6334.	6164.	8169.	5130.	5130.
59	3493.	5042.	6426.	6938.	6902.	7294.	9966.	15479.	11666.	6947.	5306.	5130.
58	7011.	8034.	10561.	10733.	10733.	11046.	14178.	21949.	20181.	13156.	7417.	5306.
57	13167.	10360.	21990.	22612.	22612.	22612.	23237.	26051.	25386.	20803.	13136.	6669.
56	13052.	10356.	22794.	25471.	26027.	26363.	26363.	26676.	26509.	25339.	19657.	9726.
55	8712.	9580.	13718.	19740.	22727.	26803.	26509.	26176.	24842.	24564.	22665.	13663.
54	7392.	5524.	6642.	9364.	13627.	22431.	24339.	23175.	19840.	19840.	22174.	18549.
53	7597.	5166.	5574.	6701.	11280.	18686.	19824.	19366.	16839.	16586.	17840.	17339.
52	8789.	5771.	6541.	7055.	12097.	15723.	19622.	20066.	17339.	16172.	16339.	16339.
51	10411.	6873.	6926.	8497.	14451.	18372.	22700.	19978.	16839.	16339.	17846.	18006.
50	14949.	8288.	8535.	11674.	16606.	18362.	18269.	16971.	17830.	18340.	22841.	24175.
49	21045.	10475.	11145.	14288.	15871.	15303.	13428.	16910.	22736.	22006.	26176.	29677.
48	35956.	16841.	16523.	16728.	19207.	13542.	12184.	18444.	26865.	28177.	27510.	29844.
47	46786.	21976.	21165.	18174.	18746.	18629.	12318.	18651.	36661.	33082.	36177.	29344.
46	35980.	30566.	26201.	19698.	15655.	14919.	14969.	18365.	27657.	33178.	33345.	30677.
45	35674.	34035.	28522.	20163.	16339.	15900.	16233.	17997.	23675.	29510.	33678.	34679.
44	35763.	35946.	27510.	26174.	17673.	16673.	17673.	18340.	20007.	25676.	31344.	36046.
43	33345.	31011.	21674.	18340.	21007.	19173.	21174.	22174.	20507.	25009.	28843.	35012.
42	28010.	24842.	18673.	18340.	22008.	18566.	19173.	21841.	23008.	26643.	27510.	31844.
41	23342.	20174.	18506.	19340.	21341.	17673.	17006.	20841.	20177.	32174.	28843.	29510.
40	23342.	21341.	22675.	21841.	20340.	16839.	16339.	18566.	26009.	31344.	30011.	29344.
39	26176.	23675.	24342.	22174.	20340.	17846.	17673.	17339.	21674.	26676.	31344.	33178.
38	28010.	23008.	23008.	21508.	19507.	19840.	21674.	21341.	23342.	22008.	26676.	33012.
37	26009.	22008.	19340.	18340.	20174.	24842.	26676.	27843.	27676.	19189.	28841.	28510.
36	29344.	21674.	17173.	18173.	24675.	31511.	31511.	32011.	27510.	19340.	17169.	27343.
35	32011.	24842.	18340.	18673.	26843.	36813.	35846.	34345.	27343.	18867.	25509.	29510.
34	32845.	26509.	20507.	28674.	28843.	39847.	38180.	35871.	28677.	28677.	32678.	32011.
33	30177.	27176.	26676.	27343.	32511.	41515.	37346.	27119.	29010.	33345.	34679.	30177.
32	27510.	28510.	33012.	35346.	39014.	43515.	37180.	29344.	29177.	34679.	33678.	28677.
31	28677.	39010.	33678.	38513.	44015.	45349.	37513.	29510.	30844.	35346.	31844.	27510.
30	33845.	30511.	31011.	37666.	45683.	47517.	39347.	31678.	36680.	39681.	33678.	27333.
29	38180.	34179.	31011.	37680.	47050.	53519.	44516.	34679.	40514.	36347.	29667.	28443.
28	42082.	36680.	31511.	36347.	50051.	59021.	47517.	36013.	43015.	37010.	25137.	12703.
27	44516.	36348.	33012.	41348.	55166.	63022.	49017.	36686.	46516.	36170.	21437.	9369.
26	40014.	34512.	36840.	46516.	59354.	65698.	51351.	42548.	47513.	30809.	13498.	6549.
25	40014.	36013.	42237.	50295.	60632.	62411.	49795.	43682.	40014.	29907.	11689.	7897.
24	42348.	40514.	45304.	51564.	57669.	52402.	43044.	43497.	40194.	30494.	13564.	8545.
23	43182.	24948.	26337.	26438.	30005.	25999.	25053.	35064.	38750.	28402.	11944.	11584.
22	44041.	24666.	16796.	16155.	10020.	12345.	11616.	16840.	17437.	10567.	8596.	10960.
21	47662.	22116.	13425.	13651.	10497.	11319.	10438.	11347.	10261.	8655.	9637.	11557.
20	49251.	27998.	15566.	14106.	13659.	13274.	12312.	11959.	10901.	11030.	12184.	12762.
19	62301.	51011.	25413.	10374.	13017.	13723.	12761.	12236.	12344.	12633.	13376.	13115.
18	73656.	69082.	39334.	17062.	13114.	14556.	13683.	13274.	12633.	12057.	13595.	12035.
17	79028.	79198.	61902.	20420.	16569.	15999.	14332.	12184.	11543.	12697.	12741.	11330.
16	71890.	75326.	67994.	31204.	17373.	16000.	14011.	11959.	12666.	13049.	11607.	10164.
15	63967.	63967.	60484.	29764.	17475.	15583.	14300.	13434.	13082.	8686.	7362.	7160.
14	55186.	41486.	35841.	20018.	15945.	14717.	12625.	11895.	11222.	7631.	7494.	8416.
13	38791.	31825.	25943.	17081.	15278.	14396.	13617.	12569.	12478.	6975.	9471.	10593.
12	35068.	30703.	24186.	17537.	16111.	15999.	15607.	15775.	15556.	10616.	10571.	10930.
11	36945.	27985.	20161.	16043.	16249.	15666.	15467.	15666.	15659.	10604.	10742.	10746.
10	24073.	18681.	14408.	14223.	13889.	13424.	13627.	14172.	14377.	10023.	9644.	9999.
9	19431.	19561.	13595.	14210.	13660.	16338.	15100.	16173.	16225.	11071.	11236.	13419.
8	18343.	15261.	14159.	14851.	15210.	17302.	19384.	24431.	25119.	16066.	16260.	22056.
7	17659.	16276.	16532.	16943.	19361.	26345.	32556.	40662.	45362.	29906.	27180.	0.
6	23874.	23843.	26008.	27052.	32240.	41226.	64753.	0.	0.	0.	0.	0.
5	41125.	45152.	46936.	47852.	46192.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1G. (contd)

TRANSMISSIVITY

GAL/DAY-FT

	37	38	39	40	41	42	43	44	45	46	47	48
65	9120.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	19123.	19867.	19398.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	15430.	20123.	20993.	20932.	0.	0.	0.	0.	0.	0.	0.	0.
62	8865.	13880.	16341.	17403.	13760.	11886.	0.	0.	0.	0.	0.	0.
61	9611.	7134.	8362.	10885.	11533.	11019.	9834.	8806.	0.	0.	0.	0.
60	5130.	9250.	5064.	5037.	9417.	9477.	5389.	7086.	4990.	0.	0.	0.
59	5130.	5890.	4481.	3391.	3312.	3280.	3397.	4641.	4036.	5191.	0.	0.
58	5130.	5882.	4425.	3431.	3142.	3970.	3110.	3591.	3149.	4569.	5230.	0.
57	5893.	4921.	3751.	3270.	3367.	3142.	3110.	3527.	2820.	3379.	3956.	3201.
56	5354.	4136.	3655.	3751.	4072.	3399.	3206.	3783.	2866.	2992.	2046.	2456.
55	7186.	5156.	4601.	4713.	4985.	3527.	3463.	4425.	2943.	2693.	2185.	1759.
54	11662.	7710.	5346.	4051.	4361.	3463.	3559.	4585.	2674.	2232.	1878.	1569.
53	14738.	12096.	7939.	5919.	3870.	3270.	3783.	4393.	2251.	1924.	1881.	1441.
52	15094.	15432.	13614.	11260.	6079.	4539.	5152.	4595.	2099.	1887.	1985.	1935.
51	16506.	16172.	15884.	14829.	11286.	11400.	11100.	6935.	2499.	2400.	2752.	2333.
50	20174.	18986.	17840.	10673.	24133.	28340.	25326.	13374.	5660.	5727.	6149.	4359.
49	28810.	26009.	22675.	24909.	31340.	32175.	25871.	18304.	10503.	12450.	12370.	8259.
48	33012.	31644.	26909.	30344.	32178.	26676.	20174.	18906.	13785.	15405.	15159.	11785.
47	33345.	34345.	29177.	39677.	26509.	20174.	17506.	19507.	14505.	14805.	14245.	11292.
46	30677.	33345.	28343.	25909.	20340.	19173.	20841.	22000.	13605.	11994.	10744.	8060.
45	31178.	33012.	26043.	28674.	20474.	25092.	20518.	24175.	12304.	10904.	9612.	7469.
44	33678.	33512.	27176.	22508.	26343.	31511.	33012.	20343.	14305.	12609.	10212.	7489.
43	36046.	35679.	30677.	28510.	30177.	29177.	25676.	21174.	11194.	10694.	9563.	7030.
42	38047.	48014.	37100.	33678.	29477.	25509.	19040.	16039.	9703.	9648.	9349.	7002.
41	36946.	43182.	41515.	33012.	28477.	24599.	10340.	16172.	9413.	8803.	8034.	5040.
40	32670.	40914.	37013.	30511.	26676.	23175.	10006.	16022.	8210.	6475.	5390.	3780.
39	32511.	35679.	32011.	27510.	25175.	21590.	10967.	16483.	10613.	6036.	5364.	3976.
38	35346.	36346.	32345.	20910.	26343.	24842.	24172.	20594.	10096.	5018.	3783.	3206.
37	39012.	35179.	29844.	25742.	24509.	24675.	29079.	22774.	12249.	4995.	3206.	3070.
36	34345.	33345.	26676.	20174.	10506.	20174.	24842.	25467.	19257.	9048.	4953.	3280.
35	32178.	29344.	23675.	10173.	17086.	19840.	24842.	26343.	23566.	14133.	7489.	5790.
34	29510.	25642.	21500.	10840.	19674.	23341.	26176.	26509.	24509.	17734.	13950.	13170.
33	27343.	26343.	25009.	24509.	24042.	26176.	26676.	24509.	24042.	19376.	16134.	15634.
32	26843.	26676.	26509.	26909.	26509.	26676.	26900.	26339.	25444.	20445.	15751.	14973.
31	26339.	26339.	26339.	26339.	26371.	26019.	24255.	22663.	21694.	16899.	12856.	13516.
30	23140.	22279.	22299.	22376.	22500.	20993.	15967.	12745.	15347.	17856.	17815.	16543.
29	12936.	9843.	9635.	10784.	11878.	10773.	8112.	6477.	7759.	9271.	9499.	9672.
28	6477.	5595.	6236.	7862.	8978.	10781.	10858.	9339.	9667.	9207.	7864.	6054.
27	5627.	5867.	7994.	12912.	14730.	20887.	22059.	22249.	22822.	19740.	13039.	8097.
26	6092.	7301.	12411.	22477.	24483.	25929.	26339.	26339.	26339.	25407.	22542.	19699.
25	7422.	7631.	10797.	20748.	25390.	26339.	26339.	26676.	26676.	29344.	30340.	44504.
24	9057.	9797.	7838.	12276.	19334.	21963.	23309.	26803.	29344.	40014.	56028.	64186.
23	19813.	22217.	12421.	7992.	9597.	10981.	16240.	25607.	39677.	56028.	66698.	68635.
22	22562.	33252.	19723.	10835.	9753.	12905.	21011.	33669.	54686.	65968.	69358.	68635.
21	20563.	33937.	24160.	10786.	10867.	21315.	28861.	41348.	59035.	62836.	67837.	68181.
20	15369.	24783.	29281.	36127.	36985.	32138.	40347.	52024.	51949.	43529.	52462.	68296.
19	13942.	22873.	37495.	46577.	40878.	45816.	53157.	50487.	31455.	19941.	24923.	37597.
18	12773.	20897.	36987.	50976.	60146.	59807.	51873.	33981.	10190.	14205.	16634.	27247.
17	10385.	13554.	25862.	43384.	53968.	47899.	31102.	10190.	14205.	14749.	15262.	17418.
16	10180.	11283.	14572.	21190.	24784.	23383.	16413.	14196.	14749.	15268.	15390.	15390.
15	7945.	8820.	9388.	10281.	10892.	11872.	10481.	10526.	10786.	10773.	10773.	10896.
14	9337.	9785.	10257.	10504.	10786.	10751.	10751.	10751.	10773.	10773.	11143.	12468.
13	11820.	10720.	10720.	10751.	10773.	10773.	10773.	10773.	10773.	11143.	14069.	19851.
12	10975.	13795.	10773.	10773.	10773.	10773.	10773.	10773.	10896.	13001.	26921.	36076.
11	10504.	10522.	10522.	10522.	10504.	10504.	10504.	10504.	11211.	10306.	40195.	50041.
10	9636.	9439.	9421.	9885.	8992.	8986.	8800.	8808.	9453.	16302.	37573.	45085.
9	13914.	13453.	12612.	10871.	9013.	8034.	8672.	8610.	9184.	14040.	32373.	42652.
8	24636.	23587.	20891.	14906.	10770.	9373.	8970.	8690.	8610.	10315.	20120.	34294.
7	0.	0.	0.	16958.	14543.	10894.	9790.	9277.	8990.	8717.	11671.	23036.
6	0.	0.	0.	0.	16956.	15460.	13790.	13203.	12861.	9536.	9301.	16393.
5	0.	0.	0.	0.	0.	22150.	23215.	22037.	19470.	13697.	9028.	11401.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	15069.	12947.	10762.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	14963.	13053.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	19012.
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE F.1G. (contd)

TRANSMISSIVITY GAL/DAY-FT

	49	50	51	52	53	54	55	56	57	58	59	60
65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	2596.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55	2338.	3478.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
54	2219.	4079.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
53	2661.	4958.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	2888.	4652.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	2363.	3814.	3594.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	2672.	2571.	4019.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	5134.	4102.	4644.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	9094.	6656.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	6526.	6153.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	6673.	5678.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	6007.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	5939.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	6130.	4367.	3666.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	5407.	3273.	3141.	4209.	5355.	0.	0.	0.	0.	0.	0.	0.
41	3505.	2442.	2648.	3790.	6164.	7712.	7140.	7087.	0.	0.	0.	0.
40	2770.	2443.	2397.	3848.	7495.	8873.	7885.	7715.	5789.	4378.	4184.	0.
39	3495.	3504.	4546.	8330.	13793.	14218.	11338.	10627.	6928.	4947.	5473.	9120.
38	3145.	3998.	7894.	12530.	15545.	15435.	12520.	8378.	4696.	4348.	5430.	9120.
37	3280.	5378.	11642.	15363.	16086.	15839.	13934.	8993.	5982.	6272.	6720.	0.
36	3482.	5380.	11395.	15400.	16086.	16866.	15565.	12922.	11128.	0.	0.	0.
35	5380.	7486.	7522.	13784.	15884.	16086.	16865.	17586.	10899.	0.	0.	0.
34	11562.	7328.	6512.	13380.	15970.	16586.	28874.	14588.	47396.	55551.	0.	0.
33	15364.	11594.	8295.	14082.	17684.	22341.	36346.	54819.	64684.	61898.	58169.	0.
32	16280.	13258.	11889.	17654.	25474.	38013.	55519.	66523.	69358.	67493.	59366.	39520.
31	15756.	16025.	19997.	26769.	39514.	55853.	66698.	69358.	69524.	69824.	59889.	16886.
30	14171.	17428.	26416.	39887.	56028.	66698.	69358.	69691.	71358.	72825.	62689.	16886.
29	7620.	12637.	24433.	53218.	66698.	69358.	69524.	71358.	76827.	77827.	65523.	16886.
28	5761.	9588.	23737.	50945.	66162.	69358.	70825.	73826.	76827.	78694.	66823.	16886.
27	7907.	10926.	17018.	33901.	53874.	66718.	72692.	76694.	79528.	79828.	66823.	16886.
26	14958.	13283.	13644.	16862.	31765.	55345.	73317.	79361.	80828.	79828.	65773.	16886.
25	33155.	10562.	13949.	13795.	19026.	37616.	68118.	76694.	80828.	78778.	65764.	23939.
24	52052.	26018.	17249.	14434.	15278.	31968.	39822.	62850.	76517.	77944.	64661.	23939.
23	59243.	32099.	21156.	16477.	15815.	16095.	22251.	39469.	59572.	66378.	36168.	23939.
22	60299.	33894.	22255.	17131.	15566.	15398.	15919.	20007.	28439.	33217.	30887.	23939.
21	61901.	30873.	19946.	15919.	15398.	15398.	15398.	15566.	16753.	17923.	18030.	23939.
20	65327.	42528.	21947.	15919.	15398.	15398.	15398.	15398.	15398.	15566.	15584.	0.
19	64875.	59139.	32684.	18348.	15566.	15398.	15398.	15398.	15398.	15398.	15398.	0.
18	54955.	57729.	39878.	21778.	15919.	15398.	15398.	15398.	15398.	15398.	15398.	0.
17	27510.	35108.	40960.	28760.	18163.	15566.	15398.	15398.	15398.	15398.	15398.	0.
16	16408.	18396.	25418.	22348.	17153.	15566.	15398.	15398.	15398.	15398.	15048.	0.
15	10773.	10773.	11727.	11884.	11020.	10773.	10773.	10773.	10773.	10459.	9337.	0.
14	11020.	10773.	10773.	10896.	10773.	10773.	10773.	10773.	10838.	9860.	7990.	0.
13	13881.	10896.	10773.	10773.	10773.	10773.	10773.	10773.	11061.	11910.	0.	0.
12	24576.	12894.	10773.	10773.	10773.	10773.	10773.	10896.	11761.	13461.	0.	0.
11	39207.	10705.	11211.	10504.	10504.	10504.	10504.	10504.	10874.	12748.	0.	0.
10	39146.	21472.	11158.	8888.	8888.	8888.	8888.	8888.	6978.	0.	0.	0.
9	43119.	33504.	19938.	10315.	8618.	8618.	8618.	8618.	8618.	0.	0.	0.
8	43316.	42553.	31086.	14640.	9164.	8618.	8618.	8618.	8618.	0.	0.	0.
7	38917.	42858.	32696.	15837.	9164.	8618.	8618.	8618.	8618.	0.	0.	0.
6	32992.	37616.	23486.	11583.	8717.	8618.	8618.	8618.	0.	0.	0.	0.
5	22426.	20917.	17881.	10172.	8717.	8618.	8618.	8618.	0.	0.	0.	0.
4	14140.	17138.	11796.	9184.	8888.	8888.	8618.	0.	0.	0.	0.	0.
3	13856.	13269.	12012.	11716.	11716.	11282.	9157.	0.	0.	0.	0.	0.
2	10567.	10468.	10374.	10374.	10149.	10778.	0.	0.	0.	0.	0.	0.
1	13406.	13406.	13406.	13406.	13406.	13406.	0.	0.	0.	0.	0.	0.

TABLE F.1H. Stress Distribution for East Texas Oil Field Discharge Case (ft^3/day)

STRESS (CFD)

	1	2	3	4	5	6	7	8	9	10	11	12
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3
53	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
52	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
51	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
50	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
49	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	6110.3	6110.3	6110.3
48	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	6110.3	6110.3	6110.3
47	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
46	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
45	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
44	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
43	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
42	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
41	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
40	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
39	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
38	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
37	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.1H. (contd)

	STREAM (CFS)											
	13	14	15	16	17	18	19	20	21	22	23	24
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3
55	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3
54	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3
53	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3
52	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0
51	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
50	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	60000.0	0.0	0.0	0.0	0.0
42	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100000.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100000.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-50000.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.1H. (contd)

STRESS (CFD)

	25	26	27	28	29	30	31	32	33	34	35	36
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	10331.0	10331.0	10331.0	10331.0
62	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	10331.0
61	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	10331.0
60	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	10331.0
59	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	10331.0
58	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	0.0
57	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	0.0	0.0
56	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0
55	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0
54	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0
53	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-18000.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12000.0	-24000.0	-18000.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12000.0	-24000.0	-18000.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12000.0	-18000.0	-18000.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-18000.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.1H. (contd)

STRESS (CFD)

	37	38	39	40	41	42	43	44	45	46	47	48
65	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0
61	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0
60	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0
59	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	-150000.0	-100000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	10331.0	10331.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	10331.0	10331.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	10331.0	10331.0
30	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0
29	-50000.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
28	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
27	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
26	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
25	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
24	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
23	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
22	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
21	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
20	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
19	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
18	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3
15	0.0	0.0	0.0	0.0	10331.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
14	10331.0	10331.0	10331.0	10331.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0
13	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0	10331.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.1H. (contd)

STRESS (CFD)

	49	50	51	52	53	54	55	56	57	58	59	60
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0
39	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0
38	0.0	0.0	0.0	0.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.4	22913.0
37	0.0	0.0	0.0	10331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0
36	0.0	10331.0	10331.0	10331.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0	0.0	0.0
35	0.0	-100000.0	10331.0	10331.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0	0.0	0.0
34	10331.0	10331.0	10331.0	10331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0	0.0
33	10331.0	10331.0	10331.0	10331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0
32	10331.0	10331.0	10331.0	10331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0
31	10331.0	10331.0	10331.0	10331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0
30	10331.0	10331.0	10331.0	10331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0
29	6110.3	6110.3	6110.3	6110.3	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9
28	6110.3	6110.3	6110.3	6110.3	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9
27	6110.3	6110.3	6110.3	6110.3	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9
26	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
25	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
24	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
23	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
22	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
21	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
20	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
19	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
18	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
17	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
16	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
15	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0
14	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0
13	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0
12	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0
11	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0
10	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0
9	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0
8	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0
7	10331.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.11. Stress Distribution for Sabine-Big Cypress Discharge Case (ft^3/day)

STRESS (CFD)

	1	2	3	4	5	6	7	8	9	10	11	12
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3
53	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
52	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
51	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
50	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
49	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	6110.3	6110.3	6110.3
48	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	6110.3	6110.3	6110.3
47	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
46	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
45	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
44	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
43	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
42	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
41	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
40	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
39	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
38	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
37	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.11. (contd)

STRESS (CFD)

	13	14	15	16	17	18	19	20	21	22	23	24
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3
55	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3
54	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3
53	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3
52	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0
51	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0
50	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	50050.0	0.0	0.0	0.0	0.0
42	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-20000.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-100000.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-50000.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.11. (contd)

STRESS (CFD)

	25	26	27	28	29	30	31	32	33	34	35	36
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	10331.0	10331.0	10331.0	10331.0
62	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	10331.0
61	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	10331.0
60	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	10331.0
59	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	10331.0
58	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	10331.0	0.0
57	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0	0.0	0.0
56	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0
55	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0
54	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0	0.0
53	6110.3	6110.3	6110.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.11. (contd)

STRESS (CFD)

	37	38	39	40	41	42	43	44	45	46	47	48
65	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0
61	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0	0.0
60	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0	0.0	0.0	0.0
59	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	10331.0	10331.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	10331.0	10331.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	10331.0	10331.0
30	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	10331.0	10331.0
29	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
28	0.0	0.0	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
27	0.0	0.0	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
26	0.0	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
25	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
24	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
23	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
22	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
21	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
20	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
19	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
18	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6110.3
15	0.0	0.0	0.0	0.0	10331.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
14	10331.0	10331.0	10331.0	10331.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0	10331.0	10331.0
13	10331.0	10331.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0	10331.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0	10331.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0	10331.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0	10331.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10331.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.11. (contd)

	STREAM (CFS)											
	49	50	51	52	53	54	55	56	57	58	59	60
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	18331.0	18331.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0
39	0.0	0.0	0.0	0.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0
38	0.0	0.0	0.0	0.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0
37	0.0	0.0	0.0	18331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0
36	0.0	18331.0	18331.0	18331.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0	0.0	0.0
35	0.0	-108400.0	18331.0	18331.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0	0.0	0.0
34	18331.0	18331.0	18331.0	18331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0	0.0
33	18331.0	18331.0	18331.0	18331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	0.0
32	18331.0	18331.0	18331.0	18331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0
31	18331.0	18331.0	18331.0	18331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0
30	18331.0	18331.0	18331.0	18331.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0	22913.0
29	6110.3	6110.3	6110.3	6110.3	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9
28	6110.3	6110.3	6110.3	6110.3	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9
27	6110.3	6110.3	6110.3	6110.3	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9	7637.9
26	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
25	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
24	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
23	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
22	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
21	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3
20	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
19	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
18	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
17	0.0	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
16	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	6110.3	0.0
15	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0
14	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0
13	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0	0.0
12	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0	0.0
11	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0	0.0
10	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0	0.0	0.0
9	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0	0.0	0.0
8	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	18331.0	0.0	0.0	0.0
7	18331.0	0.0	0.0	0.0	0.0	0.0	18331.0	18331.0	18331.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.11. (contd)

STRESS (CFD)

	61	62	63	64	65	66	67	68	69	70	71	72
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.1I. (contd)

STRESS (CFD)

	73	74	75	76	77	78	79	80	81	82	83	84
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.11. (contd)

STRESS (CFD)

	85	86	87	88	89	90	91	92	93	94	95	96
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.1I. (contd)

STRESS (CFD)

	97	98	99	100	101	102	103	104	105	106	107	108
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE F.1I. (contd)

STRESS (CFD)

	109	110	111	112	113	114	115	116	117	118	119	120
65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TOTAL STRESS GPM= 24412.16

TABLE F.1J. Effective Thickness as Defined by Net-Sand Map

THICKNESS (FT) (+=UNCONF, -=CONF.)

	1	2	3	4	5	6	7	8	9	10	11	12
65	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
64	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
63	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
62	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
61	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
60	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
59	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
58	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
57	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
56	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
55	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-150.000
54	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000
53	25.000	25.000	25.000	25.000	25.000	25.000	-150.000	-250.000	-250.000	-250.000	-250.000	-250.000
52	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
51	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
50	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
49	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
48	25.000	25.000	25.000	-250.000	-250.000	-250.000	-150.000	-250.000	-250.000	-250.000	-250.000	-250.000
47	25.000	25.000	-250.000	-250.000	-150.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
46	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
45	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
44	25.000	25.000	-150.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
43	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
42	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
41	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
40	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-350.000
39	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-350.000
38	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-350.000
37	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
36	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000
35	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-350.000	-350.000	-250.000	-250.000	-250.000
34	25.000	25.000	25.000	25.000	25.000	25.000	-250.000	-350.000	-450.000	-350.000	-250.000	-250.000
33	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-350.000	-450.000	-450.000	-250.000
32	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000	-450.000	-550.000	-450.000
31	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-450.000	-250.000	-350.000	-450.000	-550.000
30	25.000	25.000	25.000	-350.000	-350.000	-350.000	-350.000	-350.000	-450.000	-350.000	-450.000	-550.000
29	25.000	25.000	25.000	25.000	-350.000	-350.000	-450.000	-450.000	-450.000	-450.000	-550.000	-550.000
28	25.000	25.000	25.000	25.000	25.000	-350.000	-350.000	-450.000	-450.000	-450.000	-450.000	-450.000
27	25.000	25.000	25.000	25.000	25.000	25.000	-350.000	-450.000	-550.000	-450.000	-450.000	-450.000
26	25.000	25.000	25.000	25.000	25.000	25.000	-450.000	-550.000	-550.000	-550.000	-650.000	-550.000
25	25.000	25.000	25.000	25.000	25.000	25.000	-450.000	-550.000	-550.000	-550.000	-550.000	-650.000
24	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-450.000	-450.000	-650.000	-550.000	-550.000
23	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-550.000	-650.000	-650.000	-650.000
22	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-550.000	-650.000	-750.000
21	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-650.000	-650.000	-750.000
20	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-650.000	-750.000	-650.000
19	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000	-750.000	-650.000
18	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000	-650.000	-550.000
17	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000	-650.000	-550.000
16	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000	-750.000	-550.000
15	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000	-750.000	-650.000
14	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000	-650.000
13	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-650.000	-750.000
12	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-650.000	-750.000
11	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-650.000
10	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-650.000
9	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
8	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
7	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
6	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
5	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
4	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
3	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
2	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
1	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000

TABLE F.1J. (contd)

THICKNESS (FT) (+=UNCONF, -=CONF.)

	13	14	15	16	17	18	19	20	21	22	23	24
65	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
64	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
63	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
62	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
61	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
60	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
59	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
58	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-250.000
57	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000
56	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000
55	-150.000	-150.000	-250.000	25.000	25.000	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000
54	-250.000	-250.000	-250.000	-250.000	25.000	25.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000
53	-250.000	-250.000	-250.000	-250.000	-250.000	25.000	25.000	-250.000	-250.000	-250.000	-250.000	-250.000
52	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-350.000	-250.000	-250.000
51	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-350.000	-350.000	-250.000	-350.000	-250.000	-250.000
50	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-450.000	-350.000	-450.000	-350.000	-350.000
49	-250.000	-250.000	-250.000	-250.000	-350.000	-350.000	-350.000	-450.000	-450.000	-450.000	-450.000	-450.000
48	-250.000	-250.000	-250.000	-250.000	-350.000	-450.000	-350.000	-450.000	-550.000	-450.000	-450.000	-450.000
47	-250.000	-250.000	-250.000	-250.000	-250.000	-350.000	-550.000	-450.000	-450.000	-550.000	-550.000	-450.000
46	-250.000	-250.000	-250.000	-350.000	-350.000	-350.000	-450.000	-550.000	-550.000	-550.000	-450.000	-450.000
45	-250.000	-250.000	-250.000	-350.000	-350.000	-450.000	-450.000	-550.000	-550.000	-450.000	-450.000	-350.000
44	-250.000	-250.000	-250.000	-350.000	-350.000	-350.000	-450.000	-550.000	-450.000	-450.000	-450.000	-350.000
43	-250.000	-350.000	-350.000	-250.000	-250.000	-350.000	-450.000	-550.000	-450.000	-350.000	-350.000	-350.000
42	-250.000	-250.000	-350.000	-350.000	-350.000	-350.000	-450.000	-450.000	-350.000	-250.000	-350.000	-250.000
41	-350.000	-350.000	-350.000	-350.000	-550.000	-450.000	-550.000	-450.000	-250.000	-250.000	-250.000	-150.000
40	-450.000	-350.000	-350.000	-450.000	-450.000	-550.000	-550.000	-450.000	-450.000	-350.000	-250.000	-150.000
39	-350.000	-550.000	-350.000	-350.000	-550.000	-550.000	-450.000	-350.000	-250.000	-250.000	-150.000	-250.000
38	-350.000	-550.000	-450.000	-350.000	-450.000	-550.000	-350.000	-250.000	-250.000	-350.000	-450.000	-450.000
37	-250.000	-350.000	-550.000	-450.000	-450.000	-550.000	-250.000	-250.000	-350.000	-450.000	-250.000	-150.000
36	-250.000	-250.000	-350.000	-550.000	-550.000	-550.000	-250.000	-350.000	-450.000	-550.000	-450.000	-450.000
35	-250.000	-250.000	-350.000	-350.000	-550.000	-550.000	-350.000	-350.000	-550.000	-450.000	-350.000	-250.000
34	-350.000	-450.000	-250.000	-450.000	-450.000	-550.000	-250.000	-350.000	-450.000	-350.000	-250.000	-350.000
33	-250.000	-350.000	-450.000	-450.000	-650.000	-350.000	-250.000	-450.000	-450.000	-350.000	-450.000	-350.000
32	-350.000	-250.000	-350.000	-450.000	-650.000	-350.000	-250.000	-450.000	-350.000	-350.000	-250.000	-250.000
31	-450.000	-350.000	-350.000	-550.000	-650.000	-550.000	-350.000	-450.000	-350.000	-250.000	-250.000	-250.000
30	-550.000	-550.000	-450.000	-350.000	-450.000	-550.000	-350.000	-550.000	-350.000	-350.000	-350.000	-350.000
29	-650.000	-650.000	-450.000	-250.000	-350.000	-550.000	-550.000	-550.000	-450.000	-350.000	-350.000	-350.000
28	-450.000	-550.000	-450.000	-450.000	-250.000	-450.000	-650.000	-650.000	-550.000	-550.000	-450.000	-350.000
27	-450.000	-450.000	-450.000	-650.000	-450.000	-350.000	-550.000	-550.000	-250.000	-350.000	-350.000	-550.000
26	-450.000	-450.000	-450.000	-450.000	-650.000	-450.000	-550.000	-650.000	-450.000	-350.000	-450.000	-450.000
25	-550.000	-550.000	-550.000	-450.000	-450.000	-650.000	-450.000	-550.000	-550.000	-350.000	-550.000	-450.000
24	-650.000	-550.000	-650.000	-450.000	-450.000	-550.000	-550.000	-550.000	-650.000	-450.000	-550.000	-450.000
23	-550.000	-650.000	-650.000	-450.000	-450.000	-450.000	-650.000	-550.000	-650.000	-450.000	-550.000	-450.000
22	-650.000	-550.000	-650.000	-550.000	-450.000	-450.000	-550.000	-650.000	-650.000	-450.000	-550.000	-550.000
21	-650.000	-650.000	-550.000	-550.000	-650.000	-550.000	-650.000	-750.000	-650.000	-450.000	-550.000	-550.000
20	-550.000	-750.000	-550.000	-450.000	-550.000	-750.000	-750.000	-550.000	-650.000	-450.000	-550.000	-650.000
19	-450.000	-750.000	-550.000	-450.000	-450.000	-650.000	-550.000	-450.000	-750.000	-650.000	-650.000	-650.000
18	-650.000	-450.000	-550.000	-450.000	-550.000	-750.000	-750.000	-450.000	-750.000	-150.000	-650.000	-550.000
17	-450.000	-650.000	-650.000	-650.000	-650.000	-550.000	-750.000	-750.000	-750.000	-850.000	-850.000	-850.000
16	-550.000	-750.000	-550.000	-450.000	-350.000	-550.000	-750.000	-750.000	-850.000	-850.000	-750.000	-650.000
15	-650.000	-650.000	-550.000	-350.000	-550.000	-550.000	-750.000	-750.000	-750.000	-750.000	-750.000	-550.000
14	-650.000	-550.000	-550.000	-450.000	-550.000	-550.000	-650.000	-650.000	-650.000	-650.000	-850.000	-750.000
13	-550.000	-650.000	-650.000	-650.000	-550.000	-650.000	-550.000	-650.000	-650.000	-650.000	-850.000	-950.000
12	-550.000	-650.000	-750.000	-650.000	-650.000	-650.000	-650.000	-850.000	-650.000	-750.000	-850.000	-850.000
11	-750.000	-750.000	-750.000	-650.000	-950.000	-750.000	-650.000	-850.000	-650.000	-850.000	-950.000	-750.000
10	-750.000	-750.000	-850.000	-650.000	-1050.000	-750.000	-650.000	-850.000	-750.000	-850.000	-1050.000	-650.000
9	-850.000	-750.000	-1050.000	-750.000	-1050.000	-650.000	-750.000	-950.000	-950.000	-950.000	-1050.000	-850.000
8	25.000	-750.000	-950.000	-850.000	-1050.000	-950.000	-1050.000	-1050.000	-950.000	-850.000	-850.000	-950.000
7	25.000	25.000	-1050.000	-850.000	-950.000	-1250.000	-950.000	-1050.000	-950.000	-950.000	-850.000	-1050.000
6	25.000	25.000	-1250.000	-750.000	-1050.000	-1050.000	-850.000	-950.000	-1050.000	-950.000	-850.000	-1050.000
5	25.000	25.000	-1050.000	-850.000	-1250.000	-950.000	-1050.000	-1050.000	-1250.000	-1250.000	25.000	-1050.000
4	25.000	25.000	25.000	-1050.000	-1050.000	-950.000	-1050.000	-1250.000	25.000	25.000	25.000	25.000
3	25.000	25.000	25.000	-1050.000	-1050.000	-1050.000	-1250.000	25.000	25.000	25.000	25.000	25.000
2	25.000	25.000	25.000	25.000	-1250.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
1	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000

TABLE F.1J. (contd)

THICKNESS (FT) (+=UNCONF, -=CONF.)

	25	26	27	28	29	30	31	32	33	34	35	36
65	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	-150,000	-150,000
64	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	-150,000	-250,000	-250,000	-250,000
63	25,000	25,000	25,000	25,000	25,000	25,000	25,000	-250,000	-250,000	-250,000	-250,000	-250,000
62	25,000	25,000	25,000	-150,000	-150,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000
61	25,000	25,000	-150,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000
60	25,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000
59	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000
58	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000
57	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000
56	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000
55	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000
54	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-250,000	-150,000	-150,000	-250,000	-250,000
53	-250,000	-250,000	-250,000	-250,000	-350,000	-250,000	-150,000	-150,000	-150,000	-150,000	-150,000	-150,000
52	-250,000	-250,000	-350,000	-350,000	-250,000	-150,000	-150,000	-250,000	-150,000	-150,000	-150,000	-150,000
51	-250,000	-350,000	-350,000	-250,000	-250,000	-250,000	-350,000	-150,000	-150,000	-150,000	-150,000	-150,000
50	-450,000	-350,000	-350,000	-350,000	-350,000	-350,000	-250,000	-150,000	-150,000	-150,000	-250,000	-250,000
49	-450,000	-350,000	-350,000	-250,000	-250,000	-250,000	-150,000	-150,000	-250,000	-150,000	-250,000	-350,000
48	-350,000	-250,000	-250,000	-250,000	-250,000	-250,000	-150,000	-150,000	-350,000	-250,000	-250,000	-250,000
47	-350,000	-250,000	-350,000	-250,000	-250,000	-150,000	-150,000	-250,000	-350,000	-350,000	-250,000	-250,000
46	-350,000	-250,000	-250,000	-150,000	-150,000	-150,000	-150,000	-150,000	-250,000	-350,000	-350,000	-250,000
45	-250,000	-350,000	-250,000	-150,000	-150,000	-150,000	-150,000	-150,000	-250,000	-250,000	-350,000	-350,000
44	-250,000	-350,000	-250,000	-150,000	-150,000	-150,000	-150,000	-150,000	-150,000	-250,000	-250,000	-450,000
43	-350,000	-350,000	-150,000	-150,000	-250,000	-150,000	-250,000	-250,000	-150,000	-250,000	-250,000	-350,000
42	-250,000	-250,000	-150,000	-150,000	-250,000	-150,000	-150,000	-250,000	-150,000	-250,000	-250,000	-250,000
41	-250,000	-150,000	-150,000	-150,000	-250,000	-150,000	-150,000	-150,000	-350,000	-350,000	-250,000	-250,000
40	-250,000	-150,000	-250,000	-250,000	-150,000	-150,000	-150,000	-150,000	-250,000	-350,000	-250,000	-250,000
39	-250,000	-250,000	-250,000	-150,000	-250,000	-150,000	-150,000	-150,000	-150,000	-250,000	-350,000	-350,000
38	-250,000	-150,000	-250,000	-250,000	-150,000	-150,000	-250,000	-150,000	-250,000	-150,000	-250,000	-350,000
37	-250,000	-250,000	-150,000	-150,000	-150,000	-250,000	-250,000	-250,000	-350,000	-150,000	-150,000	-250,000
36	-250,000	-150,000	-150,000	-150,000	-250,000	-350,000	-250,000	-350,000	-250,000	-150,000	-150,000	-250,000
35	-350,000	-250,000	-150,000	-150,000	-250,000	-350,000	-350,000	-350,000	-250,000	-150,000	-250,000	-250,000
34	-350,000	-250,000	-150,000	-150,000	-250,000	-450,000	-350,000	-350,000	-250,000	-250,000	-350,000	-350,000
33	-250,000	-250,000	-250,000	-250,000	-250,000	-450,000	-350,000	-250,000	-250,000	-350,000	-350,000	-250,000
32	-250,000	-250,000	-350,000	-350,000	-350,000	-450,000	-350,000	-250,000	-250,000	-350,000	-350,000	-250,000
31	-250,000	-250,000	-350,000	-350,000	-450,000	-450,000	-350,000	-250,000	-250,000	-350,000	-250,000	-250,000
30	-350,000	-250,000	-250,000	-350,000	-450,000	-450,000	-350,000	-250,000	-350,000	-450,000	-350,000	-250,000
29	-350,000	-350,000	-250,000	-350,000	-450,000	-550,000	-450,000	-250,000	-450,000	-350,000	-250,000	-250,000
28	-450,000	-350,000	-250,000	-350,000	-450,000	-650,000	-450,000	-250,000	-450,000	-350,000	-250,000	-250,000
27	-450,000	-350,000	-250,000	-350,000	-550,000	-650,000	-450,000	-250,000	-550,000	-350,000	-250,000	-250,000
26	-350,000	-250,000	-350,000	-450,000	-550,000	-750,000	-450,000	-350,000	-550,000	-250,000	-250,000	-250,000
25	-350,000	-350,000	-350,000	-450,000	-550,000	-650,000	-450,000	-350,000	-550,000	-250,000	-250,000	-350,000
24	-350,000	-450,000	-550,000	-550,000	-750,000	-550,000	-450,000	-350,000	-550,000	-350,000	-450,000	-350,000
23	-450,000	-450,000	-550,000	-650,000	-650,000	-550,000	-350,000	-450,000	-550,000	-350,000	-350,000	-250,000
22	-550,000	-550,000	-650,000	-750,000	-550,000	-450,000	-350,000	-550,000	-450,000	-350,000	-350,000	-250,000
21	-550,000	-450,000	-650,000	-650,000	-550,000	-550,000	-450,000	-550,000	-450,000	-350,000	-450,000	-550,000
20	-450,000	-450,000	-650,000	-750,000	-750,000	-650,000	-650,000	-650,000	-450,000	-550,000	-650,000	-650,000
19	-550,000	-650,000	-750,000	-650,000	-550,000	-750,000	-550,000	-550,000	-650,000	-650,000	-650,000	-650,000
18	-750,000	-650,000	-750,000	-550,000	-550,000	-750,000	-650,000	-750,000	-650,000	-550,000	-750,000	-650,000
17	-750,000	-750,000	-650,000	-650,000	-750,000	-650,000	-750,000	-550,000	-450,000	-650,000	-650,000	-550,000
16	-650,000	-750,000	-750,000	-550,000	-750,000	-650,000	-650,000	-450,000	-550,000	-750,000	-550,000	-450,000
15	-550,000	-650,000	-650,000	-550,000	-750,000	-750,000	-750,000	-750,000	-750,000	-650,000	-450,000	-450,000
14	-650,000	-650,000	-650,000	-650,000	-650,000	-750,000	-550,000	-550,000	-450,000	-450,000	-450,000	-550,000
13	-650,000	-650,000	-750,000	-650,000	-750,000	-650,000	-550,000	-550,000	-550,000	-650,000	-650,000	-650,000
12	-950,000	-950,000	-750,000	-750,000	-750,000	-650,000	-650,000	-650,000	-650,000	-750,000	-750,000	-750,000
11	-650,000	-950,000	-750,000	-650,000	-650,000	-750,000	-750,000	-750,000	-750,000	-750,000	-750,000	-750,000
10	-650,000	-950,000	-750,000	-650,000	-650,000	-750,000	-750,000	-650,000	-650,000	-650,000	-650,000	-650,000
9	-950,000	-950,000	-750,000	-950,000	-750,000	-650,000	-950,000	-950,000	-950,000	-950,000	-650,000	-650,000
8	-950,000	-950,000	-750,000	-950,000	-650,000	-1050,000	-1050,000	-1050,000	-1050,000	-1050,000	-950,000	-950,000
7	-950,000	-950,000	-950,000	-950,000	-1050,000	-1250,000	-1250,000	-1250,000	-1250,000	-1050,000	-1050,000	25,000
6	-1050,000	-950,000	-1250,000	-1050,000	-1250,000	-1250,000	-1250,000	25,000	25,000	25,000	25,000	25,000
5	-1050,000	-1050,000	-1250,000	-1250,000	-1250,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
4	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
3	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
2	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
1	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000

TABLE F.1J. (contd)

THICKNESS (FT) (+=UNCONF, -=CONF.)

	37	38	39	40	41	42	43	44	45	46	47	48
65	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
64	-250.000	-250.000	-250.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
63	-250.000	-250.000	-250.000	-250.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
62	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000
61	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	25.000	25.000	25.000	25.000
60	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	25.000	25.000	25.000
59	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	-250.000	-250.000	25.000	25.000
58	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	-250.000	-250.000	-250.000	25.000
57	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-250.000	-250.000	-250.000	-150.000
56	-250.000	-150.000	-150.000	-150.000	-250.000	-150.000	-100.000	-150.000	-250.000	-250.000	-250.000	-150.000
55	-250.000	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000	-250.000	-250.000	-250.000	-150.000	-150.000
54	-250.000	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000	-250.000	-250.000	-150.000	-150.000	-150.000
53	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-250.000	-150.000	-150.000	-150.000	-150.000
52	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000
51	-150.000	-150.000	-150.000	-150.000	-150.000	-250.000	-350.000	-150.000	-150.000	-150.000	-150.000	-250.000
50	-150.000	-150.000	-150.000	-150.000	-250.000	-350.000	-350.000	-150.000	-150.000	-150.000	-250.000	-250.000
49	-250.000	-250.000	-250.000	-150.000	-350.000	-350.000	-250.000	-150.000	-150.000	-250.000	-250.000	-150.000
48	-350.000	-350.000	-150.000	-350.000	-350.000	-250.000	-150.000	-150.000	-250.000	-250.000	-250.000	-250.000
47	-350.000	-350.000	-250.000	-350.000	-250.000	-150.000	-150.000	-150.000	-250.000	-250.000	-250.000	-250.000
46	-250.000	-350.000	-250.000	-250.000	-150.000	-150.000	-150.000	-250.000	-250.000	-150.000	-150.000	-150.000
45	-250.000	-350.000	-250.000	-150.000	-150.000	-250.000	-350.000	-150.000	-150.000	-150.000	-150.000	-150.000
44	-250.000	-350.000	-250.000	-150.000	-250.000	-350.000	-350.000	-350.000	-250.000	-250.000	-150.000	-150.000
43	-350.000	-350.000	-250.000	-250.000	-350.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000
42	-450.000	-350.000	-350.000	-350.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000
41	-350.000	-450.000	-450.000	-350.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000
40	-250.000	-450.000	-350.000	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	-250.000
39	-250.000	-350.000	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-250.000	-250.000	-150.000
38	-350.000	-350.000	-350.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000
37	-350.000	-350.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000
36	-350.000	-350.000	-250.000	-150.000	-150.000	-150.000	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000
35	-350.000	-250.000	-250.000	-150.000	-150.000	-150.000	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000
34	-250.000	-250.000	-150.000	-150.000	-150.000	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000
33	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000	-150.000
32	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000
31	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
30	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
29	-250.000	-250.000	-250.000	-250.000	-350.000	-350.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
28	-250.000	-250.000	-250.000	-350.000	-450.000	-350.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
27	-250.000	-250.000	-350.000	-450.000	-350.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
26	-250.000	-350.000	-450.000	-350.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000
25	-450.000	-350.000	-350.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-650.000
24	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-650.000	-650.000
23	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-250.000	-650.000	-650.000	-650.000
22	-650.000	-450.000	-450.000	-450.000	-450.000	-250.000	-250.000	-250.000	-650.000	-650.000	-650.000	-650.000
21	-550.000	-550.000	-550.000	-450.000	-450.000	-250.000	-250.000	-250.000	-650.000	-650.000	-650.000	-650.000
20	-650.000	-550.000	-550.000	-450.000	-450.000	-250.000	-250.000	-650.000	-650.000	-650.000	-650.000	-650.000
19	-550.000	-550.000	-450.000	-450.000	-450.000	-250.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000
18	-550.000	-450.000	-450.000	-450.000	-650.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000
17	-450.000	-450.000	-450.000	-550.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000
16	-450.000	-550.000	-550.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000
15	-550.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
14	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
13	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
12	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
11	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
10	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
9	-850.000	-850.000	-850.000	-850.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
8	-950.000	-850.000	-850.000	-850.000	-850.000	-850.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
7	25.000	25.000	25.000	-850.000	-850.000	-850.000	-850.000	-750.000	-750.000	-750.000	-750.000	-750.000
6	25.000	25.000	25.000	25.000	-850.000	-850.000	-850.000	-850.000	-750.000	-750.000	-750.000	-750.000
5	25.000	25.000	25.000	25.000	25.000	-850.000	-850.000	-850.000	-850.000	-750.000	-750.000	-750.000
4	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000	-750.000	-750.000
3	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000	-750.000
2	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	-750.000
1	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000

TABLE F.1J. (contd)

THICKNESS (FT) (+=UNCONF, -=CONF.)

	49	50	51	52	53	54	55	56	57	58	59	60
65	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
64	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
63	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
62	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
61	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
60	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
59	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
58	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
57	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
56	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
55	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
54	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
53	-150.000	-250.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
52	-250.000	-250.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
51	-250.000	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
50	-150.000	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
49	-150.000	-250.000	-250.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
48	-250.000	-250.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
47	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
46	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
45	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
44	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
43	-150.000	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
42	-150.000	-150.000	-150.000	-150.000	-150.000	25.000	25.000	25.000	25.000	25.000	25.000	25.000
41	-150.000	-150.000	-250.000	-250.000	-250.000	-250.000	-150.000	-150.000	25.000	25.000	25.000	25.000
40	-250.000	-250.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	25.000
39	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000
38	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000
37	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	25.000
36	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	25.000	25.000	25.000
35	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	25.000	25.000	25.000
34	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-650.000	-650.000	25.000	25.000
33	-150.000	-150.000	-150.000	-150.000	-150.000	-150.000	-250.000	-650.000	-650.000	-650.000	-650.000	25.000
32	-150.000	-150.000	-150.000	-150.000	-250.000	-250.000	-650.000	-650.000	-650.000	-650.000	-650.000	-650.000
31	-250.000	-250.000	-250.000	-250.000	-250.000	-650.000	-650.000	-650.000	-650.000	-650.000	-650.000	-150.000
30	-250.000	-250.000	-250.000	-250.000	-650.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-150.000
29	-250.000	-250.000	-250.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-150.000
28	-250.000	-250.000	-650.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-150.000
27	-250.000	-650.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000	-150.000
26	-650.000	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-150.000
25	-650.000	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
24	-650.000	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
23	-650.000	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
22	-650.000	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
21	-650.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000
20	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000
19	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000
18	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000
17	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000
16	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000
15	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000
14	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000
13	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000
12	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000
11	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000
10	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000
9	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000
8	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000
7	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000
6	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000	25.000
5	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000	25.000
4	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000	25.000	25.000
3	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000	25.000	25.000
2	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000	25.000	25.000	25.000
1	-750.000	-750.000	-750.000	-750.000	-750.000	-750.000	25.000	25.000	25.000	25.000	25.000	25.000

APPENDIX F.2: INPUT FILES FOR DETERMINATION OF FLOW NEAR SALT DOME BY FINITE ELEMENT THREE-DIMENSIONAL GROUND-WATER (FE3DGW) FLOW MODEL

TABLE F.2A. HAIN3.OUT: Input File Used in PROG1 for Determination of Flow Through Dome Breach

```
FILE NAME= HAIN3.OUT

SOLUTION MININIG - HAIN3.OUT FOR DETERMINATION OF FLOW THROUGH BREACH
    1    0       1.00       1.00       1.00       1.00
    1CARRIZZO AQUIFER
0.1323E+020.1323E+020.1323E+020.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
    2WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
    3WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
    4WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
    5WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
    6WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
    7WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
    8HOLE MATERIAL
10000.0   10000.0   10000.0   0.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
1
    1      0.00       0.00     100.00  -2100.00     1     3     1
     0.0  102  -100.0  200 -2100.0
    2   5000.00       0.00      95.00  -2100.00     1     3     1
     0.0  102  -100.0  200 -2100.0
    3  10000.00       0.00      90.00  -2100.00     1     3     1
     0.0  102  -100.0  200 -2100.0
    4  15000.00       0.00      85.00  -2100.00     1     3     1
     0.0  102  -100.0  200 -2100.0
    6  25000.00       0.00      75.00   -900.00     1     3     1
     0.0  102  -100.0  200  -900.0
    8  35000.00       0.00      65.00  -2100.00     1     3     1
     0.0  102  -100.0  200 -2100.0
    9  40000.00       0.00      60.00  -2100.00     1     3     1
```

TABLE F.2A. (contd)

0.0	102	-100.0	200	-2100.0			
10	45000.00	0.00	55.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
11	50000.00	0.00	50.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
12	55000.00	0.00	45.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
13	60000.00	0.00	40.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
14	65000.00	0.00	35.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
15	70000.00	0.00	30.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
16	75000.00	0.00	25.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
17	80000.00	0.00	20.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
18	0.00	5000.00	100.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
19	5000.00	5000.00	95.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
20	10000.00	5000.00	90.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
21	15000.00	5000.00	85.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
25	35000.00	5000.00	65.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
26	40000.00	5000.00	60.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
27	45000.00	5000.00	55.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
28	50000.00	5000.00	50.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
29	55000.00	5000.00	45.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
30	60000.00	5000.00	40.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			

TABLE F.2A. (contd)

31	65000.00	5000.00	35.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
32	70000.00	5000.00	30.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
33	75000.00	5000.00	25.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
34	80000.00	5000.00	20.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
35	0.00	10000.00	100.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
36	5000.00	10000.00	95.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
37	10000.00	10000.00	90.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
38	15000.00	10000.00	85.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
39	20000.00	10000.00	80.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
40	25000.00	10000.00	75.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
41	30000.00	10000.00	70.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
42	35000.00	10000.00	65.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
43	40000.00	10000.00	60.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
44	45000.00	10000.00	55.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
45	50000.00	10000.00	50.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
46	55000.00	10000.00	45.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
47	60000.00	10000.00	40.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
48	65000.00	10000.00	35.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
49	70000.00	10000.00	30.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
50	75000.00	10000.00	25.00	-2100.00	1	3	1

TABLE F.2A. (contd)

	0.0	102	-100.0	200	-2100.0		
51	80000.00	10000.00	20.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
52	0.00	15000.00	100.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
53	5000.00	15000.00	95.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
54	10000.00	15000.00	90.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
55	15000.00	15000.00	85.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
56	20000.00	15000.00	80.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
57	25000.00	15000.00	75.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
58	30000.00	15000.00	70.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
59	35000.00	15000.00	65.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
60	40000.00	15000.00	60.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
61	45000.00	15000.00	55.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
62	50000.00	15000.00	50.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
63	55000.00	15000.00	45.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
64	60000.00	15000.00	40.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
65	65000.00	15000.00	35.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
66	70000.00	15000.00	30.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
67	75000.00	15000.00	25.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
68	80000.00	15000.00	20.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
69	0.00	20000.00	100.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		

TABLE F.2A. (contd)

70	5000.00	20000.00	95.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
71	10000.00	20000.00	90.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
72	15000.00	20000.00	85.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
73	20000.00	20000.00	80.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
74	25000.00	20000.00	75.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
75	30000.00	20000.00	70.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
76	35000.00	20000.00	65.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
77	40000.00	20000.00	60.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
78	45000.00	20000.00	55.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
79	50000.00	20000.00	50.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
80	55000.00	20000.00	45.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
81	60000.00	20000.00	40.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
82	65000.00	20000.00	35.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
83	70000.00	20000.00	30.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
84	75000.00	20000.00	25.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
85	80000.00	20000.00	20.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
86	0.00	25000.00	100.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
87	5000.00	25000.00	95.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
88	10000.00	25000.00	90.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
89	15000.00	25000.00	85.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			

TABLE F.2A. (contd)

90	20000.00	25000.00	80.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
91	25000.00	25000.00	75.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
92	30000.00	25000.00	70.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
93	35000.00	25000.00	65.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
94	40000.00	25000.00	60.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
95	45000.00	25000.00	55.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
96	50000.00	25000.00	50.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
97	55000.00	25000.00	45.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
98	60000.00	25000.00	40.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
99	65000.00	25000.00	35.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
100	70000.00	25000.00	30.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
101	75000.00	25000.00	25.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
102	80000.00	25000.00	20.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
103	0.00	30000.00	100.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
104	5000.00	30000.00	95.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
105	10000.00	30000.00	90.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
106	15000.00	30000.00	85.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
107	20000.00	30000.00	80.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		
108	25000.00	30000.00	75.00	-2100.00	1	3	1
	0.0	102	-100.0	200	-2100.0		

TABLE F.2A. (contd)

109	30000.00	30000.00	70.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
110	35000.00	30000.00	65.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
111	40000.00	30000.00	60.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
112	45000.00	30000.00	55.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
113	50000.00	30000.00	50.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
114	55000.00	30000.00	45.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
115	60000.00	30000.00	40.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
116	65000.00	30000.00	35.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
117	70000.00	30000.00	30.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
118	75000.00	30000.00	25.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
119	80000.00	30000.00	20.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
120	0.00	35000.00	100.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
121	5000.00	35000.00	95.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
122	10000.00	35000.00	90.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
123	15000.00	35000.00	85.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
124	20000.00	35000.00	80.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
125	25000.00	35000.00	75.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
126	30000.00	35000.00	70.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			
127	35000.00	35000.00	65.00	-2100.00	1	3	1
0.0	102	-100.0	200	-2100.0			

TABLE F.2A. (contd)

```
128  40000.00  35000.00      60.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
129  45000.00  35000.00      55.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
130  50000.00  35000.00      50.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
131  55000.00  35000.00      45.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
132  60000.00  35000.00      40.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
133  65000.00  35000.00      35.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
134  70000.00  35000.00      30.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
135  75000.00  35000.00      25.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
136  80000.00  35000.00      20.00  -2100.00    1    3    1
   0.0  102  -100.0  200 -2100.0
200  22500.00      0.00      77.50   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
201  21000.00      0.00      79.00   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
202  20825.00      0.00      79.10   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
203  20000.00      0.00      80.00  -1560.00    1    3    1
   0.0  102  -100.0  200 -1560.0
204  19825.00      0.00      80.18  -1700.00    1    6    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.8  506 -1700.0
205  19750.00      0.00      80.25  -1740.00    1    7    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.8  506 -1700.0  607
-1740.0
206  19325.00      0.00      80.68  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
207  18000.00      0.00      82.00  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
208  17000.00      0.00      83.00  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
209  16000.00      0.00      84.00  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
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 210  23232.23   1767.77      76.77   -900.00     1    3    1
   0.0  102  -100.0  200  -900.0
 211  22171.57   2828.43      77.83   -900.00     1    3    1
   0.0  102  -100.0  200  -900.0
 212  22047.83   2952.17      77.95   -900.00     1    3    1
   0.0  102  -100.0  200  -900.0
 213  21464.47   3535.53      78.54  -1560.00     1    3    1
   0.0  102  -100.0  200 -1560.0
 214  21340.72   3659.28      78.66  -1700.00     1    6    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.8  506 -1700.0
 215  21287.69   3712.31      78.71  -1740.00     1    7    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.8  506 -1700.0  607
-1740.0
 216  20987.17   4012.83      79.01  -2100.00     1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
 217  20050.25   4949.75      79.95  -2100.00     1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
 218  19343.15   5656.85      80.66  -2100.00     1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
 219  18636.04   6363.96      81.36  -2100.00     1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
 220  25000.00   2500.00      75.00   -900.00     1    3    1
   0.0  102  -100.0  200  -900.0
 221  25000.00   4000.00      75.00   -900.00     1    3    1
   0.0  102  -100.0  200  -900.0
 222  25000.00   4175.00      75.00   -900.00     1    3    1
   0.0  102  -100.0  200  -900.0
 223  25000.00   5000.00      75.00  -1560.00     1    3    1
   0.0  102  -100.0  200 -1560.0
 224  25000.00   5175.00      75.00  -1700.00     1    6    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.8  506 -1700.0
 225  25000.00   5250.00      75.00  -1740.00     1    7    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.8  506 -1700.0  607
-1740.0
 226  25000.00   5675.00      75.00  -2100.00     1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
 227  25000.00   7000.00      75.00  -2100.00     1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
 228  25000.00   8000.00      75.00  -2100.00     1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
```

TABLE F.2A. (contd)

229	25000.00	9000.00	75.00	-2100.00	1	5	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-2100.0			
230	26767.77	1767.77	73.23	-900.00	1	3	1				
0.0	102	-100.0	200	-900.0							
231	27828.43	2828.43	72.17	-900.00	1	3	1				
0.0	102	-100.0	200	-900.0							
232	27952.17	2952.17	72.05	-900.00	1	3	1				
0.0	102	-100.0	200	-900.0							
233	28535.54	3535.53	71.46	-1560.00	1	3	1				
0.0	102	-100.0	200	-1560.0							
234	28659.28	3659.28	71.34	-1700.00	1	6	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-1668.8	506	-1700.0	
235	28712.31	3712.31	71.29	-1740.00	1	7	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-1668.8	506	-1700.0	607
-1740.0											
236	29012.83	4012.83	70.99	-2100.00	1	5	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-2100.0			
237	29949.75	4949.75	70.05	-2100.00	1	5	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-2100.0			
238	30656.86	5656.85	69.34	-2100.00	1	5	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-2100.0			
239	31363.96	6363.96	68.64	-2100.00	1	5	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-2100.0			
240	27309.70	956.71	72.69	-900.00	1	3	1				
0.0	102	-100.0	200	-900.0							
241	28695.52	1530.73	71.30	-900.00	1	3	1				
0.0	102	-100.0	200	-900.0							
242	28857.20	1597.70	71.14	-900.00	1	3	1				
0.0	102	-100.0	200	-900.0							
243	29619.40	1913.42	70.38	-1560.00	1	3	1				
0.0	102	-100.0	200	-1560.0							
244	29781.08	1980.39	70.22	-1700.00	1	6	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-1668.8	506	-1700.0	
245	29850.37	2009.09	70.15	-1740.00	1	7	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-1668.8	506	-1700.0	607
-1740.0											
246	30243.02	2171.73	69.76	-2100.00	1	5	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-2100.0			
247	31467.16	2676.78	68.53	-2100.00	1	5	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-2100.0			
248	32391.04	3061.47	67.61	-2100.00	1	5	1				
0.0	102	-100.0	203	-1250.0	304	-1600.0	405	-2100.0			

TABLE F.2A. (contd)

```
249  32700.00   3800.00       66.69  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
250  27451.96    487.73       72.55   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
251  28923.14    780.36       71.08   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
252  29094.78    814.60       70.91   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
253  29903.93    975.45       70.10  -1560.00    1    3    1
   0.0  102  -100.0  200 -1560.0
254  30075.56   1009.59       69.92  -1700.00    1    6    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.4  506 -1700.0
255  30149.12   1024.22       69.85  -1740.00    1    7    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.4  506 -1700.0  607
-1740.0
256  30565.96   1107.14       69.43  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
257  31865.50   1365.63       68.13  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
258  32846.29   1560.72       67.15  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
259  33827.07   1755.81       66.17  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
260  27487.96    245.04       72.51   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
261  28980.74    392.07       71.02   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
262  29154.90    409.22       70.85   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
263  29975.92    100.00       70.02  -1560.00    1    3    1 Y= ADJUSTED
   0.0  102  -100.0  200 -1560.0
264  30150.08    100.00       69.85  -1700.00    1    6    1 Y=ADJUSTED
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.4  506 -1700.0
265  30224.72    100.00       69.78  -1740.00    1    7    1 Y=ADJUSTED
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.4  506 -1700.0  607
-1740.0
266  30647.67    556.25       69.35  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
```

TABLE F.2A. (contd)

```
267  31966.29    686.12      68.03  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
268  32961.48    784.14      67.04  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
269  33956.66    882.15      66.04  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
270  27496.97    122.94      72.50   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
271  28995.16    196.71      71.00   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
272  29169.95    205.32      70.83   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
273  29993.95     15.81      70.01  -1560.00    1    3    1 Y-ADJUSTED
   0.0  102  -100.0  200 -1560.0
274  30168.74     15.81      69.83  -1700.00    1    6    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.4  506 -1700.0
275  30243.65     15.81      69.76  -1740.00    1    7    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.4  506 -1700.0  607
-1740.0
276  30668.13     50.00      69.33  -2100.00    1    5    1 Y-ADJUSTED
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
277  31991.53    344.24      68.01  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
278  32990.32    393.42      67.01  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
279  33500.00    442.60      66.01  -2100.00    1    5    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
280  27500.00      0.00      72.50   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
281  29000.00      0.00      71.00   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
282  29175.00      0.00      70.82   -900.00    1    3    1
   0.0  102  -100.0  200  -900.0
283  30000.00      0.00      70.00  -1560.00    1    3    1
   0.0  102  -100.0  200 -1560.0
284  30175.00      0.00      69.82  -1700.00    1    6    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.4  506 -1700.0
285  30250.00      0.00      69.75  -1740.00    1    7    1
   0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1668.4  506 -1700.0  607
```

TABLE F.2A. (contd)

```
-1740.0
  286  30675.00        0.00      69.32  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  287  32000.00        0.00      68.00  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  288  33000.00        0.00      67.00  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  289  34000.00        0.00      66.00  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
2
0
    1 100.0
 1001 100.0
 2001 100.0
   18 100.0
 1018 100.0
 2018 100.0
   35 100.0
 1035 100.0
 2035 100.0
   52 100.0
 1052 100.0
 2052 100.0
   69 100.0
 1069 100.0
 2069 100.0
   86 100.0
 1086 100.0
 2086 100.0
  103 100.0
 1103 100.0
 2103 100.0
  120 100.0
 1120 100.0
 2120 100.0
   17 20.00
 1017 20.00
 2017 20.00
```

TABLE F.2A. (contd)

```
  34 20.00
1034 20.00
2034 20.00
  51 20.00
1051 20.00
2051 20.00
  68 20.00
1068 20.00
2068 20.00
  85 20.00
1085 20.00
2085 20.00
 102 20.00
1102 20.00
2102 20.00
 119 20.00
1119 20.00
2119 20.00
 136 20.00
1136 20.00
2136 20.00
4
4274 0.0
5274 0.0
4284 0.0
5284 0.0
5
   1     1     4     4    21    20     3
   2     1     4    21    38    37    20
   3     1     4    38    55    54    37
   4     1     4    55    72    71    54
   5     1     4    72    89    88    71
   6     1     4    89   106   105    88
   7     1     4   106   123   122   105
   8     1     4     3    20    19     2
   9     1     4    20    37    36    19
  10     1     4    37    54    53    36
  11     1     4    54    71    70    53
```

TABLE F.2A. (contd)

12	1	4	71	88	87	70
13	1	4	88	105	104	87
14	1	4	105	122	121	104
15	1	4	2	19	18	1
16	1	4	19	36	35	18
17	1	4	36	53	52	35
18	1	4	53	70	69	52
19	1	4	70	87	86	69
20	1	4	87	104	103	86
21	1	4	104	121	120	103
22	1	4	42	59	58	41
23	1	4	59	76	75	58
24	1	4	76	93	92	75
25	1	4	93	110	109	92
26	1	4	110	127	126	109
27	1	4	41	58	57	40
28	1	4	58	75	74	57
29	1	4	75	92	91	74
30	1	4	92	109	108	91
31	1	4	109	126	125	108
32	1	4	40	57	56	39
33	1	4	57	74	73	56
34	1	4	74	91	90	73
35	1	4	91	108	107	90
36	1	4	108	125	124	107
37	1	4	39	56	55	38
38	1	4	56	73	72	55
39	1	4	73	90	89	72
40	1	4	90	107	106	89
41	1	4	107	124	123	106
42	1	4	17	34	33	16
43	1	4	34	51	50	33
44	1	4	51	68	67	50
45	1	4	68	85	84	67
46	1	4	85	102	101	84
47	1	4	102	119	118	101
48	1	4	119	136	135	118
49	1	4	16	33	32	15

TABLE F.2A. (contd)

50	1	4	33	50	49	32
51	1	4	50	67	66	49
52	1	4	67	84	83	66
53	1	4	84	101	100	83
54	1	4	101	118	117	100
55	1	4	118	135	134	117
56	1	4	15	32	31	14
57	1	4	32	49	48	31
58	1	4	49	66	65	48
59	1	4	66	83	82	65
60	1	4	83	100	99	82
61	1	4	100	117	116	99
62	1	4	117	134	133	116
63	1	4	14	31	30	13
64	1	4	31	48	47	30
65	1	4	48	65	64	47
66	1	4	65	82	81	64
67	1	4	82	99	98	81
68	1	4	99	116	115	98
69	1	4	116	133	132	115
70	1	4	13	30	29	12
71	1	4	30	47	46	29
72	1	4	47	64	63	46
73	1	4	64	81	80	63
74	1	4	81	98	97	80
75	1	4	98	115	114	97
76	1	4	115	132	131	114
77	1	4	12	29	28	11
78	1	4	29	46	45	28
79	1	4	46	63	62	45
80	1	4	63	80	79	62
81	1	4	80	97	96	79
82	1	4	97	114	113	96
83	1	4	114	131	130	113
84	1	4	11	28	27	10
85	1	4	28	45	44	27
86	1	4	45	62	61	44
87	1	4	62	79	78	61

TABLE F.2A. (contd)

88	1	4	79	96	95	78
89	1	4	96	113	112	95
90	1	4	113	130	129	112
91	1	4	10	27	26	9
92	1	4	27	44	43	26
93	1	4	44	61	60	43
94	1	4	61	78	77	60
95	1	4	78	95	94	77
96	1	4	95	112	111	94
97	1	4	112	129	128	111
98	1	4	9	26	25	8
99	1	4	26	43	42	25
100	1	4	43	60	59	42
101	1	4	60	77	76	59
102	1	4	77	94	93	76
103	1	4	94	111	110	93
104	1	4	111	128	127	110
105	1	4	280	281	271	270
106	1	4	281	282	272	271
107	1	4	282	283	273	272
108	1	4	283	284	274	273
109	1	4	284	285	275	274
110	1	4	285	286	276	275
111	1	4	286	287	277	276
112	1	4	287	288	278	277
113	1	4	288	289	279	278
114	1	4	270	271	261	260
115	1	4	271	272	262	261
116	1	4	272	273	263	262
117	1	4	273	274	264	263
118	1	4	274	275	265	264
119	1	4	275	276	266	265
120	1	4	276	277	267	266
121	1	4	277	278	268	267
122	1	4	278	279	269	268
123	1	4	260	261	251	250
124	1	4	261	262	252	251

TABLE F.2A. (contd)

125	1	4	262	263	253	252
126	1	4	263	264	254	253
127	1	4	264	265	255	254
128	1	4	265	266	256	255
129	1	4	266	267	257	256
130	1	4	267	268	258	257
131	1	4	268	269	259	258
132	1	4	250	251	241	240
133	1	4	251	252	242	241
134	1	4	252	253	243	242
135	1	4	253	254	244	243
136	1	4	254	255	245	244
137	1	4	255	256	246	245
138	1	4	256	257	247	246
139	1	4	257	258	248	247
140	1	4	258	259	249	248
141	1	4	240	241	231	230
142	1	4	241	242	232	231
143	1	4	242	243	233	232
144	1	4	243	244	234	233
145	1	4	244	245	235	234
146	1	4	245	246	236	235
147	1	4	246	247	237	236
148	1	4	247	248	238	237
149	1	4	248	249	239	238
150	1	4	230	231	221	220
151	1	4	231	232	222	221
152	1	4	232	233	223	222
153	1	4	233	234	224	223
154	1	4	234	235	225	224
155	1	4	235	236	226	225
156	1	4	236	237	227	226
157	1	4	237	238	228	227
158	1	4	238	239	229	228
159	1	4	220	221	211	210
160	1	4	221	222	212	211
161	1	4	222	223	213	212

TABLE F.2A. (contd)

162	1	4	223	224	214	213
163	1	4	224	225	215	214
164	1	4	225	226	216	215
165	1	4	226	227	217	216
166	1	4	227	228	218	217
167	1	4	228	229	219	218
168	1	4	210	211	201	200
169	1	4	211	212	202	201
170	1	4	212	213	203	202
171	1	4	213	214	204	203
172	1	4	214	215	205	204
173	1	4	215	216	206	205
174	1	4	216	217	207	206
175	1	4	217	218	208	207
176	1	4	218	219	209	208
177	1	4	239	25	42	41
178	1	4	229	239	41	40
179	1	4	229	40	39	219
180	1	4	219	39	38	21
181	1	4	4	209	219	21
182	1	4	6	220	210	200
183	1	4	6	240	230	220
184	1	4	6	260	250	240
185	1	4	6	280	270	260
187	1	4	259	269	8	25
186	1	4	279	289	8	269
188	1	4	239	249	259	25

6

TABLE F.2B. HSTEDY•CRD: Input File for PROG3I to Define as Steady-State Simulation

```
FILE NAME= HSTEDY.CRD

,STEADY STATE SOLUTION WITH NO SURFACE FLUX
     0     0     1     1     0     0
```

TABLE F.2C. HAIN3LECH•OUT: Input File Used in PROG1 for Determining Flow After Salt Dome Collapse

```
FILE NAME= HAIN3LECH.OUT

HAINSVILLE SALT DOME - LONG TERM EVALUATION AFTER DESOLUTION TO -1700  FT. ELEV.
     1     0       1.00       1.00       1.00       1.00
     1CARRIZZO AQUIFER
0.1323E+020.1323E+020.1323E+020.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
     2WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
     3WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
     4WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
     5WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
     6WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
     7WILCOX AQUIFER
0.2480E+010.2480E+010.2480E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
     8COLLAPSED MATERIAL (2 TIMES PERMEABLE THAN SURROUNDING)
0.4960E+010.4960E+010.4960E+010.1000E+000.1000E+010.1000E+010.1000E+010.1000E-03
1
     1       0.00       0.00     200.00   -2100.00     1     3     1
      0.0  102  -100.0  203 -2100.0
     2  10000.00       0.00     190.00   -2100.00     1     3     1
      0.0  102  -100.0  203 -2100.0
     3  20000.00       0.00     180.00   -2100.00     1     3     1
      0.0  102  -100.0  203 -2100.0
     4  30000.00       0.00     170.00   -2100.00     1     3     1
      0.0  102  -100.0  203 -2100.0
     5  40000.00       0.00     160.00   -2100.00     1     3     1
      0.0  102  -100.0  203 -2100.0
     6  50000.00       0.00     150.00   -2100.00     1     3     1
      0.0  102  -100.0  203 -2100.0
     7  60000.00       0.00     140.00   -2100.00     1     3     1
      0.0  102  -100.0  203 -2100.0
     9  80000.00       0.00     120.00   -1700.00     1     9     1
```

TABLE F.2C. (contd)

```
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
   11 100000.00       0.00      100.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   12 110000.00       0.00       90.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   13 120000.00       0.00       80.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   14 130000.00       0.00       70.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   15 140000.00       0.00       60.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   16 150000.00       0.00       50.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   17 160000.00       0.00       40.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   18 170000.00       0.00       30.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   19 180000.00       0.00       20.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   20 190000.00       0.00       10.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   21       0.00  10000.00      200.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   22  10000.00  10000.00      190.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   23  20000.00  10000.00      180.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   24  30000.00  10000.00      170.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   25  40000.00  10000.00      160.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   26  50000.00  10000.00      150.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   27  60000.00  10000.00      140.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
   31 100000.00  10000.00      100.00   -2100.00     1     3     1
     0.0  102  -100.0  203 -2100.0
```

TABLE F.2C. (contd)

32	110000.00	10000.00	90.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
33	120000.00	10000.00	80.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
34	130000.00	10000.00	70.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
35	140000.00	10000.00	60.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
36	150000.00	10000.00	50.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
37	160000.00	10000.00	40.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
38	170000.00	10000.00	30.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
39	180000.00	10000.00	20.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
40	190000.00	10000.00	10.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
41	0.00	20000.00	200.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
42	10000.00	20000.00	190.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
43	20000.00	20000.00	180.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
44	30000.00	20000.00	170.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
45	40000.00	20000.00	160.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
46	50000.00	20000.00	150.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
47	60000.00	20000.00	140.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
48	70000.00	20000.00	130.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
49	80000.00	20000.00	120.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				
50	90000.00	20000.00	110.00	-2100.00	1	3	1
	0.0 102	-100.0	203 -2100.0				

TABLE F.2C. (contd)

51	100000.00	20000.00	100.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
52	110000.00	20000.00	90.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
53	120000.00	20000.00	80.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
54	130000.00	20000.00	70.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
55	140000.00	20000.00	60.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
56	150000.00	20000.00	50.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
57	160000.00	20000.00	40.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
58	170000.00	20000.00	30.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
59	180000.00	20000.00	20.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
60	190000.00	20000.00	10.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
61	0.00	30000.00	200.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
62	10000.00	30000.00	190.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
63	20000.00	30000.00	180.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
64	30000.00	30000.00	170.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
65	40000.00	30000.00	160.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
66	50000.00	30000.00	150.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
67	60000.00	30000.00	140.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
68	70000.00	30000.00	130.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
69	80000.00	30000.00	120.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		

TABLE F.2C. (contd)

70	90000.00	30000.00	110.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
71	100000.00	30000.00	100.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
72	110000.00	30000.00	90.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
73	120000.00	30000.00	80.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
74	130000.00	30000.00	70.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
75	140000.00	30000.00	60.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
76	150000.00	30000.00	50.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
77	160000.00	30000.00	40.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
78	170000.00	30000.00	30.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
79	160000.00	30000.00	20.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
80	190000.00	30000.00	10.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
81	0.00	40000.00	200.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
82	10000.00	40000.00	190.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
83	20000.00	40000.00	180.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
84	30000.00	40000.00	170.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
85	40000.00	40000.00	160.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
86	50000.00	40000.00	150.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
87	60000.00	40000.00	140.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
88	70000.00	40000.00	130.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			

F.97

TABLE F.2C. (contd)

89	80000.00	40000.00	120.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
90	90000.00	40000.00	110.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
91	100000.00	40000.00	100.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
92	110000.00	40000.00	90.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
93	120000.00	40000.00	80.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
94	130000.00	40000.00	70.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
95	140000.00	40000.00	60.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
96	150000.00	40000.00	50.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
97	160000.00	40000.00	40.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
98	170000.00	40000.00	30.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
99	180000.00	40000.00	20.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
100	190000.00	40000.00	10.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
101	0.00	50000.00	200.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
102	10000.00	50000.00	190.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
103	20000.00	50000.00	180.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
104	30000.00	50000.00	170.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
105	40000.00	50000.00	160.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
106	50000.00	50000.00	150.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
107	60000.00	50000.00	140.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		

TABLE F.2C. (contd)

108	70000.00	50000.00	130.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
109	80000.00	50000.00	120.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
110	90000.00	50000.00	110.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
111	100000.00	50000.00	100.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
112	110000.00	50000.00	90.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
113	120000.00	50000.00	80.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
114	130000.00	50000.00	70.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
115	140000.00	50000.00	60.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
116	150000.00	50000.00	50.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
117	160000.00	50000.00	40.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
118	170000.00	50000.00	30.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
119	180000.00	50000.00	20.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
120	190000.00	50000.00	10.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
121	0.00	60000.00	200.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
122	10000.00	60000.00	190.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
123	20000.00	60000.00	180.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
124	30000.00	60000.00	170.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
125	40000.00	60000.00	160.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
126	50000.00	60000.00	150.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			

TABLE F.2C. (contd)

127	60000.00	60000.00	140.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
128	70000.00	60000.00	130.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
129	80000.00	60000.00	120.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
130	90000.00	60000.00	110.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
131	100000.00	60000.00	100.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
132	110000.00	60000.00	90.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
133	120000.00	60000.00	80.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
134	130000.00	60000.00	70.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
135	140000.00	60000.00	60.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
136	150000.00	60000.00	50.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
137	160000.00	60000.00	40.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
138	170000.00	60000.00	30.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
139	180000.00	60000.00	20.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
140	190000.00	60000.00	10.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
141	0.00	70000.00	200.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
142	10000.00	70000.00	190.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
143	20000.00	70000.00	180.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
144	30000.00	70000.00	170.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
145	40000.00	70000.00	160.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		

TABLE F.2C. (contd)

146	50000.00	70000.00	150.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
147	60000.00	70000.00	140.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
148	70000.00	70000.00	130.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
149	80000.00	70000.00	120.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
150	90000.00	70000.00	110.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
151	100000.00	70000.00	100.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
152	110000.00	70000.00	90.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
153	120000.00	70000.00	80.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
154	130000.00	70000.00	70.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
155	140000.00	70000.00	60.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
156	150000.00	70000.00	50.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
157	160000.00	70000.00	40.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
158	170000.00	70000.00	30.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
159	180000.00	70000.00	20.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
160	190000.00	70000.00	10.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
161	0.00	80000.00	200.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
162	10000.00	80000.00	190.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
163	20000.00	80000.00	180.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			
164	30000.00	80000.00	170.00	-2100.00	1	3	1
0.0	102	-100.0	203	-2100.0			

TABLE F.2C. (contd)

165	40000.00	80000.00	160.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
166	50000.00	80000.00	150.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
167	60000.00	80000.00	140.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
168	70000.00	80000.00	130.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
169	80000.00	80000.00	120.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
170	90000.00	80000.00	110.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
171	100000.00	80000.00	100.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
172	110000.00	80000.00	90.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
173	120000.00	80000.00	80.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
174	130000.00	80000.00	70.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
175	140000.00	80000.00	60.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
176	150000.00	80000.00	50.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
177	160000.00	80000.00	40.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
178	170000.00	80000.00	30.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
179	180000.00	80000.00	20.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
180	190000.00	80000.00	10.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
181	0.00	90000.00	200.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
182	10000.00	90000.00	190.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		
183	20000.00	90000.00	180.00	-2100.00	1	3	1
	0.0	102	-100.0	203	-2100.0		

TABLE F.2C. (contd)

```
184  30000.00  90000.00    170.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
185  40000.00  90000.00    160.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
186  50000.00  90000.00    150.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
187  60000.00  90000.00    140.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
188  70000.00  90000.00    130.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
189  80000.00  90000.00    120.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
190  90000.00  90000.00    110.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
191 100000.00  90000.00    100.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
192 110000.00  90000.00     90.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
193 120000.00  90000.00     80.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
194 130000.00  90000.00     70.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
195 140000.00  90000.00     60.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
196 150000.00  90000.00     50.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
197 160000.00  90000.00     40.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
198 170000.00  90000.00     30.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
199 180000.00  90000.00     20.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
200 190000.00  90000.00     10.00  -2100.00    1    3    1
   0.0  102  -100.0  203 -2100.0
201  77500.00      0.00    122.50  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
202  76000.00      0.00    124.00  -1700.00    1    9    1
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TABLE F.2C. (contd)

```
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  203  75000.00      0.00     125.00  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  204  74825.00      0.00     125.17  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  205  74750.00      0.00     125.25  -1740.00    1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  607
 -1740.0
  206  74325.00      0.00     125.67  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  207  73000.00      0.00     127.00  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  208  71000.00      0.00     129.00  -2100.00    1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  209  67000.00      0.00     133.00  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  210  62000.00      0.00     138.00  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  211  77690.30    956.71     122.31  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  212  76304.48   1530.73     123.70  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  213  75380.60   1913.42     124.62  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  214  75216.92   1980.39     124.78  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  215  75149.63   2009.09     124.85  -1740.00    1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  607
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TABLE F.2C. (contd)

```
 -1740.0
  216  74756.98   2171.73    125.24  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  217  73532.84   2678.78    126.47  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  218  71685.09   3444.15    128.31  -2100.00    1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  219  67989.57   4974.88    132.01  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  220  63370.17   6888.30    136.63  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  221  78232.23   1767.77    121.77  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  222  77171.57   2828.43    122.83  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  223  76464.47   3535.53    123.54  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  224  76340.72   3659.28    123.66  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  225  76287.69   3712.31    123.71  -1740.00    1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  6070
 -1740.0
  226  75987.17   4012.83    124.01  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  227  75050.25   4949.75    124.95  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  228  73636.04   6363.96    126.36  -2100.00    1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  229  70807.61   9192.39    129.19  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  230  67272.08  12727.92    132.73  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  231  79043.29   2309.70    120.96  -1700.00    1    9    1
```

TABLE F.2C. (contd)

```
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  232  78469.27   3695.52    121.53  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  233  78086.59   4619.40    121.91  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  234  78019.62   4781.08    121.98  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  235  77990.91   4850.37    122.01  -1740.00    1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  607
 -1740.0
  236  77828.27   5243.02    122.17  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  237  77321.22   6467.16    122.68  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  238  76555.85   8314.92    123.44  -2100.00    1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  239  75025.12  12019.43    124.97  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  240  73111.70  16629.83    126.89  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  241  80000.00   2500.00    120.00  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  242  80000.00   4000.00    120.00  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  243  80000.00   5000.00    120.00  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  244  80000.00   5175.00    120.00  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  245  80000.00   5250.00    120.00  -1740.00    1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  607
```

TABLE F.2C. (contd)

```
-1740.0
  246  80000.00   5675.00     120.00  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  247  80000.00   7000.00     120.00  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  248  80000.00   9000.00     120.00  -2100.00     1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  249  80000.00  13000.00     120.00  -2100.00     1    3    1
     0.0  102  -100.0  203 -2100.0
  250  80000.00  18000.00     120.00  -2100.00     1    3    1
     0.0  102  -100.0  203 -2100.0
  251  80956.71   2309.70     119.04  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  252  81530.73   3695.52     118.47  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  253  81913.41   4619.40     118.09  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  254  81980.39   4781.08     118.02  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  255  82009.09   4850.37     117.99  -1740.00     1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  607
 -1740.0
  256  82171.73   5243.02     117.83  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  257  82670.78   6467.16     117.32  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  258  83444.15   8314.92     116.56  -2100.00     1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  259  84974.88  12010.43     115.03  -2100.00     1    3    1
     0.0  102  -100.0  203 -2100.0
  260  86888.30  16629.83     113.11  -2100.00     1    3    1
     0.0  102  -100.0  203 -2100.0
  261  81767.77   1767.77     118.23  -1700.00     1    9    1
```

TABLE F.2C. (contd)

```
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  262  82828.43    2828.43     117.17  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  263  83535.53    3535.53     116.46  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  264  83659.28    3659.28     116.34  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  265  83712.31    3712.31     116.29  -1740.00     1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  607
 -1740.0
  266  84012.83    4012.83     115.99  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  267  84949.75    4949.75     115.05  -2100.00     1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  268  86363.96    6363.96     113.64  -2100.00     1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  269  89192.39    9192.39     110.81  -2100.00     1    3    1
     0.0  102  -100.0  203 -2100.0
  270  92727.92   12727.92     107.27  -2100.00     1    3    1
     0.0  102  -100.0  203 -2100.0
  271  82309.70     956.71     117.69  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  272  83695.52    1530.73     116.30  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  273  84619.40    1913.42     115.38  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  274  84781.08    1980.39     115.22  -1700.00     1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  275  84850.37    2009.09     115.15  -1740.00     1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  607
```

TABLE F.2C. (contd)

```
 -1740.0
  276  85243.02   2171.73     114.76  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  277  86467.16   2678.78     113.53  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  278  88314.91   3444.15     111.69  -2100.00    1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  279  92010.44   4974.88     107.99  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  280  96629.84   6888.30     103.37  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  281  82500.00      0.00     117.50  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  282  84000.00      0.00     116.00  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  283  85000.00      0.00     115.00  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  284  85175.00      0.00     114.82  -1700.00    1    9    1
0.,102,-100.,203,-300.,304,-500.,405,-700.,506,-1000.,607,
-1300.,708,-1670.,800,-1700.,
  285  85250.00      0.00     114.75  -1740.00    1    7    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -1670.0  506 -1700.0  607
 -1740.0
  286  85675.00      0.00     114.32  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  287  87000.00      0.00     113.00  -2100.00    1    5    1
     0.0  102  -100.0  203 -1250.0  304 -1600.0  405 -2100.0
  288  89000.00      0.00     111.00  -2100.00    1    4    1
     0.0  102  -100.0  203 -1250.0  300 -2100.0
  289  93000.00      0.00     107.00  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
  290  98000.00      0.00     102.00  -2100.00    1    3    1
     0.0  102  -100.0  203 -2100.0
2
0
```

TABLE F.2C. (contd)

1	200.0
1001	200.0
2001	200.0
21	200.0
1021	200.0
2021	200.0
41	200.0
1041	200.0
2041	200.0
61	200.0
1061	200.0
2061	200.0
81	200.0
1081	200.0
2081	200.0
101	200.0
1101	200.0
2101	200.0
121	200.0
1121	200.0
2121	200.0
141	200.0
1141	200.0
2141	200.0
161	200.0
1161	200.0
2161	200.0
181	200.0
1181	200.0
2181	200.0
20	10.00
1020	10.00
2020	10.00
40	10.00
1040	10.00
2040	10.00
60	10.00

TABLE F.2C. (contd)

1060	10.00
2060	10.00
80	10.00
1080	10.00
2080	10.00
100	10.00
1100	10.00
2100	10.00
120	10.00
1120	10.00
2120	10.00
140	10.00
1140	10.00
2140	10.00
160	10.00
1160	10.00
2160	10.00
180	10.00
1180	10.00
2180	10.00
200	10.00
1200	10.00
2200	10.00
9	170.0
201	170.0
202	170.0
203	170.0
204	170.0
211	170.0
212	170.0
213	170.0
214	170.0
221	170.0
222	170.0
223	170.0
224	170.0
231	170.0
232	170.0

TABLE F.2C. (contd)

233	170.0
234	170.0
241	170.0
242	170.0
243	170.0
244	170.0
251	170.0
252	170.0
253	170.0
254	170.0
261	170.0
262	170.0
263	170.0
264	170.0
271	170.0
272	170.0
273	170.0
274	170.0
281	170.0
282	170.0
283	170.0
284	170.0

5

1	1	4	7	27	26	6
2	1	4	27	47	46	26
3	1	4	47	67	66	46
4	1	4	67	87	86	66
5	1	4	87	107	106	86
6	1	4	107	127	126	106
7	1	4	127	147	146	126
8	1	4	147	167	166	146
9	1	4	167	167	186	166
10	1	4	6	26	25	5
11	1	4	26	46	45	25
12	1	4	46	66	65	45
13	1	4	66	86	85	65

TABLE F.2C. (contd)

14	1	4	86	106	105	85
15	1	4	106	126	125	105
16	1	4	126	146	145	125
17	1	4	146	166	165	145
18	1	4	166	186	185	165
19	1	4	5	25	24	4
20	1	4	25	45	44	24
21	1	4	45	65	64	44
22	1	4	65	85	84	64
23	1	4	85	105	104	84
24	1	4	105	125	124	104
25	1	4	125	145	144	124
26	1	4	145	165	164	144
27	1	4	165	185	184	164
28	1	4	4	24	23	3
29	1	4	24	44	43	23
30	1	4	44	64	63	43
31	1	4	64	84	83	63
32	1	4	84	104	103	83
33	1	4	104	124	123	103
34	1	4	124	144	143	123
35	1	4	144	164	163	143
36	1	4	164	184	183	163
37	1	4	3	23	22	2
38	1	4	23	43	42	22
39	1	4	43	63	62	42
40	1	4	63	83	82	62
41	1	4	83	103	102	82
42	1	4	103	123	122	102
43	1	4	123	143	142	122
44	1	4	143	163	162	142
45	1	4	163	183	182	162
46	1	4	2	22	21	1
47	1	4	22	42	41	21
48	1	4	42	62	61	41
49	1	4	62	82	81	61
50	1	4	82	102	101	81
51	1	4	102	122	121	101

TABLE F.2C. (contd)

52	1	4	122	142	141	121
53	1	4	142	162	161	141
54	1	4	162	182	181	161
55	1	4	51	71	70	50
56	1	4	71	91	90	70
57	1	4	91	111	110	90
58	1	4	111	131	130	110
59	1	4	131	151	150	130
60	1	4	151	171	170	150
61	1	4	171	191	190	170
62	1	4	50	70	69	49
63	1	4	70	90	89	69
64	1	4	90	110	109	89
65	1	4	110	130	129	109
66	1	4	130	150	149	129
67	1	4	150	170	169	149
68	1	4	170	190	189	169
69	1	4	49	69	68	48
70	1	4	69	89	88	68
71	1	4	89	109	108	88
72	1	4	109	129	128	108
73	1	4	129	149	148	128
74	1	4	149	169	168	148
75	1	4	169	189	188	168
76	1	4	48	68	67	47
77	1	4	68	88	87	67
78	1	4	88	108	107	87
79	1	4	108	128	127	107
80	1	4	128	148	147	127
81	1	4	148	168	167	147
82	1	4	168	188	187	167
83	1	4	20	40	39	19
84	1	4	40	60	59	39
85	1	4	60	80	79	59
86	1	4	80	100	99	79
87	1	4	100	120	119	99
88	1	4	120	140	139	119

TABLE F.2C. (contd)

89	1	4	140	160	159	139
90	1	4	160	180	179	159
91	1	4	180	200	199	179
92	1	4	19	39	38	18
93	1	4	39	59	58	38
94	1	4	59	79	78	58
95	1	4	79	99	98	78
96	1	4	99	119	118	98
97	1	4	119	139	138	118
98	1	4	139	159	158	138
99	1	4	159	179	178	158
100	1	4	179	199	198	178
101	1	4	18	38	37	17
102	1	4	38	58	57	37
103	1	4	58	78	77	57
104	1	4	78	98	97	77
105	1	4	98	118	117	97
106	1	4	118	138	137	117
107	1	4	138	158	157	137
108	1	4	158	178	177	157
109	1	4	178	198	197	177
110	1	4	17	37	36	16
111	1	4	37	57	56	36
112	1	4	57	77	76	56
113	1	4	77	97	96	76
114	1	4	97	117	116	96
115	1	4	117	137	136	116
116	1	4	137	157	156	136
117	1	4	157	177	176	156
118	1	4	177	197	196	176
119	1	4	16	36	35	15
120	1	4	36	56	55	35
121	1	4	56	76	75	55
122	1	4	76	96	95	75
123	1	4	96	116	115	95
124	1	4	116	136	135	115
125	1	4	136	156	155	135
126	1	4	156	176	175	155

TABLE F.2C. (contd)

127	1	4	176	196	195	175
128	1	4	15	35	34	14
129	1	4	35	55	54	34
130	1	4	55	75	74	54
131	1	4	75	95	94	74
132	1	4	95	115	114	94
133	1	4	115	135	134	114
134	1	4	135	155	154	134
135	1	4	155	175	174	154
136	1	4	175	195	194	174
137	1	4	14	34	33	13
138	1	4	34	54	53	33
139	1	4	54	74	73	53
140	1	4	74	94	93	73
141	1	4	94	114	113	93
142	1	4	114	134	133	113
143	1	4	134	154	153	133
144	1	4	154	174	173	153
145	1	4	174	194	193	173
146	1	4	13	33	32	12
147	1	4	33	53	52	32
148	1	4	53	73	72	52
149	1	4	73	93	92	72
150	1	4	93	113	112	92
151	1	4	113	133	132	112
152	1	4	133	153	152	132
153	1	4	153	173	172	152
154	1	4	173	193	192	172
155	1	4	12	32	31	11
156	1	4	32	52	51	31
157	1	4	52	72	71	51
158	1	4	72	92	91	71
159	1	4	92	112	111	91
160	1	4	112	132	131	111
161	1	4	132	152	151	131
162	1	4	152	172	171	151
163	1	4	172	192	191	171
164	1	4	281	282	272	271

TABLE F.2C. (contd)

165	1	4	282	283	273	272
166	1	4	283	284	274	273
167	1	4	284	285	275	274
168	1	4	285	286	276	275
169	1	4	286	287	277	276
170	1	4	287	288	278	277
171	1	4	288	289	279	278
172	1	4	289	290	280	279
173	1	4	271	272	262	261
174	1	4	272	273	263	262
175	1	4	273	274	264	263
176	1	4	274	275	265	264
177	1	4	275	276	266	265
178	1	4	276	277	267	266
179	1	4	277	278	268	267
180	1	4	278	279	269	268
181	1	4	279	280	270	269
182	1	4	261	262	252	251
183	1	4	262	263	253	252
184	1	4	263	264	254	253
185	1	4	264	265	255	254
186	1	4	265	266	256	255
187	1	4	266	267	257	256
188	1	4	267	268	258	257
189	1	4	268	269	259	258
190	1	4	269	270	260	259
191	1	4	251	252	242	241
192	1	4	252	253	243	242
193	1	4	253	254	244	243
194	1	4	254	255	245	244
195	1	4	255	256	246	245
196	1	4	256	257	247	246
197	1	4	257	258	248	247
198	1	4	258	259	249	248
199	1	4	259	260	250	249
200	1	4	241	242	232	231
201	1	4	242	243	233	232

TABLE F.2C. (contd)

202	1	4	243	244	234	233
203	1	4	244	245	235	234
204	1	4	245	246	236	235
205	1	4	246	247	237	236
206	1	4	247	248	238	237
207	1	4	248	249	239	238
208	1	4	249	250	240	239
209	1	4	231	232	222	221
210	1	4	232	233	223	222
211	1	4	233	234	224	223
212	1	4	234	235	225	224
213	1	4	235	236	226	225
214	1	4	236	237	227	226
215	1	4	237	238	228	227
216	1	4	238	239	229	228
217	1	4	239	240	230	229
218	1	4	221	222	212	211
219	1	4	222	223	213	212
220	1	4	223	224	214	213
221	1	4	224	225	215	214
222	1	4	225	226	216	215
223	1	4	226	227	217	216
224	1	4	227	228	218	217
225	1	4	228	229	219	218
226	1	4	229	230	220	219
227	1	4	211	212	202	201
228	1	4	212	213	203	202
229	1	4	213	214	204	203
230	1	4	214	215	205	204
231	1	4	215	216	206	205
232	1	4	216	217	207	206
233	1	4	217	218	208	207
234	1	4	218	219	209	208
235	1	4	219	220	210	209
236	1	4	210	220	27	7
237	1	4	220	230	47	27
238	1	4	230	240	48	47

TABLE F.2C. (contd)

239	1	4	240	250	49	48
240	1	4	250	260	50	49
241	1	4	260	270	51	50
242	1	4	290	11	31	280
243	1	4	280	31	51	270
244	1	4	9	221	211	201
245	1	4	9	241	231	221
246	1	4	9	261	251	241
247	1	4	9	281	271	261

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APPENDIX F.3: REPOSITORY INVENTORIES

The following ORIGEN output tables were provided by BNI to represent the inventory in the repository for the first 30,000 yr. For periods after that (up to 10^6 yr) PNL generated inventories using ORIGEN. These are listed in Appendix L.

These inventions are given for BWR and PWR assemblies. The repository for the reference site analysis is assumed to contain the following:

	Spent Fuel Assemblies	Canisters
BWR	151,513	75,757
PWR	107,917	107,917
TOTAL	257,430	183,674

TABLE F.3A. Grams of Fission-Product Elements in a BWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
H	8.590E-03	8.120E-03	7.675E-03	6.481E-03	4.890E-03	1.584E-03	3.065E-05	3.906E-10	2.883E-27	0.0	0.0	0.0
LI	3.052E-05	3.052E-05	3.052E-05	3.052E-05	3.052E-05	3.052E-05	3.052E-05	3.052E-05	3.052E-05	3.052E-05	3.052E-05	3.052E-05
BE	2.281E-05	2.281E-05	2.281E-05	2.281E-05	2.281E-05	2.281E-05	2.281E-05	2.281E-05	2.281E-05	2.280E-05	2.276E-05	2.265E-05
C	4.011E-06	4.011E-06	4.010E-06	4.009E-06	4.006E-06	3.997E-06	3.963E-06	3.868E-06	3.554E-06	2.790E-06	1.197E-06	1.065E-07
CO	1.719E-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NI	6.332E-11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CU	5.783E-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZN	8.322E-06	5.711E-09	5.711E-09	5.711E-09	5.711E-09	5.711E-09	5.711E-09	5.711E-09	5.711E-09	5.711E-09	5.711E-09	5.711E-09
GA	4.624E-06	1.379E-07	1.379E-07	1.379E-07	1.379E-07	1.379E-07	1.379E-07	1.379E-07	1.379E-07	1.379E-07	1.379E-07	1.379E-07
GE	9.848E-02	9.843E-02	9.843E-02	9.843E-02	9.843E-02	9.843E-02	9.843E-02	9.843E-02	9.843E-02	9.843E-02	9.843E-02	9.843E-02
AS	3.011E-02	2.979E-02	2.979E-02	2.979E-02	2.979E-02	2.979E-02	2.979E-02	2.979E-02	2.979E-02	2.979E-02	2.979E-02	2.979E-02
SE	8.566E 00	8.566E 00	8.566E 00	8.566E 00	8.566E 00	8.566E 00	8.565E 00	8.563E 00	8.557E 00	8.538E 00	8.476E 00	8.322E 00
BR	3.312E 00	3.311E 00	3.311E 00	3.311E 00	3.311E 00	3.311E 00	3.311E 00	3.313E 00	3.320E 00	3.339E 00	3.401E 00	3.555E 00
KR	5.602E 01	5.578E 01	5.557E 01	5.501E 01	5.429E 01	5.292E 01	5.241E 01	5.240E 01	5.240E 01	5.240E 01	5.240E 01	5.240E 01
RB	5.189E 01	5.212E 01	5.233E 01	5.289E 01	5.361E 01	5.490E 01	5.549E 01	5.550E 01	5.550E 01	5.550E 01	5.550E 01	5.550E 01
SR	1.378E 02	1.323E 02	1.303E 02	1.248E 02	1.165E 02	9.191E 01	6.018E 01	5.337E 01	5.332E 01	5.332E 01	5.332E 01	5.332E 01
Y	7.123E 01	6.941E 01	6.937E 01	6.936E 01	6.936E 01	6.936E 01	6.935E 01	6.935E 01	6.935E 01	6.935E 01	6.935E 01	6.935E 01
ZR	5.387E 02	5.372E 02	5.390E 02	5.445E 02	5.528E 02	5.774E 02	6.091E 02	6.159E 02	6.159E 02	6.157E 02	6.152E 02	6.136E 02
NB	4.897E 00	2.135E-01	5.092E-03	6.505E-04	1.051E-03	2.651E-03	8.253E-03	2.426E-02	8.025E-02	2.401E-01	7.976E-01	2.375E 00
MO	4.948E 02	5.080E 02	5.084E 02	5.084E 02	5.084E 02	5.084E 02	5.084E 02	5.084E 02	5.084E 02	5.084E 02	5.084E 02	5.084E 02
TC	1.199E 02	1.203E 02	1.203E 02	1.203E 02	1.203E 02	1.203E 02	1.203E 02	1.202E 02	1.199E 02	1.191E 02	1.164E 02	1.091E 02
RU	3.604E 02	3.429E 02	3.370E 02	3.318E 02	3.311E 02	3.311E 02	3.311E 02	3.312E 02	3.315E 02	3.322E 02	3.349E 02	3.423E 02
RH	6.855E 01	7.429E 01	7.430E 01	7.430E 01	7.430E 01	7.430E 01	7.430E 01	7.430E 01	7.430E 01	7.430E 01	7.430E 01	7.430E 01
PD	1.851E 02	1.969E 02	2.027E 02	2.079E 02	2.086E 02	2.086E 02	2.086E 02	2.086E 02	2.086E 02	2.086E 02	2.086E 02	2.085E 02
AG	1.228E 01	1.217E 01	1.214E 01	1.213E 01	1.212E 01	1.213E 01	1.213E 01	1.213E 01	1.213E 01	1.214E 01	1.216E 01	1.223E 01
CD	1.533E 01	1.545E 01	1.547E 01	1.548E 01	1.548E 01	1.547E 01	1.546E 01	1.546E 01	1.546E 01	1.546E 01	1.546E 01	1.546E 01
IN	3.611E-01	3.785E-01	3.802E-01	3.846E-01	3.907E-01	4.056E-01	4.131E-01	4.134E-01	4.134E-01	4.134E-01	4.134E-01	4.134E-01
SN	1.311E 01	1.298E 01	1.296E 01	1.296E 01	1.296E 01	1.296E 01	1.295E 01	1.295E 01	1.293E 01	1.287E 01	1.268E 01	1.219E 01
SB	4.545E 00	4.164E 00	3.835E 00	3.201E 00	2.800E 00	2.645E 00	2.644E 00	2.644E 00	2.644E 00	2.644E 00	2.644E 00	2.644E 00
TE	7.294E 01	7.229E 01	7.262E 01	7.325E 01	7.365E 01	7.381E 01	7.381E 01	7.382E 01	7.384E 01	7.389E 01	7.408E 01	7.457E 01
I	3.657E 01	3.592E 01	3.594E 01	3.594E 01	3.594E 01	3.594E 01	3.594E 01	3.594E 01	3.594E 01	3.594E 01	3.593E 01	3.591E 01
XE	8.015E 02	8.017E 02	8.017E 02	8.017E 02	8.017E 02	8.017E 02	8.017E 02	8.017E 02	8.017E 02	8.017E 02	8.017E 02	8.017E 02
CS	4.274E 02	4.204E 02	4.131E 02	3.964E 02	3.764E 02	3.226E 02	2.496E 02	2.316E 02	2.314E 02	2.314E 02	2.313E 02	2.309E 02
BA	2.123E 02	2.183E 02	2.255E 02	2.422E 02	2.622E 02	3.161E 02	3.890E 02	4.070E 02	4.072E 02	4.072E 02	4.074E 02	4.077E 02
LA	1.863E 02	1.859E 02	1.859E 02	1.859E 02	1.859E 02	1.859E 02	1.859E 02	1.859E 02	1.859E 02	1.859E 02	1.859E 02	1.859E 02
CE	4.164E 02	3.833E 02	3.713E 02	3.635E 02	3.630E 02	3.630E 02	3.630E 02	3.630E 02	3.630E 02	3.630E 02	3.630E 02	3.630E 02
PR	1.669E 02	1.710E 02	1.710E 02	1.710E 02	1.710E 02	1.710E 02	1.710E 02	1.710E 02	1.710E 02	1.710E 02	1.710E 02	1.710E 02
ND	5.616E 02	5.927E 02	6.047E 02	6.125E 02	6.130E 02	6.131E 02	6.131E 02	6.130E 02	6.130E 02	6.130E 02	6.130E 02	6.130E 02
PM	2.289E 01	1.784E 01	1.370E 01	6.201E 00	1.654E 00	8.394E-03	7.777E-11	0.0	0.0	0.0	0.0	0.0
SM	1.116E 02	1.175E 02	1.216E 02	1.291E 02	1.335E 02	1.349E 02	1.342E 02	1.333E 02	1.331E 02	1.331E 02	1.331E 02	1.331E 02
EU	2.396E 01	2.303E 01	2.241E 01	2.092E 01	1.926E 01	1.712E 01	1.734E 01	1.817E 01	1.842E 01	1.842E 01	1.842E 01	1.842E 01
GD	1.138E 01	1.245E 01	1.308E 01	1.462E 01	1.636E 01	1.879E 01	1.930E 01	1.931E 01	1.931E 01	1.931E 01	1.931E 01	1.931E 01
TB	3.993E-01	3.890E-01	3.888E-01	3.887E-01	3.887E-01	3.887E-01	3.887E-01	3.887E-01	3.887E-01	3.887E-01	3.887E-01	3.887E-01
DY	1.939E-01	2.049E-01	2.052E-01	2.052E-01	2.052E-01	2.052E-01	2.052E-01	2.052E-01	2.052E-01	2.052E-01	2.052E-01	2.052E-01
HO	1.930E-02	1.929E-02	1.929E-02	1.929E-02	1.929E-02	1.928E-02	1.928E-02	1.926E-02	1.921E-02	1.914E-02	1.911E-02	1.911E-02
ER	7.490E-03	7.529E-03	7.529E-03	7.530E-03	7.530E-03	7.532E-03	7.539E-03	7.557E-03	7.607E-03	7.674E-03	7.705E-03	7.706E-03
TM	7.393E-06	7.005E-06	6.891E-06	6.853E-06	6.844E-06	6.842E-06	6.842E-06	6.842E-06	6.842E-06	6.842E-06	6.842E-06	6.842E-06
YB	1.090E-06	1.808E-06	1.921E-06	1.959E-06	1.968E-06	1.970E-06	1.970E-06	1.970E-06	1.970E-06	1.970E-06	1.970E-06	1.970E-06
TOTAL	5.199E 03	5.199E 03	5.199E 03	5.199E 03	5.199E 03	5.199E 03	5.199E 03	5.199E 03	5.199E 03	5.199E 03	5.199E 03	5.199E 03

TABLE F.3B. Grams of Heavy Elements in a BWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
HE	4.414E-02	7.391E-02	8.460E-02	1.034E-01	1.351E-01	2.802E-01	8.082E-01	1.974E 00	4.227E 00	6.935E 00	1.188E 01	1.904E 01
SF	2.214E-07	4.403E-07	5.800E-07	9.186E-07	1.398E-06	2.637E-06	3.815E-06	4.512E-06	6.585E-06	1.188E-05	2.529E-05	4.558E-05
TL	2.593E-13	5.741E-13	8.799E-13	1.610E-12	2.191E-12	2.117E-12	1.111E-12	2.598E-13	3.459E-13	1.014E-12	3.387E-12	9.822E-12
PB	6.739E-08	2.024E-07	4.396E-07	1.684E-06	4.876E-06	1.958E-05	5.483E-05	8.850E-05	1.663E-04	1.642E-03	3.303E-02	3.832E-01
BI	2.451E-11	4.703E-11	6.833E-11	1.229E-10	1.827E-10	3.561E-10	2.574E-09	5.016E-08	2.347E-06	8.800E-05	3.593E-03	7.199E-02
PO	3.311E-14	6.661E-14	1.040E-13	3.399E-13	1.585E-12	2.292E-11	4.980E-10	6.908E-09	9.771E-08	7.202E-07	4.157E-06	1.453E-05
AT	1.973E-20	6.577E-21	6.823E-21	7.646E-21	9.242E-21	1.846E-20	9.064E-20	7.608E-19	1.180E-17	1.439E-16	1.589E-15	9.219E-15
RN	2.485E-13	5.404E-13	8.288E-13	1.555E-12	2.291E-12	4.271E-12	2.655E-11	2.490E-10	2.859E-09	2.108E-08	1.216E-07	4.252E-07
FR	2.097E-16	1.194E-16	1.518E-16	2.484E-16	4.074E-16	1.032E-15	3.383E-15	1.413E-14	1.321E-13	1.389E-12	1.479E-11	8.513E-11
RA	4.338E-09	8.091E-09	1.248E-08	2.880E-08	6.665E-08	3.858E-07	3.992E-06	3.875E-05	4.453E-04	3.282E-03	1.895E-02	6.623E-02
AC	1.083E-09	2.221E-09	3.352E-09	6.695E-09	1.212E-08	3.239E-08	9.582E-08	2.684E-07	8.992E-07	2.617E-06	8.518E-06	2.378E-05
TH	2.482E-04	3.453E-04	4.430E-04	7.384E-04	1.238E-03	3.322E-03	1.151E-02	3.883E-02	1.423E-01	4.392E-01	1.465E 00	4.162E 00
PA	5.823E-05	5.973E-05	6.106E-05	6.503E-05	7.167E-05	9.825E-05	1.915E-04	4.574E-04	1.384E-03	4.009E-03	1.298E-02	3.602E-02
U	1.765E 05	1.765E 05	1.765E 05	1.765E 05	1.765E 05	1.765E 05	1.765E 05	1.765E 05	1.765E 05	1.767E 05	1.769E 05	1.773E 05
NP	7.335E 01	6.307E 01	6.311E 01	6.328E 01	6.380E 01	6.771E 01	8.740E 01	1.366E 02	2.244E 02	2.650E 02	2.661E 02	2.644E 02
PU	1.546E 03	1.550E 03	1.541E 03	1.516E 03	1.482E 03	1.403E 03	1.346E 03	1.325E 03	1.280E 03	1.170E 03	8.795E 02	4.673E 02
AM	1.840E 01	2.768E 01	3.651E 01	6.055E 01	9.345E 01	1.659E 02	1.924E 02	1.439E 02	5.390E 01	1.067E 01	4.727E 00	7.719E-01
CM	4.279E 00	2.718E 00	2.318E 00	1.996E 00	1.655E 00	7.889E-01	8.022E-02	2.401E-02	2.212E-02	1.784E-02	8.654E-03	1.341E-03
BK	8.122E-09	3.684E-09	1.670E-09	1.556E-10	2.978E-12	3.999E-19	8.719E-24	8.650E-24	8.412E-24	7.767E-24	5.877E-24	2.650E-24
CF	3.215E-09	7.512E-09	9.385E-09	1.054E-08	1.024E-08	9.174E-09	7.692E-09	5.213E-09	1.361E-09	4.299E-11	8.200E-14	1.112E-19
ES	3.806E-13	3.159E-15	1.255E-15	7.986E-17	8.102E-19	8.559E-27	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1.781E 05	1.781E 05	1.781E 05	1.781E 05	1.781E 05	1.781E 05	1.781E 05	1.781E 05	1.781E 05	1.781E 05	1.781E 05	1.781E 05

TABLE F.3C. Curies of Light-Element Isotopes in a BWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
H 3	4.752E 01	4.491E 01	4.245E 01	3.585E 01	2.705E 01	8.763E 00	1.696E-01	2.161E-06	1.595E-23	0.0	0.0	0.0
C 14	2.634E-01	2.633E-01	2.633E-01	2.632E-01	2.631E-01	2.624E-01	2.602E-01	2.540E-01	2.334E-01	1.832E-01	7.856E-02	6.990E-03
CL 36	1.968E-03	1.968E-03	1.968E-03	1.967E-03	1.967E-03	1.967E-03	1.967E-03	1.966E-03	1.963E-03	1.954E-03	1.924E-03	1.840E-03
MN 54	2.467E 01	1.070E 01	4.639E 00	3.782E-01	5.799E-03	3.205E-10	0.0	0.0	0.0	0.0	0.0	0.0
FE 55	2.152E 02	1.648E 02	1.263E 02	5.675E 01	1.496E 01	7.228E-02	5.680E-10	0.0	0.0	0.0	0.0	0.0
CO 58	1.588E 02	4.557E 00	1.308E-01	3.092E-06	6.023E-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 60	4.179E 02	3.663E 02	3.211E 02	2.162E 02	1.119E 02	8.020E 00	7.908E-04	2.832E-15	0.0	0.0	0.0	0.0
NI 59	1.508E-01	1.508E-01	1.508E-01	1.508E-01	1.508E-01	1.507E-01	1.506E-01	1.504E-01	1.495E-01	1.469E-01	1.383E-01	1.163E-01
NI 63	2.297E 01	2.280E 01	2.263E 01	2.212E 01	2.130E 01	1.832E 01	1.081E 01	2.396E 00	1.227E-02	3.505E-09	0.0	0.0
ZN 65	2.020E 01	7.189E 00	2.558E 00	1.152E-01	6.577E-04	6.957E-13	0.0	0.0	0.0	0.0	0.0	0.0
ZR 93	9.300E-02	9.300E-02	9.300E-02	9.300E-02	9.300E-02	9.300E-02	9.299E-02	9.298E-02	9.293E-02	9.280E-02	9.232E-02	9.099E-02
ZR 95	1.508E 04	3.160E 02	6.622E 00	6.094E-05	2.463E-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NB 93M	7.032E-03	1.160E-02	1.591E-02	2.744E-02	4.273E-02	7.399E-02	8.809E-02	8.833E-02	8.829E-02	8.816E-02	8.771E-02	8.644E-02
NB 94	5.889E-02	5.889E-02	5.889E-02	5.888E-02	5.887E-02	5.883E-02	5.869E-02	5.828E-02	5.689E-02	5.307E-02	4.163E-02	2.081E-02
NB 95	1.500E 04	6.681E 02	1.468E 01	1.314E-04	5.310E-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NB 95M	1.869E 02	4.013E 00	8.410E-02	7.739E-07	3.127E-15	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MO 93	1.434E-03	1.433E-03	1.433E-03	1.432E-03	1.430E-03	1.424E-03	1.401E-03	1.338E-03	1.138E-03	7.168E-04	1.422E-04	1.398E-06
IN113M	2.895E 02	3.204E 01	3.544E 00	4.919E-03	8.155E-08	6.158E-27	0.0	0.0	0.0	0.0	0.0	0.0
SN113	2.894E 02	3.202E 01	3.542E 00	4.916E-03	8.150E-08	6.155E-27	0.0	0.0	0.0	0.0	0.0	0.0
SN119M	2.224E 03	7.915E 02	2.817E 02	1.269E 01	7.243E-02	7.676E-11	0.0	0.0	0.0	0.0	0.0	0.0
SN121M	2.430E-01	2.397E-01	2.364E-01	2.267E-01	2.115E-01	1.603E-01	6.071E-02	3.789E-03	2.300E-07	2.060E-19	0.0	0.0
SN123	1.054E 02	1.482E 01	2.084E 00	5.792E-03	3.183E-07	2.903E-24	0.0	0.0	0.0	0.0	0.0	0.0
SB125	6.318E 02	4.954E 02	3.843E 02	1.794E 02	5.041E 01	3.147E-01	6.012E-09	0.0	0.0	0.0	0.0	0.0
TE125M	1.369E 02	1.207E 02	9.385E 01	4.382E 01	1.231E 01	7.685E-02	1.468E-09	0.0	0.0	0.0	0.0	0.0
EU154	2.830E 01	2.611E 01	2.409E 01	1.891E 01	1.263E 01	2.517E 00	8.860E-03	8.744E-10	0.0	0.0	0.0	0.0
EU155	1.579E 01	1.367E 01	1.183E 01	7.668E 00	3.723E 00	2.070E-01	8.390E-06	2.369E-18	0.0	0.0	0.0	0.0
GD153	2.577E 02	9.004E 01	3.146E 01	1.341E 00	7.004E-03	5.140E-12	0.0	0.0	0.0	0.0	0.0	0.0
TB160	1.194E 03	3.601E 01	1.086E 00	2.975E-05	7.415E-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUMTOT	3.635E 04	3.263E 03	1.379E 03	5.961E 02	2.552E 02	3.910E 01	1.171E 01	3.047E 00	6.363E-01	5.668E-01	4.405E-01	3.233E-01
TOTAL	1.175E 05	3.267E 03	1.380E 03	5.962E 02	2.552E 02	3.910E 01	1.171E 01	3.048E 00	6.367E-01	5.671E-01	4.408E-01	3.236E-01

TABLE F.30. Curies of Fission-Product Isotopes in a BWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
H 3	8.326E 01	7.870E 01	7.439E 01	6.282E 01	4.739E 01	1.535E 01	2.971E-01	3.786E-06	2.795E-23	0.0	0.0	0.0
SE 79	6.212E-02	6.212E-02	6.212E-02	6.212E-02	6.212E-02	6.211E-02	6.206E-02	6.193E-02	6.147E-02	6.017E-02	5.504E-02	4.511E-02
KR 85	1.414E 03	1.326E 03	1.243E 03	1.024E 03	7.415E 02	2.037E 02	2.213E 00	5.417E-06	1.243E-25	0.0	0.0	0.0
SR 89	9.903E 04	7.612E 02	5.853E 00	2.657E-06	7.122E-17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SR 90	1.144E 04	1.116E 04	1.089E 04	1.011E 04	8.939E 03	5.458E 03	9.709E 02	6.989E 00	2.217E-07	8.335E-29	0.0	0.0
Y 90	1.103E 04	1.116E 04	1.089E 04	1.011E 04	8.941E 03	5.459E 03	9.711E 02	6.995E 00	2.217E-07	8.337E-29	0.0	0.0
Y 91	1.301E 05	1.741E 03	2.315E 01	5.440E-05	2.259E-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZR 93	4.438E-01	4.440E-01	4.440E-01	4.440E-01	4.440E-01	4.440E-01	4.440E-01	4.439E-01	4.437E-01	4.430E-01	4.408E-01	4.344E-01
NB 93M	3.707E-02	5.868E-02	7.908E-02	1.337E-01	2.060E-01	3.539E-01	4.206E-01	4.217E-01	4.215E-01	4.209E-01	4.188E-01	4.127E-01
ZR 95	1.883E 05	3.946E 03	8.270E 01	7.610E-04	3.075E-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NB 95	1.911E 05	8.346E 03	1.833E 02	1.641E-03	6.632E-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TC 99	2.042E 00	2.050E 00	2.050E 00	2.050E 00	2.050E 00	2.050E 00	2.049E 00	2.048E 00	2.043E 00	2.030E 00	1.984E 00	1.858E 00
RU103	1.889E 05	3.158E 02	5.171E-01	2.415E-09	3.151E-23	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RH103M	1.890E 05	3.161E 02	5.204E-01	2.417E-09	3.154E-23	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU106	7.810E 04	3.933E 04	1.980E 04	2.528E 03	8.181E 01	8.976E-05	1.242E-25	0.0	0.0	0.0	0.0	0.0
RH106	8.383E 04	3.933E 04	1.980E 04	2.528E 03	8.181E 01	8.976E-05	1.242E-25	0.0	0.0	0.0	0.0	0.0
PD107	1.739E-02	1.739E-02	1.739E-02	1.739E-02	1.739E-02	1.739E-02	1.739E-02	1.739E-02	1.739E-02	1.738E-02	1.737E-02	1.733E-02
SB125	2.064E 03	1.613E 03	1.251E 03	5.842E 02	1.641E 02	1.024E 00	1.956E-08	0.0	0.0	0.0	0.0	0.0
TE125M	4.453E 02	3.931E 02	3.056E 02	1.427E 02	4.008E 01	2.501E-01	4.777E-09	0.0	0.0	0.0	0.0	0.0
SN126	1.158E-01	1.158E-01	1.158E-01	1.158E-01	1.158E-01	1.157E-01	1.157E-01	1.155E-01	1.150E-01	1.134E-01	1.080E-01	9.402E-02
SB126	1.273E 02	1.621E-02	1.621E-02	1.621E-02	1.621E-02	1.620E-02	1.620E-02	1.617E-02	1.610E-02	1.587E-02	1.512E-02	1.316E-02
SB126M	6.310E 01	1.158E-01	1.158E-01	1.158E-01	1.158E-01	1.157E-01	1.157E-01	1.155E-01	1.150E-01	1.134E-01	1.080E-01	9.402E-02
I129	4.742E-03	4.800E-03	4.800E-03	4.800E-03	4.800E-03	4.800E-03	4.800E-03	4.800E-03	4.800E-03	4.800E-03	4.798E-03	4.794E-03
CS134	2.035E 04	1.454E 04	1.039E 04	3.785E 03	7.037E 02	8.771E-01	5.177E-11	0.0	0.0	0.0	0.0	0.0
CS135	6.522E-02	6.532E-02	6.532E-02	6.532E-02	6.532E-02	6.532E-02	6.532E-02	6.531E-02	6.530E-02	6.526E-02	6.512E-02	6.473E-02
CS137	1.577E 04	1.541E 04	1.506E 04	1.406E 04	1.253E 04	7.904E 03	1.577E 03	1.576E 01	1.573E-06	1.568E-26	0.0	0.0
BA137M	1.495E 04	1.458E 04	1.425E 04	1.330E 04	1.185E 04	7.477E 03	1.492E 03	1.491E 01	1.488E-06	1.483E-26	0.0	0.0
CE144	1.584E 05	6.501E 04	2.669E 04	1.847E 03	2.156E 01	3.988E-07	0.0	0.0	0.0	0.0	0.0	0.0
PR144	1.592E 05	6.502E 04	2.669E 04	1.847E 03	2.156E 01	3.988E-07	0.0	0.0	0.0	0.0	0.0	0.0
PR144M	1.902E 03	7.802E 02	3.203E 02	2.216E 01	2.587E-01	4.786E-09	0.0	0.0	0.0	0.0	0.0	0.0
PM147	2.068E 04	1.655E 04	1.271E 04	5.751E 03	1.534E 03	7.785E 00	7.213E-08	0.0	0.0	0.0	0.0	0.0
SM151	5.702E 01	5.743E 01	5.700E 01	5.574E 01	5.370E 01	4.626E 01	2.745E 01	6.176E 00	3.336E-02	1.110E-08	0.0	0.0
EU154	1.499E 03	1.383E 03	1.275E 03	1.001E 03	6.690E 02	1.333E 02	4.653E-01	4.592E-08	0.0	0.0	0.0	0.0
EU155	9.680E 02	8.378E 02	7.251E 02	4.701E 02	2.283E 02	1.269E 01	5.144E-04	1.452E-16	0.0	0.0	0.0	0.0
SUMTOT	1.570E 06	3.140E 05	1.727E 05	6.923E 04	4.665E 04	2.672E 04	5.044E 03	5.414E 01	3.337E 00	3.284E 00	3.218E 00	3.039E 00
TOTAL	1.998E 07	3.149E 05	1.729E 05	6.924E 04	4.666E 04	2.673E 04	5.044E 03	5.414E 01	3.337E 00	3.284E 00	3.218E 00	3.039E 00

TABLE F.3E. Curies of Heavy-Element Isotopes in a BWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
PB210	2.417E-10	3.759E-10	5.737E-10	1.816E-09	7.120E-09	1.033E-07	2.245E-06	3.114E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
PB214	2.995E-09	5.132E-09	7.942E-09	2.043E-08	5.497E-08	3.710E-07	3.943E-06	3.833E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
BI210	2.428E-10	3.761E-10	5.739E-10	1.816E-09	7.121E-09	1.033E-07	2.245E-06	3.114E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
BI214	2.995E-09	5.132E-09	7.942E-09	2.043E-08	5.497E-08	3.710E-07	3.943E-06	3.833E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
PO210	1.465E-10	2.942E-10	4.592E-10	1.515E-09	7.121E-09	1.033E-07	2.245E-06	3.114E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
PO214	7.683E-09	5.132E-09	7.942E-09	2.043E-08	5.497E-08	3.710E-07	3.943E-06	3.833E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
PO218	2.995E-09	5.132E-09	7.942E-09	2.043E-08	5.497E-08	3.710E-07	3.943E-06	3.833E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
RN222	2.995E-09	5.132E-09	7.942E-09	2.043E-08	5.497E-08	3.710E-07	3.943E-06	3.833E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
RA226	2.993E-09	5.132E-09	7.942E-09	2.043E-08	5.497E-08	3.710E-07	3.943E-06	3.833E-05	4.404E-04	3.247E-03	1.874E-02	6.550E-02
TH230	4.167E-06	5.716E-06	7.273E-06	1.199E-05	2.000E-05	5.378E-05	1.893E-04	6.520E-04	2.416E-03	7.417E-03	2.408E-02	6.509E-02
TH234	5.816E-02	5.812E-02	5.813E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.813E-02
PA233	4.247E-02	4.448E-02	4.450E-02	4.462E-02	4.499E-02	4.775E-02	6.163E-02	9.630E-02	1.582E-01	1.868E-01	1.876E-01	1.864E-01
PA234M	5.861E-02	5.812E-02	5.813E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.813E-02
U234	1.784E-01	1.792E-01	1.801E-01	1.828E-01	1.870E-01	2.025E-01	2.411E-01	2.833E-01	2.942E-01	2.929E-01	2.883E-01	2.758E-01
U236	3.852E-02	3.852E-02	3.852E-02	3.853E-02	3.854E-02	3.859E-02	3.876E-02	3.925E-02	4.087E-02	4.490E-02	5.398E-02	6.149E-02
U238	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.812E-02	5.813E-02
NP237	4.366E-02	4.448E-02	4.450E-02	4.462E-02	4.499E-02	4.775E-02	6.163E-02	9.630E-02	1.582E-01	1.868E-01	1.876E-01	1.864E-01
NP239	2.630E 06	2.250E 00	2.250E 00	2.249E 00	2.248E 00	2.244E 00	2.230E 00	2.190E 00	2.055E 00	1.715E 00	9.094E-01	1.485E-01
PU238	2.885E 02	3.130E 02	3.158E 02	3.099E 02	2.981E 02	2.552E 02	1.481E 02	3.140E 01	1.501E-01	1.907E-06	2.581E-20	0.0
PU239	5.361E 01	5.431E 01	5.431E 01	5.430E 01	5.430E 01	5.427E 01	5.417E 01	5.387E 01	5.285E 01	5.004E 01	4.124E 01	2.353E 01
PU240	8.481E 01	8.482E 01	8.483E 01	8.485E 01	8.488E 01	8.490E 01	8.444E 01	8.273E 01	7.700E 01	6.273E 01	3.060E 01	3.936E 00
PU241	2.039E 04	1.945E 04	1.854E 04	1.608E 04	1.268E 04	4.908E 03	1.768E 02	1.582E-02	2.375E-03	2.009E-03	1.117E-03	2.087E-04
PU242	2.708E-01	2.708E-01	2.708E-01	2.708E-01	2.708E-01	2.708E-01	2.708E-01	2.707E-01	2.704E-01	2.694E-01	2.660E-01	2.564E-01
AM241	2.267E 01	5.449E 01	8.477E 01	1.672E 02	2.799E 02	5.285E 02	6.194E 02	4.542E 02	1.481E 02	6.030E 00	1.199E-03	2.087E-04
AM243	2.248E 00	2.250E 00	2.250E 00	2.249E 00	2.248E 00	2.244E 00	2.230E 00	2.190E 00	2.055E 00	1.715E 00	9.094E-01	1.485E-01
CM242	6.199E 03	1.320E 03	2.799E 02	3.308E 00	6.513E-01	5.933E-01	4.311E-01	1.732E-01	7.115E-03	7.808E-07	1.070E-20	0.0
CM244	1.895E 02	1.824E 02	1.756E 02	1.565E 02	1.292E 02	6.009E 01	4.117E 00	1.942E-03	4.428E-15	0.0	0.0	0.0
SUMTOT	2.657E 06	2.146E 04	1.954E 04	1.686E 04	1.354E 04	5.897E 03	1.093E 03	6.277E 02	2.833E 02	1.234E 02	7.501E 01	2.956E 01
TOTAL	5.474E 06	2.146E 04	1.955E 04	1.687E 04	1.354E 04	5.899E 03	1.094E 03	6.282E 02	2.834E 02	1.234E 02	7.506E 01	2.973E 01

TABLE F.3F. Grams of Fission-Product Elements in a PWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
H	2.639E-02	2.494E-02	2.357E-02	1.991E-02	1.502E-02	4.866E-03	9.418E-05	1.200E-09	8.859E-27	0.0	0.0	0.0
LI	8.934E-05	8.934E-05	8.934E-05	8.934E-05	8.934E-05	8.934E-05	8.934E-05	8.934E-05	8.934E-05	8.934E-05	8.934E-05	8.934E-05
BE	6.895E-05	6.895E-05	6.895E-05	6.895E-05	6.895E-05	6.895E-05	6.895E-05	6.894E-05	6.893E-05	6.890E-05	6.878E-05	6.845E-05
C	1.212E-05	1.212E-05	1.212E-05	1.212E-05	1.211E-05	1.208E-05	1.198E-05	1.169E-05	1.074E-05	8.433E-06	3.616E-06	3.218E-07
CO	7.299E-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NI	2.619E-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CU	2.329E-09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZN	3.273E-05	1.743E-08	1.743E-08	1.743E-08	1.743E-08	1.743E-08	1.743E-08	1.743E-08	1.743E-08	1.743E-08	1.743E-08	1.743E-08
GA	1.794E-05	4.093E-07	4.093E-07	4.093E-07	4.093E-07	4.093E-07	4.093E-07	4.093E-07	4.093E-07	4.093E-07	4.093E-07	4.093E-07
GE	3.047E-01	3.045E-01	3.045E-01	3.045E-01	3.045E-01	3.045E-01	3.045E-01	3.045E-01	3.045E-01	3.045E-01	3.045E-01	3.045E-01
AS	9.348E-02	9.229E-02	9.229E-02	9.229E-02	9.229E-02	9.229E-02	9.229E-02	9.229E-02	9.229E-02	9.229E-02	9.229E-02	9.229E-02
SE	2.598E 01	2.598E 01	2.598E 01	2.598E 01	2.598E 01	2.598E 01	2.598E 01	2.597E 01	2.595E 01	2.589E 01	2.570E 01	2.524E 01
BR	9.990E 00	9.984E 00	9.984E 00	9.984E 00	9.984E 00	9.985E 00	9.987E 00	9.992E 00	1.001E 01	1.007E 01	1.026E 01	1.073E 01
KR	1.703E 02	1.696E 02	1.689E 02	1.672E 02	1.650E 02	1.608E 02	1.592E 02	1.591E 02	1.591E 02	1.591E 02	1.591E 02	1.591E 02
RB	1.572E 02	1.579E 02	1.586E 02	1.603E 02	1.625E 02	1.668E 02	1.684E 02	1.684E 02	1.684E 02	1.684E 02	1.684E 02	1.684E 02
SR	4.219E 02	4.029E 02	3.970E 02	3.802E 02	3.549E 02	2.797E 02	1.828E 02	1.620E 02	1.619E 02	1.619E 02	1.619E 02	1.619E 02
Y	2.174E 02	2.107E 02	2.105E 02	2.105E 02	2.105E 02	2.105E 02	2.105E 02	2.105E 02	2.105E 02	2.105E 02	2.105E 02	2.105E 02
ZR	1.631E 03	1.624E 03	1.630E 03	1.647E 03	1.672E 03	1.747E 03	1.844E 03	1.865E 03	1.865E 03	1.864E 03	1.863E 03	1.858E 03
NB	1.797E 01	7.815E-01	1.830E-02	1.886E-03	3.096E-03	7.936E-03	2.487E-02	7.326E-02	2.426E-01	7.258E-01	2.412E 00	7.181E 00
MO	1.485E 03	1.533E 03	1.535E 03	1.535E 03	1.535E 03	1.535E 03	1.535E 03	1.535E 03	1.535E 03	1.535E 03	1.535E 03	1.535E 03
TC	3.578E 02	3.594E 02	3.594E 02	3.594E 02	3.594E 02	3.594E 02	3.593E 02	3.590E 02	3.582E 02	3.559E 02	3.478E 02	3.258E 02
RU	1.104E 03	1.044E 03	1.024E 03	1.007E 03	1.005E 03	1.005E 03	1.005E 03	1.005E 03	1.006E 03	1.008E 03	1.016E 03	1.038E 03
RH	1.966E 02	2.175E 02	2.175E 02	2.175E 02	2.175E 02	2.175E 02	2.175E 02	2.175E 02	2.175E 02	2.175E 02	2.175E 02	2.175E 02
PD	5.525E 02	5.916E 02	6.110E 02	6.282E 02	6.307E 02	6.308E 02	6.308E 02	6.308E 02	6.307E 02	6.307E 02	6.306E 02	6.304E 02
AG	3.584E 01	3.543E 01	3.534E 01	3.528E 01	3.528E 01	3.528E 01	3.528E 01	3.528E 01	3.529E 01	3.531E 01	3.539E 01	3.560E 01
CD	4.887E 01	4.929E 01	4.938E 01	4.942E 01	4.941E 01	4.936E 01	4.933E 01	4.933E 01	4.933E 01	4.933E 01	4.933E 01	4.933E 01
IN	1.056E 00	1.124E 00	1.129E 00	1.144E 00	1.164E 00	1.210E 00	1.237E 00	1.238E 00	1.238E 00	1.238E 00	1.238E 00	1.238E 00
SN	4.182E 01	4.131E 01	4.125E 01	4.124E 01	4.123E 01	4.123E 01	4.123E 01	4.121E 01	4.115E 01	4.098E 01	4.039E 01	3.887E 01
SB	1.465E 01	1.344E 01	1.236E 01	1.027E 01	8.947E 00	8.434E 00	8.431E 00	8.432E 00	8.432E 00	8.432E 00	8.432E 00	8.432E 00
TE	2.210E 02	2.185E 02	2.195E 02	2.216E 02	2.229E 02	2.234E 02	2.235E 02	2.235E 02	2.235E 02	2.237E 02	2.243E 02	2.258E 02
I	1.106E 02	1.082E 02	1.083E 02	1.083E 02	1.083E 02	1.083E 02	1.083E 02	1.083E 02	1.083E 02	1.083E 02	1.083E 02	1.082E 02
XE	2.446E 03	2.446E 03	2.446E 03	2.446E 03	2.446E 03	2.446E 03	2.446E 03	2.446E 03	2.446E 03	2.446E 03	2.446E 03	2.447E 03
CS	1.269E 03	1.246E 03	1.223E 03	1.170E 03	1.108E 03	9.445E 02	7.231E 02	6.685E 02	6.679E 02	6.678E 02	6.675E 02	6.666E 02
BA	6.387E 02	6.574E 02	6.809E 02	7.339E 02	7.957E 02	9.594E 02	1.181E 03	1.235E 03	1.236E 03	1.236E 03	1.236E 03	1.237E 03
LA	5.628E 02	5.613E 02	5.613E 02	5.613E 02	5.613E 02	5.613E 02	5.613E 02	5.613E 02	5.613E 02	5.613E 02	5.613E 02	5.613E 02
CE	1.285E 03	1.168E 03	1.126E 03	1.098E 03	1.096E 03	1.096E 03	1.096E 03	1.096E 03	1.096E 03	1.096E 03	1.096E 03	1.096E 03
PR	5.003E 02	5.154E 02	5.154E 02	5.154E 02	5.154E 02	5.154E 02	5.154E 02	5.154E 02	5.154E 02	5.154E 02	5.154E 02	5.154E 02
ND	1.675E 03	1.784E 03	1.826E 03	1.854E 03	1.856E 03	1.856E 03	1.856E 03	1.856E 03	1.856E 03	1.856E 03	1.856E 03	1.856E 03
PM	6.663E 01	5.215E 01	4.004E 01	1.812E 01	4.835E 00	2.458E-02	2.278E-10	0.0	0.0	0.0	0.0	0.0
SM	3.350E 02	3.526E 02	3.647E 02	3.864E 02	3.995E 02	4.034E 02	4.012E 02	3.986E 02	3.979E 02	3.979E 02	3.979E 02	3.979E 02
EU	7.508E 01	7.258E 01	7.055E 01	6.563E 01	6.018E 01	5.310E 01	5.365E 01	5.619E 01	5.692E 01	5.692E 01	5.692E 01	5.692E 01
GD	3.623E 01	4.006E 01	4.213E 01	4.720E 01	5.289E 01	6.086E 01	6.256E 01	6.256E 01	6.256E 01	6.256E 01	6.256E 01	6.256E 01
TB	1.214E 00	1.174E 00	1.172E 00	1.172E 00	1.172E 00	1.172E 00	1.172E 00	1.172E 00	1.172E 00	1.172E 00	1.172E 00	1.172E 00
DY	5.900E-01	6.328E-01	6.339E-01	6.340E-01	6.340E-01	6.340E-01	6.340E-01	6.340E-01	6.340E-01	6.340E-01	6.340E-01	6.340E-01
HO	6.303E-02	6.296E-02	6.296E-02	6.296E-02	6.296E-02	6.295E-02	6.293E-02	6.286E-02	6.269E-02	6.244E-02	6.233E-02	6.233E-02
ER	2.518E-02	2.534E-02	2.534E-02	2.534E-02	2.534E-02	2.535E-02	2.537E-02	2.544E-02	2.561E-02	2.585E-02	2.596E-02	2.597E-02
TM	2.747E-05	2.574E-05	2.522E-05	2.504E-05	2.499E-05	2.499E-05	2.499E-05	2.499E-05	2.499E-05	2.499E-05	2.499E-05	2.499E-05
YB	3.972E-06	7.210E-06	7.728E-06	7.909E-06	7.955E-06	7.964E-06	7.964E-06	7.964E-06	7.964E-06	7.964E-06	7.964E-06	7.964E-06
TOTAL	1.571E 04	1.571E 04	1.571E 04	1.571E 04	1.571E 04	1.571E 04	1.571E 04	1.571E 04	1.571E 04	1.571E 04	1.571E 04	1.571E 04

TABLE F.3G. Grams of Heavy Elements in a PWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
HE	1.041E-01	1.903E-01	2.228E-01	2.828E-01	3.825E-01	8.231E-01	2.364E 00	5.674E 00	1.194E 01	1.910E 01	3.283E 01	5.210E 01
SF	5.654E-07	1.294E-06	1.796E-06	3.051E-06	4.833E-06	9.424E-06	1.367E-05	1.583E-05	2.210E-05	3.808E-05	7.834E-05	1.394E-04
TL	5.648E-13	1.633E-12	2.818E-12	5.989E-12	8.775E-12	8.739E-12	4.542E-12	9.207E-13	9.174E-13	2.695E-12	9.021E-12	2.623E-11
PB	1.048E-07	4.550E-07	1.178E-06	5.570E-06	1.802E-05	7.843E-05	2.240E-04	3.600E-04	5.966E-04	5.057E-03	1.006E-01	1.168E 00
BI	4.906E-11	1.192E-10	1.936E-10	3.976E-10	6.070E-10	9.784E-10	6.551E-09	1.451E-07	6.981E-06	2.583E-04	1.045E-02	2.088E-01
PO	2.873E-14	7.843E-14	1.589E-13	7.339E-13	3.993E-12	6.339E-11	1.440E-09	2.054E-08	2.964E-07	2.199E-06	1.272E-05	4.443E-05
AT	4.891E-20	1.340E-20	1.381E-20	1.531E-20	1.853E-20	4.057E-20	2.443E-19	2.251E-18	3.503E-17	4.210E-16	4.615E-15	2.672E-14
RN	5.370E-13	1.514E-12	2.608E-12	5.624E-12	8.698E-12	1.446E-11	7.829E-11	7.418E-10	8.674E-09	6.436E-08	3.722E-07	1.300E-06
FR	5.091E-16	2.615E-16	3.428E-16	5.859E-16	9.885E-16	2.596E-15	8.922E-15	3.955E-14	3.846E-13	4.044E-12	4.290E-11	2.466E-10
RA	8.790E-09	1.941E-08	3.259E-08	8.198E-08	1.917E-07	1.097E-06	1.160E-05	1.154E-04	1.351E-03	1.002E-02	5.796E-02	2.025E-01
AC	2.283E-09	5.209E-09	8.117E-09	1.673E-08	3.074E-08	8.353E-08	2.509E-07	7.101E-07	2.384E-06	6.945E-06	2.261E-05	6.309E-05
TH	5.845E-04	8.661E-04	1.150E-03	2.008E-03	3.463E-03	9.571E-03	3.394E-02	1.167E-01	4.325E-01	1.339E 00	4.460E 00	1.263E 01
PA	1.501E-04	1.542E-04	1.578E-04	1.683E-04	1.859E-04	2.565E-04	5.042E-04	1.211E-03	3.671E-03	1.064E-02	3.444E-02	9.546E-02
U	4.412E 05	4.412E 05	4.412E 05	4.412E 05	4.412E 05	4.412E 05	4.412E 05	4.413E 05	4.414E 05	4.417E 05	4.425E 05	4.436E 05
NP	2.392E 02	2.036E 02	2.037E 02	2.041E 02	2.056E 02	2.165E 02	2.714E 02	4.088E 02	6.541E 02	7.676E 02	7.707E 02	7.657E 02
PU	4.187E 03	4.206E 03	4.181E 03	4.112E 03	4.016E 03	3.792E 03	3.630E 03	3.568E 03	3.447E 03	3.146E 03	2.364E 03	1.262E 03
AM	5.449E 01	8.062E 01	1.055E 02	1.731E 02	2.657E 02	4.697E 02	5.444E 02	4.090E 02	1.570E 02	3.514E 01	1.603E 01	2.618E 00
CM	1.425E 01	9.776E 00	8.574E 00	7.451E 00	6.176E 00	2.944E 00	3.052E-01	9.835E-02	9.073E-02	7.309E-02	3.533E-02	5.461E-03
BK	4.611E-08	2.092E-08	9.482E-09	8.833E-10	1.691E-11	2.271E-18	6.322E-23	6.271E-23	6.099E-23	5.632E-23	4.261E-23	1.921E-23
CF	1.691E-08	4.131E-08	5.195E-08	5.852E-08	5.683E-08	5.092E-08	4.268E-08	2.893E-08	7.561E-09	2.405E-10	4.662E-13	7.789E-19
ES	2.561E-12	2.328E-14	9.254E-15	5.887E-16	5.968E-18	6.305E-26	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	4.457E 05	4.457E 05	4.457E 05	4.457E 05	4.457E 05	4.457E 05	4.457E 05	4.457E 05	4.457E 05	4.457E 05	4.457E 05	4.457E 05

TABLE F.3H. Curies of Light-Element Isotopes in a PWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
H 3	1.214E 02	1.148E 02	1.085E 02	9.161E 01	6.911E 01	2.239E 01	4.334E-01	5.522E-06	4.077E-23	0.0	0.0	0.0
C 14	6.853E-01	6.852E-01	6.851E-01	6.848E-01	6.844E-01	6.828E-01	6.770E-01	6.608E-01	6.072E-01	4.767E-01	2.094E-01	1.819E-02
CL 36	5.126E-03	5.126E-03	5.126E-03	5.126E-03	5.126E-03	5.126E-03	5.125E-03	5.123E-03	5.115E-03	5.092E-03	5.013E-03	4.794E-03
MN 54	4.532E 01	1.965E 01	8.522E 00	6.948E-01	1.066E-02	5.889E-10	0.0	0.0	0.0	0.0	0.0	0.0
FE 55	2.572E 03	1.970E 03	1.509E 03	6.782E 02	1.788E 02	8.644E-01	6.793E-09	0.0	0.0	0.0	0.0	0.0
CO 58	3.157E 03	9.062E 01	2.601E 00	6.150E-05	1.198E-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 60	3.629E 03	3.181E 03	2.788E 03	1.878E 03	9.716E 02	6.964E 01	6.867E-03	2.459E-14	0.0	0.0	0.0	0.0
NI 59	2.118E 00	2.118E 00	2.118E 00	2.117E 00	2.117E 00	2.117E 00	2.116E 00	2.112E 00	2.099E 00	2.063E 00	1.942E 00	1.633E 00
NI 63	3.061E 02	3.038E 02	3.015E 02	2.948E 02	2.839E 02	2.442E 02	1.441E 02	3.193E 01	1.637E-01	4.677E-08	0.0	0.0
ZN 65	6.348E 01	2.259E 01	8.037E 00	3.620E-01	2.068E-03	2.187E-12	0.0	0.0	0.0	0.0	0.0	0.0
ZR 93	1.049E-01	1.049E-01	1.049E-01	1.049E-01	1.049E-01	1.049E-01	1.049E-01	1.049E-01	1.049E-01	1.047E-01	1.042E-01	1.027E-01
ZR 95	2.142E 04	4.489E 02	9.406E 00	8.656E-05	3.498E-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NB 93M	6.576E-03	1.181E-02	1.674E-02	2.995E-02	4.746E-02	8.325E-02	9.940E-02	9.967E-02	9.962E-02	9.948E-02	9.897E-02	9.753E-02
NB 94	6.242E-01	6.242E-01	6.242E-01	6.241E-01	6.240E-01	6.236E-01	6.220E-01	6.177E-01	6.029E-01	5.625E-01	4.413E-01	2.205E-01
NB 95	2.190E 04	9.494E 02	2.085E 01	1.867E-04	7.543E-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MO 93	1.396E-02	1.396E-02	1.396E-02	1.395E-02	1.393E-02	1.387E-02	1.364E-02	1.303E-02	1.108E-02	6.981E-03	1.385E-03	1.362E-05
TC 99	2.575E-03	2.589E-03	2.589E-03	2.589E-03	2.589E-03	2.588E-03	2.588E-03	2.586E-03	2.580E-03	2.563E-03	2.505E-03	2.347E-03
IN113M	4.128E 02	4.568E 01	5.054E 00	6.844E-03	1.105E-07	8.341E-27	0.0	0.0	0.0	0.0	0.0	0.0
SN113	4.126E 02	4.565E 01	5.051E 00	6.659E-03	1.104E-07	8.336E-27	0.0	0.0	0.0	0.0	0.0	0.0
SN119M	3.082E 03	1.097E 03	3.902E 02	1.758E 01	1.005E-01	1.066E-10	0.0	0.0	0.0	0.0	0.0	0.0
SN123	1.489E 02	2.094E 01	2.944E 00	8.160E-03	4.484E-07	4.090E-24	0.0	0.0	0.0	0.0	0.0	0.0
SB125	7.875E 02	6.187E 02	4.800E 02	2.241E 02	6.296E 01	3.927E-01	7.501E-09	0.0	0.0	0.0	0.0	0.0
TE125M	1.671E 02	1.507E 02	1.172E 02	5.472E 01	1.530E 01	9.589E-02	1.832E-09	0.0	0.0	0.0	0.0	0.0
SUMTOT	5.823E 04	9.082E 03	5.761E 03	3.243E 03	1.585E 03	3.412E 02	1.482E 02	3.555E 01	3.696E 00	3.321E 00	2.800E 00	2.079E 00
TOTAL	2.070E 05	9.098E 03	5.762E 03	3.244E 03	1.586E 03	3.414E 02	1.482E 02	3.555E 01	3.696E 00	3.321E 00	2.800E 00	2.079E 00

TABLE F.3I. Curies of Fission-Product Isotopes in a PWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
H 3	2.557E 02	2.417E 02	2.285E 02	1.929E 02	1.456E 02	4.716E 01	9.129E-01	1.163E-05	8.586E-23	0.0	0.0	0.0
SE 79	1.888E-01	1.888E-01	1.888E-01	1.888E-01	1.888E-01	1.887E-01	1.886E-01	1.882E-01	1.868E-01	1.828E-01	1.697E-01	1.371E-01
KR 85	4.367E 03	4.095E 03	3.839E 03	3.162E 03	2.289E 03	6.289E 02	6.834E 00	1.673E-05	3.839E-25	0.0	0.0	0.0
SR 89	3.641E 05	2.799E 03	2.149E 01	9.756E-06	2.615E-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SR 90	3.493E 04	3.408E 04	3.325E 04	3.087E 04	2.729E 04	1.666E 04	2.964E 03	2.138E 01	6.780E-07	2.549E-28	0.0	0.0
Y 90	3.648E 04	3.409E 04	3.325E 04	3.088E 04	2.730E 04	1.667E 04	2.965E 03	2.138E 01	6.782E-07	2.550E-28	0.0	0.0
Y 91	4.784E 05	6.403E 03	8.511E 01	2.000E-04	8.308E-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZR 93	1.342E 00	1.343E 00	1.343E 00	1.343E 00	1.343E 00	1.343E 00	1.342E 00	1.342E 00	1.342E 00	1.340E 00	1.333E 00	1.313E 00
NB 93M	9.427E-02	1.606E-01	2.232E-01	3.908E-01	6.128E-01	1.067E 00	1.272E 00	1.275E 00	1.275E 00	1.273E 00	1.266E 00	1.248E 00
ZR 95	6.893E 05	1.445E 04	3.027E 02	2.786E-03	1.126E-11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NB 95	7.013E 05	3.056E 04	6.710E 02	6.007E-03	2.428E-11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TC 99	6.095E 00	6.124E 00	6.124E 00	6.124E 00	6.124E 00	6.124E 00	6.122E 00	6.118E 00	6.104E 00	6.065E 00	5.927E 00	5.552E 00
RU103	6.872E 05	1.149E 03	1.955E 00	9.130E-09	1.191E-22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RH103M	6.874E 05	1.150E 03	1.957E 00	9.139E-09	1.192E-22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU106	2.597E 05	1.308E 05	6.584E 04	8.405E 03	2.720E 02	2.985E-04	4.130E-25	0.0	0.0	0.0	0.0	0.0
RH106	2.867E 05	1.308E 05	6.584E 04	8.405E 03	2.720E 02	2.985E-04	4.130E-25	0.0	0.0	0.0	0.0	0.0
PD107	5.180E-02	5.181E-02	5.181E-02	5.181E-02	5.181E-02	5.181E-02	5.181E-02	5.181E-02	5.180E-02	5.179E-02	5.175E-02	5.164E-02
SB125	6.802E 03	5.323E 03	4.129E 03	1.928E 03	5.416E 02	3.374E 00	6.445E-08	0.0	0.0	0.0	0.0	0.0
TE125M	1.439E 03	1.297E 03	1.008E 03	4.708E 02	1.323E 02	8.242E-01	1.574E-08	0.0	0.0	0.0	0.0	0.0
SN126	3.577E-01	3.577E-01	3.577E-01	3.577E-01	3.577E-01	3.576E-01	3.575E-01	3.570E-01	3.553E-01	3.504E-01	3.338E-01	2.905E-01
SB126	5.067E 02	5.008E-02	5.008E-02	5.008E-02	5.008E-02	5.007E-02	5.005E-02	4.998E-02	4.973E-02	4.905E-02	4.673E-02	4.067E-02
SB126M	2.283E 02	3.577E-01	3.577E-01	3.577E-01	3.577E-01	3.576E-01	3.575E-01	3.570E-01	3.552E-01	3.504E-01	3.338E-01	2.905E-01
I129	1.422E-02	1.444E-02	1.444E-02	1.444E-02	1.444E-02	1.444E-02	1.444E-02	1.444E-02	1.444E-02	1.443E-02	1.443E-02	1.442E-02
CS134	7.127E 04	5.091E 04	3.637E 04	1.325E 04	2.464E 03	3.003E 00	1.773E-10	0.0	0.0	0.0	0.0	0.0
CS135	1.711E-01	1.714E-01	1.714E-01	1.714E-01	1.714E-01	1.714E-01	1.714E-01	1.714E-01	1.714E-01	1.713E-01	1.709E-01	1.699E-01
CS137	4.786E 04	4.677E 04	4.570E 04	4.265E 04	3.801E 04	2.398E 04	4.785E 03	4.783E 01	4.777E-06	4.759E-26	0.0	0.0
BA137M	4.537E 04	4.424E 04	4.324E 04	4.035E 04	3.596E 04	2.269E 04	4.526E 03	4.525E 01	4.519E-06	4.502E-26	0.0	0.0
CE144	5.577E 05	2.290E 05	9.400E 04	6.504E 03	7.587E 01	1.404E-06	0.0	0.0	0.0	0.0	0.0	0.0
PR144	5.618E 05	2.290E 05	9.400E 04	6.504E 03	7.587E 01	1.404E-06	0.0	0.0	0.0	0.0	0.0	0.0
PR144M	6.699E 03	2.748E 03	1.128E 03	7.805E 01	9.104E-01	1.684E-08	0.0	0.0	0.0	0.0	0.0	0.0
PM147	5.980E 04	4.837E 04	3.714E 04	1.681E 04	4.485E 03	2.280E 01	2.112E-07	0.0	0.0	0.0	0.0	0.0
SM151	1.731E 02	1.749E 02	1.736E 02	1.697E 02	1.635E 02	1.409E 02	8.358E 01	1.881E 01	1.017E-01	3.383E-08	0.0	0.0
EU154	4.902E 03	4.522E 03	4.172E 03	3.275E 03	2.188E 03	4.360E 02	1.533E 00	1.513E-07	0.0	0.0	0.0	0.0
EU155	3.205E 03	2.774E 03	2.401E 03	1.556E 03	7.557E 02	4.202E 01	1.703E-03	4.808E-16	0.0	0.0	0.0	0.0
SUMTOT	5.598E 06	1.056E 06	5.668E 05	2.155E 05	1.424E 05	8.134E 04	1.534E 04	1.646E 02	1.001E 01	9.847E 00	9.647E 00	9.108E 00
TOTAL	7.293E 07	1.059E 06	5.673E 05	2.155E 05	1.425E 05	8.135E 04	1.534E 04	1.646E 02	1.001E 01	9.847E 00	9.647E 00	9.108E 00

TABLE F.3J. Curies of Heavy-Element Isotopes in a PWR Assembly

	DISCHARGE	1. YR	2. YR	5. YR	10. YR	30. YR	100. YR	300. YR	1000. YR	3000. YR	10000. YR	30000. YR
PB210	2.206E-10	4.882E-10	9.396E-10	3.996E-09	1.790E-08	2.856E-07	6.489E-06	9.259E-05	1.336E-03	9.914E-03	5.733E-02	2.003E-01
PB214	5.873E-09	1.104E-08	1.814E-08	5.113E-08	1.457E-07	1.041E-06	1.145E-05	1.142E-04	1.336E-03	9.914E-03	5.733E-02	2.003E-01
BI210	2.227E-10	4.885E-10	9.400E-10	3.997E-09	1.791E-08	2.856E-07	6.489E-06	9.259E-05	1.336E-03	9.914E-03	5.733E-02	2.003E-01
BI214	5.873E-09	1.104E-08	1.814E-08	5.113E-08	1.457E-07	1.041E-06	1.145E-05	1.142E-04	1.336E-03	9.914E-03	5.733E-02	2.003E-01
PO210	1.235E-10	3.363E-10	6.862E-10	3.245E-09	1.791E-08	2.856E-07	6.489E-06	9.259E-05	1.336E-03	9.914E-03	5.733E-02	2.003E-01
PO214	8.320E-09	1.104E-08	1.814E-08	5.113E-08	1.457E-07	1.041E-06	1.145E-05	1.142E-04	1.336E-03	9.914E-03	5.733E-02	2.003E-01
PO218	5.873E-09	1.104E-08	1.814E-08	5.113E-08	1.457E-07	1.041E-06	1.145E-05	1.142E-04	1.336E-03	9.914E-03	5.733E-02	2.003E-01
RN222	5.873E-09	1.104E-08	1.814E-08	5.113E-08	1.457E-07	1.041E-06	1.145E-05	1.142E-04	1.336E-03	9.914E-03	5.733E-02	2.003E-01
RA226	5.867E-09	1.104E-08	1.814E-08	5.113E-08	1.457E-07	1.041E-06	1.145E-05	1.142E-04	1.336E-03	9.914E-03	5.733E-02	2.003E-01
TH230	9.717E-06	1.417E-05	1.865E-05	3.224E-05	5.538E-05	1.538E-04	5.564E-04	1.960E-03	7.358E-03	2.267E-02	7.368E-02	1.990E-01
TH234	1.453E-01	1.451E-01	1.452E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01
PA233	1.348E-01	1.436E-01	1.436E-01	1.440E-01	1.450E-01	1.526E-01	1.914E-01	2.883E-01	4.613E-01	5.413E-01	5.435E-01	5.400E-01
PA234M	1.472E-01	1.451E-01	1.452E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01
U234	5.125E-01	5.154E-01	5.183E-01	5.272E-01	5.415E-01	5.935E-01	7.231E-01	8.643E-01	9.008E-01	8.968E-01	8.821E-01	8.419E-01
U236	1.159E-01	1.159E-01	1.159E-01	1.160E-01	1.160E-01	1.161E-01	1.166E-01	1.180E-01	1.225E-01	1.337E-01	1.590E-01	1.799E-01
U238	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01	1.451E-01
NP237	1.403E-01	1.436E-01	1.436E-01	1.440E-01	1.450E-01	1.526E-01	1.914E-01	2.883E-01	4.613E-01	5.413E-01	5.435E-01	5.400E-01
NP239	9.236E 06	7.631E 00	7.630E 00	7.628E 00	7.625E 00	7.611E 00	7.563E 00	7.427E 00	6.971E 00	5.815E 00	3.084E 00	5.036E-01
PU238	9.832E 02	1.054E 03	1.061E 03	1.040E 03	1.001E 03	8.564E 02	4.970E 02	1.052E 02	4.867E-01	4.561E-06	6.144E-20	0.0
PU239	1.400E 02	1.424E 02	1.424E 02	1.424E 02	1.424E 02	1.423E 02	1.421E 02	1.413E 02	1.387E 02	1.314E 02	1.084E 02	6.201E 01
PU240	2.358E 02	2.358E 02	2.359E 02	2.360E 02	2.361E 02	2.363E 02	2.352E 02	2.305E 02	2.145E 02	1.747E 02	8.525E 01	1.097E 01
PU241	5.736E 04	5.470E 04	5.216E 04	4.524E 04	3.568E 04	1.380E 04	4.975E 02	4.750E-02	9.583E-03	8.103E-03	4.505E-03	8.419E-04
PU242	8.294E-01	8.295E-01	8.295E-01	8.295E-01	8.295E-01	8.294E-01	8.294E-01	8.291E-01	8.281E-01	8.251E-01	8.147E-01	7.855E-01
AM241	5.015E 01	1.397E 02	2.249E 02	4.567E 02	7.740E 02	1.474E 03	1.731E 03	1.269E 03	4.139E 02	1.685E 01	4.734E-03	8.419E-04
AM243	7.621E 00	7.631E 00	7.630E 00	7.628E 00	7.625E 00	7.611E 00	7.563E 00	7.427E 00	6.971E 00	5.815E 00	3.084E 00	5.036E-01
CM242	1.743E 04	3.713E 03	7.867E 02	9.020E 00	1.551E 00	1.412E 00	1.026E 00	4.123E-01	1.694E-02	1.659E-06	2.546E-20	0.0
CM244	7.091E 02	6.827E 02	6.570E 02	5.857E 02	4.836E 02	2.249E 02	1.541E 01	7.268E-03	1.657E-14	0.0	0.0	0.0
SUMTOT	9.313E 06	6.068E 04	5.529E 04	4.772E 04	3.833E 04	1.676E 04	3.137E 03	1.764E 03	7.847E 02	3.381E 02	2.038E 02	7.931E 01
TCTAL	1.932E 07	6.069E 04	5.530E 04	4.773E 04	3.834E 04	1.676E 04	3.140E 03	1.765E 03	7.848E 02	3.381E 02	2.040E 02	7.978E 01

APPENDIX G

GRAPHICAL RESULTS OF HYDROLOGIC AND TRANSPORT SIMULATIONS

APPENDIX G

GRAPHICAL RESULTS OF HYDROLOGIC AND TRANSPORT SIMULATIONS

This appendix shows the output from the VTT hydrologic model, and shows the plots of concentration versus time for the geotransported radioisotopes as simulated by the MMT model. The scenarios used in this appendix are:

PIR1, base case, times 200 and 1000 (Scenario 1)
PIR2, East Texas field removed, Sabine discharge (Scenario 2)
PIR3, East Texas field removed, Big Cypress discharge (Scenario 2)
PIR4, well scenario (Scenario 3)
PIR5, PIR2, but lower Kd values (Scenario 4)

APPENDIX G.1 AND G.2: OUTPUT FROM VTT HYDROLOGIC MODEL

TABLE G.1. Printer Map of Model Results for Sabine-Big Cypress Bayou Discharge. Model generated aquifer potentiometric surface (ft MSL)

LINE \ COLUMN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
65																									
64																									
63																									
62																									
61																									
60																									
59																									450
58																								450	432
57																							450	437	420
56																							450	431	414
55												450	450	450	450							450	443	427	411
54									450	450	449	451	450	450	449	450					450	443	433	410	405
53							450	450	450	446	443	439	442	442	442	444	450			450	436	425	415	404	395
52						450	440	415	431	422	425	424	420	438	429	431	435	450	450	420	415	406	398	390	382
51					450	435	440	426	417	415	413	410	415	416	416	416	416	417	414	406	398	392	386	379	372
50					450	442	428	421	415	410	405	405	407	407	407	406	405	402	399	393	387	382	377	372	366
49				456	446	437	428	423	418	418	403	399	400	401	400	399	397	394	391	386	381	376	372	367	363
48				450	439	430	422	419	415	408	402	397	393	394	394	393	392	389	385	381	377	373	369	365	361
47			450	435	422	416	410	404	402	399	395	392	380	386	388	388	387	384	381	378	374	371	367	364	359
46			450	390	383	394	388	377	382	381	380	382	382	381	380	382	382	380	378	375	372	369	365	361	356
45			450	427	400	377	372	369	370	368	362	370	374	375	376	377	376	375	374	372	369	366	363	359	354
44			450	442	414	384	373	368	364	360	358	363	367	370	371	372	372	372	371	369	367	364	360	356	351
43				450	427	370	369	372	360	362	355	355	361	365	367	368	368	368	368	368	365	361	350	353	349
42					450	379	392	385	375	364	358	356	355	362	365	366	365	365	364	363	361	358	354	350	346
41						450	423	404	385	350	353	354	361	364	364	364	363	362	361	360	357	354	351	347	342
40						450	436	410	390	363	370	371	360	367	365	363	361	360	358	356	354	351	347	343	339
39					450	407	438	432	400	412	406	388	376	370	366	362	360	357	355	353	350	346	343	339	336
38				450	451	413	459	468	463	468	444	411	385	373	366	361	357	355	352	349	346	342	340	336	333
37				456	465	479	487	492	499	500	500	433	396	375	365	359	355	352	349	345	342	339	336	334	330
36										500	469	429	397	375	363	355	351	348	345	341	338	336	333	331	328
35								500	500	475	444	412	386	369	358	351	347	344	341	338	335	333	330	320	325
34							500	401	468	447	418	391	373	362	353	347	344	341	338	334	332	329	327	324	322
33						500	471	452	437	416	394	375	363	356	349	344	340	337	334	331	328	325	323	321	319
32					500	456	438	415	402	388	374	362	355	350	344	346	337	334	330	326	324	321	319	317	315
31				425	430	416	401	389	379	370	361	353	348	344	348	336	333	330	326	322	319	314	314	313	312
30				414	408	398	387	377	368	360	353	348	344	340	336	333	329	326	322	318	314	306	309	310	310
29					398	387	377	368	361	354	348	344	340	336	332	329	325	322	318	315	312	309	308	308	307
28						377	367	360	353	348	343	339	335	331	328	324	321	318	315	313	310	308	307	306	306
27							356	351	346	342	337	334	330	327	323	320	317	314	312	310	308	306	305	304	304
26							345	343	340	336	332	328	325	322	319	316	313	311	308	306	305	303	302	302	302

TABLE G.1. (contd)

25.	340	337	334	330	326	323	320	317	314	312	309	307	305	303	301	300	299	299	299
24.		333	328	324	320	317	315	312	310	307	305	303	301	299	298	297	296	296	296
23.			323	318	315	312	310	307	305	303	301	299	297	295	294	293	293	292	293
22.				311	309	306	304	302	301	298	296	294	293	291	290	290	289	289	289
21.				303	302	301	300	298	296	294	292	290	289	287	286	285	285	284	285
20.				297	297	296	295	293	291	290	288	286	285	283	282	281	280	280	280
19.				292	291	291	290	288	287	285	283	282	280	279	278	277	276	276	276
18.				287	286	286	285	283	282	280	279	277	276	275	273	272	272	272	272
17.				282	282	281	280	279	278	276	275	273	272	270	269	268	267	268	269
16.				278	278	277	276	274	273	272	270	269	267	266	265	265	264	265	266
15.				275	274	273	271	270	269	267	266	264	263	262	262	261	261	261	262
14.					270	269	267	266	264	262	261	260	259	258	257	257	257	257	258
13.					266	265	263	262	260	258	256	255	254	253	252	252	252	253	254
12.					263	261	260	258	256	254	252	251	249	248	247	247	247	247	248
11.						258	257	255	252	250	248	246	245	243	242	242	242	242	243
10.						255	253	251	249	246	244	241	239	238	237	236	236	237	237
9.							251	248	245	242	239	236	234	232	231	230	230	230	229
8.								245	241	237	234	231	228	226	224	223	222	222	221
7.									235	232	229	226	223	220	218	216	214	214	212
6.									228	226	223	220	217	214	210	207	203	205	205
5.									225	220	217	214	211	206	200	200		200	200
4.										215	212	208	205	200					
3.										209	205	200	200						
2.											200								
1.																			

TABLE G.1. (contd)

MODELED POTENTIALS FOR THE SABINE - BIG CYPRESS BAYOU DISCHARGE
MAX= 0.5000E+03 MIN= 0.1919E+03 RMS= 0.3042E+03 PLUS MEANS NEW IS HIGHER
AVG= 0.298E+03 # ACTIVE NODES= 2703 AVG POS= 296.0637 # POS= 2703 AVG NEG= 0.0000 # NEG= 0
BASE FILE NAME NULL.FIL NEW FILE NAMEOP1YPIR3POT.A01

COLUMN / LINE	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
65										270	244	200													
64								296	266	274	256	238	208	200											
63							293	289	286	280	270	251	234	222	200										
62			450	450	456	381	341	332	322	309	288	272	263	249	242	208	200								
61		450	438	426	418	378	357	355	351	342	325	307	289	269	263	253	244	208	200						
60	450	455	420	404	383	356	348	353	358	356	347	334	316	297	282	268	254	229	217	200					
59	432	417	401	382	357	324	338	339	347	352	348	339	324	301	284	268	252	234	221	208	200				
58	416	400	383	365	344	325	315	325	331	334	329	322	311	297	282	267	253	238	226	215	206	200			
57	405	390	373	355	336	320	307	315	318	316	313	309	301	290	278	265	254	241	231	221	212	205	200		
56	399	383	365	346	327	312	300	305	307	305	302	298	291	282	273	263	254	244	235	226	217	210	204	200	
55	395	377	358	337	311	300	294	297	298	296	293	288	282	276	269	261	254	245	238	232	222	215	208	203	200
54	392	372	352	332	315	305	297	284	298	288	285	281	276	271	265	259	253	246	240	234	226	218	210	204	201
53	383	365	344	327	315	306	298	289	280	280	278	274	270	266	261	257	251	246	241	236	228	220	212	205	200
52	371	355	338	325	314	306	298	290	282	274	272	269	265	261	258	254	250	247	243	238	230	223	214	206	200
51	363	349	334	323	314	306	298	290	282	275	268	265	260	257	255	252	249	247	244	239	232	225	218	210	203
50	356	345	335	323	315	306	298	290	282	275	269	262	255	252	252	251	249	247	244	240	253	227	220	213	205
49	355	344	334	324	315	306	297	290	283	276	270	263	255	252	252	250	249	247	244	239	233	227	221	213	205
48	354	340	334	325	316	306	297	290	284	278	271	265	259	253	252	251	249	247	243	239	233	227	220	212	202
47	353	340	335	326	317	305	297	290	285	279	273	267	262	255	252	251	249	247	244	239	233	226	219	211	200
46	350	343	335	326	316	306	297	291	285	280	275	270	265	260	254	252	250	240	245	240	233	226	218	208	200
45	348	342	335	326	316	307	299	292	286	281	277	272	268	264	259	256	252	250	240	242	232	225	216	200	
44	346	340	333	324	316	307	300	293	287	282	278	275	271	267	263	259	256	253	250	246	230	223	217	200	
43	344	338	330	323	315	307	300	294	288	284	280	276	273	270	267	263	259	256	252	247	238	231	224	213	200
42	341	335	328	321	314	307	301	295	290	285	281	278	275	272	269	266	263	259	256	251	244	238	232	224	216
41	338	332	326	320	314	307	300	295	291	287	283	279	276	274	271	268	265	262	259	255	249	245	240	236	232
40	334	329	324	319	313	307	301	296	291	288	284	281	278	275	273	270	267	265	262	259	255	252	250	250	252
39	332	327	322	317	312	306	301	296	292	288	285	282	279	277	274	271	269	267	265	263	260	259	259	263	268
38	329	325	320	315	310	306	302	297	293	289	286	283	281	278	275	272	270	268	266	265	264	264	266	272	280
37	327	323	318	313	309	306	302	299	295	290	287	284	282	279	276	273	270	268	267	266	266	267	271	279	288
36	324	320	316	312	308	305	302	299	296	292	288	285	283	280	277	273	270	268	266	266	266	269	273	280	295
35	322	318	314	310	308	305	303	300	297	293	290	287	284	281	277	273	269	266	265	265	266	270	273	271	254
34	319	316	312	309	307	305	303	300	297	294	291	288	285	281	277	272	268	264	262	263	265	272	276	277	274
33	316	313	311	308	307	305	303	300	298	295	293	289	286	282	277	272	266	261	258	259	262	268	272	273	272
32	313	311	309	308	306	305	303	301	299	297	294	291	287	283	278	273	265	254	250	253	253	259	261	263	261
31	311	310	308	307	306	305	303	302	300	298	296	293	289	285	281	275	267	254	249	246	243	241	240	249	245
30	309	308	307	306	306	305	304	303	301	300	298	295	292	288	284	279	274	267	261	257	254	252	247	238	246
29	307	307	306	306	305	305	304	304	303	302	300	298	296	293	291	287	284	281	276	269	263	257	250	240	232
28	305	305	305	305	305	305	305	305	305	304	304	303	303	303	303	301	298	295	290	280	271	261	251	238	225

TABLE G.1. (contd)

27*	304	304	304	304	305	305	306	306	306	307	308	311	314	315	315	314	309	301	294	285	276	265	248	233	224
26*	302	302	303	304	304	305	306	307	308	310	314	320	324	325	323	322	317	308	297	287	276	264	249	236	225
25*	300	301	302	303	304	305	307	309	311	314	322	330	334	332	328	324	316	308	298	286	275	264	258	251	243
24*	297	299	300	302	304	305	308	310	313	319	329	340	345	342	334	327	319	308	297	286	275	268	262	257	251
23*	294	296	299	301	303	305	308	311	315	324	337	347	352	350	343	332	320	307	296	285	277	270	264	259	254
22*	290	293	295	298	301	304	308	312	316	330	344	353	358	356	349	336	321	308	296	286	278	271	265	260	254
21*	285	287	290	293	297	302	307	313	321	334	347	359	367	360	351	339	324	309	296	286	277	271	264	259	252
20*	280	281	285	289	293	298	304	312	322	333	347	361	369	361	351	341	326	310	296	285	274	269	262	256	248
19*	276	277	280	284	289	294	301	309	319	331	345	363	367	364	352	345	329	311	295	282	273	268	260	257	253
18*	272	273	275	279	284	290	297	305	315	326	338	352	357	355	349	342	332	319	306	294	284	274	266	261	257
17*	269	270	271	275	279	285	291	300	309	319	330	342	349	351	340	343	335	324	313	301	291	282	274	267	261
16*	266	267	268	270	274	279	285	293	302	312	323	334	344	350	351	349	338	328	317	306	298	291	285	278	267
15*	263	264	265	266	269	273	278	284	292	302	313	327	342	353	361	373	344	331	321	311	303	301	297	290	276
14*	259	260	260	261	263	266	270	275	282	289	299	317	341	359	371	353	338	332	325	315	301	304	303	299	291
13*	254	255	255	255	256	257	260	264	272	284	305	321	336	334	336	330	324	320	319	312	295	299	300	300	295
12*	248	249	248	248	248	249	251	254	260	269	282	293	302	306	308	308	306	306	306	306	297	291	294	296	297
11*	243	242	241	240	240	240	241	243	247	253	260	267	273	278	283	286	289	291	293	296	292	286	289	290	293
10*	236	235	233	232	231	230	230	230	232	234	237	240	244	249	257	264	269	274	278	282	284	280	281	282	281
9*	228	226	224	223	221	219	218	217	217	217	215	216	218	222	231	241	249	256	262	268	275	274	271	273	273
8*	219	217	216	214	211	210	208	207	206	205	200	200	200	200	211	222	231	238	244	252	261	265	261	263	268
7*	211	209	208	206	205	204	202	200	200	200					200	211	217	222	227	233	243	252	254	259	261
6*	204	203	203	202	200	200										210	208	209	211	215	225	237	246	251	253
5*	200	200	200	200													200	200	200	200	210	222	234	241	244
4*																					200	209	220	229	233
3*																						200	200	215	219
2*																							200	206	209
1*																								200	200

TABLE G.1. (contd)

LINE \ COLUMN	51	52	53	54	55	56	57	58	59	60
65										
64										
63										
62										
61										
60										
59										
58										
57										
56										
55										
54										
53										
52										
51	200									
50	200									
49	200									
48										
47										
46										
45										
44										
43	200									
42	209	200	200							
41	225	213	224	200	200	200				
40	253	254	250	248	237	223	200	200	200	
39	274	276	270	270	252	250	240	230	210	203
38	286	289	291	287	278	269	254	233	218	200
37	293	298	300	296	286	270	236	200	200	
36	298	301	302	298	285	262	200			
35	265	297	299	293	270	252	200			
34	276	290	293	286	273	249	223	200		
33	266	282	285	280	269	255	238	220	200	
32	257	274	278	276	270	261	250	237	222	200
31	259	268	274	270	273	268	268	251	243	230
30	254	261	266	271	278	274	269	262	258	258
29	246	251	257	264	271	278	276	269	265	266
28	236	241	253	257	264	269	273	269	268	268
27	223	234	242	250	256	261	266	265	267	267

TABLE G.1. (contd)

26*	210	219	225	241	249	253	257	258	259	260
25*	234	226	210	233	241	246	248	250	250	251
24*	243	235	223	210	233	238	240	242	243	244
23*	249	239	222	210	229	230	233	235	238	240
22*	245	233	219	206	217	223	222	230	234	236
21*	242	228	210	202	210	213	210	222	220	232
20*	236	223	215	202	204	209	202	213	219	
19*	240	235	221	200	198	196	200	203	206	
18*	251	242	222	200	201	196	194	192	192	
17*	255	240	236	224	215	209	205	205	209	
16*	260	253	243	232	223	215	212	212	214	
15*	260	258	246	236	226	215	212	217	220	
14*	280	268	268	263	256	247	236	212	206	
13*	281	284	283	279	274	267	258	247		
12*	294	292	286	285	282	277	278	266		
11*	294	291	273	278	278	276	269	256		
10*	287	290	283	264	261	269	259			
9*	278	266	268	284	279	263	274			
8*	272	279	286	290	292	293	302			
7*	264	268	274	281	291	298	310			
6*	256	259	263	269	277	284				
5*	246	248	251	256	263	270				
4*	234	235	237	241	248					
3*	220	221	223	227	233					
2*	210	211	212	215						
1*	200	200	200	200						

TABLE G.2. Printer Map of Model Results for East Texas Oil Field Area Discharge. Model generated aquifer potentiometric surface (ft MSL).

LINE \ COLUMN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
65																									
64																									
63																									
62																									
61																									
60																									
59																									450
58																								450	432
57																							450	436	420
56																							450	430	414
55												450	450	450	450							450	443	426	418
54									450	450	449	451	450	449	449	450					450	442	432	416	403
53							450	450	450	446	443	439	441	442	441	444	450			450	435	423	413	402	392
52						450	446	415	431	422	425	424	426	429	429	430	435	450	450	427	412	403	394	386	378
51					450	435	440	426	417	415	413	410	414	415	415	414	414	415	411	403	395	388	382	375	368
50					450	441	428	421	415	409	405	405	406	406	405	404	402	400	396	390	383	378	373	367	361
49				450	446	437	428	423	418	410	403	399	399	399	399	397	395	391	387	382	376	371	367	362	357
48				450	439	430	422	419	415	408	401	396	392	393	392	391	389	385	381	376	372	368	364	359	355
47			450	435	422	416	409	404	402	398	395	391	388	385	386	385	384	381	377	373	369	365	362	358	353
46			450	390	383	394	388	377	382	381	380	381	381	380	379	380	378	376	373	378	366	363	359	355	350
45			450	427	400	377	372	369	370	368	362	370	373	373	373	373	373	371	369	366	363	360	356	352	346
44			450	442	414	380	373	368	364	360	357	362	366	367	368	368	368	367	365	364	361	357	353	349	343
43				450	427	370	369	372	368	362	355	354	359	362	364	364	364	363	362	362	358	354	350	345	340
42					450	379	392	385	375	364	357	355	353	359	361	361	360	359	358	357	354	350	346	341	336
41						450	423	404	385	354	353	353	356	360	360	358	357	355	354	352	349	346	341	337	331
40						450	436	414	390	382	377	368	364	362	360	357	355	352	350	348	345	341	336	332	326
39					454	407	430	432	400	412	405	384	371	365	360	356	352	349	347	344	340	336	331	327	322
38				450	451	413	459	460	462	459	443	407	381	367	360	354	349	346	343	339	335	331	327	323	319
37				456	465	479	487	492	499	500	500	429	391	369	358	351	346	342	339	334	330	326	323	319	315
36										500	467	424	391	368	355	346	341	338	334	329	325	322	319	315	311
35								500	500	473	441	407	379	360	349	341	336	333	330	325	322	318	315	311	308
34							500	480	467	444	413	384	365	353	344	337	333	329	325	321	317	314	311	307	304
33						500	469	450	434	411	388	367	355	346	339	333	329	325	321	316	312	309	306	303	300
32					500	454	426	410	397	382	367	354	346	340	334	329	325	321	316	312	307	302	300	299	296
31				420	425	411	395	383	372	362	353	345	339	335	330	325	321	317	312	307	301	291	294	294	293
30				409	403	392	388	378	361	353	345	339	334	330	326	322	318	313	308	304	298	288	291	292	291
29					392	381	370	361	353	346	340	335	330	326	322	318	314	309	305	301	297	293	291	291	290
28						378	368	352	346	340	335	330	326	322	318	314	310	306	302	299	296	293	291	290	289
27							348	343	338	333	329	325	321	317	313	310	306	303	300	297	294	292	290	289	288
26							337	335	331	327	323	319	316	312	309	306	302	299	297	294	292	290	288	287	286

TABLE G.2. (contd)

25*	332	329	326	321	318	314	311	307	305	302	299	296	293	291	289	287	286	285	285
24*		325	320	316	312	309	306	303	300	298	295	292	290	288	286	285	284	283	283
23*			315	310	306	303	301	298	296	294	291	289	287	285	283	282	281	280	280
22*				303	300	298	296	294	292	289	287	285	283	281	280	279	278	277	277
21*				295	294	293	291	289	287	285	283	281	279	278	277	276	275	274	274
20*				289	289	288	287	285	283	281	279	277	276	275	273	272	271	271	270
19*				284	284	283	282	280	279	277	275	274	272	271	269	268	267	267	267
18*				279	279	278	277	276	275	273	271	270	268	267	266	264	264	264	264
17*				275	275	274	273	272	270	269	267	266	264	263	262	261	259	260	261
16*				271	271	270	269	268	266	265	263	262	261	260	259	258	257	258	258
15*				269	267	266	265	264	262	261	259	258	257	256	255	255	254	253	256
14*					264	263	261	260	258	256	255	254	253	252	251	251	251	251	252
13*					260	259	258	256	254	252	251	250	249	248	247	247	247	247	248
12*					257	256	254	253	251	249	247	246	244	243	243	242	242	242	243
11*						253	251	249	247	245	243	242	240	239	238	238	238	238	238
10*						250	248	246	244	242	239	237	236	234	233	233	233	233	233
9*							246	243	241	238	235	233	230	229	228	227	227	227	226
8*								240	237	234	231	228	226	224	222	221	220	220	219
7*									232	229	226	223	221	218	216	214	213	212	211
6*									225	224	221	218	215	212	209	207	203	205	204
5*									221	219	216	213	210	206	200	200		200	200
4*										214	211	207	204	200					
3*										209	205	200	200						
2*											200								
1*																			

TABLE G.2. (contd)

MODELED POTENTIALS FOR THE EAST TEXAS OIL FIELD DISCHARGE CASE
MAX= 0.5000E+03 MIN= 0.1919E+03 RMS= 0.29864E+03 PLUS MEANS NEW IS HIGHER
AVG= 0.292E+03 # ACTIVE NODES= 2703 AVG POS= 292.3422 # POS= 2703 AVG NEG= 0.0000 # NEG= 0
BASE FILE NAME NULL.FIL NEW FILE NAMEDP1:PIR1POT.A01

LINE \ COLUMN	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
65*										270	244	200													
64*								296	286	274	256	230	200	200											
63*							293	289	286	288	270	251	234	222	200										
62*			450	456	450	381	341	332	322	309	260	272	263	249	242	200	200								
61*		450	438	426	410	378	357	355	351	341	325	307	289	269	263	253	244	200	200						
60*	450	435	420	404	383	336	348	353	358	356	347	334	316	297	282	260	254	229	217	200					
59*	432	416	400	382	357	324	330	339	347	352	348	339	324	301	284	268	252	234	221	200	200				
58*	415	399	383	365	344	325	315	325	331	334	329	322	311	297	282	267	253	238	226	215	206	200			
57*	405	389	372	354	336	320	307	315	318	316	313	308	301	290	277	265	253	241	231	221	211	205	200		
56*	399	382	365	346	326	312	300	305	306	304	301	297	291	282	272	263	253	243	234	226	217	210	204	200	
55*	394	376	357	336	311	300	293	297	298	295	292	288	282	275	268	261	253	244	237	230	222	215	208	203	200
54*	390	371	351	331	314	304	296	288	289	287	284	280	275	270	264	259	252	245	239	233	225	218	210	204	201
53*	381	362	342	325	313	304	296	288	288	280	277	274	269	265	261	256	251	246	241	236	228	220	212	205	200
52*	367	351	335	322	312	303	296	288	280	273	271	268	264	261	257	254	250	246	242	238	230	222	214	206	200
51*	359	345	330	319	310	303	295	287	280	273	267	264	260	256	254	251	249	246	243	239	232	225	218	210	203
50*	353	340	320	319	310	302	294	286	279	272	267	261	254	252	251	250	248	246	243	239	232	226	220	213	205
49*	350	339	320	319	310	301	291	284	278	272	266	261	254	252	251	249	248	246	243	238	232	227	221	213	205
48*	348	338	329	319	310	299	290	283	278	272	267	262	257	252	251	249	248	246	242	238	232	226	220	212	202
47*	346	337	328	319	309	298	289	282	277	272	267	262	258	253	251	250	248	246	243	238	232	226	219	211	200
46*	343	336	327	318	307	297	288	282	276	272	267	263	259	255	252	250	249	247	244	240	233	225	218	208	200
45*	340	334	326	316	306	296	288	281	276	271	267	263	260	257	254	252	250	249	246	241	232	225	216	200	
44*	337	331	323	313	304	295	287	280	275	270	267	263	260	258	255	253	251	249	248	245	230	223	217	200	
43*	334	328	319	310	302	294	286	280	274	270	266	263	260	258	255	253	251	250	248	244	235	229	222	212	200
42*	330	323	315	307	300	292	284	278	273	269	265	262	260	257	255	254	252	250	248	245	239	234	229	222	215
41*	326	319	311	305	297	290	282	276	272	268	264	261	259	257	255	254	252	251	249	246	243	239	236	233	230
40*	321	315	308	302	295	287	280	275	270	266	262	260	257	256	254	253	252	251	250	249	246	245	244	246	249
39*	317	311	305	298	291	285	278	273	268	264	261	258	256	254	253	252	252	251	251	250	250	250	253	258	265
38*	314	308	302	295	288	282	276	271	266	262	258	255	253	252	252	251	251	252	252	252	253	255	260	268	278
37*	310	304	298	291	285	279	274	269	263	259	255	252	250	249	249	250	251	252	252	253	255	259	266	275	287
36*	307	301	294	288	283	274	272	266	259	255	252	249	245	244	246	249	251	252	253	254	257	261	268	277	295
35*	303	298	291	286	281	276	271	263	255	252	250	246	236	234	244	248	251	252	253	255	258	264	269	268	253
34*	300	295	289	284	280	276	270	262	256	253	252	249	245	244	248	250	251	252	253	255	259	267	273	275	273
33*	296	292	288	284	280	276	271	264	258	256	255	253	251	251	252	252	252	251	251	253	257	265	269	271	271
32*	294	290	287	284	281	278	273	260	263	261	259	257	256	256	256	255	253	250	248	250	252	257	260	262	261
31*	291	289	286	284	282	279	275	272	268	265	263	261	260	260	260	259	257	251	248	249	243	241	240	249	245
30*	290	288	286	284	282	280	278	275	272	269	266	263	263	264	265	265	264	262	259	256	253	251	247	230	245
29*	289	287	286	284	283	282	280	278	276	273	269	261	267	271	274	275	276	276	274	268	262	257	250	240	232

TABLE G.2. (contd)

28*	288	287	286	285	284	283	282	281	280	278	277	275	281	287	291	293	293	293	289	280	271	261	251	238	225
27*	287	286	286	285	285	285	285	284	284	284	283	290	296	304	308	309	306	301	294	285	276	265	248	233	224
26*	286	285	285	285	286	286	287	287	288	290	295	305	312	317	319	320	316	307	297	287	276	264	249	236	225
25*	285	285	285	286	286	287	289	290	293	297	307	318	326	327	325	323	318	308	297	286	275	264	258	251	243
24*	283	284	284	285	287	288	291	293	297	304	317	331	338	337	331	327	318	308	297	285	275	268	262	257	251
23*	281	282	283	285	287	289	292	296	301	311	328	341	347	346	340	330	319	307	295	285	277	270	264	259	254
22*	278	280	281	284	286	290	294	298	306	320	337	349	354	353	347	335	321	307	296	286	278	271	265	260	254
21*	274	276	278	281	285	289	294	301	312	326	342	356	366	358	350	338	323	308	296	286	277	271	264	259	252
20*	270	272	275	278	282	288	294	303	314	327	343	359	368	368	351	341	326	310	296	285	274	269	262	256	248
19*	267	268	271	275	280	285	293	302	313	326	342	362	366	363	352	345	329	311	295	282	273	268	260	257	253
18*	264	265	267	271	276	282	290	299	309	322	335	350	356	355	349	342	331	319	306	294	284	274	266	261	257
17*	262	262	264	267	272	278	285	294	304	316	328	348	349	350	348	343	334	324	312	301	291	282	274	267	261
16*	259	260	261	264	268	273	280	288	298	309	320	333	344	349	351	349	338	328	317	306	298	291	285	278	267
15*	256	257	258	260	263	268	273	280	289	300	312	326	341	355	361	373	344	331	321	311	303	301	297	298	276
14*	253	254	254	256	258	261	266	271	279	289	299	317	341	359	371	353	338	332	325	315	301	304	303	299	291
13*	249	249	249	250	251	254	257	262	270	283	305	321	336	334	335	330	324	320	319	312	295	299	300	300	295
12*	244	244	244	244	244	246	248	252	258	268	281	293	302	306	300	308	306	306	306	305	297	291	294	296	297
11*	239	238	238	237	237	238	239	241	246	252	259	267	273	278	283	286	288	291	293	296	292	286	289	290	293
10*	233	232	230	229	229	228	228	229	231	234	236	240	244	249	257	264	269	274	278	282	284	280	281	282	281
9*	225	224	222	221	219	218	217	216	217	216	215	216	218	222	231	241	249	255	262	268	275	274	271	273	273
8*	217	216	214	213	211	209	208	206	206	205	200	200	200	208	211	222	231	238	244	252	261	265	261	263	268
7*	210	206	207	206	204	203	202	200	200	200					200	211	217	222	227	233	243	252	254	259	261
6*	204	203	203	202	200	200										210	200	209	211	215	225	237	246	251	253
5*	200	200	200	200													200	200	200	200	210	222	234	241	244
4*																					200	209	220	229	253
3*																						200	208	215	219
2*																							200	206	209
1*																								200	200

TABLE G.2. (contd)

COLUMN / LINE	51	52	53	54	55	56	57	58	59	60
65										
64										
63										
62										
61										
60										
59										
58										
57										
56										
55										
54										
53										
52										
51	200									
50	200									
49	200									
48										
47										
46										
45										
44										
43	200									
42	209	200	200							
41	224	213	224	200	200	200				
40	252	253	258	247	237	223	200	200	200	
39	272	275	278	270	252	250	244	234	218	203
38	284	288	291	287	278	269	254	233	218	200
37	292	298	299	295	286	278	236	208	200	
36	297	301	302	298	285	262	208			
35	285	297	299	293	278	252	208			
34	276	290	293	286	273	249	223	200		
33	266	282	285	279	269	255	238	220	200	
32	257	274	278	276	270	261	250	237	222	200
31	259	268	274	274	273	268	260	251	243	230
30	254	261	266	271	278	274	269	262	258	258
29	246	251	257	264	271	270	276	269	265	266
28	236	241	250	257	264	269	273	269	268	268
27	223	234	242	250	256	261	266	265	267	267
26	218	219	225	241	248	253	257	258	259	268
25	234	226	218	233	241	246	248	250	250	251

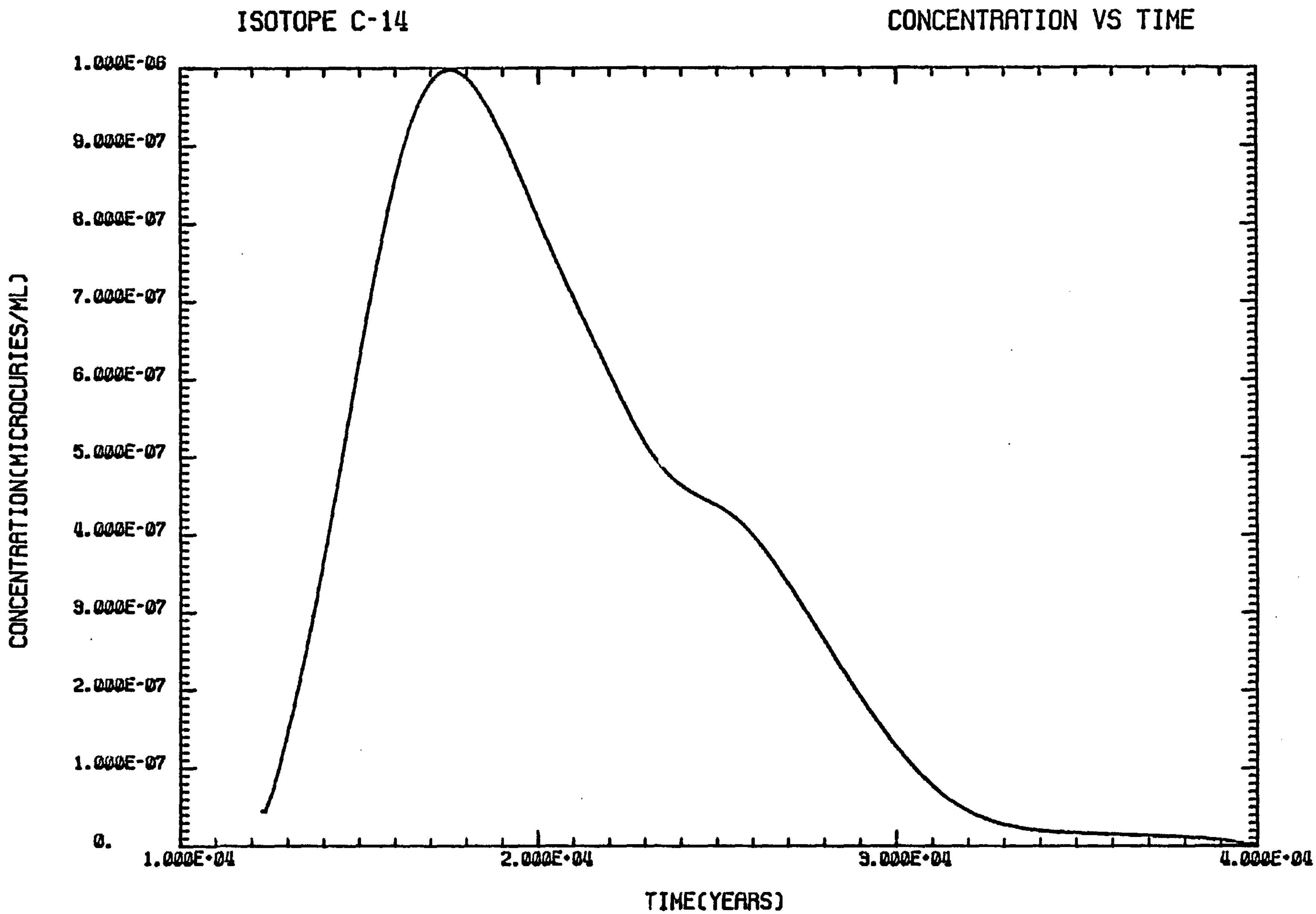
TABLE G.2. (contd)

24*	243	233	223	218	233	238	240	242	243	244
23*	245	235	222	210	225	230	233	235	238	240
22*	245	233	219	206	217	223	222	230	234	236
21*	242	220	218	202	210	213	210	222	220	232
20*	236	223	215	202	204	205	202	213	219	
19*	246	235	221	208	198	196	200	203	206	
18*	251	242	222	208	201	196	190	192	192	
17*	255	240	236	224	215	209	205	205	205	
16*	260	253	243	232	225	215	212	212	214	
15*	268	258	246	236	226	215	212	217	228	
14*	280	264	268	263	256	247	236	212	206	
13*	281	284	283	279	274	267	258	247		
12*	294	292	286	285	282	277	270	266		
11*	290	291	273	278	278	276	269	256		
10*	287	290	283	264	261	269	259			
9*	278	286	288	284	279	263	279			
8*	272	279	286	290	292	293	302			
7*	264	268	274	281	291	298	318			
6*	256	259	263	269	277	288				
5*	246	248	251	256	264	278				
4*	234	235	237	241	248					
3*	220	221	223	227	233					
2*	210	211	212	215						
1*	200	200	200	200						

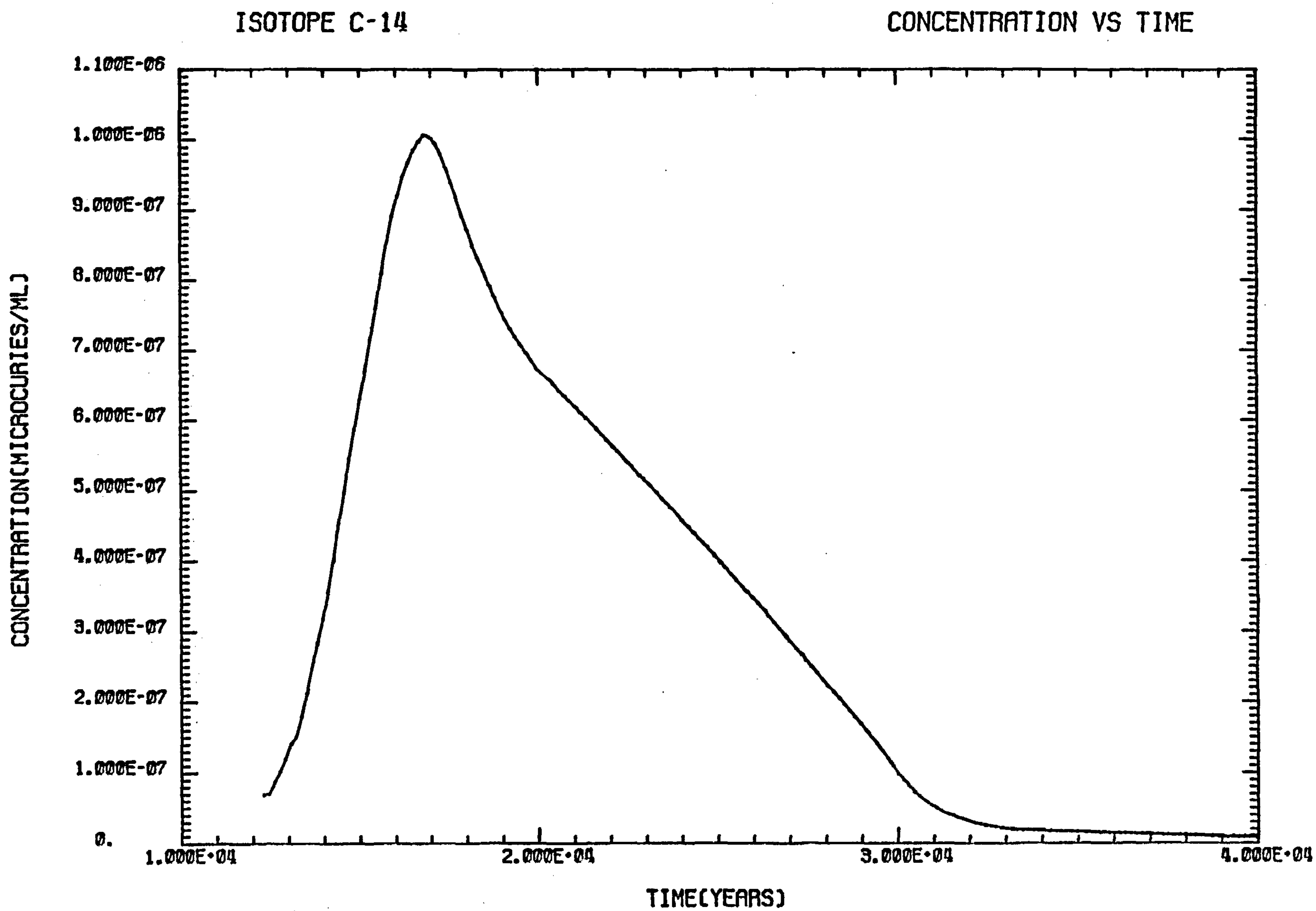
APPENDIX G.3: OUTPUT FROM MMT TRANSPORT MODEL

Scenario 1. Base Case. Discharge in the East Texas Oil Field. Release at 200 years and 1000 years. Simulation runs PIR1. (Concentration versus time)

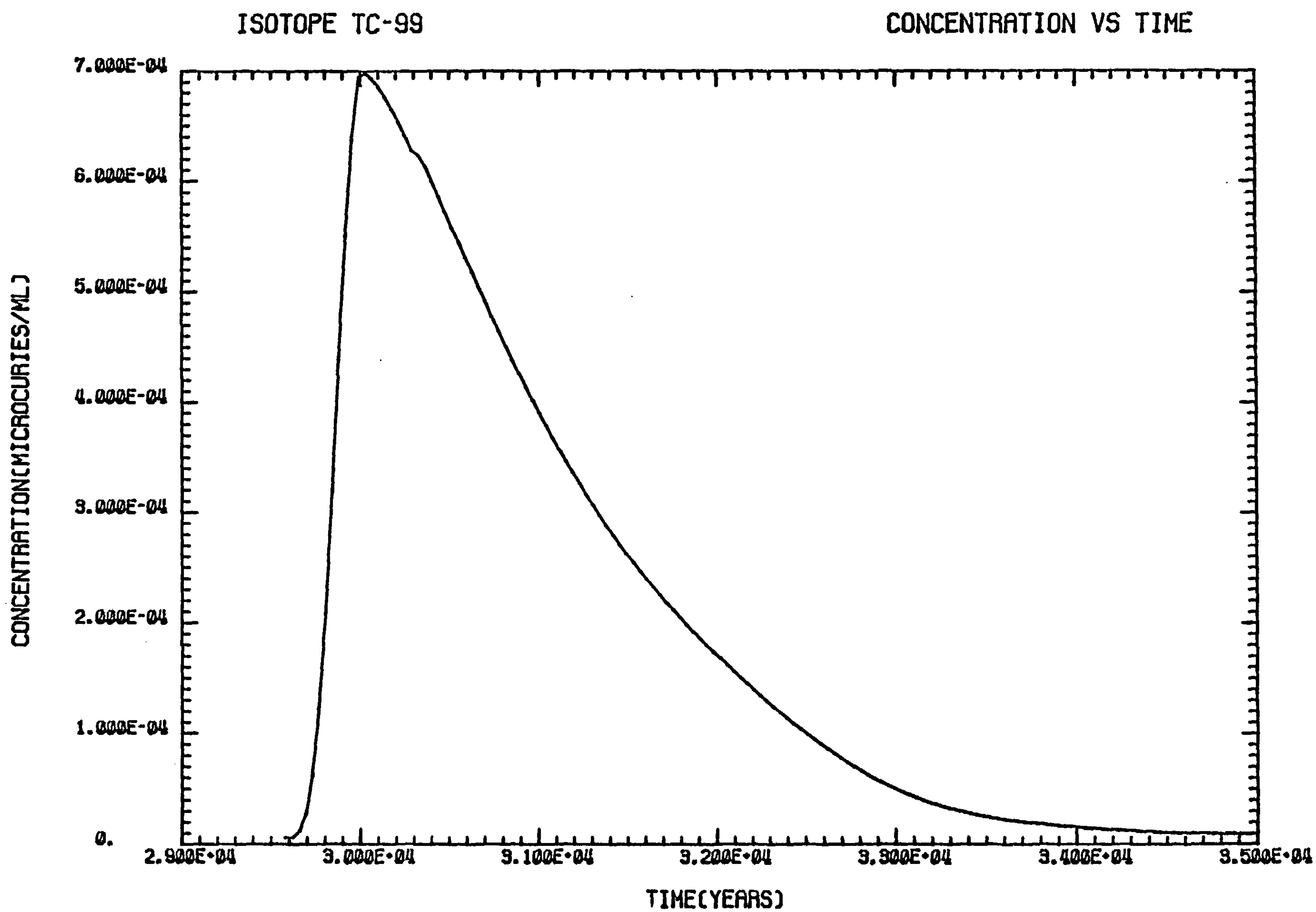
Pages G.14 through G.12 show concentration relationships between 200- and 1000-year releases. Pages G.22 through G.39 are concentration versus time plots for 200-year releases.



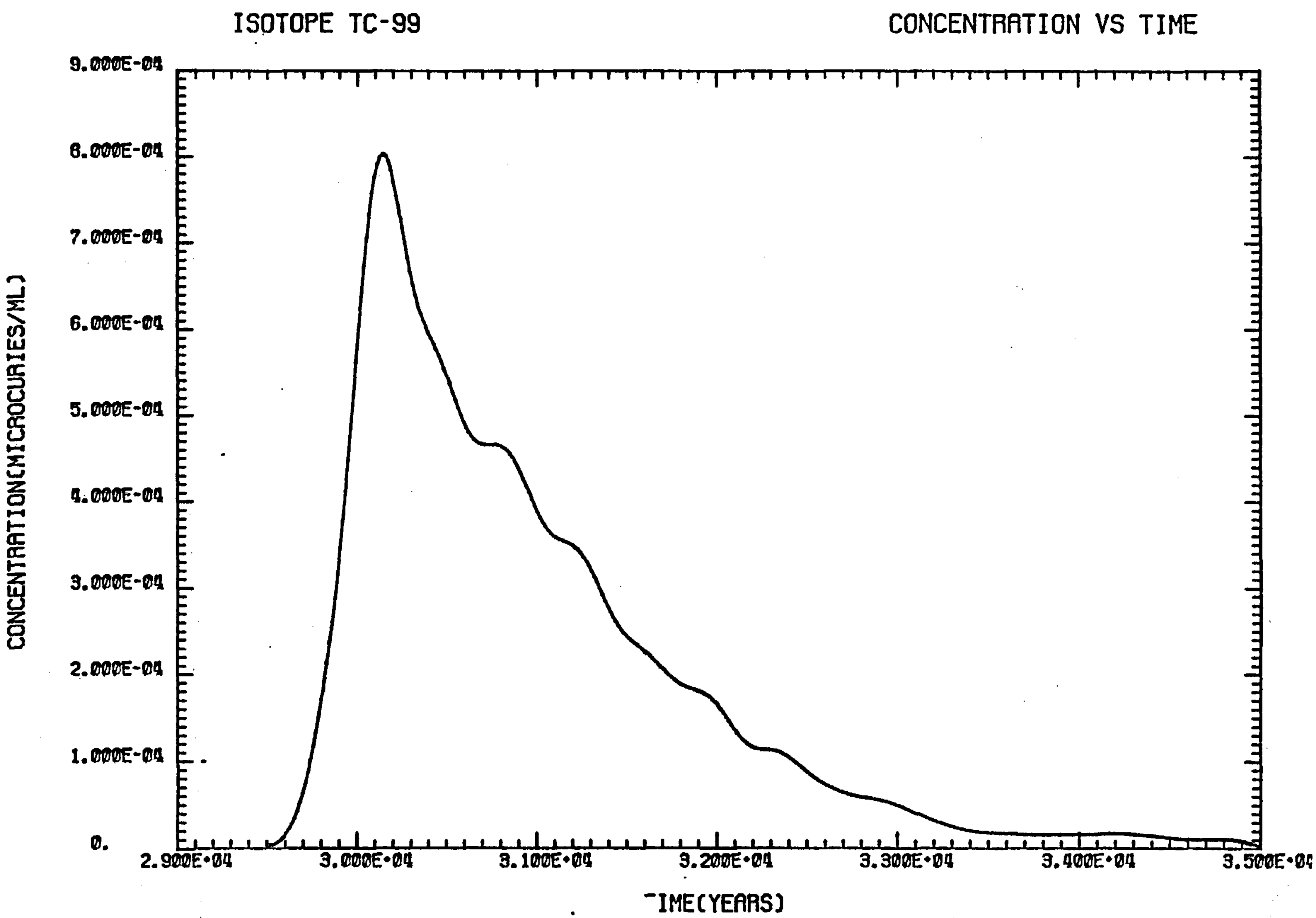
200-Year Release



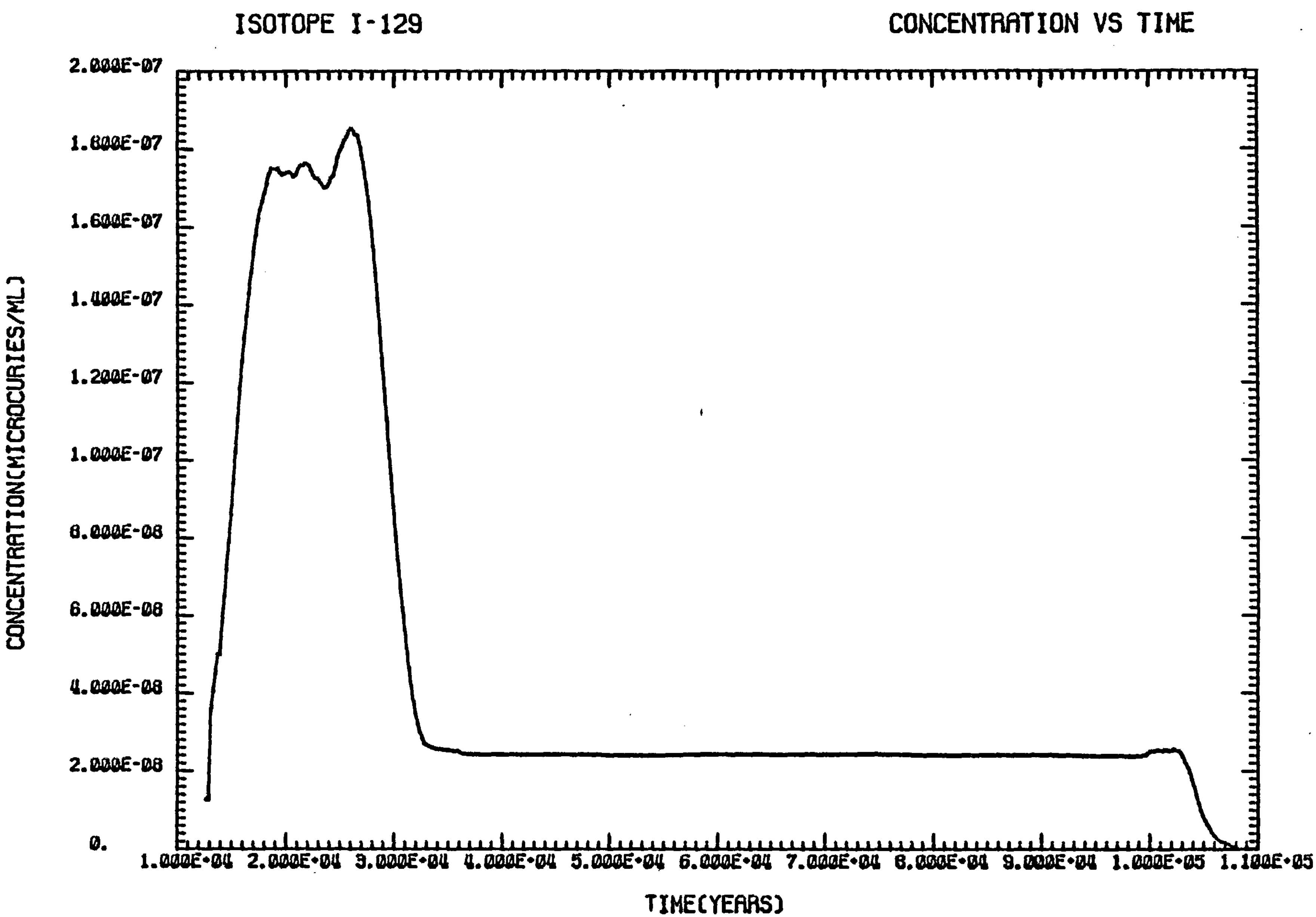
1000-Year Release



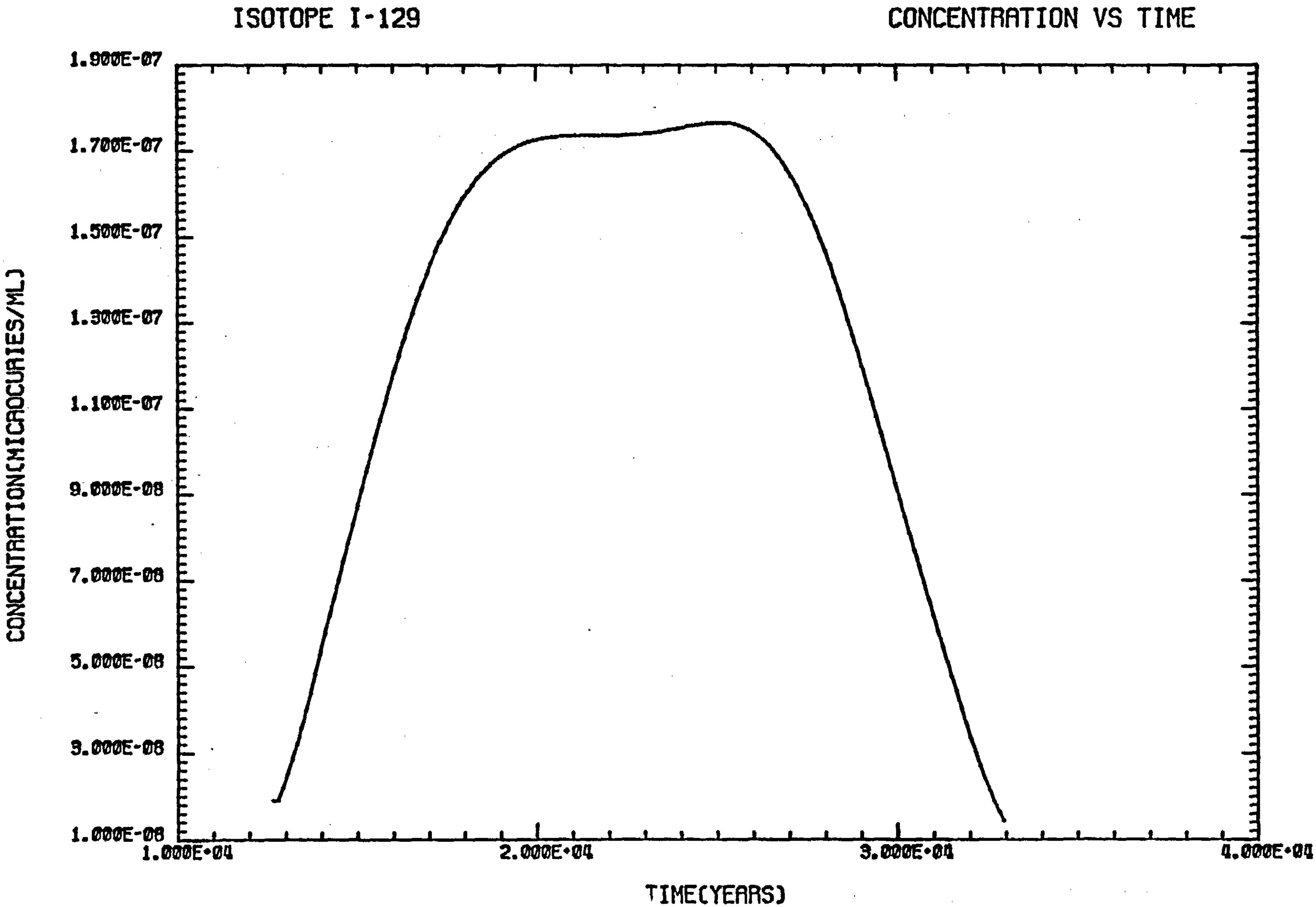
200-Year Release



1000-Year Release

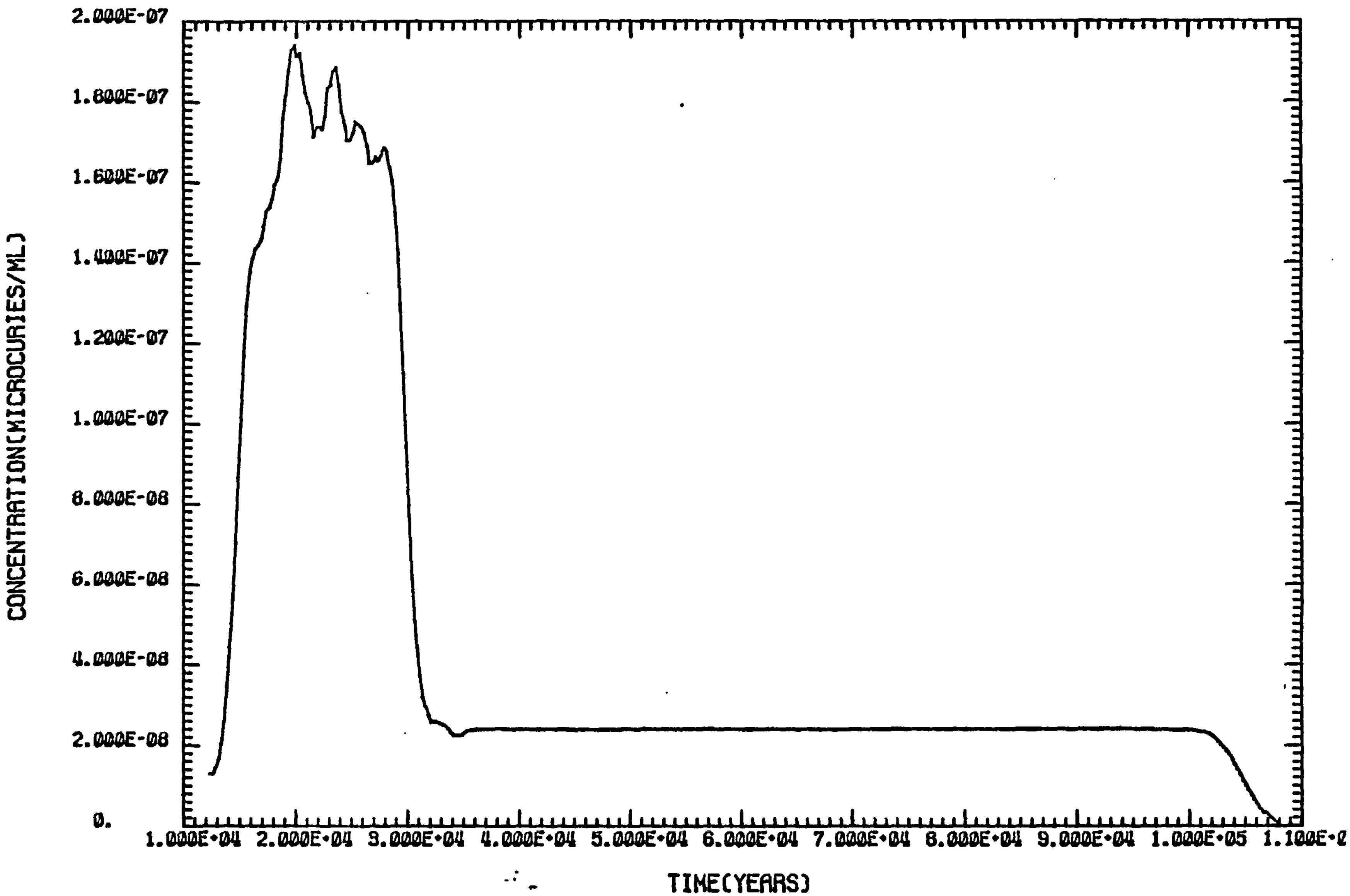


200-Year Release

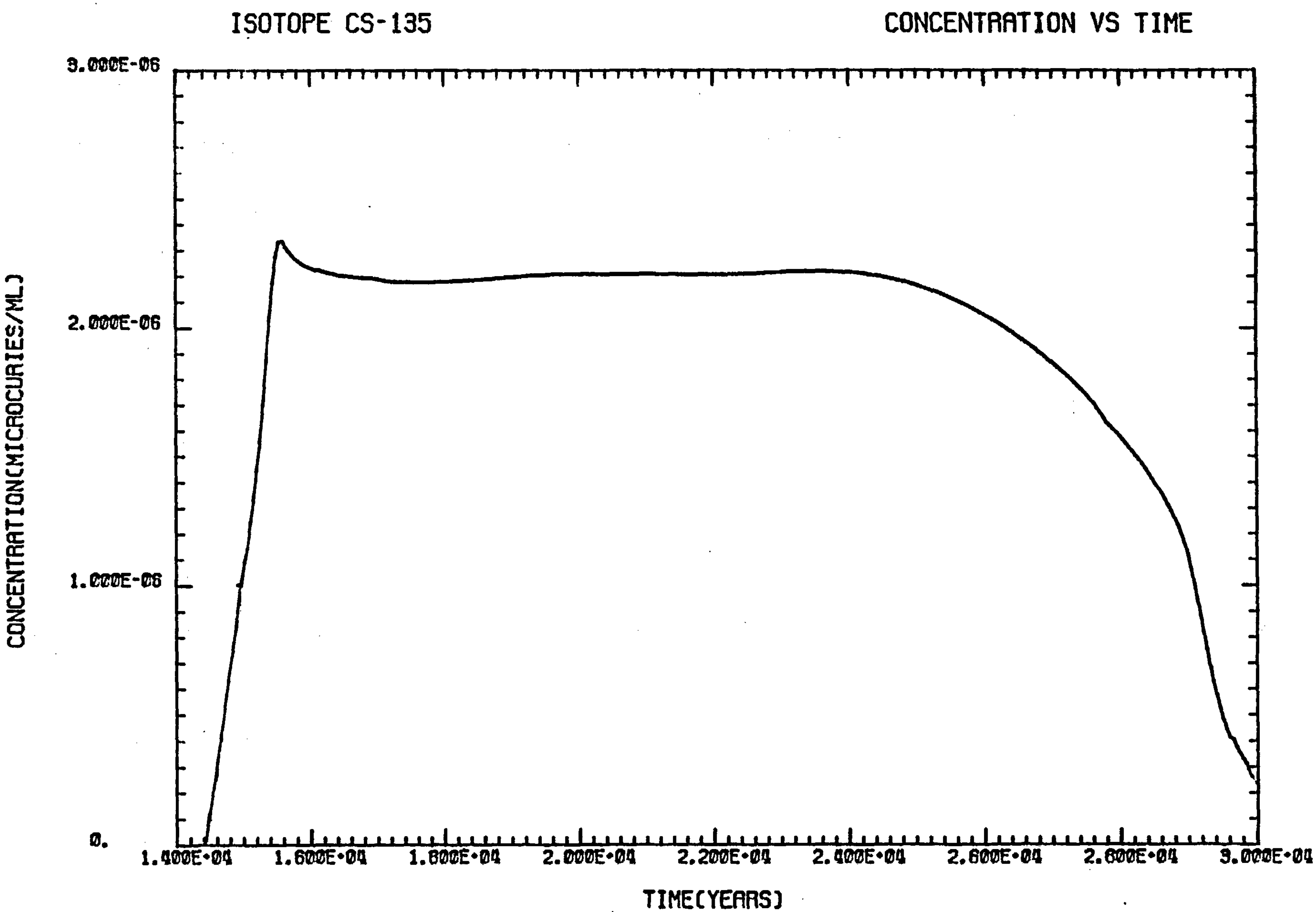


200-Year Release

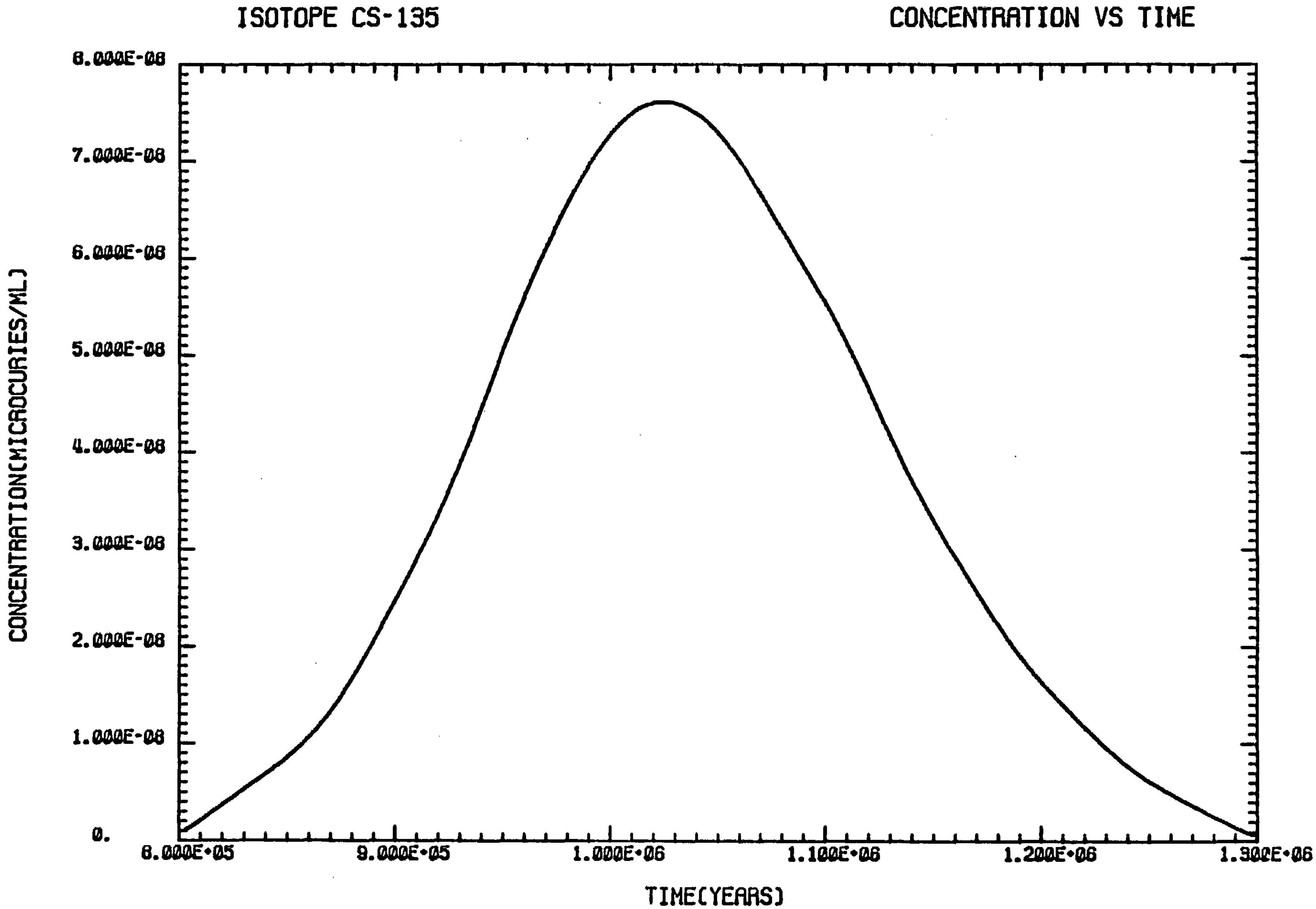
ISOTOPE I-129 CONCENTRATION VS TIME

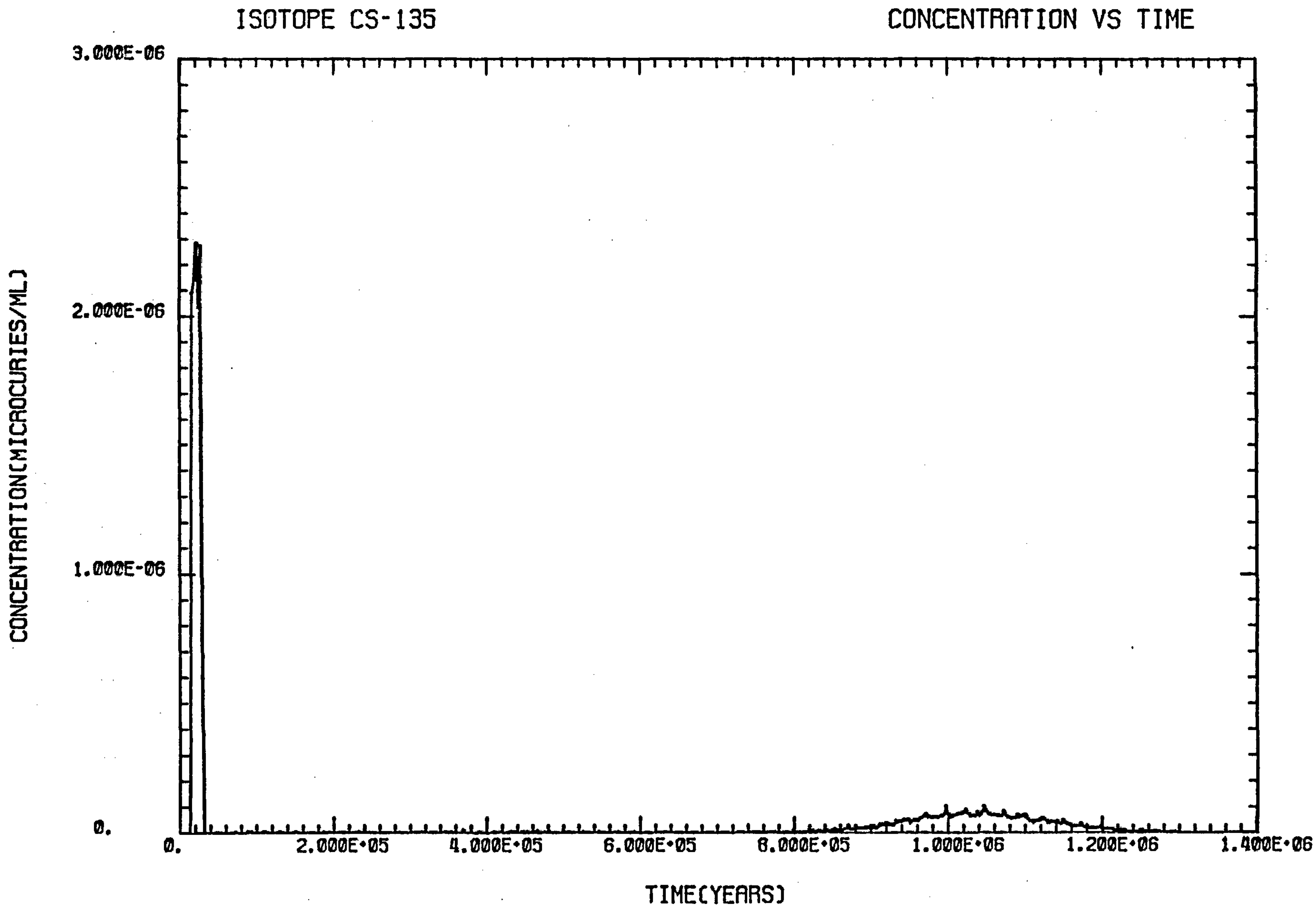


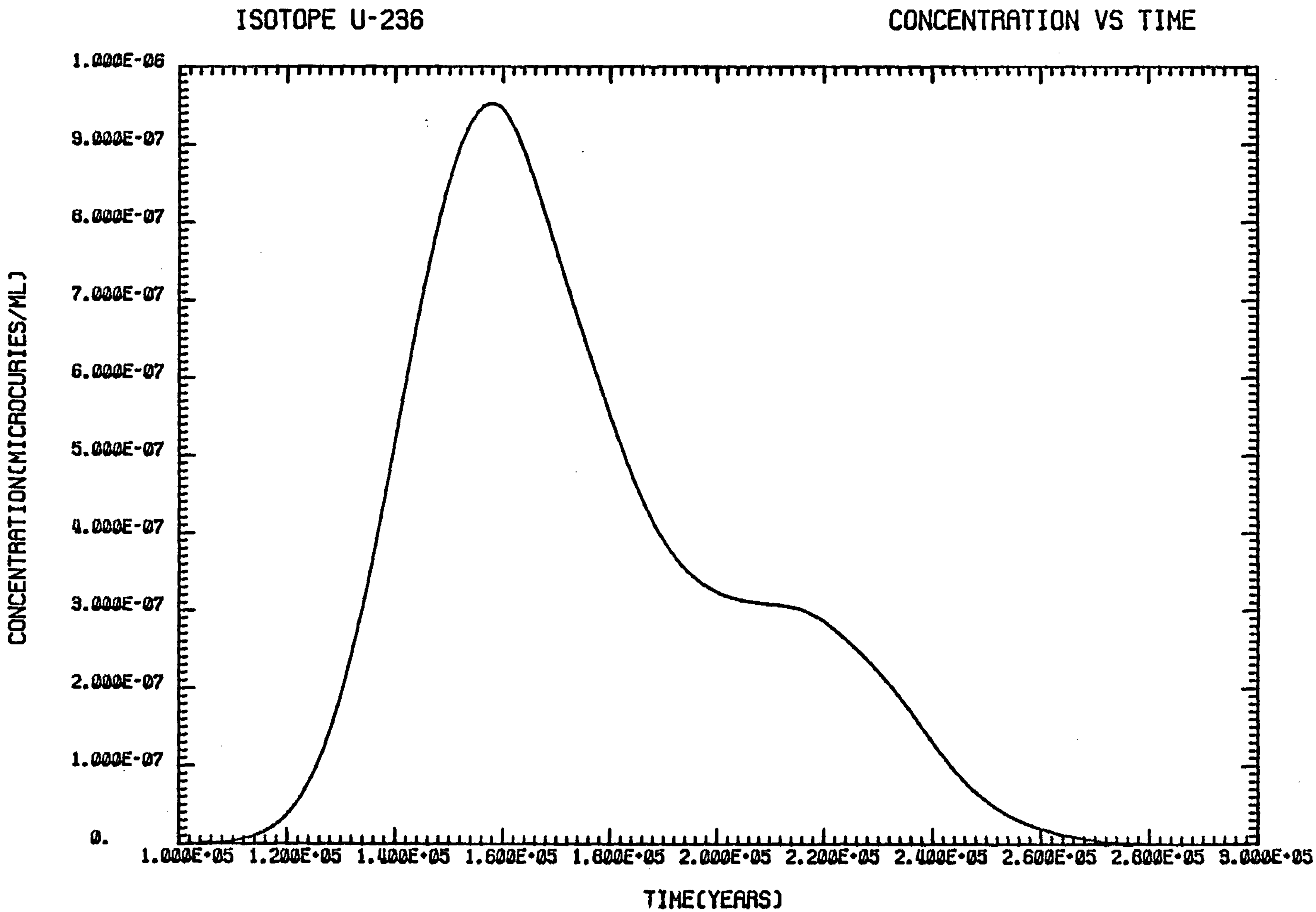
1000-Year Release

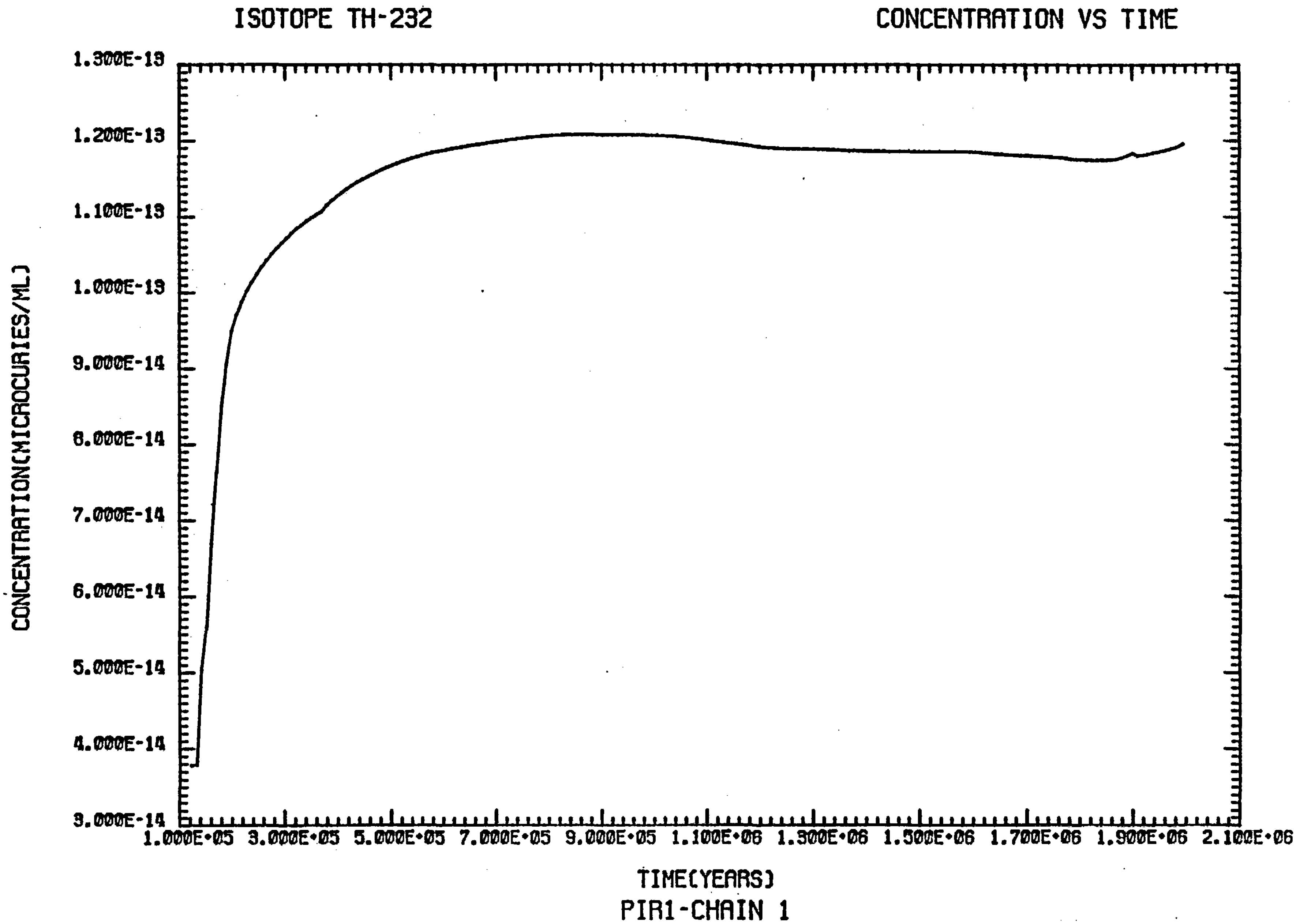


ISOTOPE CS-135
CONCENTRATION VS TIME
3.000E-06
2.000E-06
1.000E-06
0.
1.400E+04
1.600E+04
1.800E+04
2.000E+04
2.200E+04
2.400E+04
2.600E+04
2.800E+04
3.000E+04
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

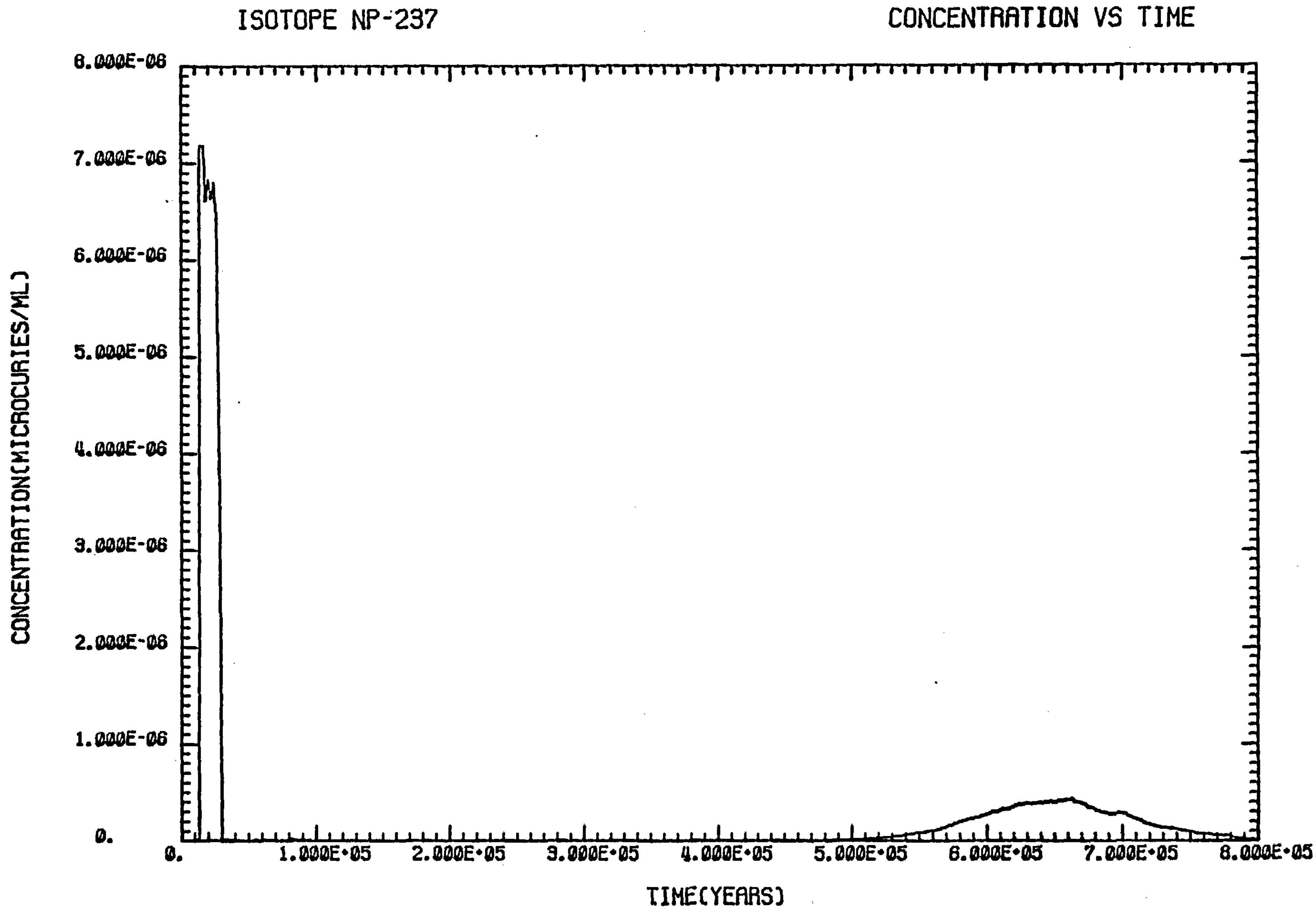

ISOTOPE CS-135
CONCENTRATION VS TIME
8.000E-08
7.000E-08
6.000E-08
5.000E-08
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
8.000E+05
9.000E+05
1.000E+06
1.100E+06
1.200E+06
1.300E+06
TIME(YEARS)

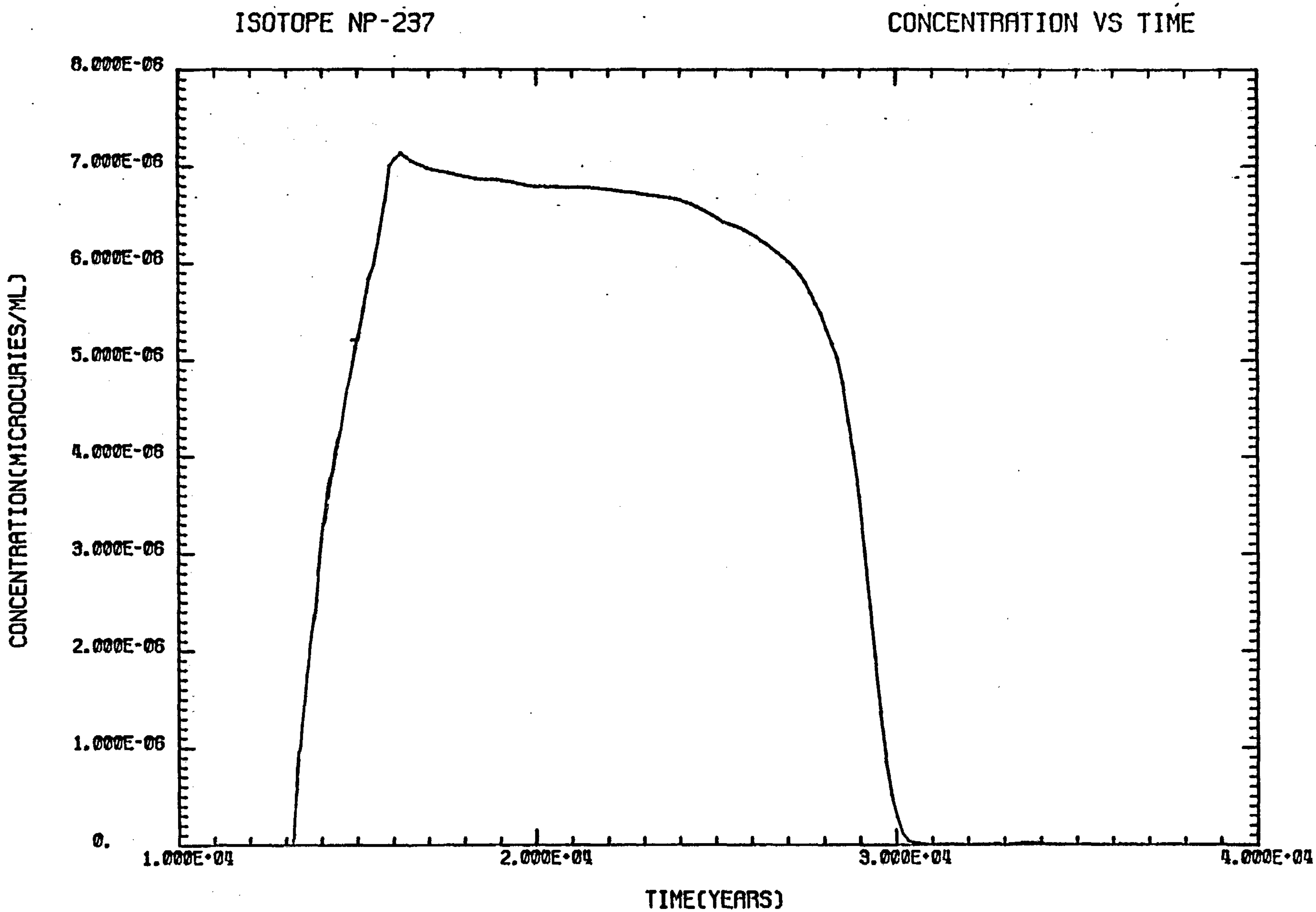

ISOTOPE CS-135
CONCENTRATION VS TIME
3.000E-06
2.000E-06
1.000E-06
0.
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)


ISOTOPE U-236
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.000E-06
9.000E-07
8.000E-07
7.000E-07
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
1.000E+05
1.200E+05
1.400E+05
1.600E+05
1.800E+05
2.000E+05
2.200E+05
2.400E+05
2.600E+05
2.800E+05
3.000E+05
TIME(YEARS)

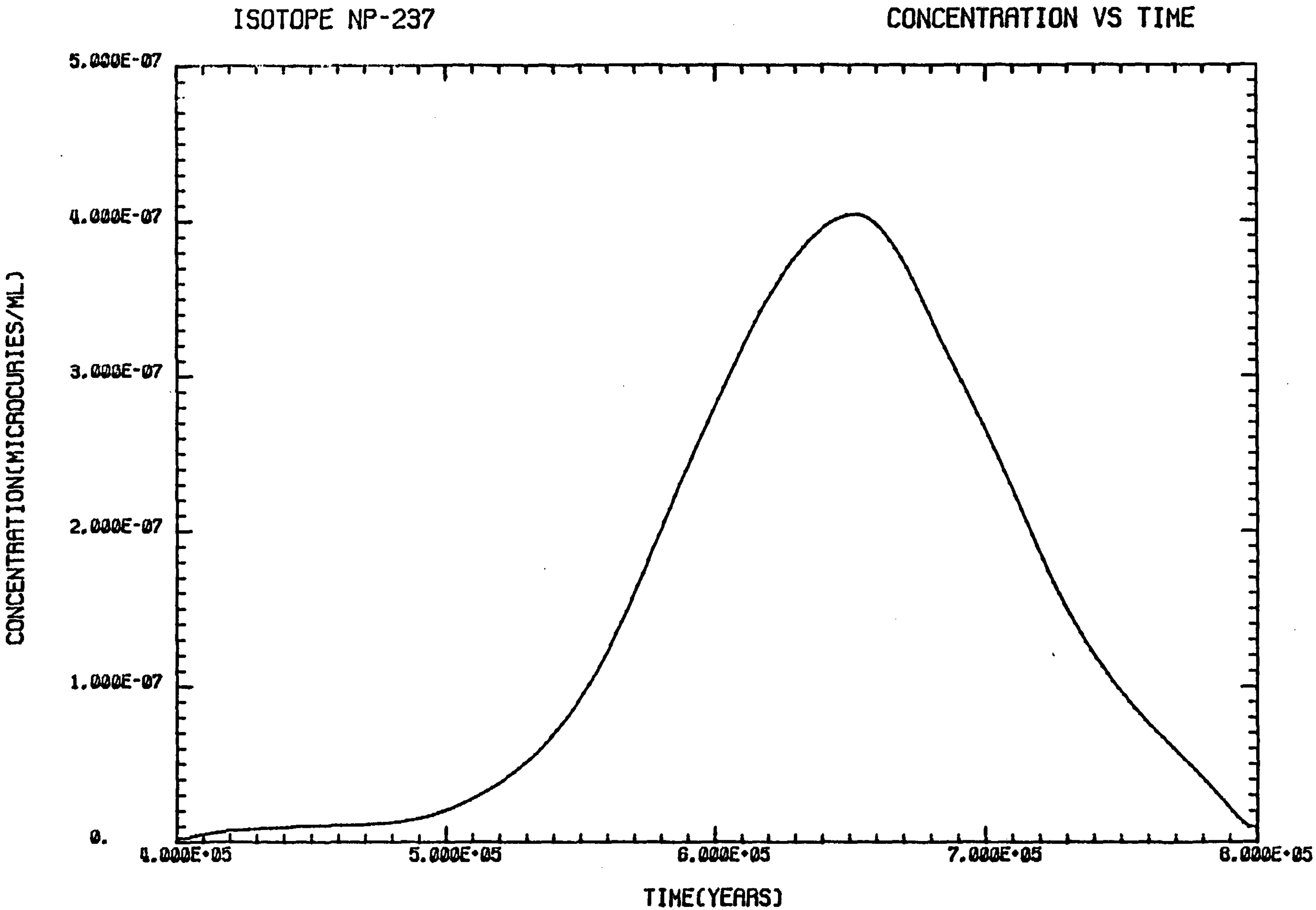

ISOTOPE TH-232
CONCENTRATION VS TIME
1.300E-13
1.200E-13
1.100E-13
1.000E-13
9.000E-14
8.000E-14
7.000E-14
6.000E-14
5.000E-14
4.000E-14
3.000E-14
CONCENTRATION(MICROCURIES/ML)
1.000E+05
3.000E+05
5.000E+05
7.000E+05
9.000E+05
1.100E+06
1.300E+06
1.500E+06
1.700E+06
1.900E+06
2.100E+06
TIME(YEARS)
PIR1-CHAIN 1

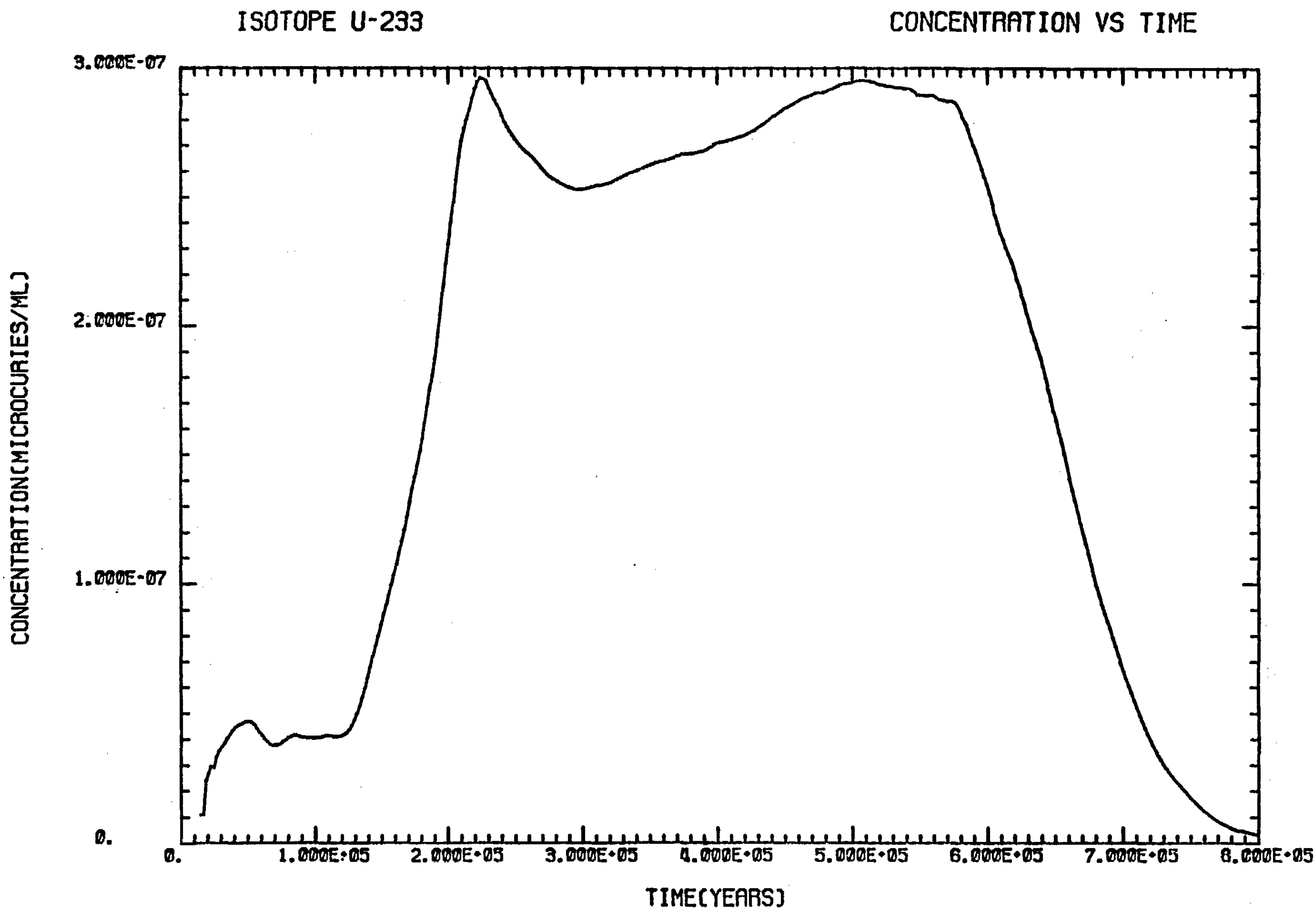
G.27

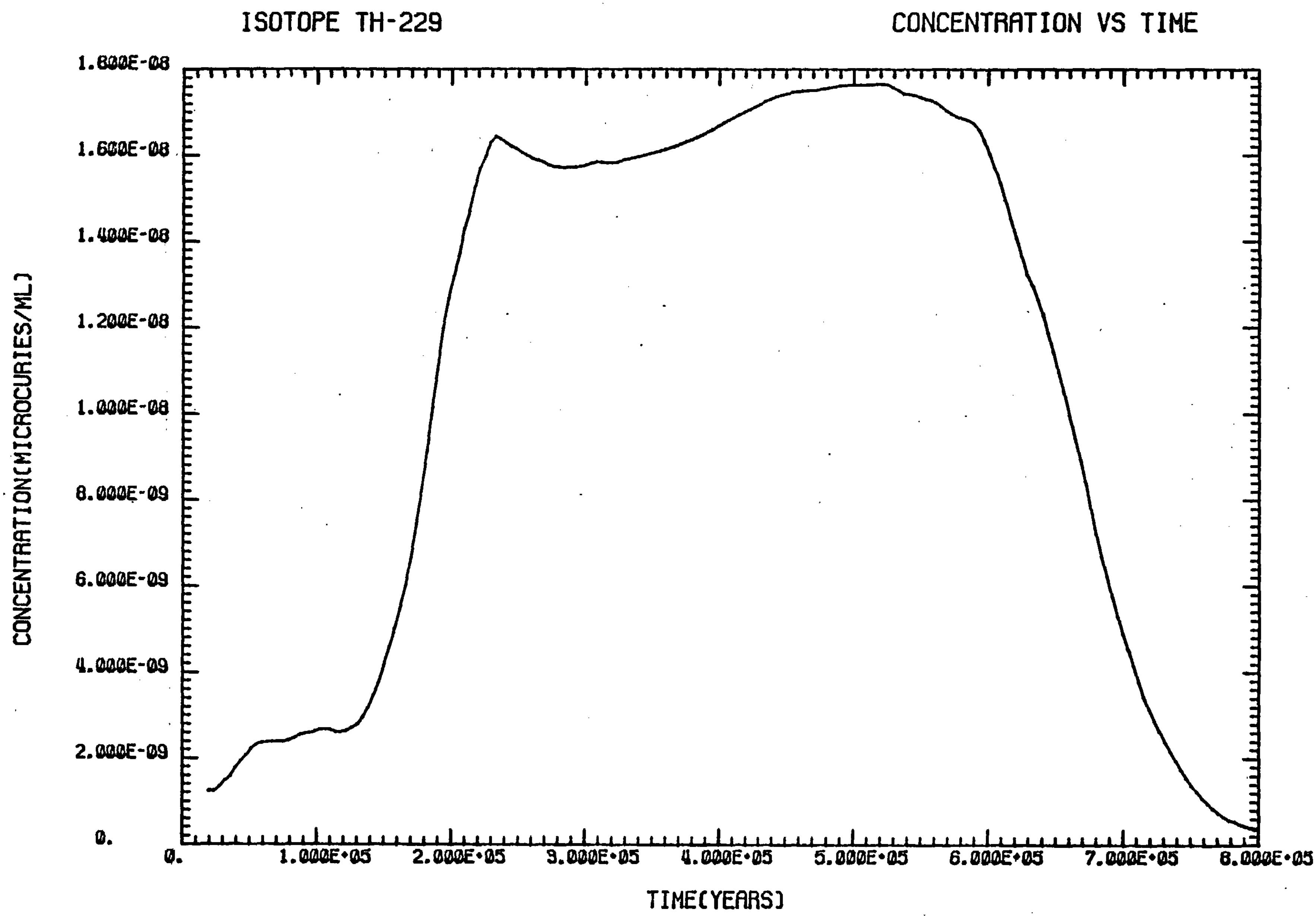

ISOTOPE NP-237
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
TIME(YEARS)
8.000E-06
7.000E-06
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
0.
1.000E+05
2.000E+05
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05

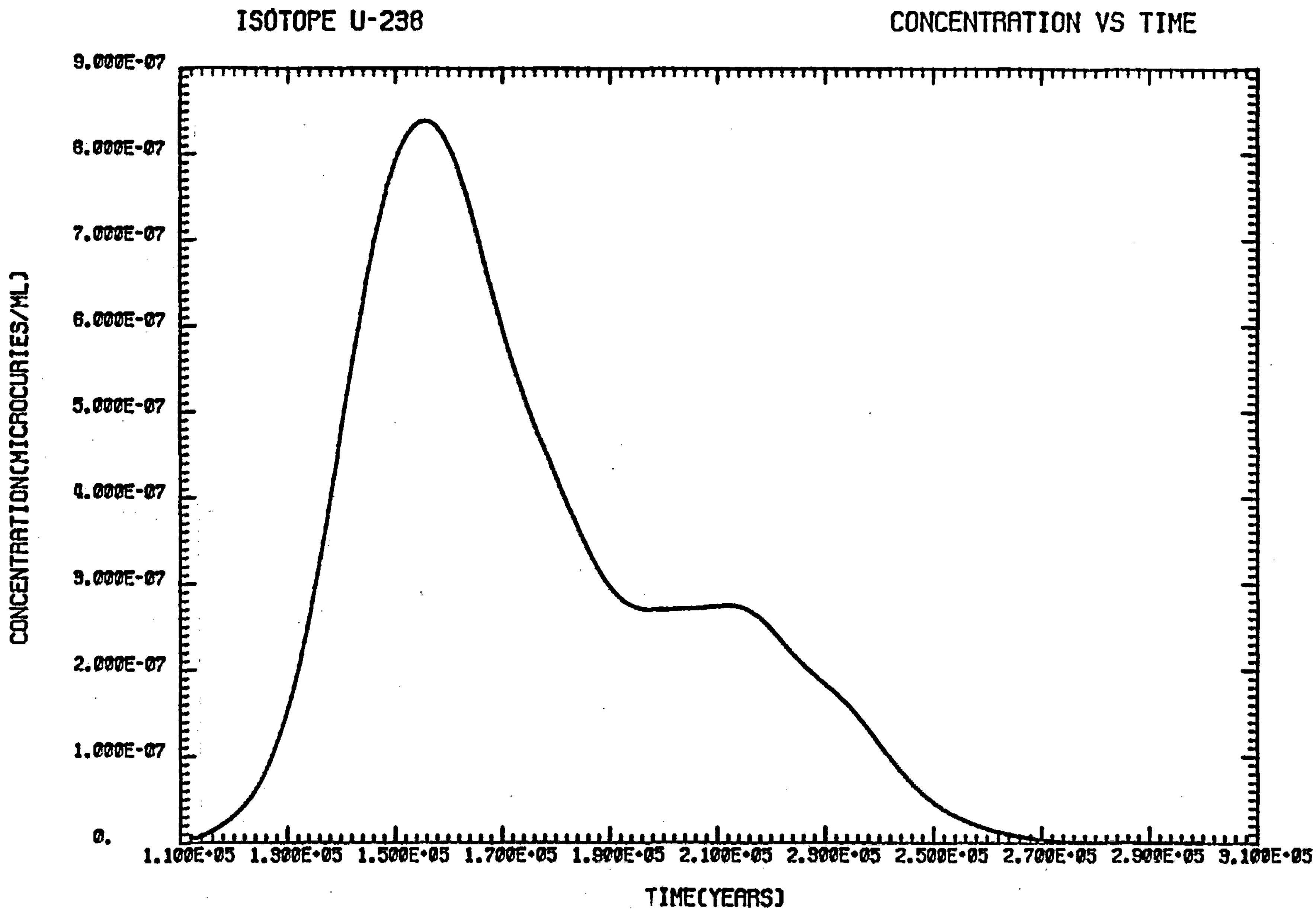


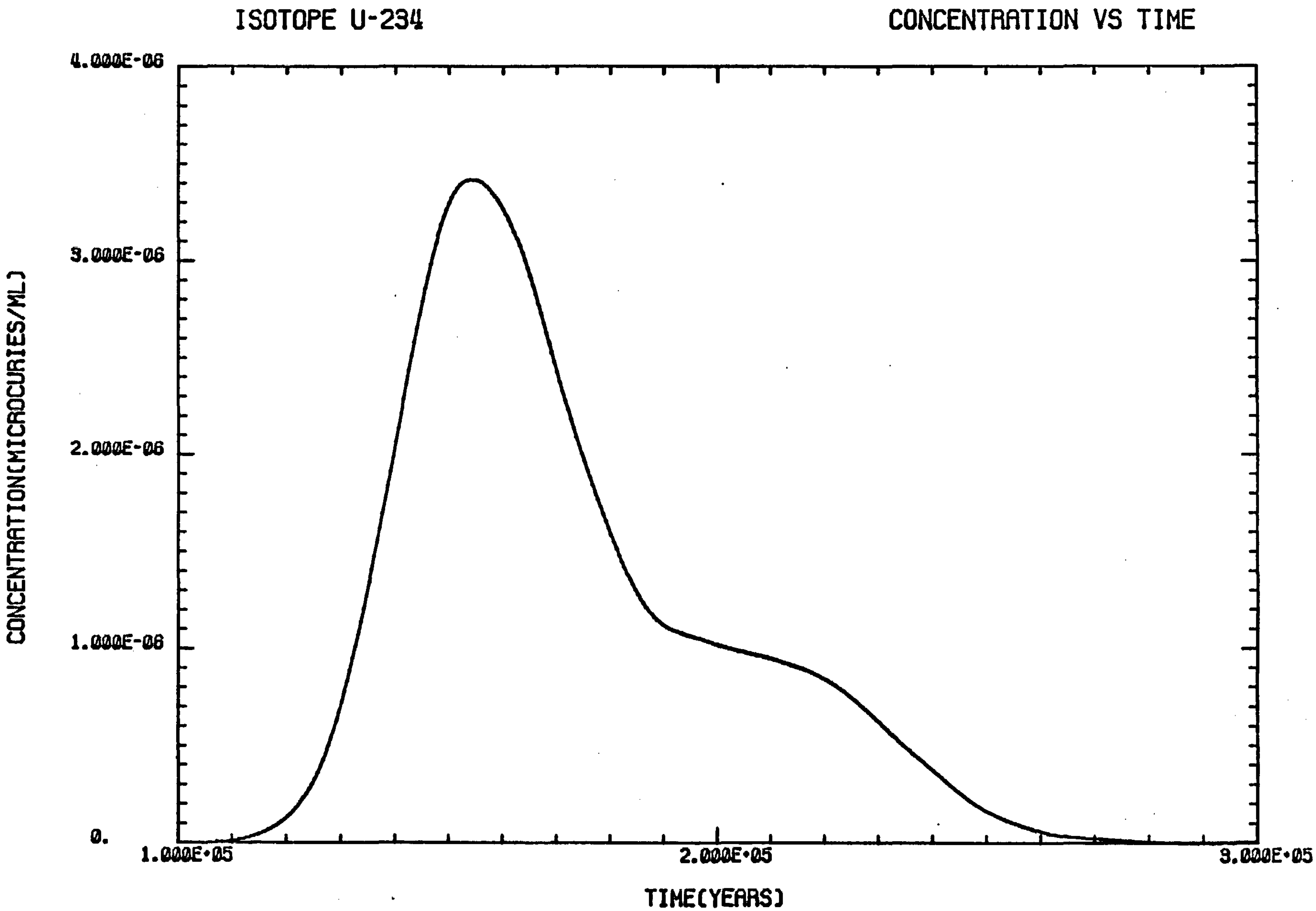
ISOTOPE NP-237
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
8.000E-06
7.000E-06
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
1.000E+04
2.000E+04
3.000E+04
4.000E+04
TIME(YEARS)


ISOTOPE NP-237
CONCENTRATION VS TIME
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
CONCENTRATION(MICROCURIES/ML)
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
TIME(YEARS)

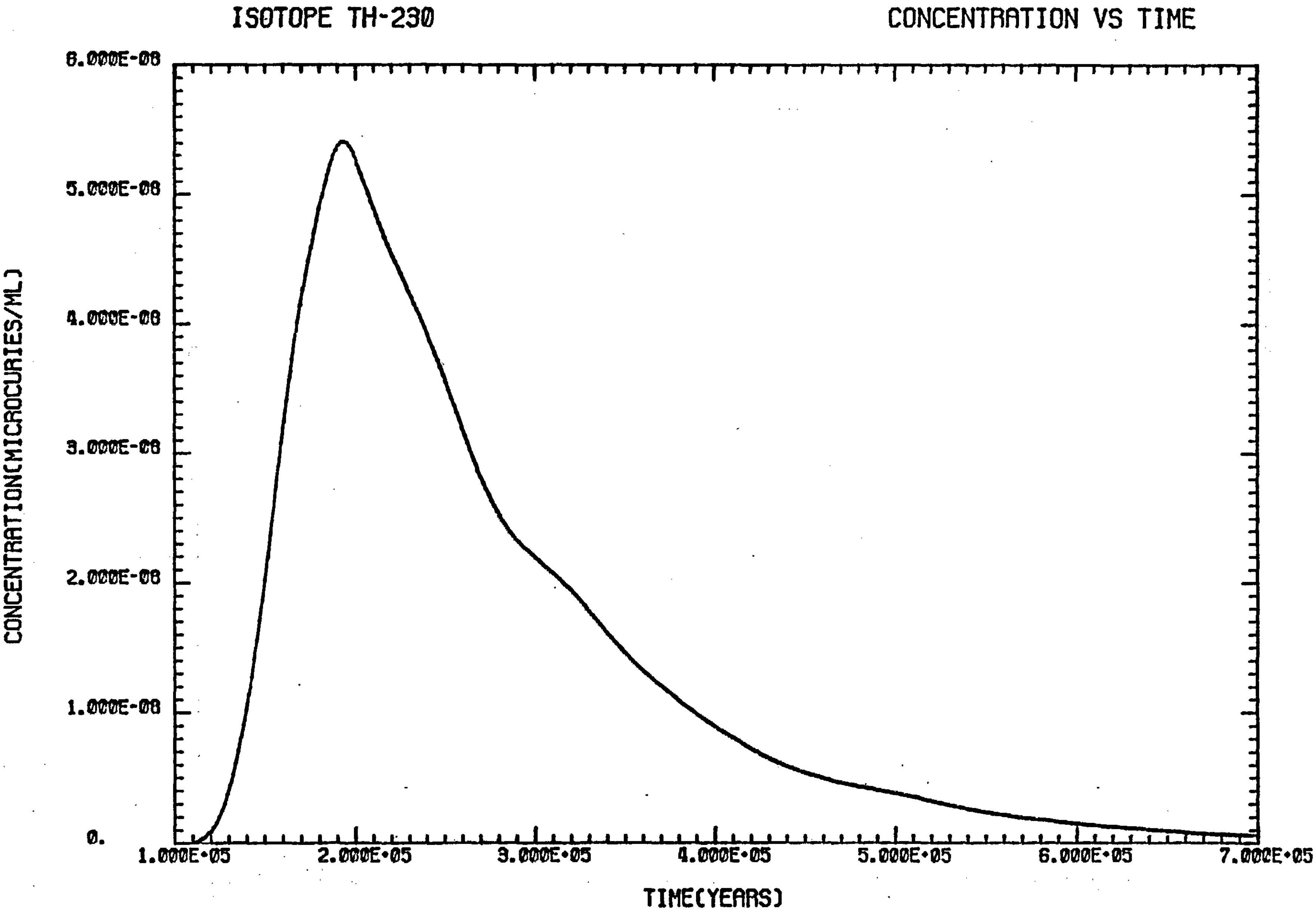

ISOTOPE U-233
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
3.000E-07
2.000E-07
1.000E-07
0.
0.
1.000E+05
2.000E+05
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
TIME(YEARS)

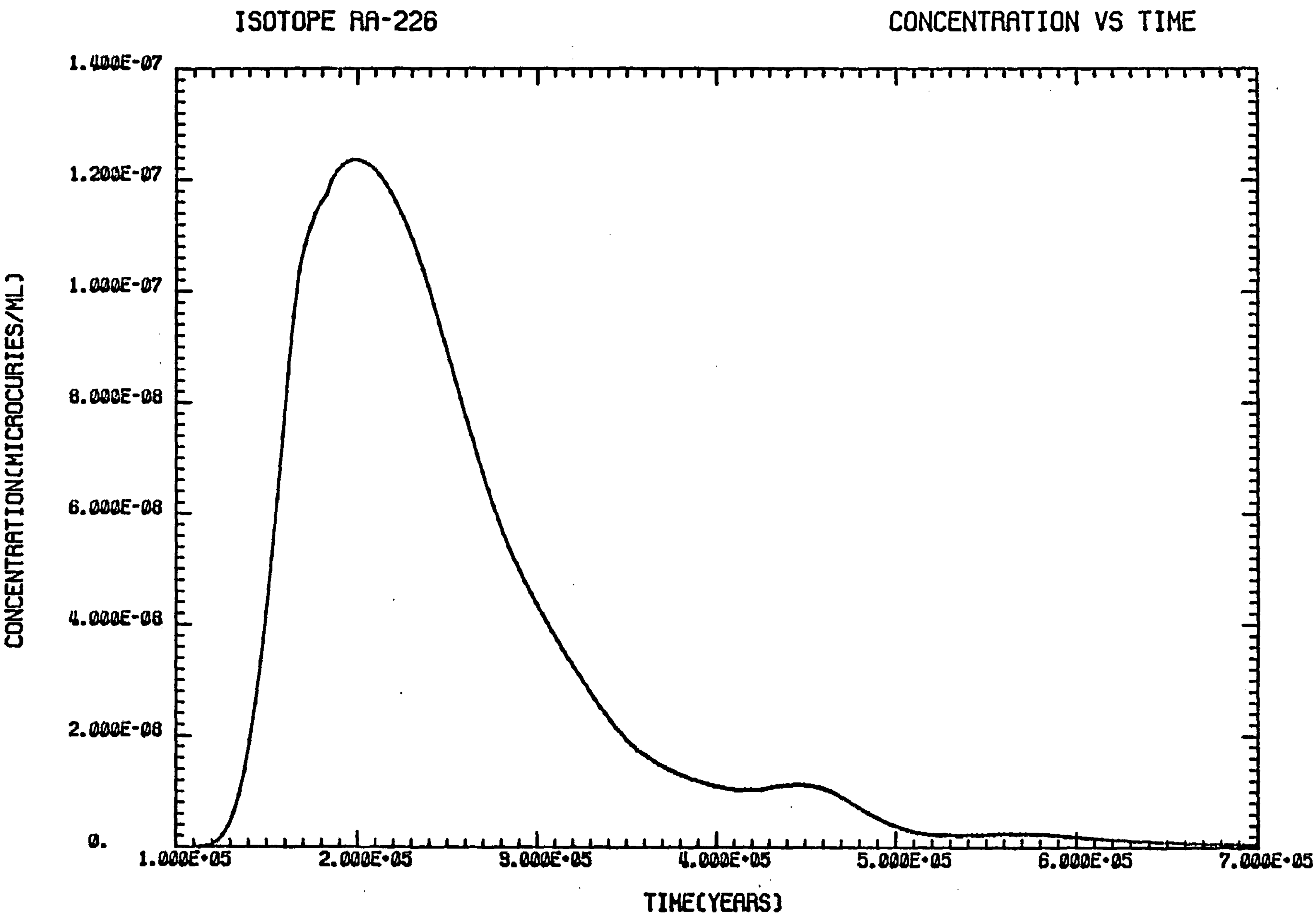

ISOTOPE TH-229
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.800E-08
1.600E-08
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
0.
1.000E+05
2.000E+05
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
TIME(YEARS)


ISOTOPE U-238
CONCENTRATION VS TIME
9.000E-07
8.000E-07
7.000E-07
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
CONCENTRATION(MICROCURIES/ML)
1.100E+05 1.300E+05 1.500E+05 1.700E+05 1.900E+05 2.100E+05 2.300E+05 2.500E+05 2.700E+05 2.900E+05 3.100E+05
TIME(YEARS)

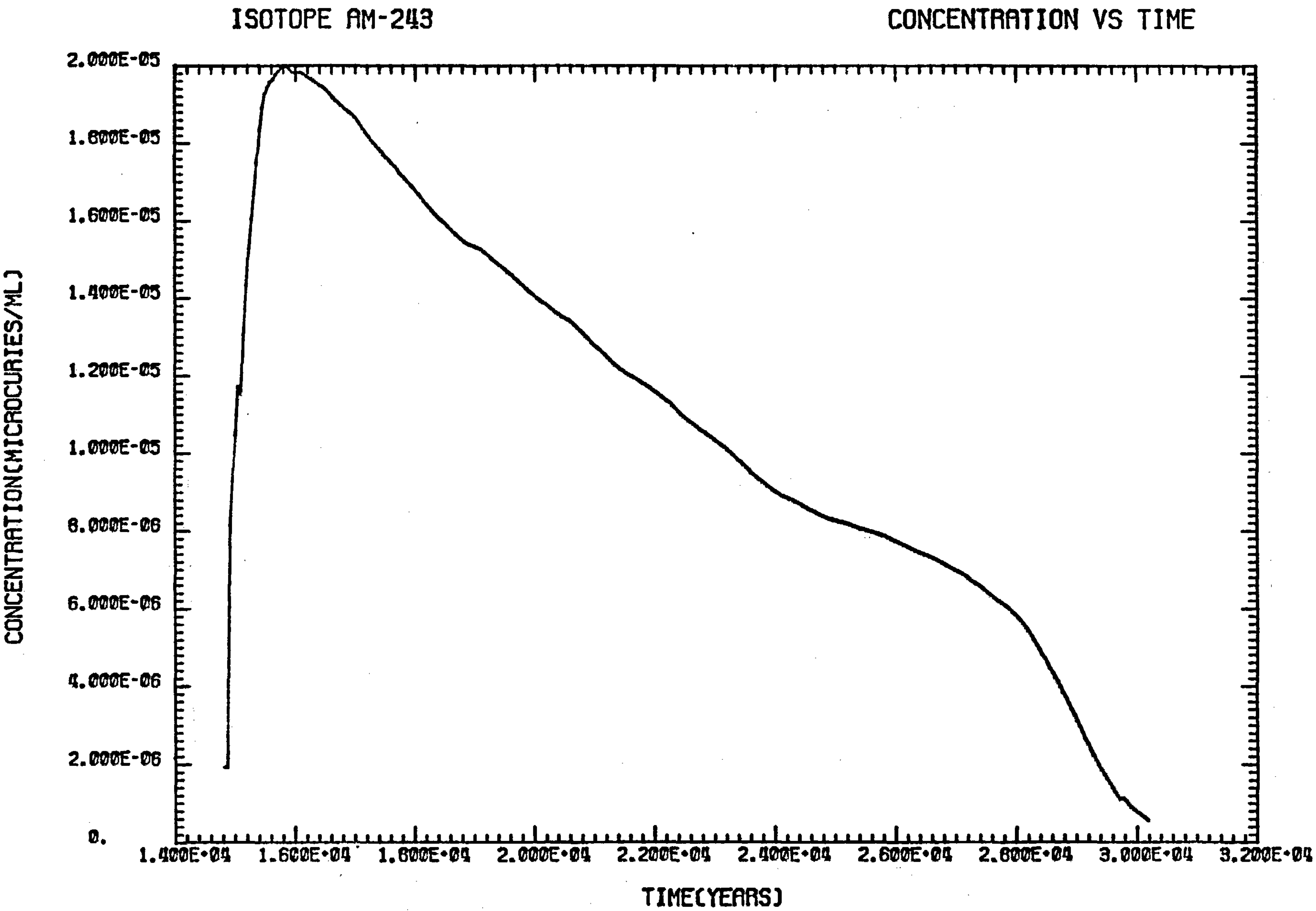


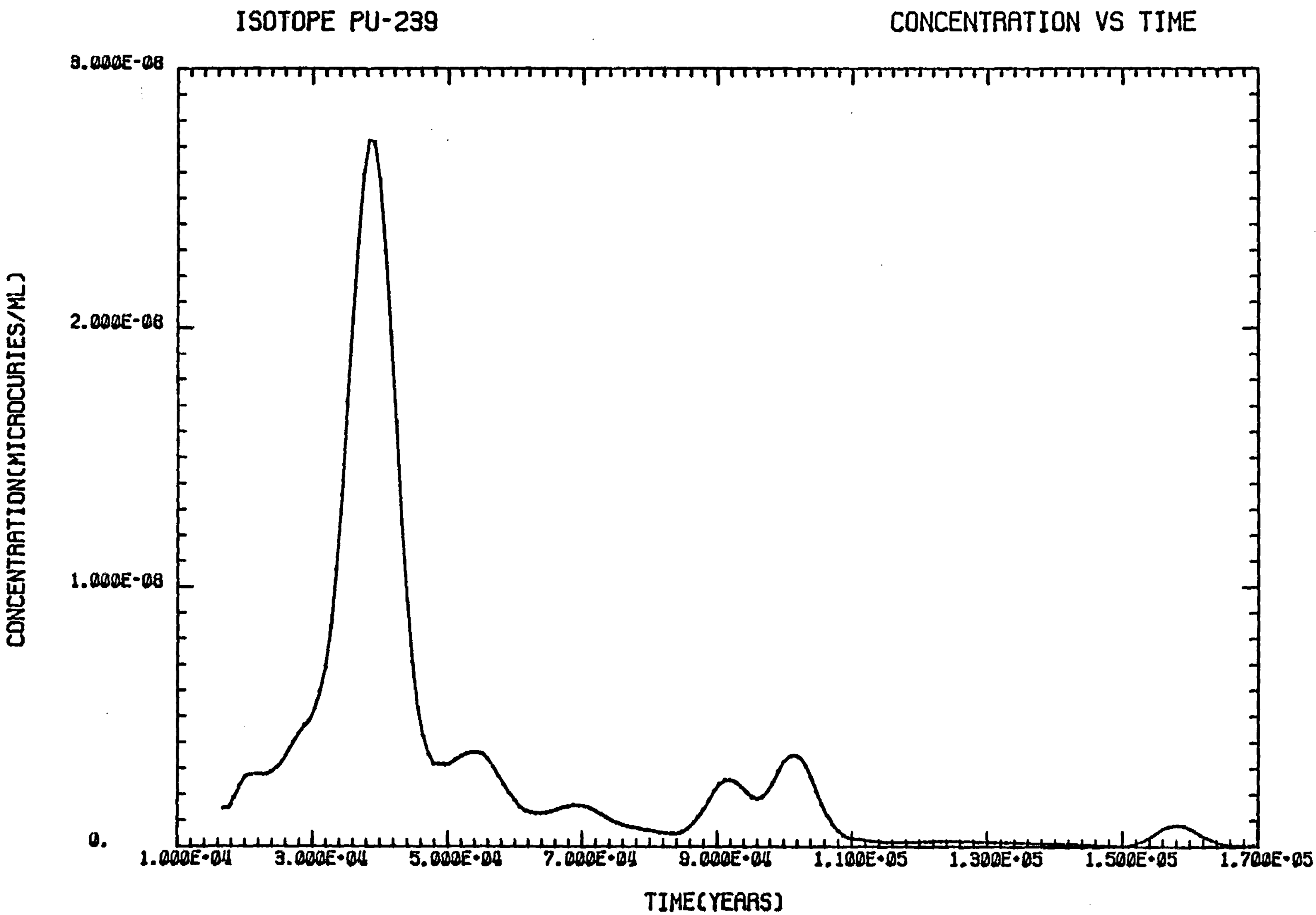
ISOTOPE U-234
CONCENTRATION VS TIME
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
1.000E+05
2.000E+05
3.000E+05
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

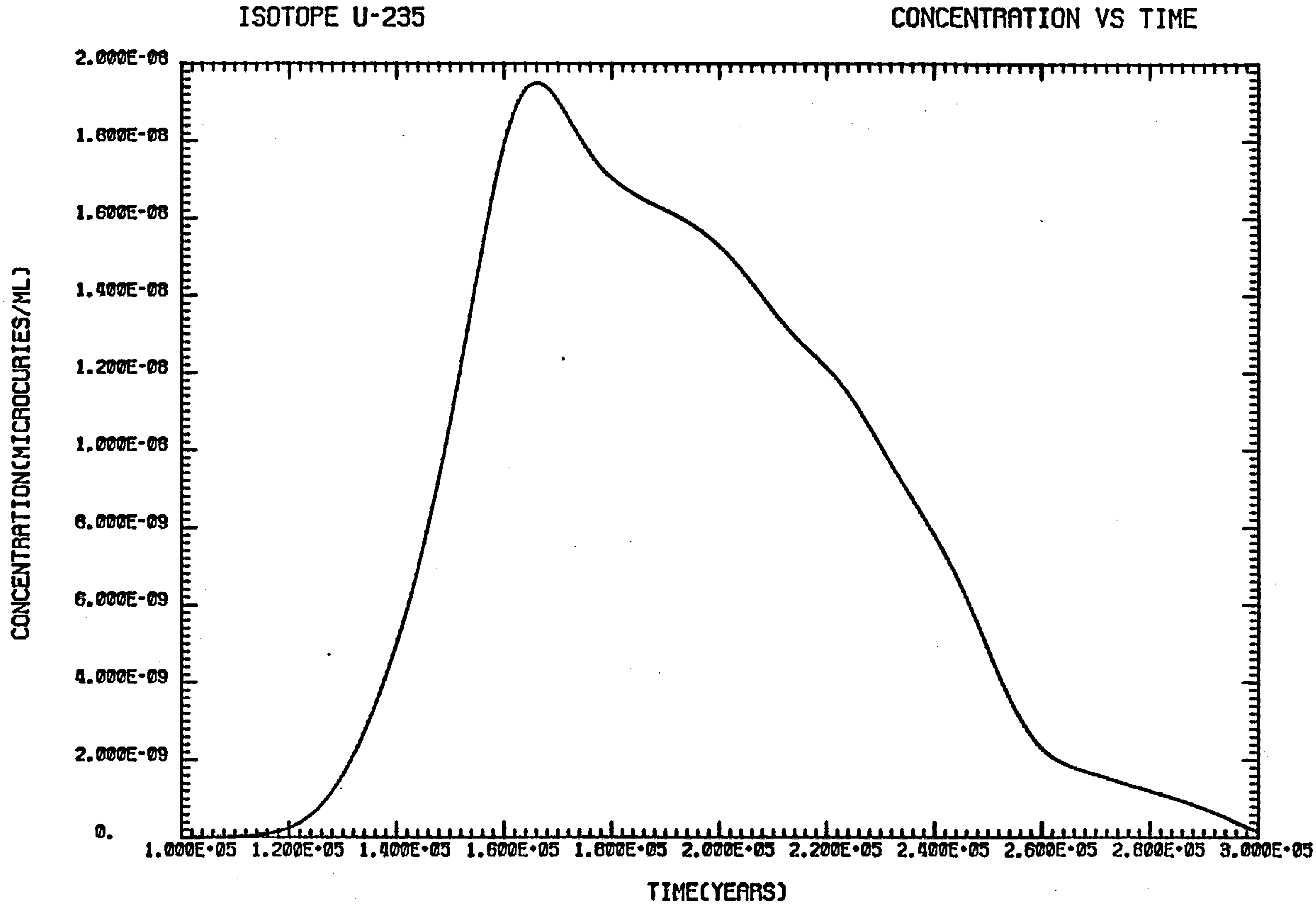

ISOTOPE TH-230
CONCENTRATION VS TIME
6.000E-08
5.000E-08
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
1.000E+05
2.000E+05
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
TIME(YEARS)

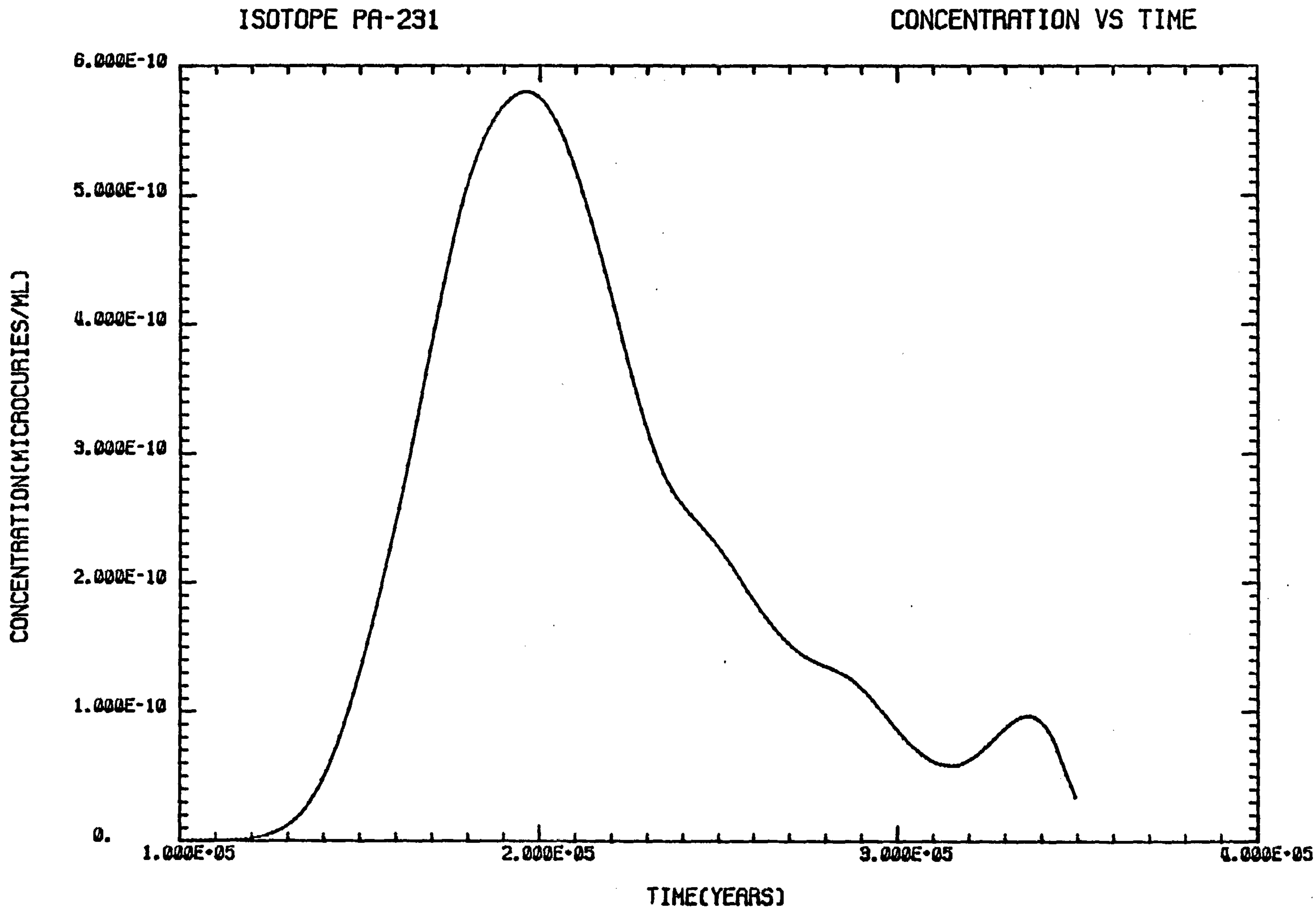


ISOTOPE RA-226
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.400E-07
1.200E-07
1.000E-07
8.000E-08
6.000E-08
4.000E-08
2.000E-08
0.
1.000E+05
2.000E+05
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
TIME(YEARS)

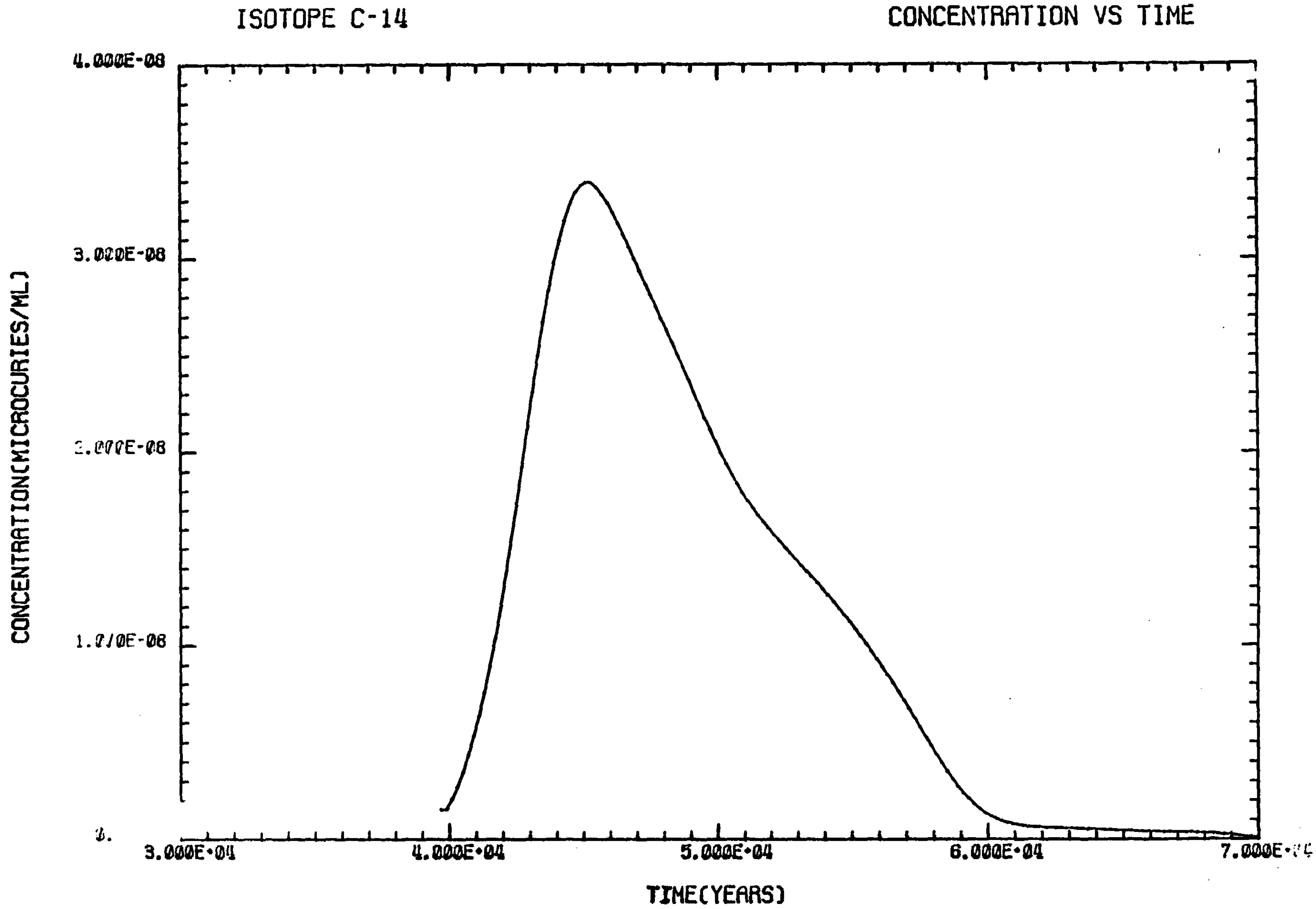

ISOTOPE AM-243
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
2.000E-05
1.800E-05
1.600E-05
1.400E-05
1.200E-05
1.000E-05
8.000E-06
6.000E-06
4.000E-06
2.000E-06
0.
1.400E+04
1.600E+04
1.800E+04
2.000E+04
2.200E+04
2.400E+04
2.600E+04
2.800E+04
3.000E+04
3.200E+04
TIME(YEARS)


ISOTOPE PU-239
CONCENTRATION VS TIME
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
1.000E+04
3.000E+04
5.000E+04
7.000E+04
9.000E+04
1.100E+05
1.300E+05
1.500E+05
1.700E+05
TIME(YEARS)

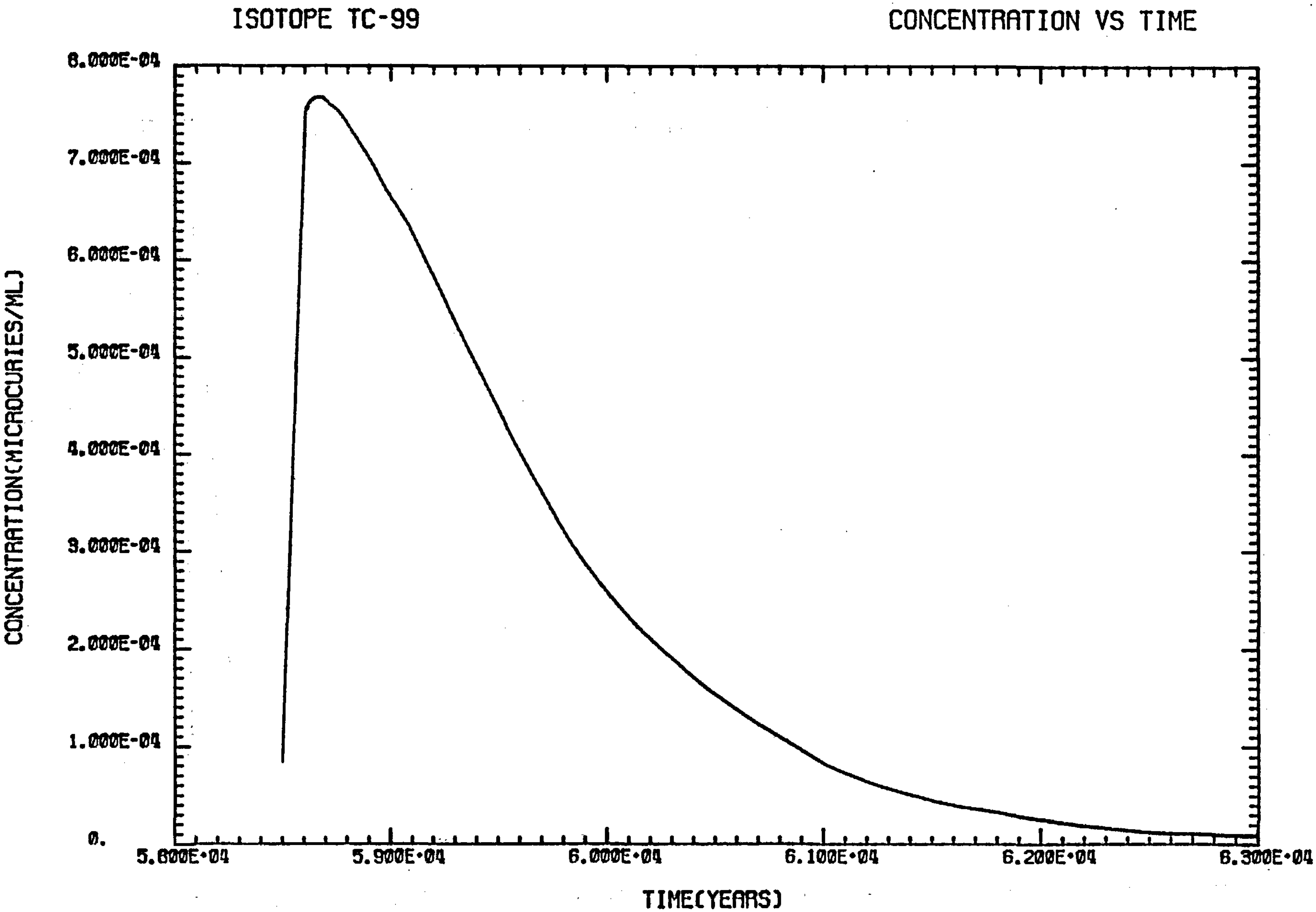

ISOTOPE U-235
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
TIME(YEARS)
2.000E-08
1.800E-08
1.600E-08
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
1.000E+05
1.200E+05
1.400E+05
1.600E+05
1.800E+05
2.000E+05
2.200E+05
2.400E+05
2.600E+05
2.800E+05
3.000E+05

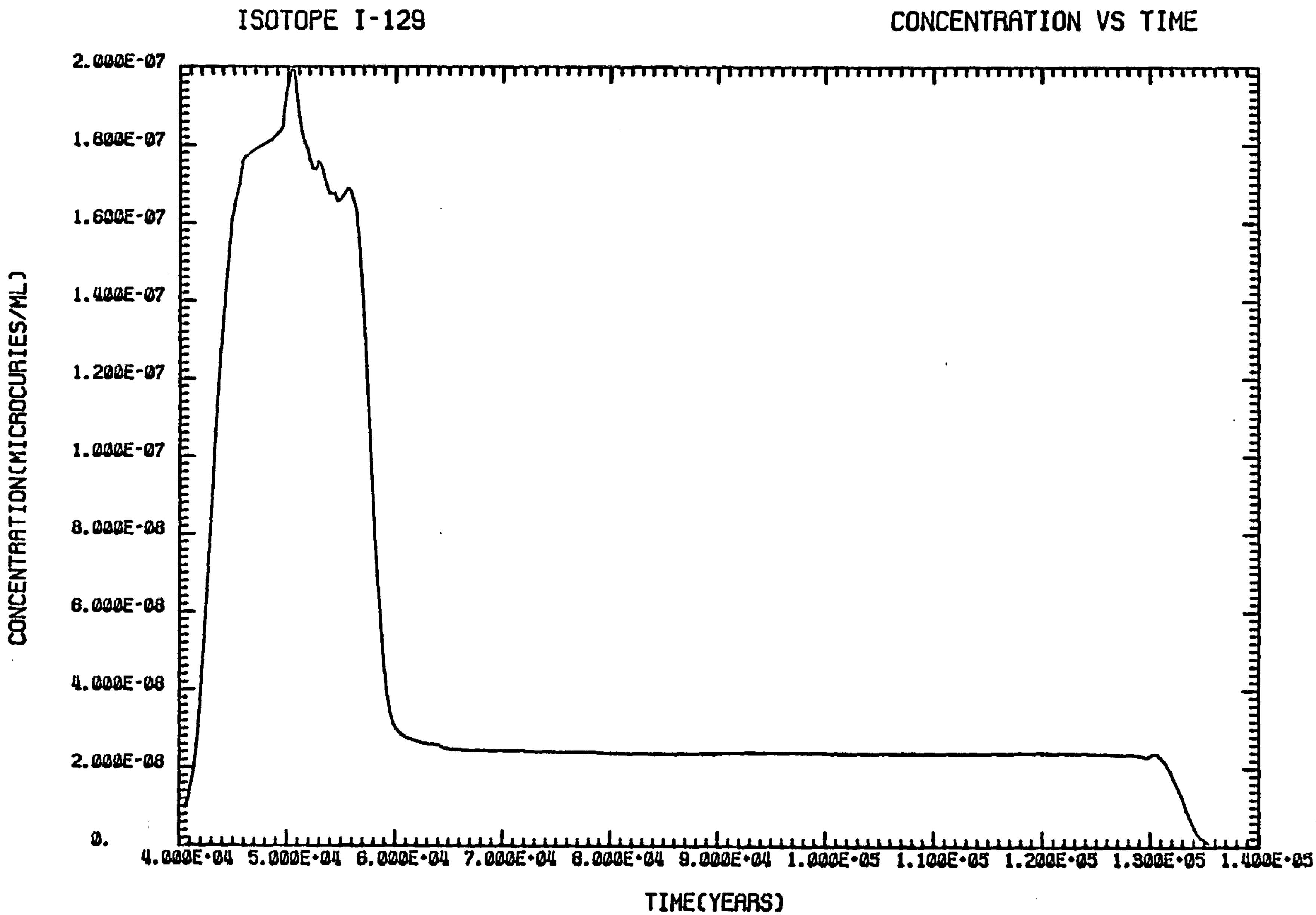

ISOTOPE PA-231
CONCENTRATION VS TIME
6.000E-10
5.000E-10
4.000E-10
3.000E-10
2.000E-10
1.000E-10
0.
CONCENTRATION(MICROCURIES/ML)
1.000E+05
2.000E+05
3.000E+05
4.000E+05
TIME(YEARS)

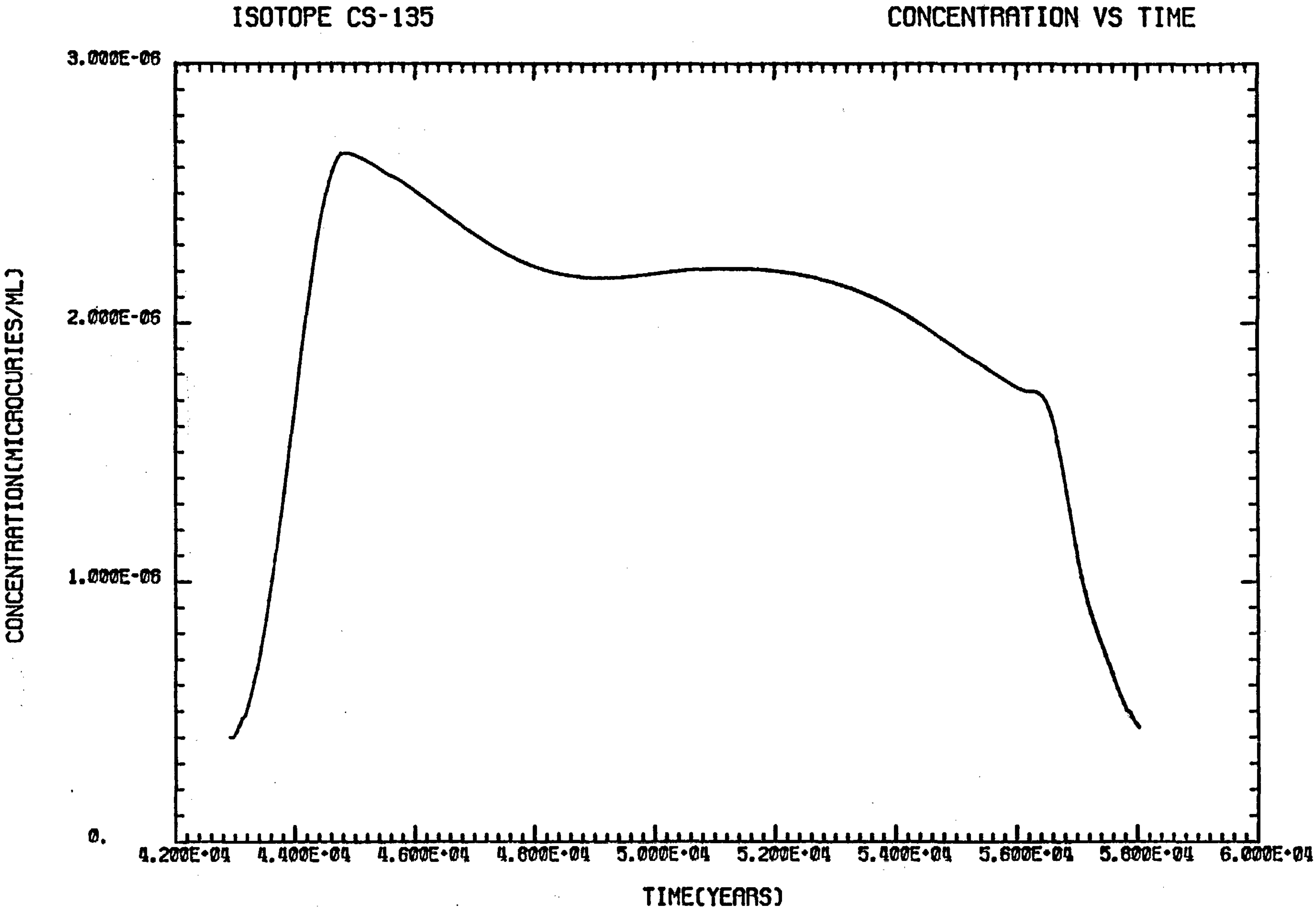
Scenario 2. Base Case. East Texas Oil Field removed from hydrologic model Discharge points in the Sabine River and Big Cypress Bayou. Release at 200 years. Simulation runs PIR2 and PIR3 are for Sabine River and Big Cypress Bayou, respectively. (Concentration versus time)



ISOTOPE C-14
CONCENTRATION VS TIME
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
3.000E+04
4.000E+04
5.000E+04
6.000E+04
7.000E+04
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

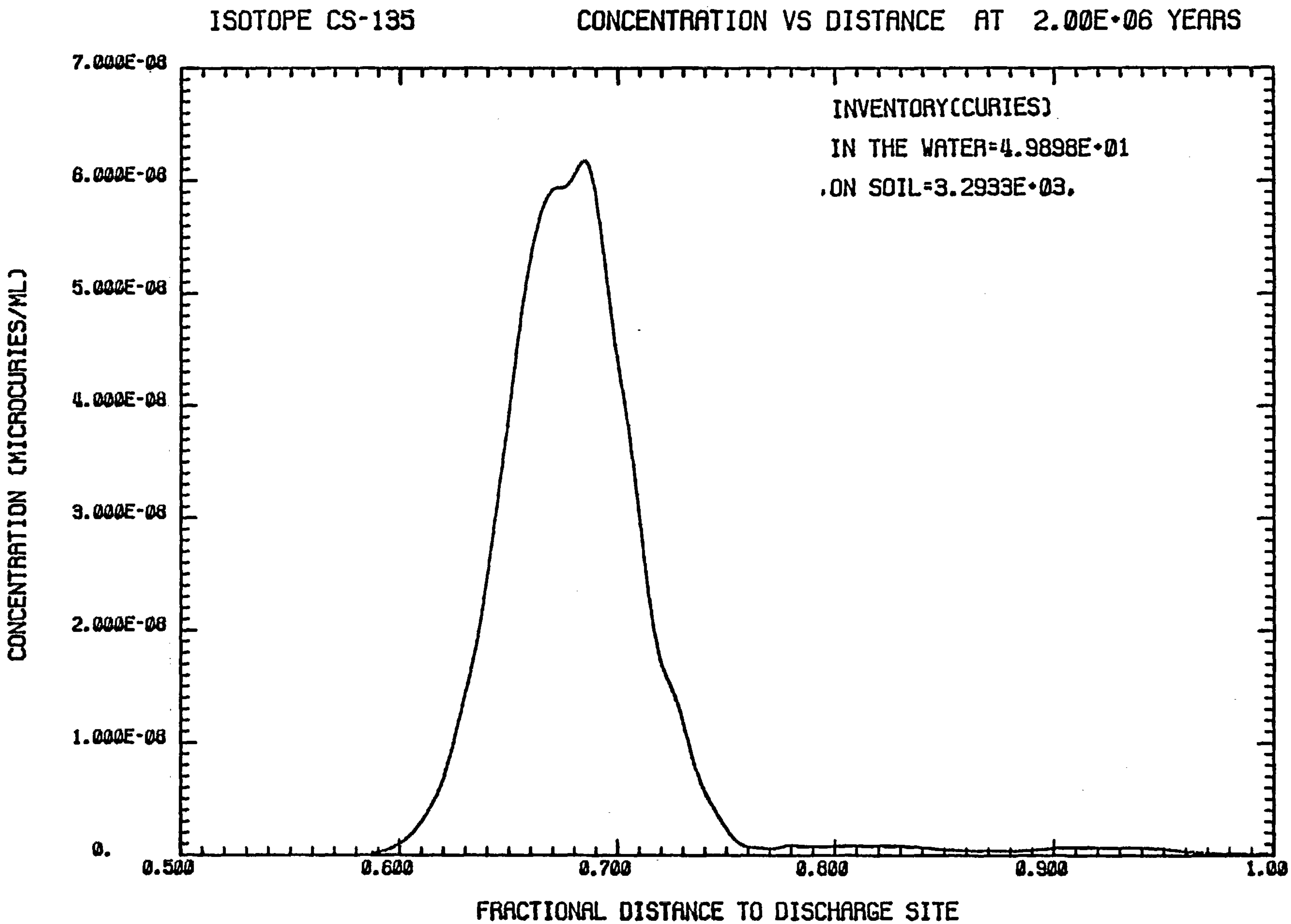

ISOTOPE TC-99
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
8.000E-04
7.000E-04
6.000E-04
5.000E-04
4.000E-04
3.000E-04
2.000E-04
1.000E-04
0.
5.800E+04
5.900E+04
6.000E+04
6.100E+04
6.200E+04
6.300E+04
TIME(YEARS)

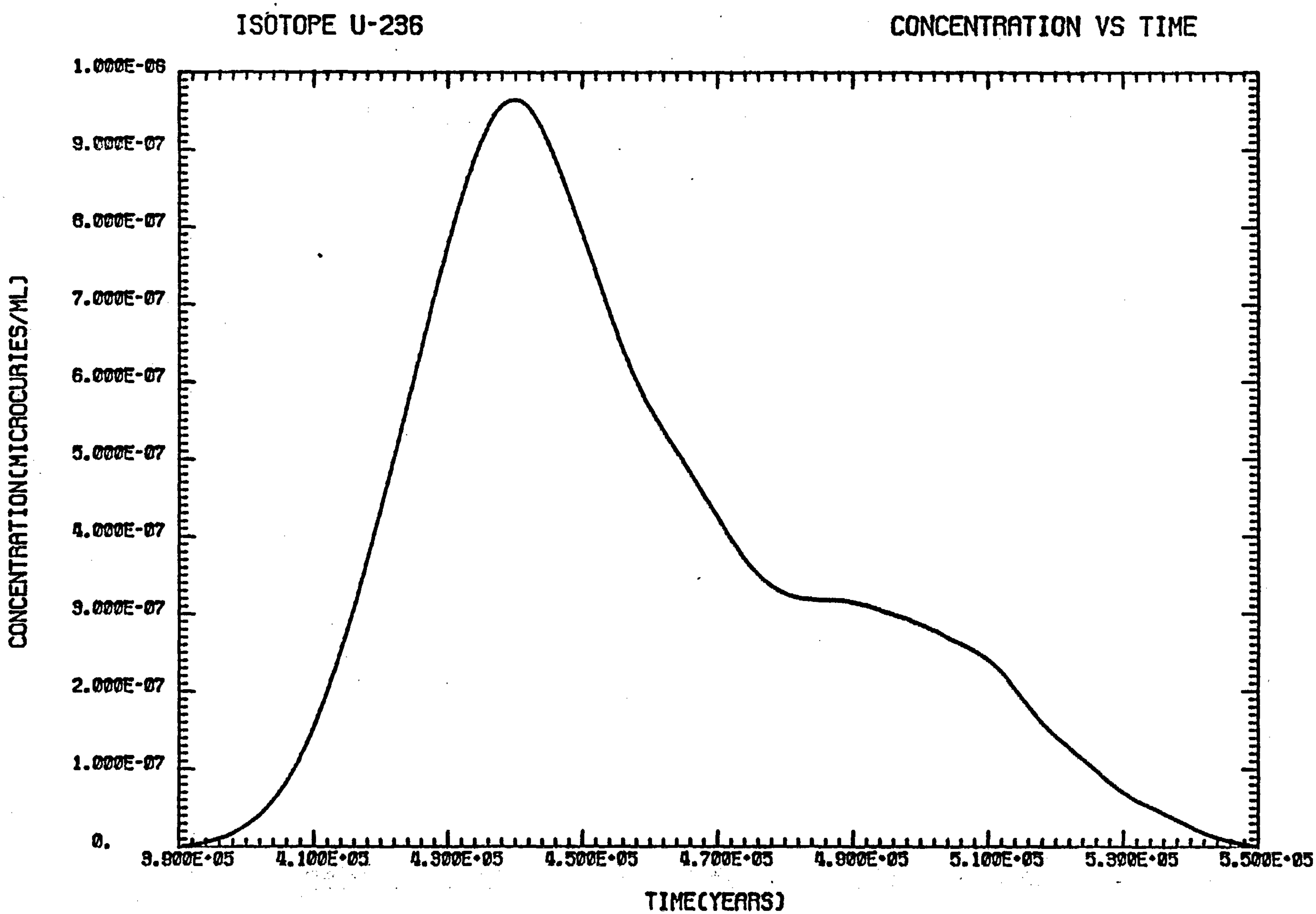

ISOTOPE I-129
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
2.000E-07
1.800E-07
1.600E-07
1.400E-07
1.200E-07
1.000E-07
8.000E-08
6.000E-08
4.000E-08
2.000E-08
0.
4.000E+04
5.000E+04
6.000E+04
7.000E+04
8.000E+04
9.000E+04
1.000E+05
1.100E+05
1.200E+05
1.300E+05
1.400E+05
TIME(YEARS)

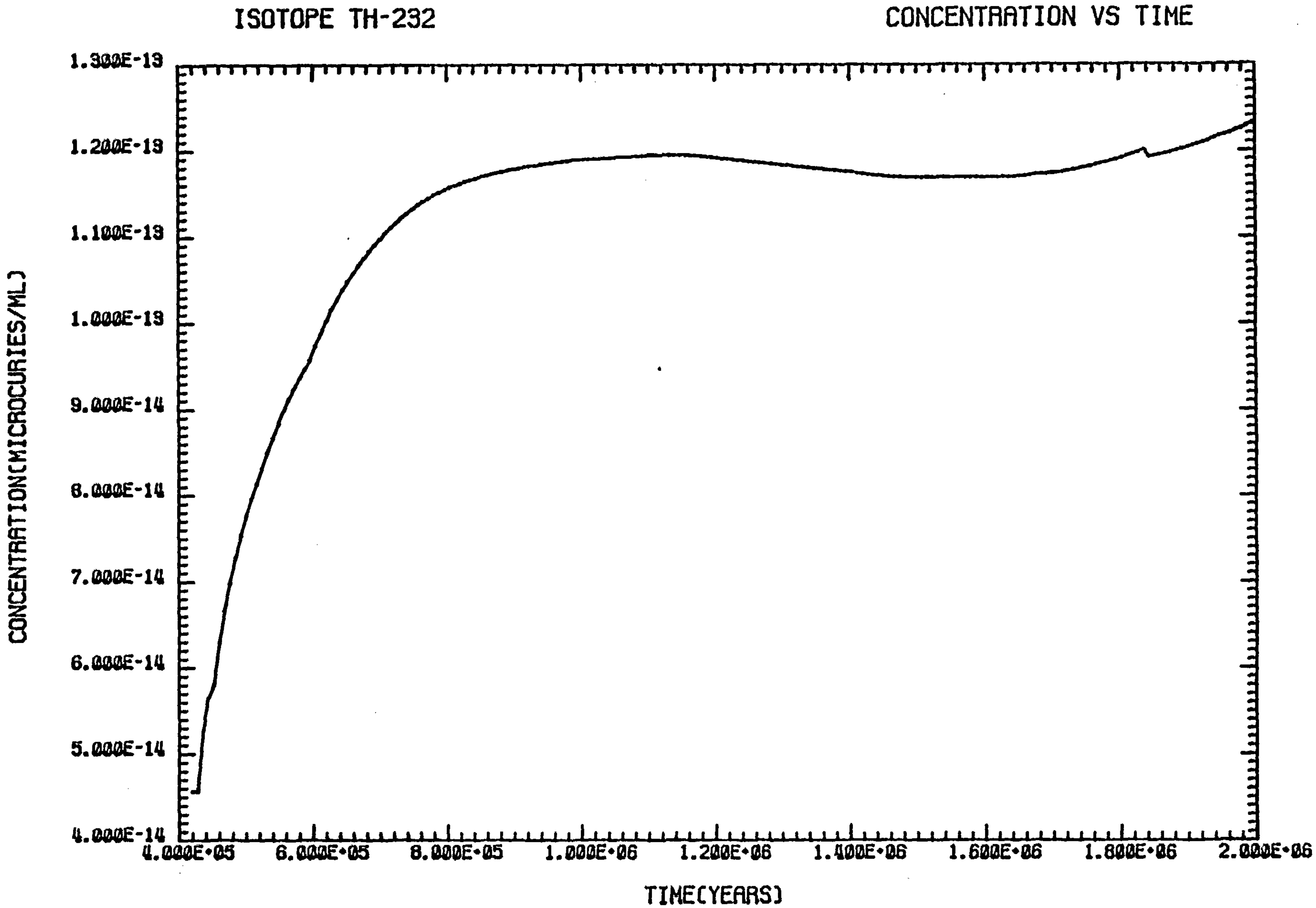


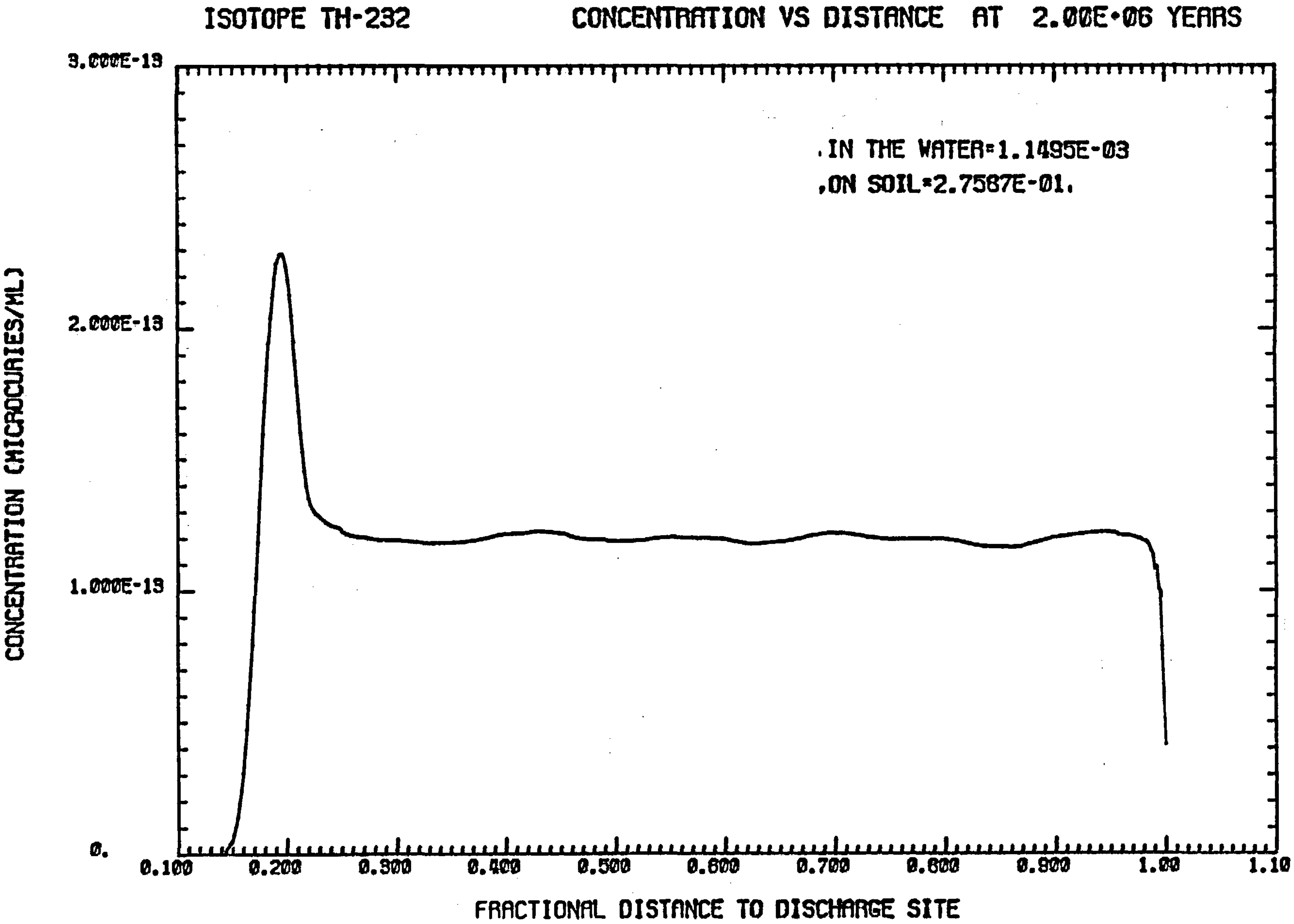
ISOTOPE CS-135
CONCENTRATION VS TIME
3.000E-06
2.000E-06
1.000E-06
0.
CONCENTRATION(MICROCURIES/ML)
4.200E+04
4.400E+04
4.600E+04
4.800E+04
5.000E+04
5.200E+04
5.400E+04
5.600E+04
5.800E+04
6.000E+04
TIME(YEARS)

G.45


ISOTOPE CS-135
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
INVENTORY(CURIES)
IN THE WATER=4.9898E+01
ON SOIL=3.2933E+03
CONCENTRATION (MICROCURIES/ML)
7.000E-08
6.000E-08
5.000E-08
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
0.500
0.600
0.700
0.800
0.900
1.00
FRACTIONAL DISTANCE TO DISCHARGE SITE

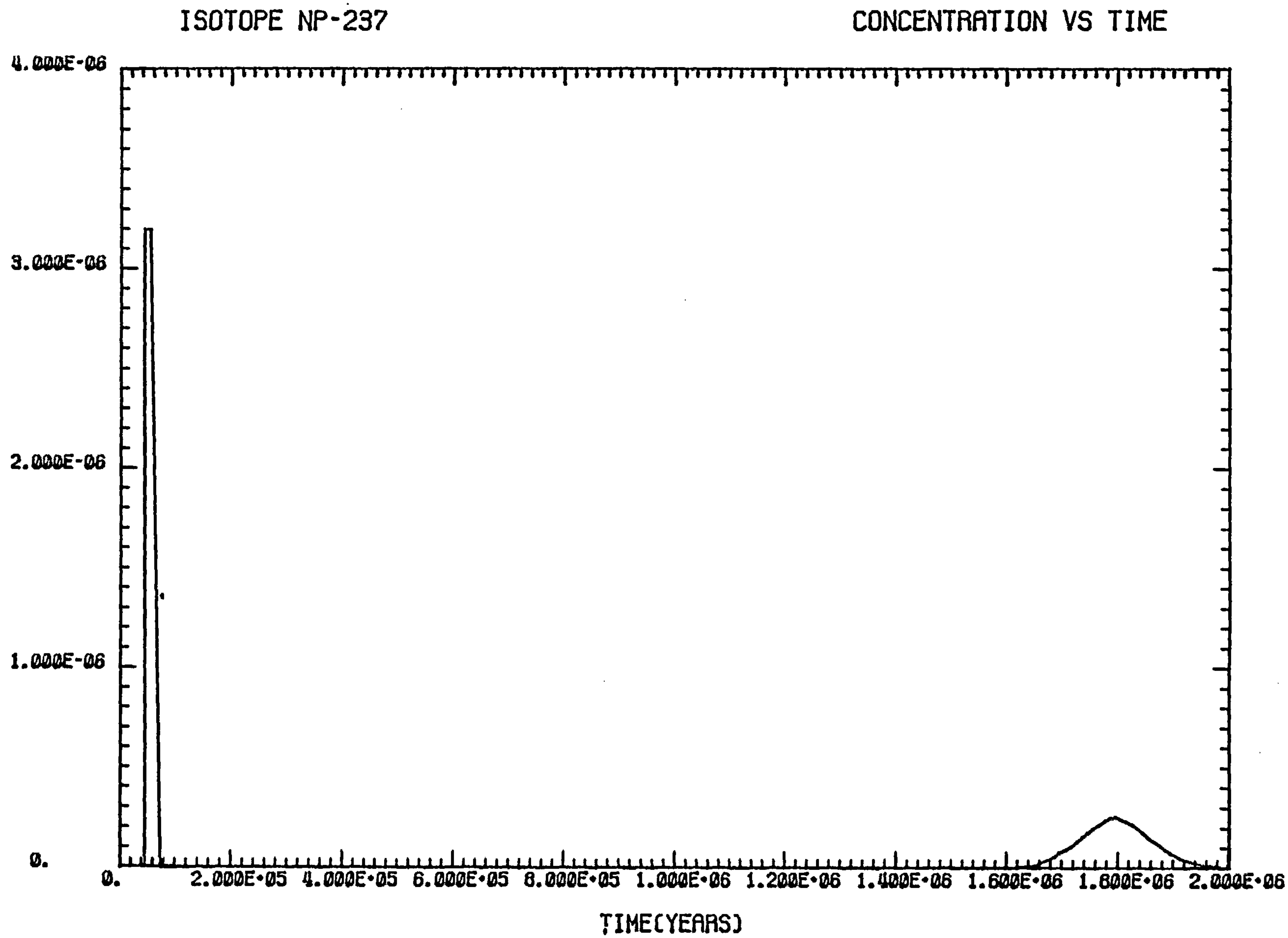

ISOTOPE U-236
CONCENTRATION VS TIME
1.000E-06
9.000E-07
8.000E-07
7.000E-07
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
3.900E+05
4.100E+05
4.300E+05
4.500E+05
4.700E+05
4.900E+05
5.100E+05
5.300E+05
5.500E+05
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)


ISOTOPE TH-232
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.300E-13
1.200E-13
1.100E-13
1.000E-13
9.000E-14
8.000E-14
7.000E-14
6.000E-14
5.000E-14
4.000E-14
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
1.600E+06
1.800E+06
2.000E+06
TIME(YEARS)

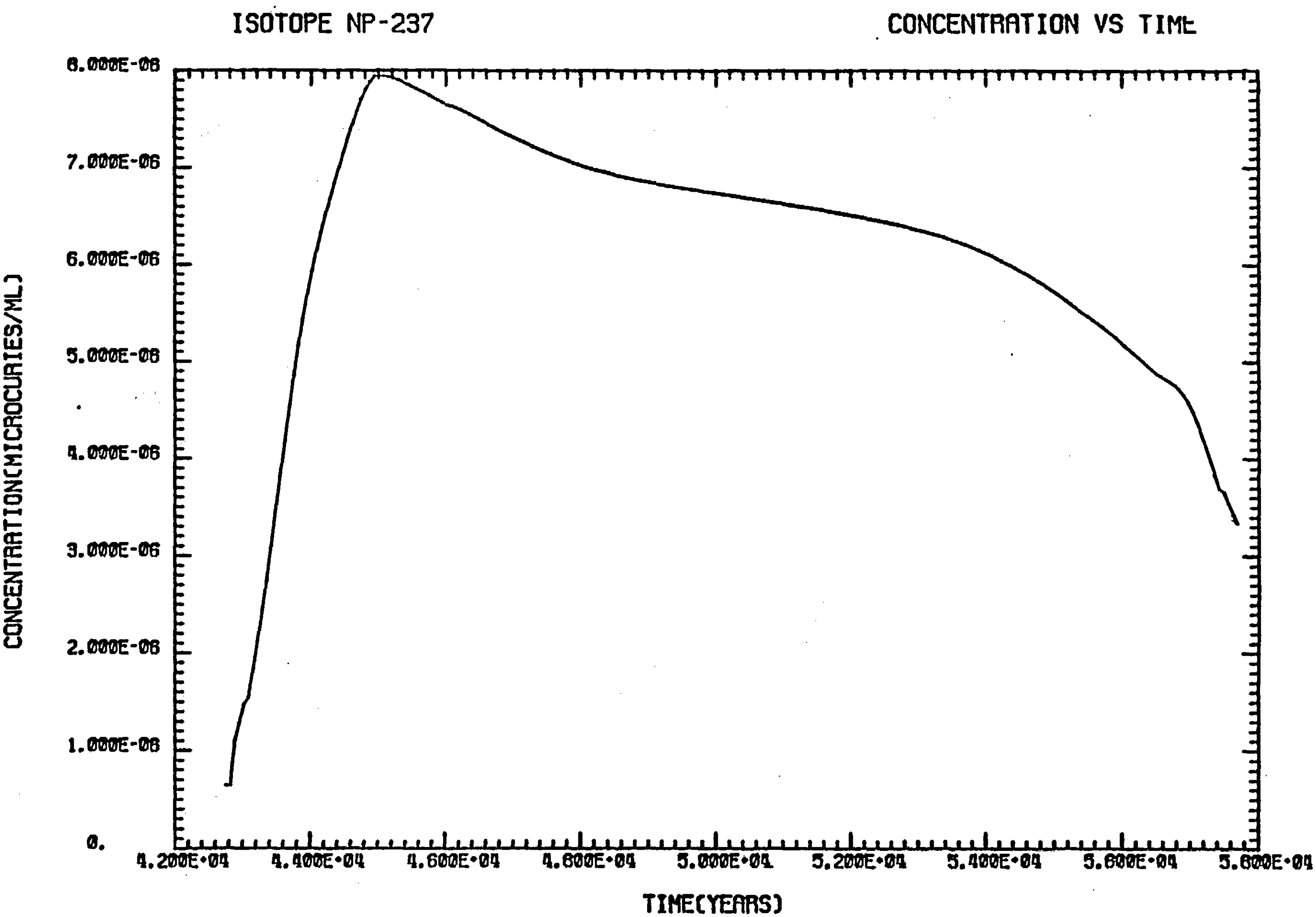


ISOTOPE TH-232
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
.IN THE WATER=1.1495E-03
,ON SOIL=2.7587E-01,
3.000E-13
2.000E-13
1.000E-13
0.
CONCENTRATION (MICROCURIES/ML)
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.00
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE

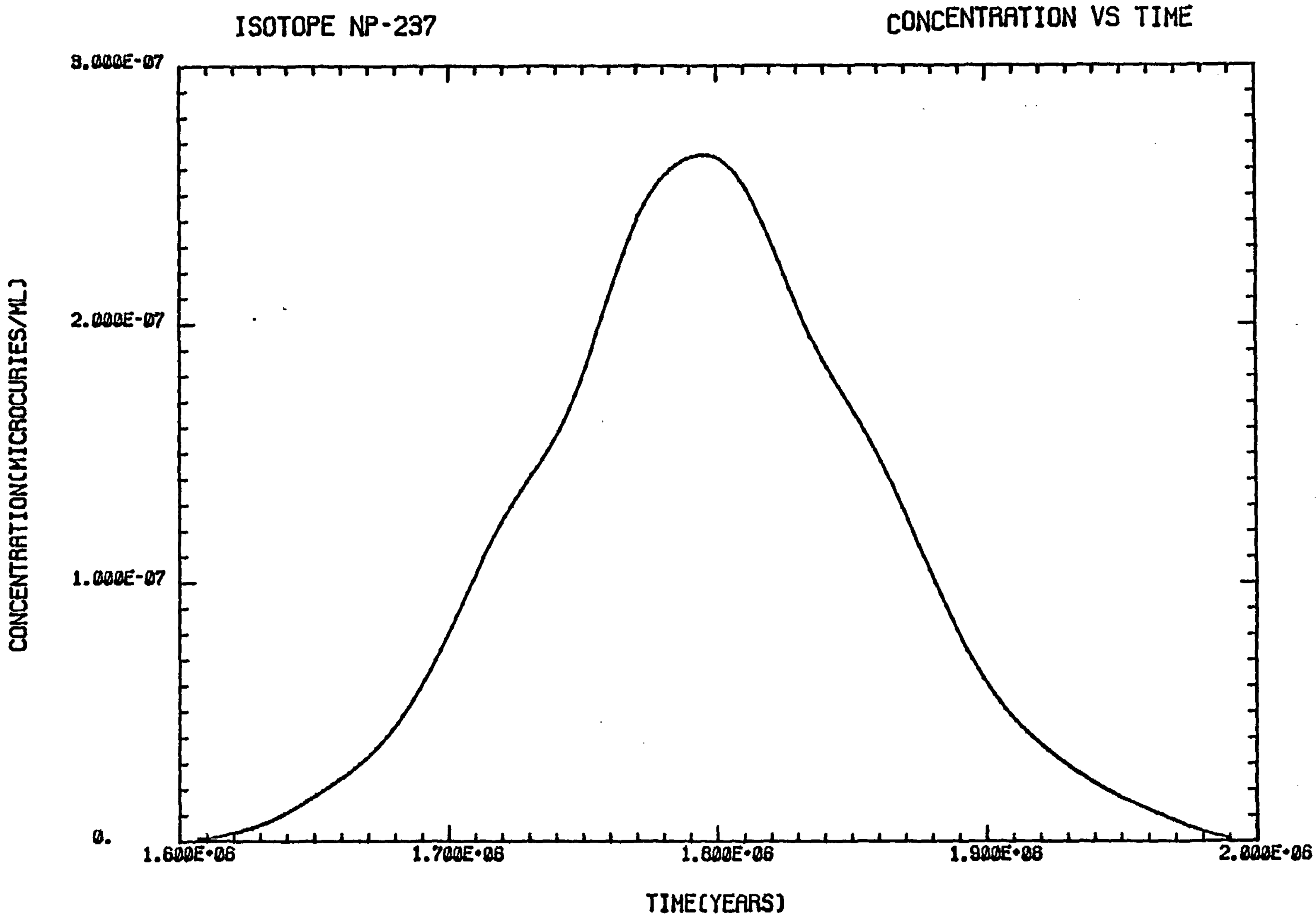
G.49

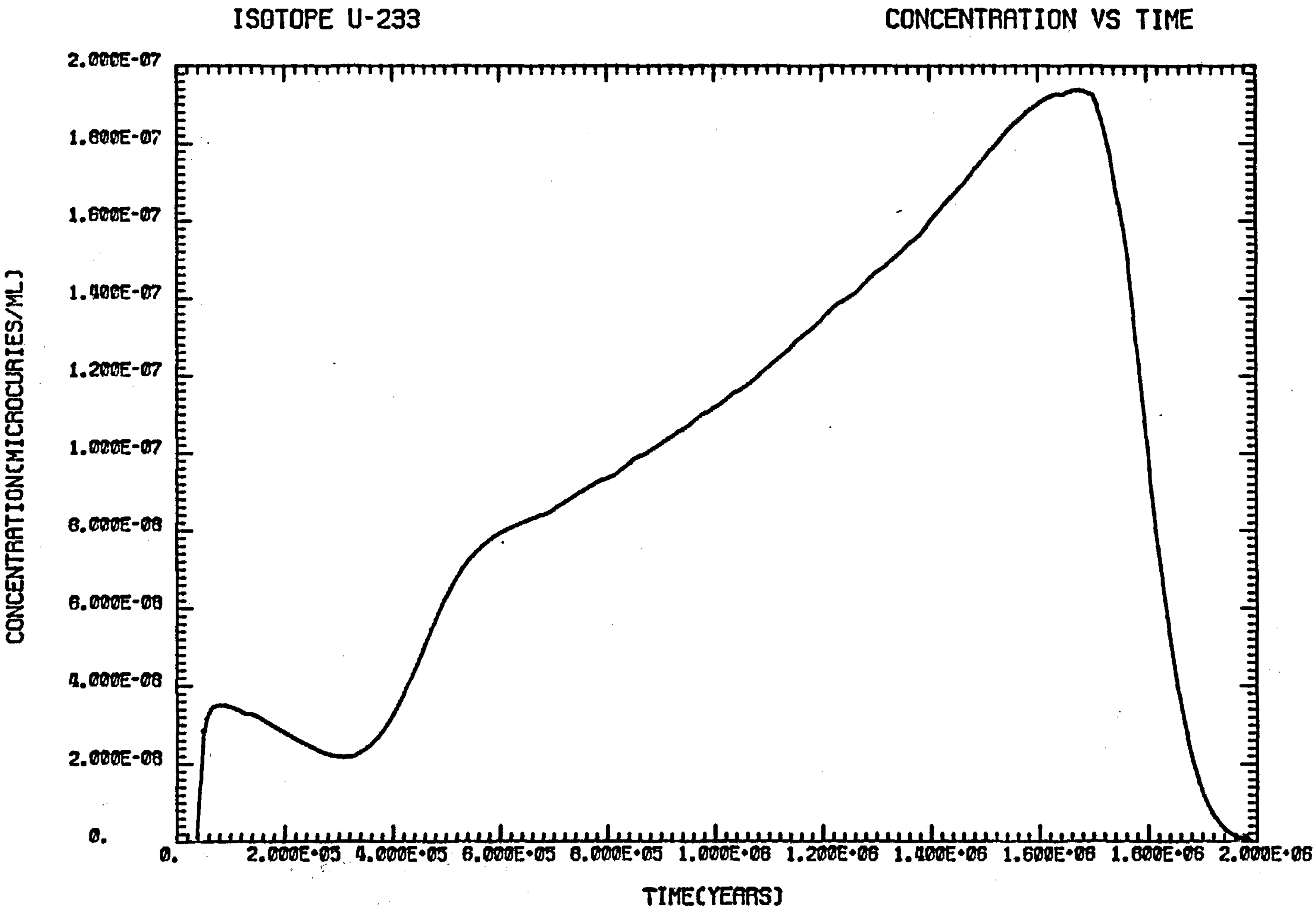


ISOTOPE NP-237
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
TIME(YEARS)

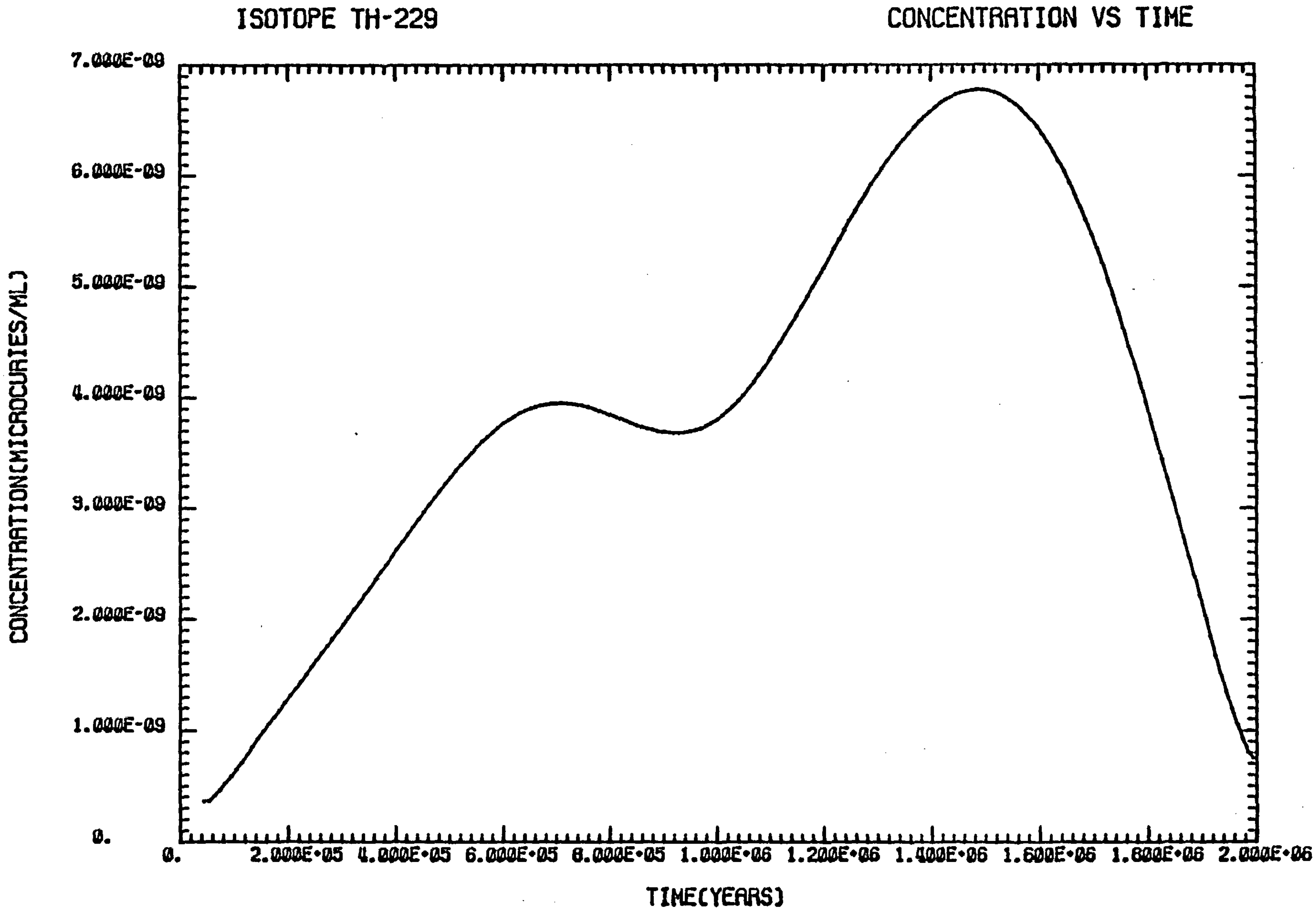


ISOTOPE NP-237
CONCENTRATION VS TIME
8.000E-06
7.000E-06
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
CONCENTRATION(MICROCURIES/ML)
4.200E+04
4.400E+04
4.600E+04
4.800E+04
5.000E+04
5.200E+04
5.400E+04
5.600E+04
5.800E+04
TIME(YEARS)


ISOTOPE NP-237
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
3.000E-07
2.000E-07
1.000E-07
0.
1.600E+06
1.700E+06
1.800E+06
1.900E+06
2.000E+06
TIME(YEARS)

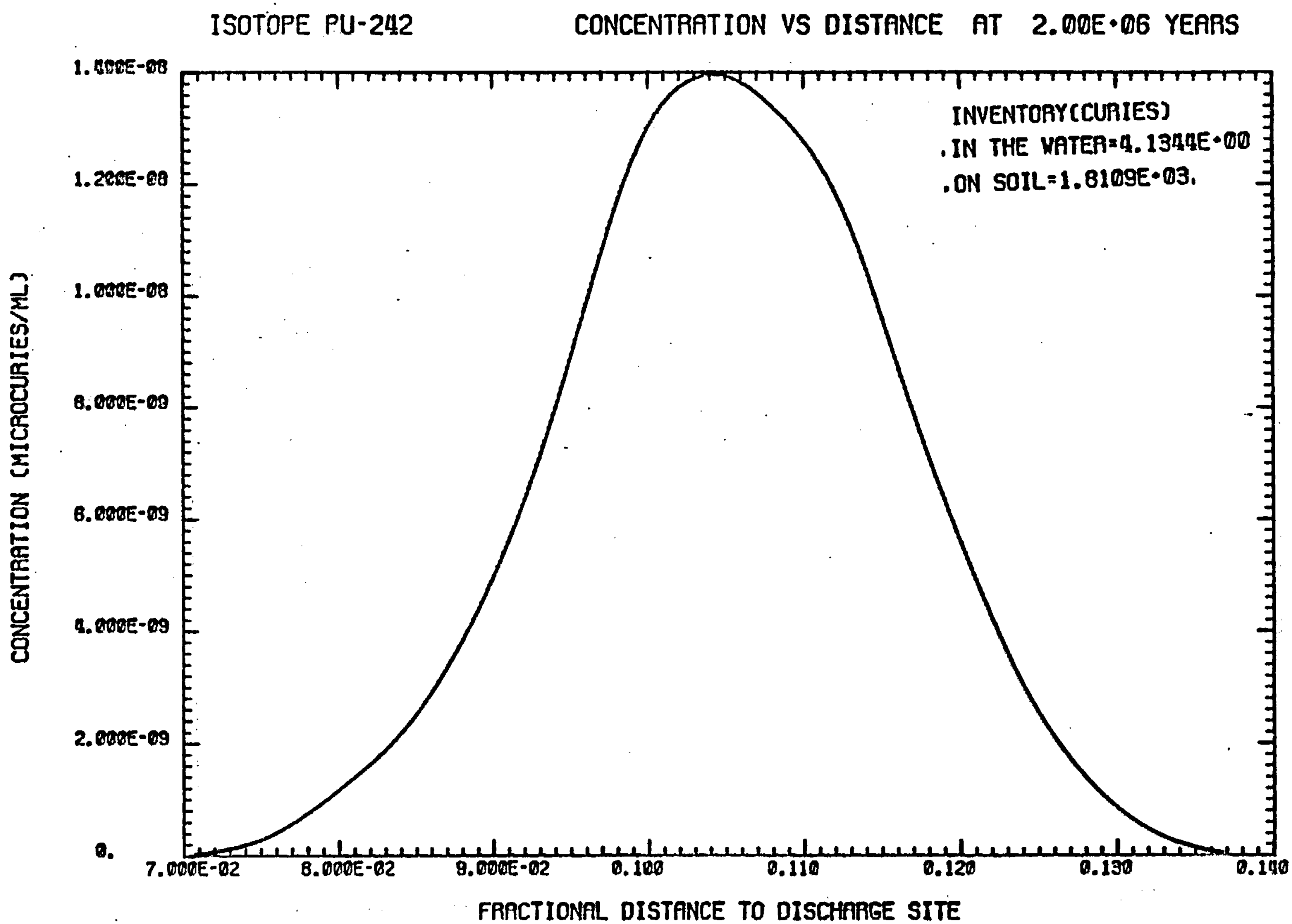


ISOTOPE U-233
CONCENTRATION VS TIME
2.000E-07
1.800E-07
1.600E-07
1.400E-07
1.200E-07
1.000E-07
8.000E-08
6.000E-08
4.000E-08
2.000E-08
0.
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
1.600E+06
1.800E+06
2.000E+06
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

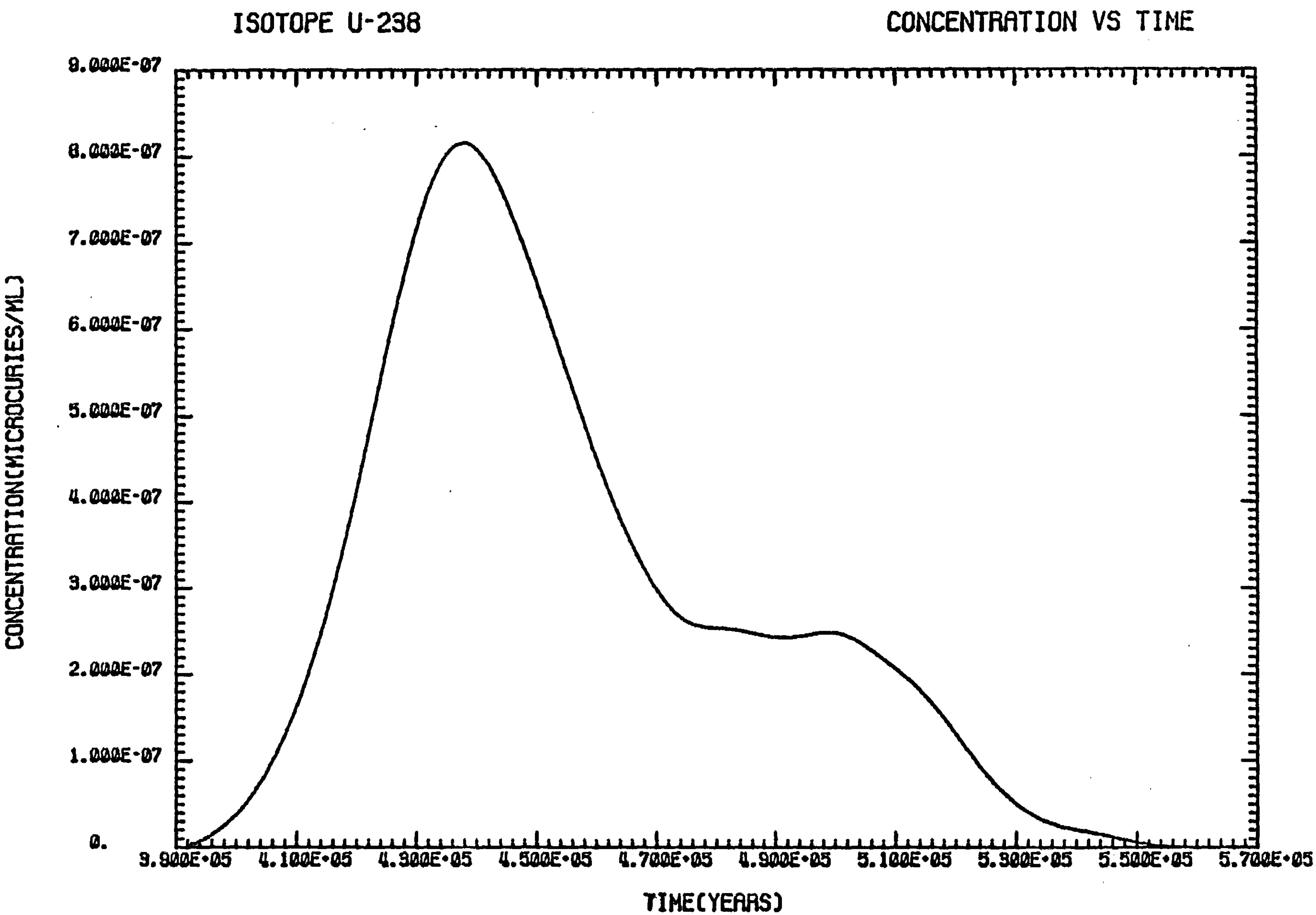


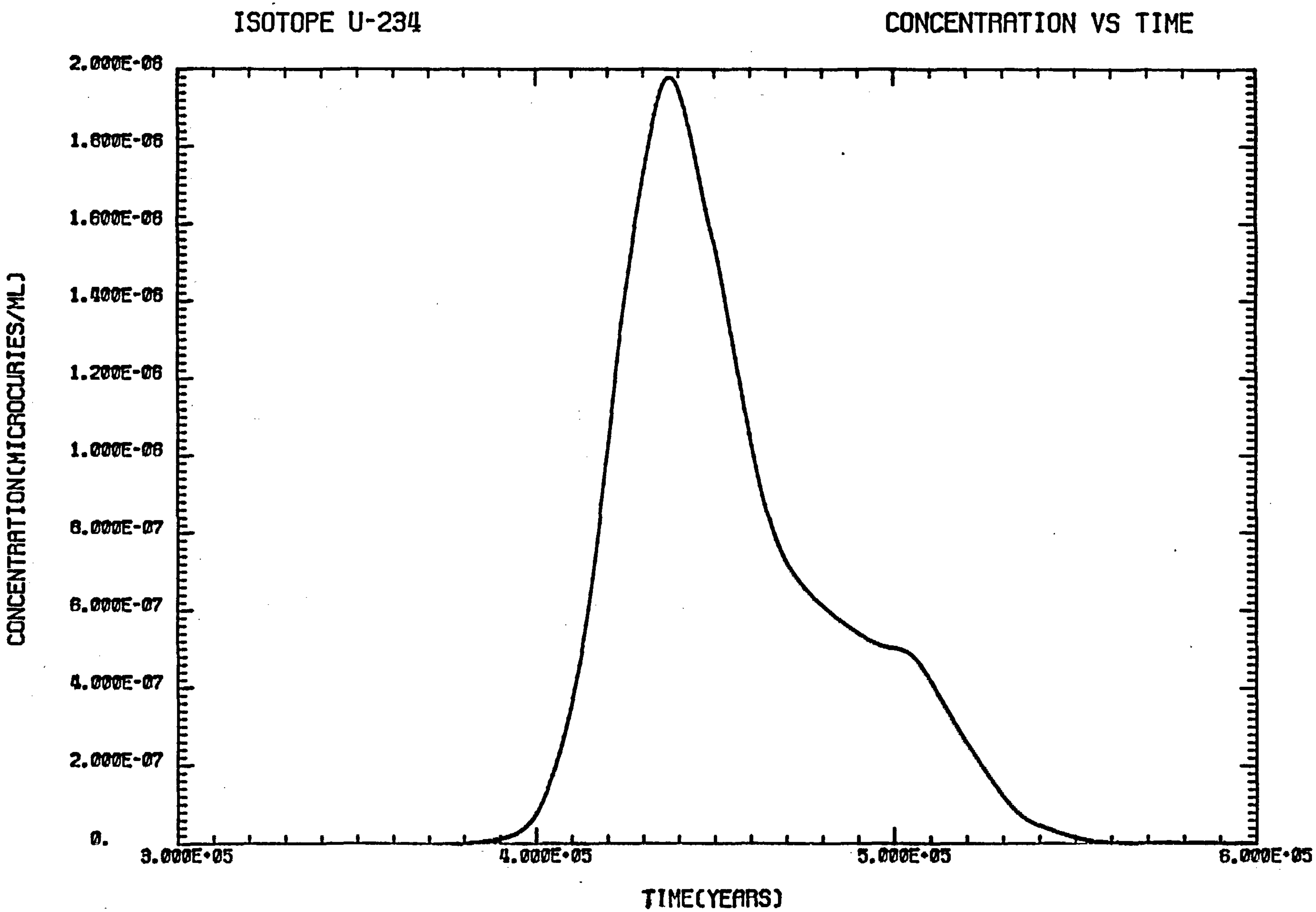
ISOTOPE TH-229
CONCENTRATION VS TIME
7.000E-09
6.000E-09
5.000E-09
4.000E-09
3.000E-09
2.000E-09
1.000E-09
0.
CONCENTRATION(MICROCURIES/ML)
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
1.600E+06
1.800E+06
2.000E+06
TIME(YEARS)

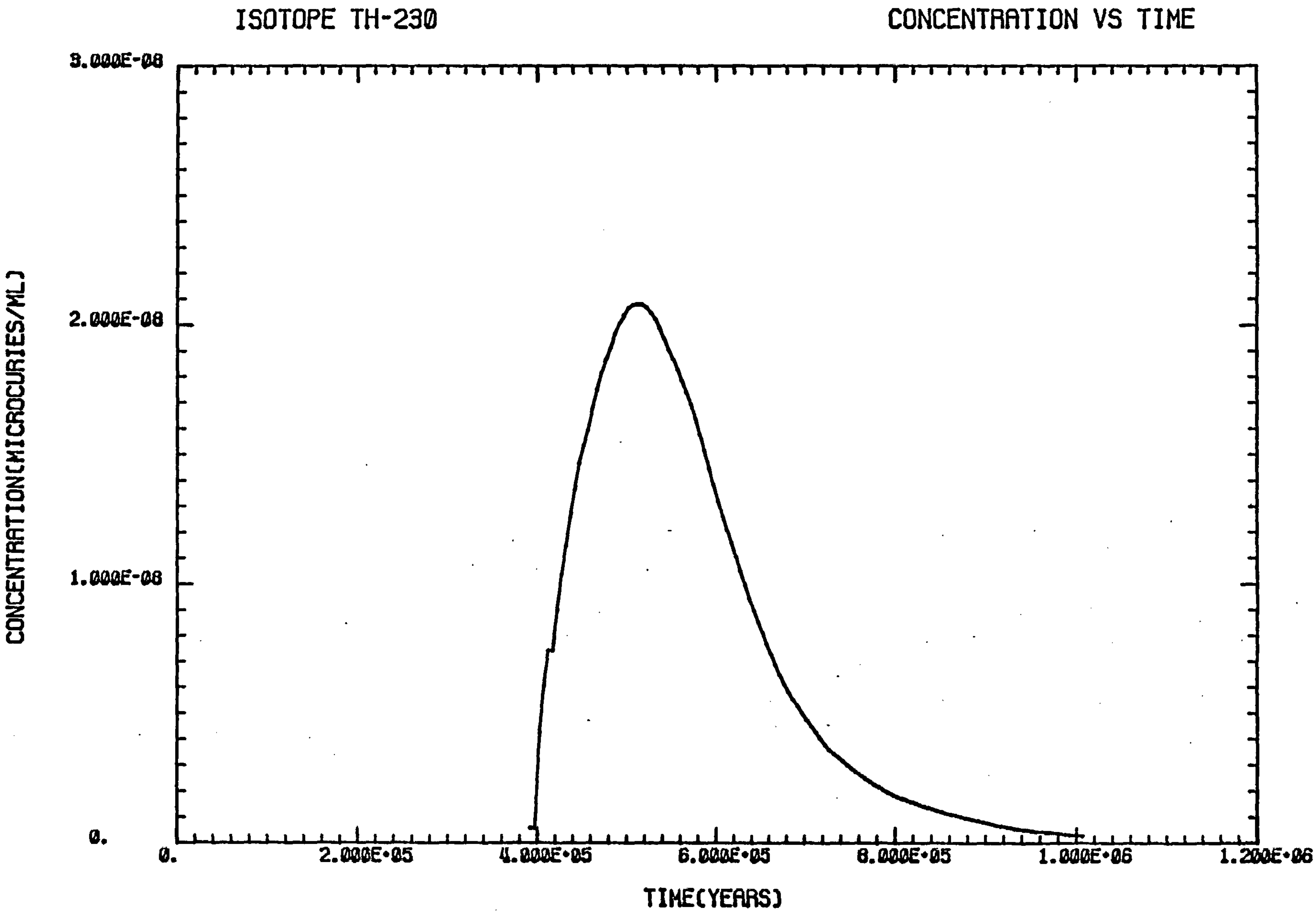
G.54



ISOTOPE PU-242
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
INVENTORY(CURIES)
.IN THE WATER=4.1344E+00
.ON SOIL=1.8109E+03.
CONCENTRATION (MICROCURIES/ML)
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
7.000E-02
8.000E-02
9.000E-02
0.100
0.110
0.120
0.130
0.140
FRACTIONAL DISTANCE TO DISCHARGE SITE

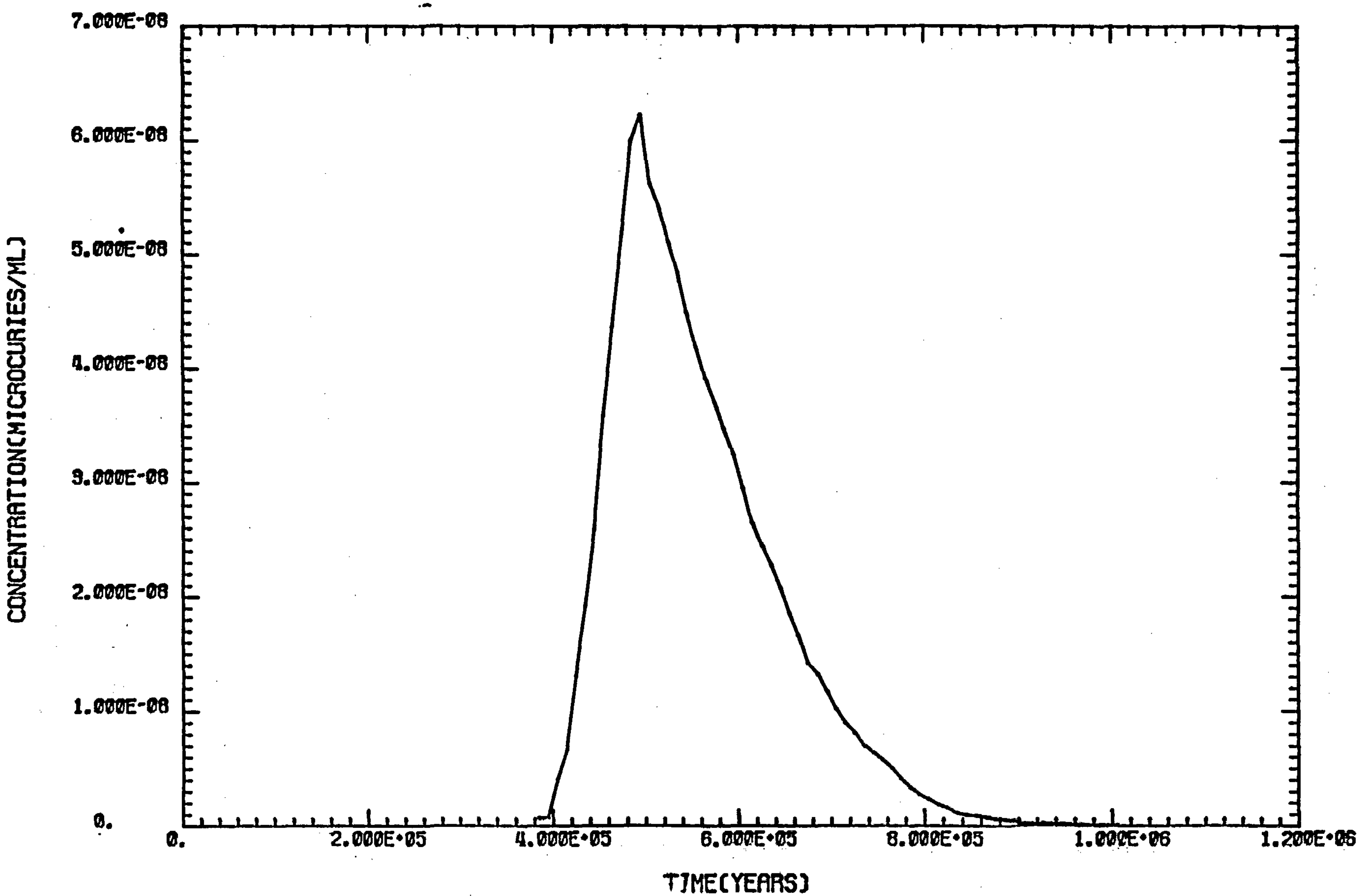

ISOTOPE U-238
CONCENTRATION VS TIME
9.000E-07
8.000E-07
7.000E-07
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
CONCENTRATION(MICROCURIES/ML)
3.900E+05
4.100E+05
4.300E+05
4.500E+05
4.700E+05
4.900E+05
5.100E+05
5.300E+05
5.500E+05
5.700E+05
TIME(YEARS)

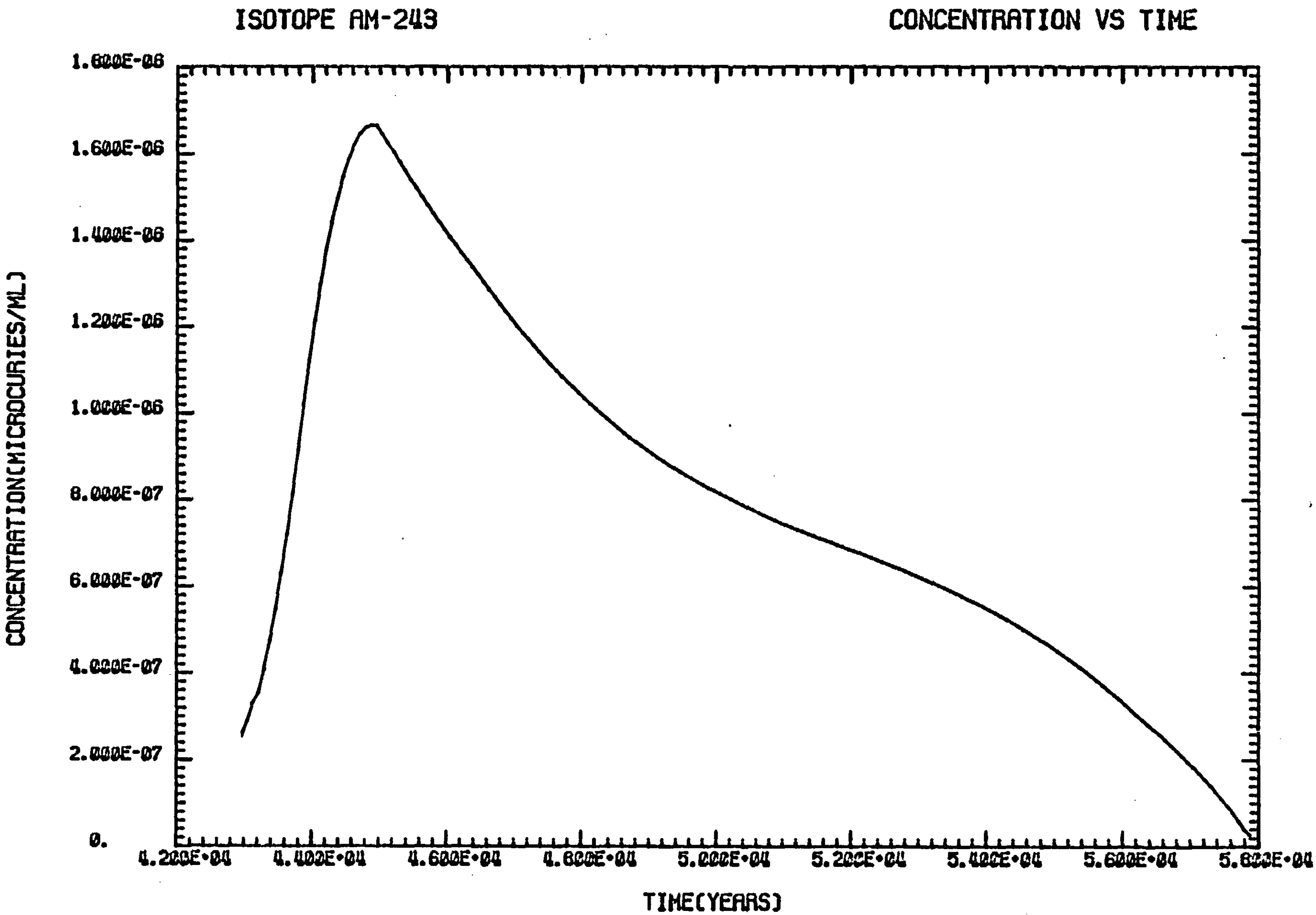

ISOTOPE U-234
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
2.000E-06
1.800E-06
1.600E-06
1.400E-06
1.200E-06
1.000E-06
8.000E-07
6.000E-07
4.000E-07
2.000E-07
0.
3.000E+05
4.000E+05
5.000E+05
6.000E+05
TIME(YEARS)

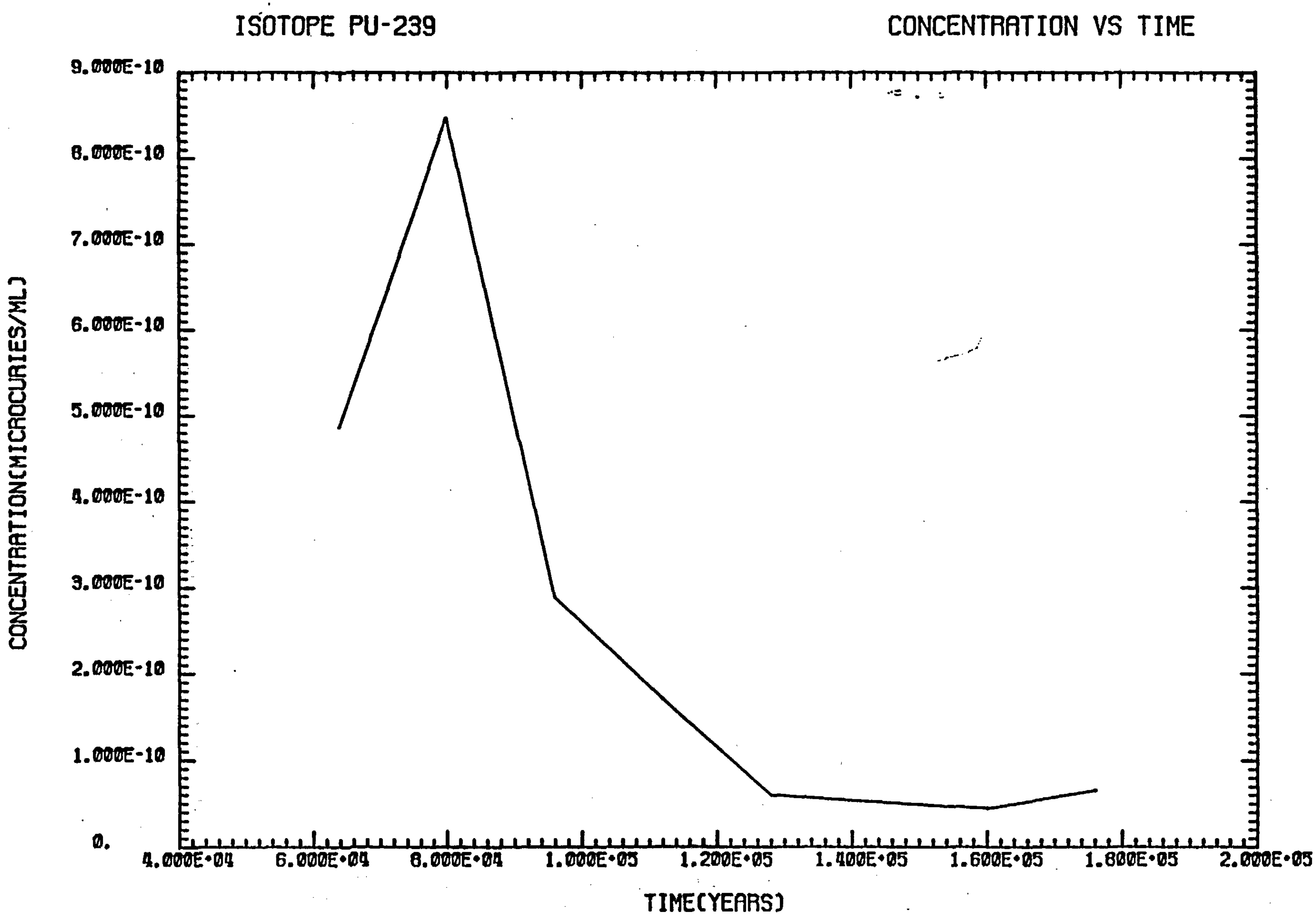


ISOTOPE TH-230
CONCENTRATION VS TIME
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
TIME(YEARS)

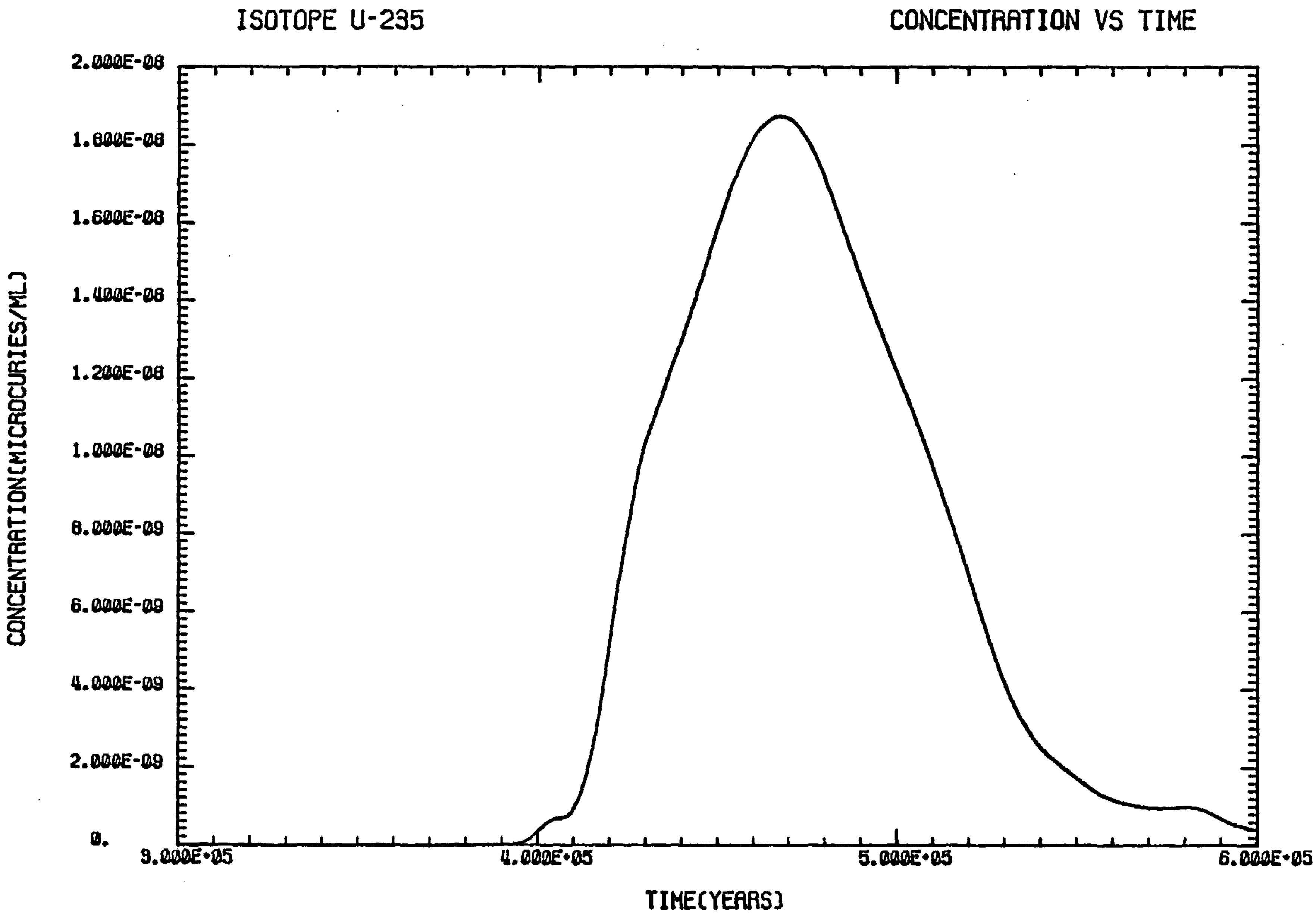
ISOTOPE RA-226 CONCENTRATION VS TIME




ISOTOPE AM-243
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.800E-06
1.600E-06
1.400E-06
1.200E-06
1.000E-06
8.000E-07
6.000E-07
4.000E-07
2.000E-07
0.
4.200E+04
4.400E+04
4.600E+04
4.800E+04
5.000E+04
5.200E+04
5.400E+04
5.600E+04
5.800E+04
TIME(YEARS)

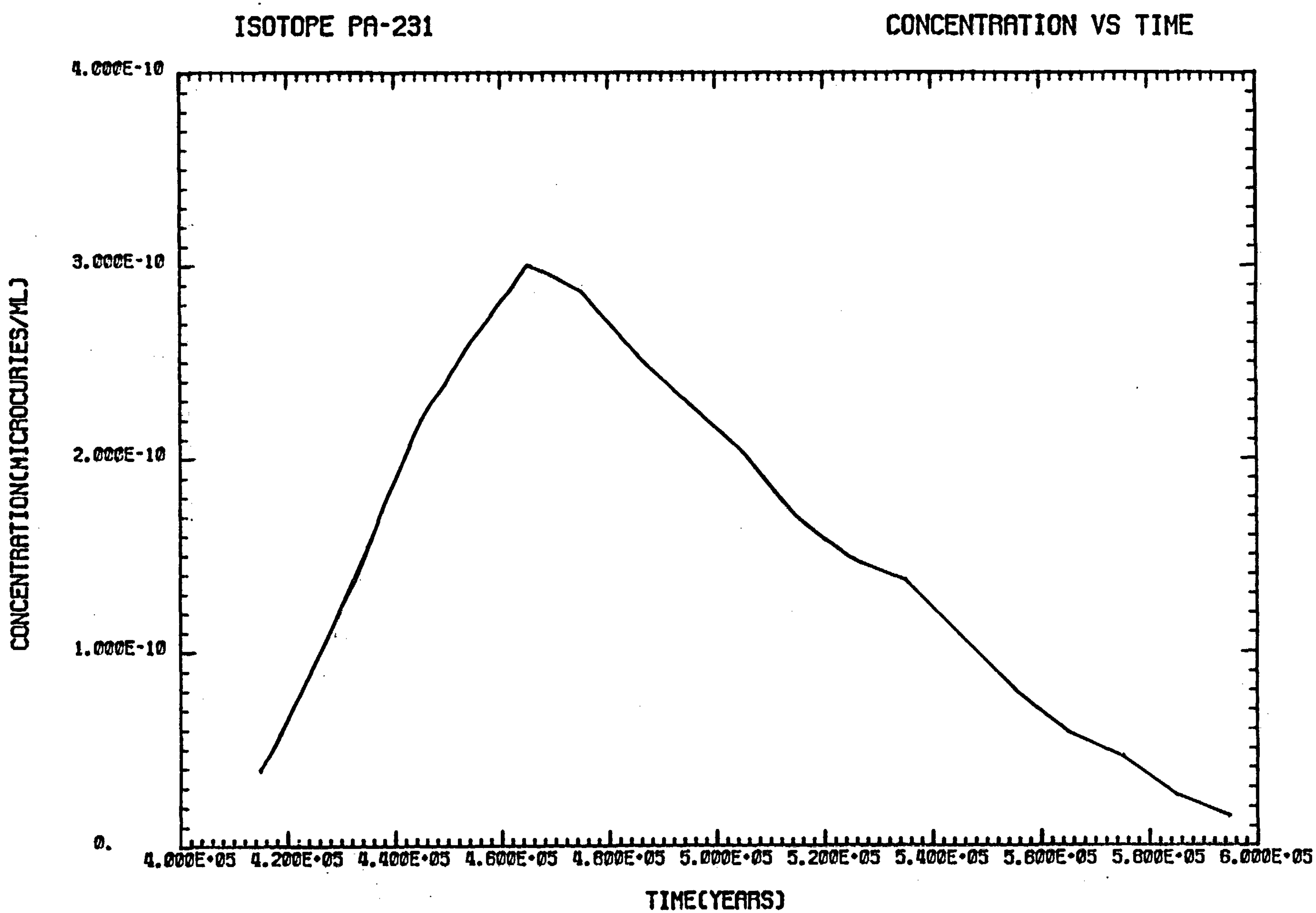


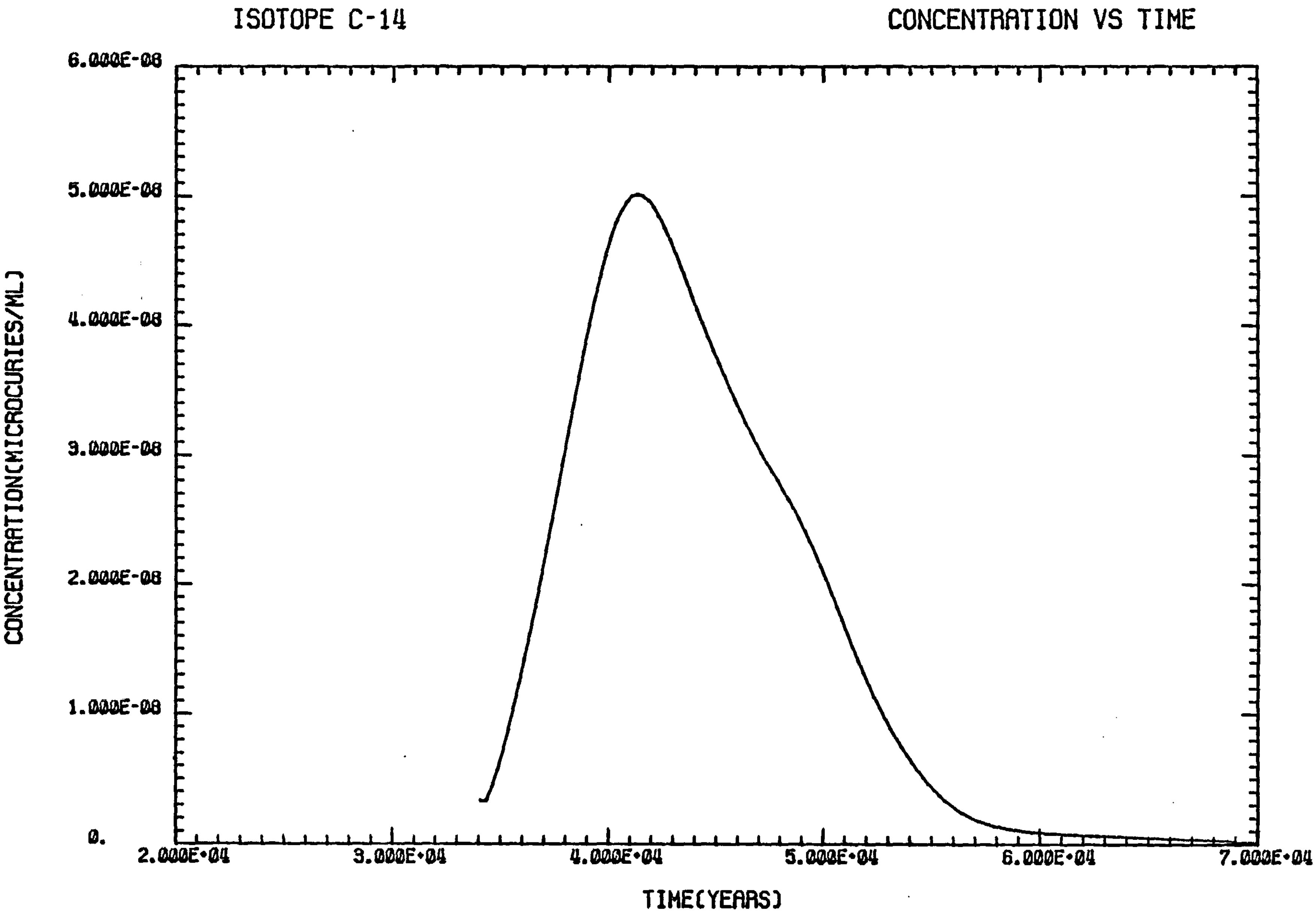
ISOTOPE PU-239
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
9.000E-10
8.000E-10
7.000E-10
6.000E-10
5.000E-10
4.000E-10
3.000E-10
2.000E-10
1.000E-10
0.
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
1.400E+05
1.600E+05
1.800E+05
2.000E+05
TIME(YEARS)



ISOTOPE U-235
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
TIME(YEARS)
2.000E-08
1.800E-08
1.600E-08
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
3.000E+05
4.000E+05
5.000E+05
6.000E+05

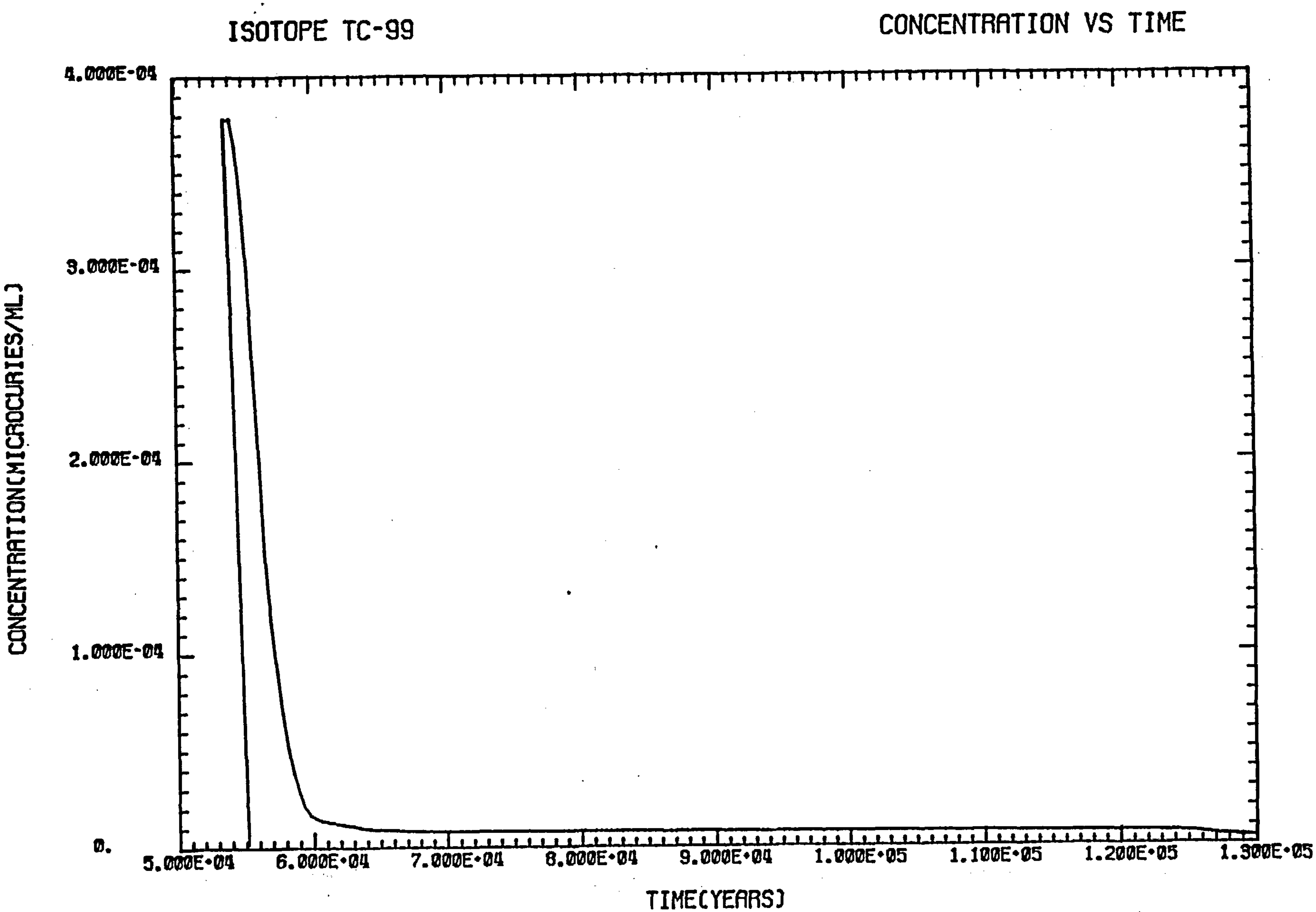
G.62


ISOTOPE PA-231
CONCENTRATION VS TIME
4.000E-10
3.000E-10
2.000E-10
1.000E-10
0.
CONCENTRATION(MICROCURIES/ML)
4.000E+05 4.200E+05 4.400E+05 4.600E+05 4.800E+05 5.000E+05 5.200E+05 5.400E+05 5.600E+05 5.800E+05 6.000E+05
TIME(YEARS)

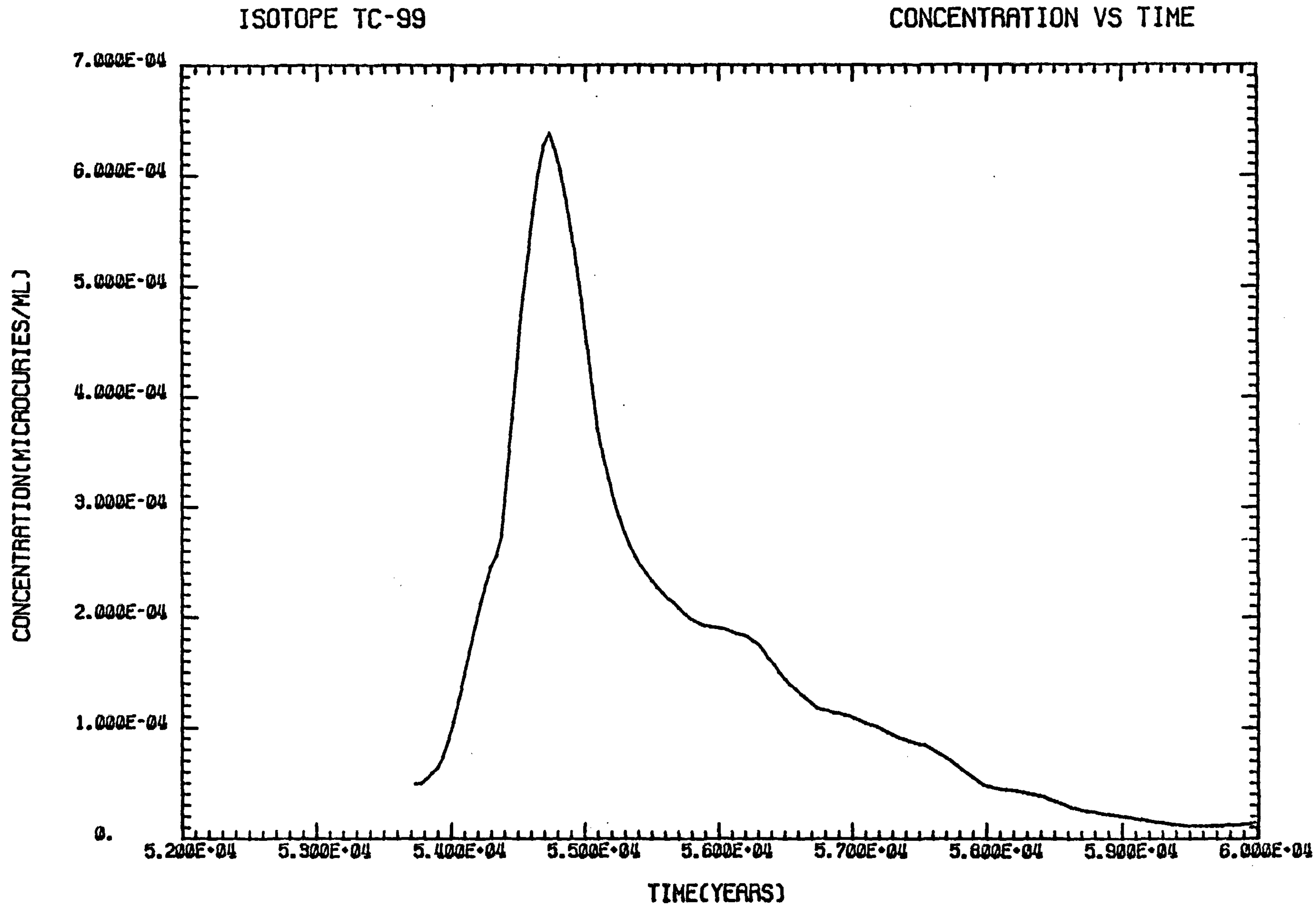


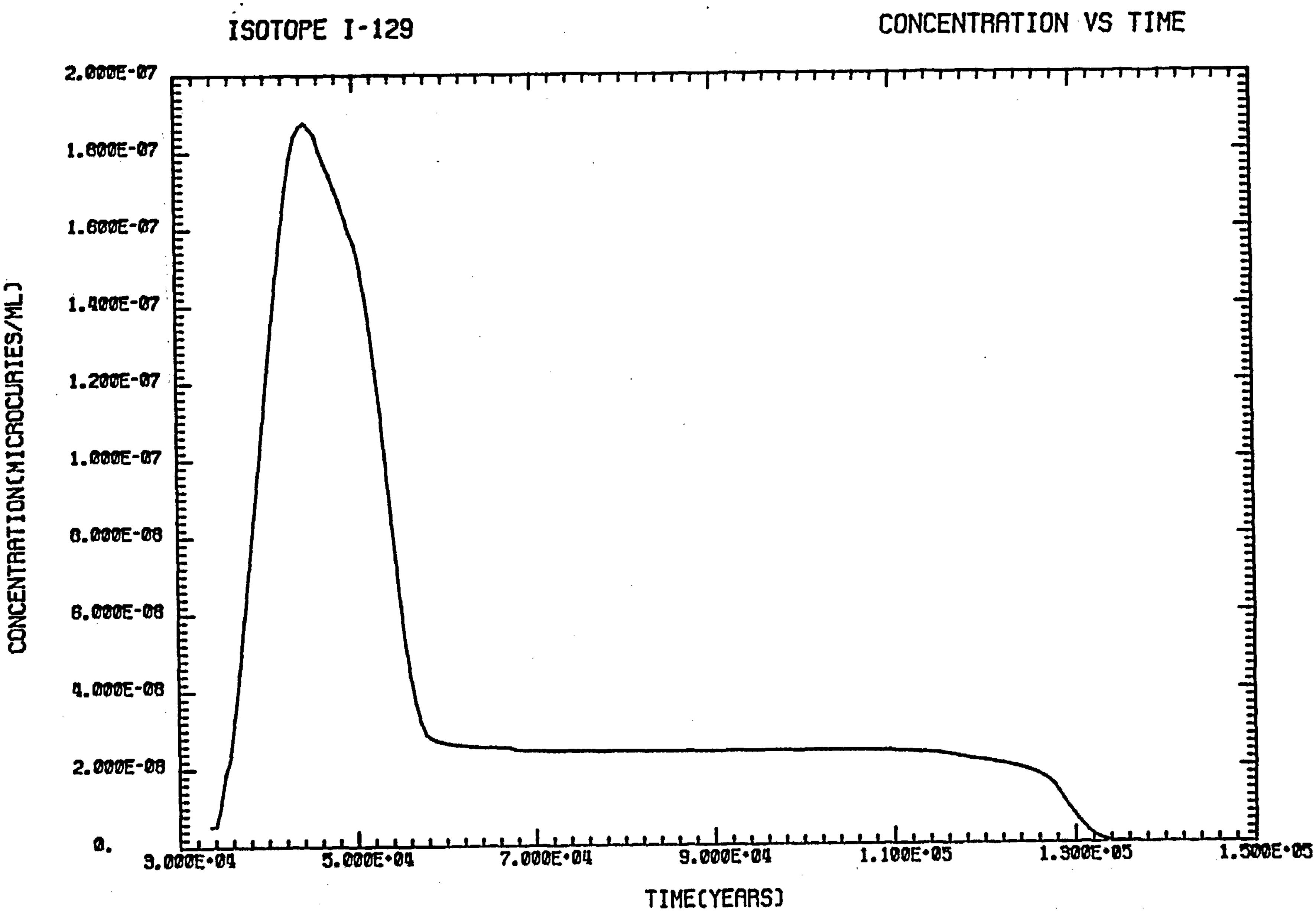
ISOTOPE C-14
CONCENTRATION VS TIME
6.000E-08
5.000E-08
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
2.000E+04
3.000E+04
4.000E+04
5.000E+04
6.000E+04
7.000E+04
TIME(YEARS)

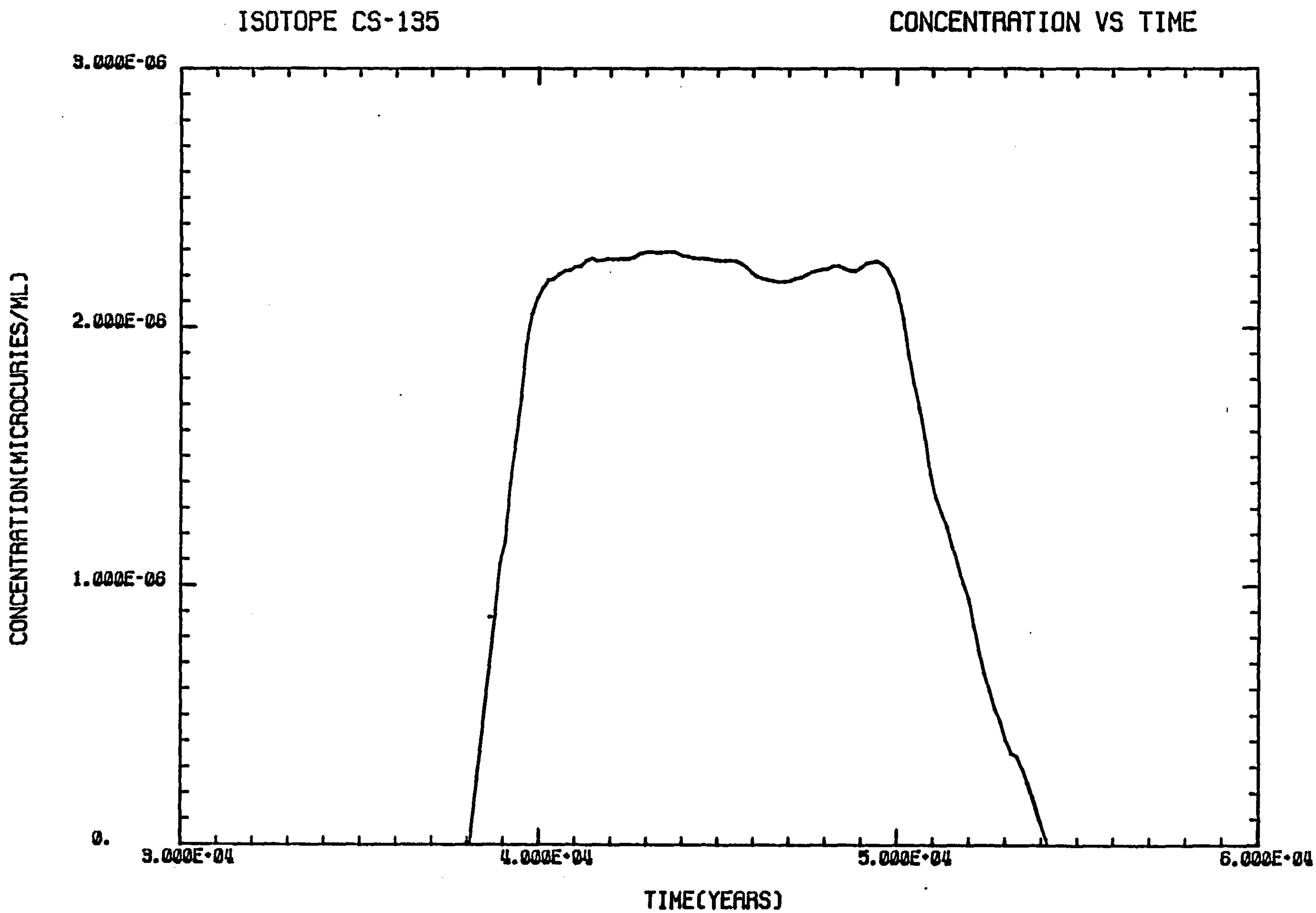
G.64


ISOTOPE TC-99
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
4.000E-04
3.000E-04
2.000E-04
1.000E-04
0.
5.000E+04
6.000E+04
7.000E+04
8.000E+04
9.000E+04
1.000E+05
1.100E+05
1.200E+05
1.300E+05
TIME(YEARS)

G.65

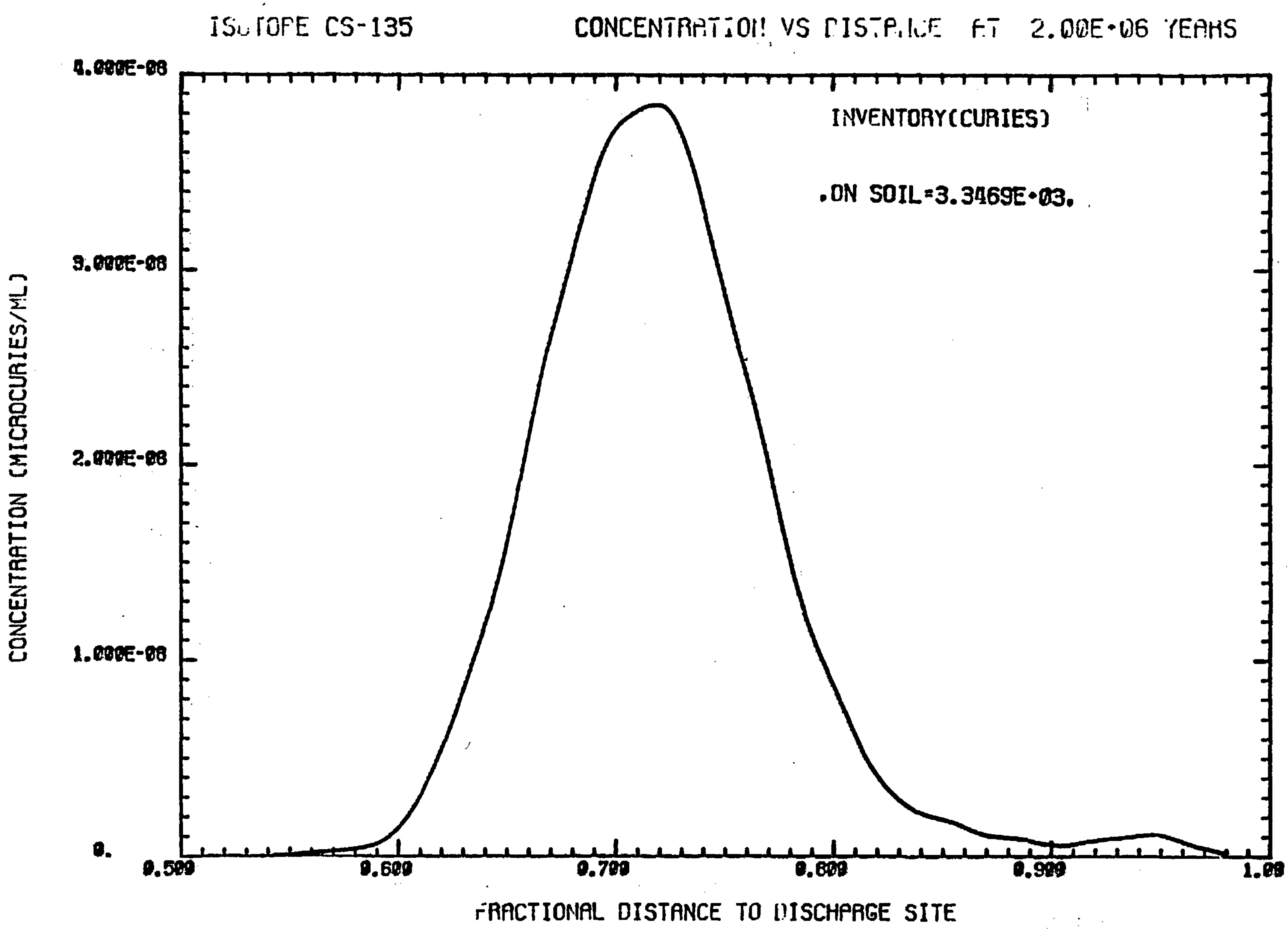

ISOTOPE TC-99
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
7.000E-04
6.000E-04
5.000E-04
4.000E-04
3.000E-04
2.000E-04
1.000E-04
0.
5.200E+04
5.300E+04
5.400E+04
5.500E+04
5.600E+04
5.700E+04
5.800E+04
5.900E+04
6.000E+04
TIME(YEARS)

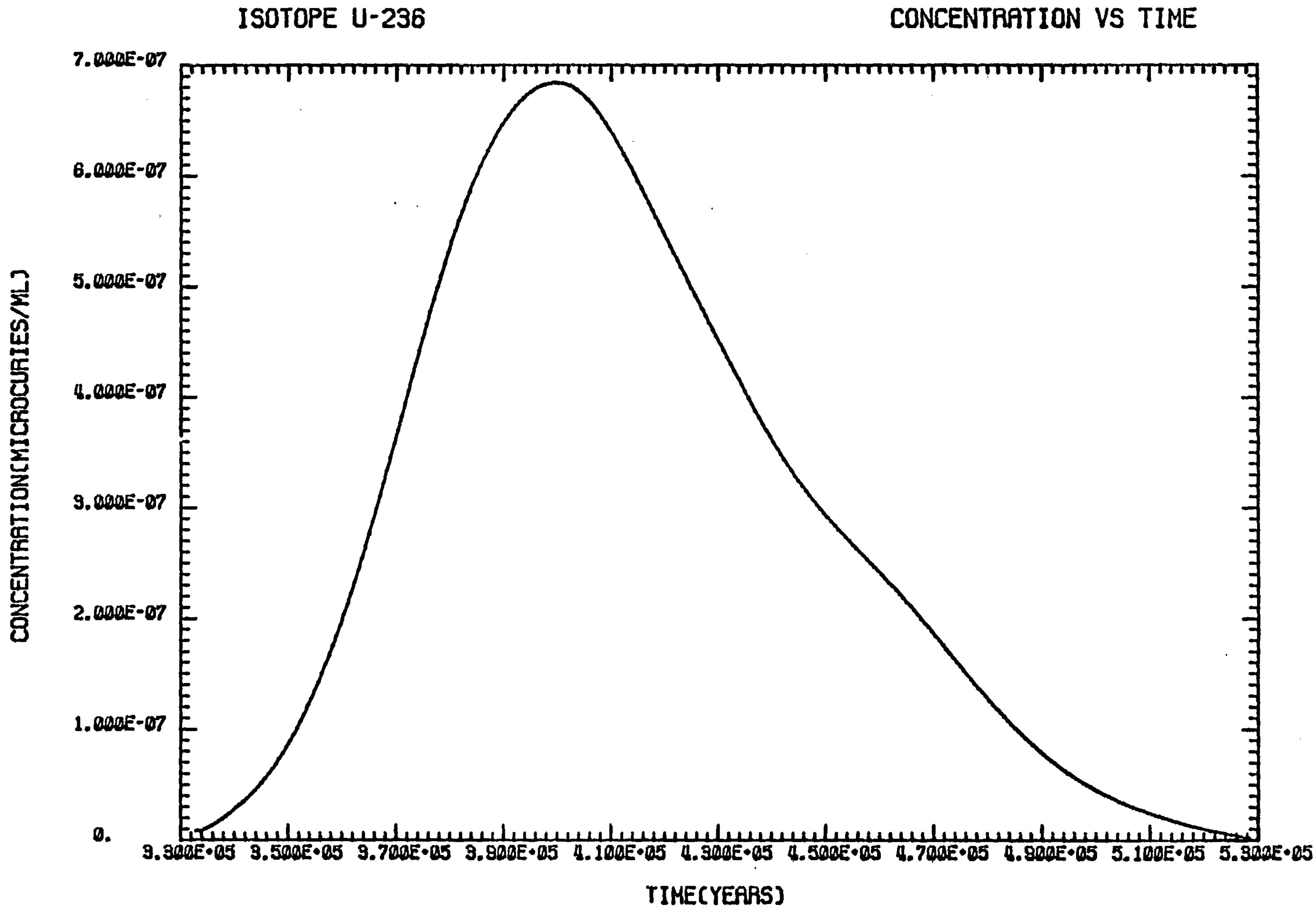

ISOTOPE I-129
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
2.000E-07
1.800E-07
1.600E-07
1.400E-07
1.200E-07
1.000E-07
8.000E-08
6.000E-08
4.000E-08
2.000E-08
0.
3.000E+04
5.000E+04
7.000E+04
9.000E+04
1.100E+05
1.300E+05
1.500E+05
TIME(YEARS)

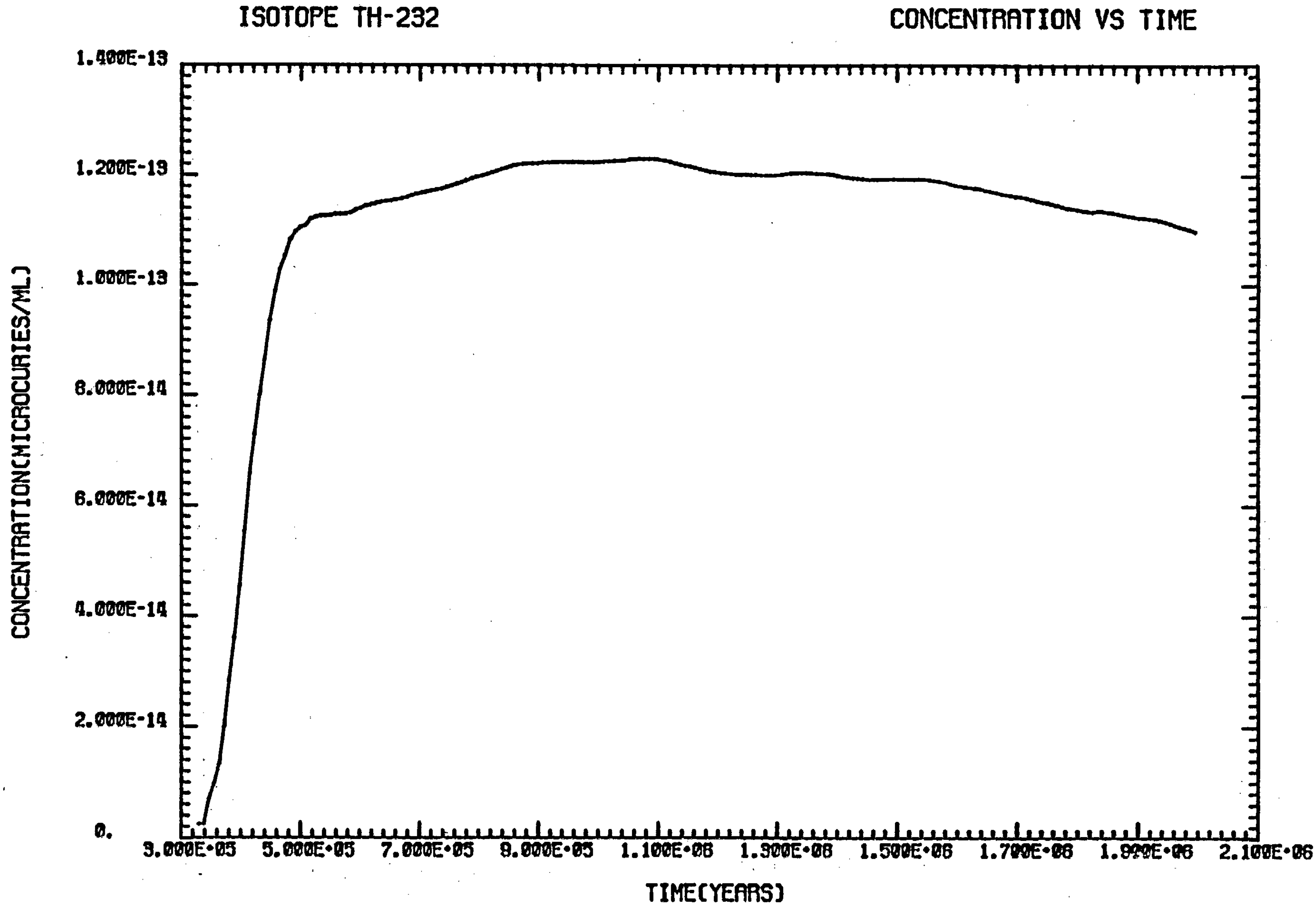


ISOTOPE CS-135
CONCENTRATION VS TIME
3.000E-06
2.000E-06
1.000E-06
0.
3.000E+04
4.000E+04
5.000E+04
6.000E+04
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

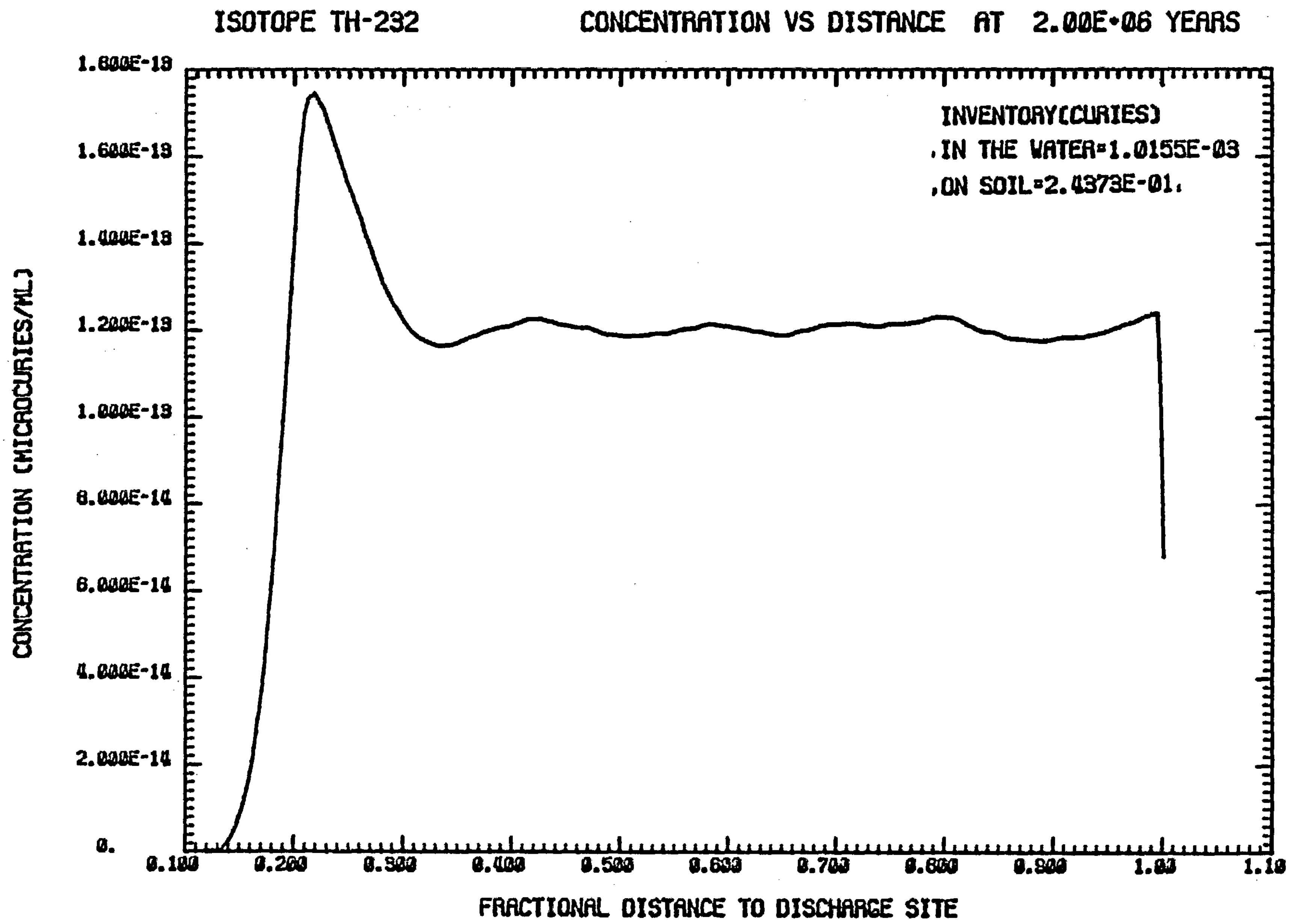
G.68


ISOTOPE CS-135
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
INVENTORY(CURIES)
ON SOIL=3.3469E+03
CONCENTRATION (MICROCURIES/ML)
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
0.500
0.600
0.700
0.800
0.900
1.00
FRACTIONAL DISTANCE TO DISCHARGE SITE

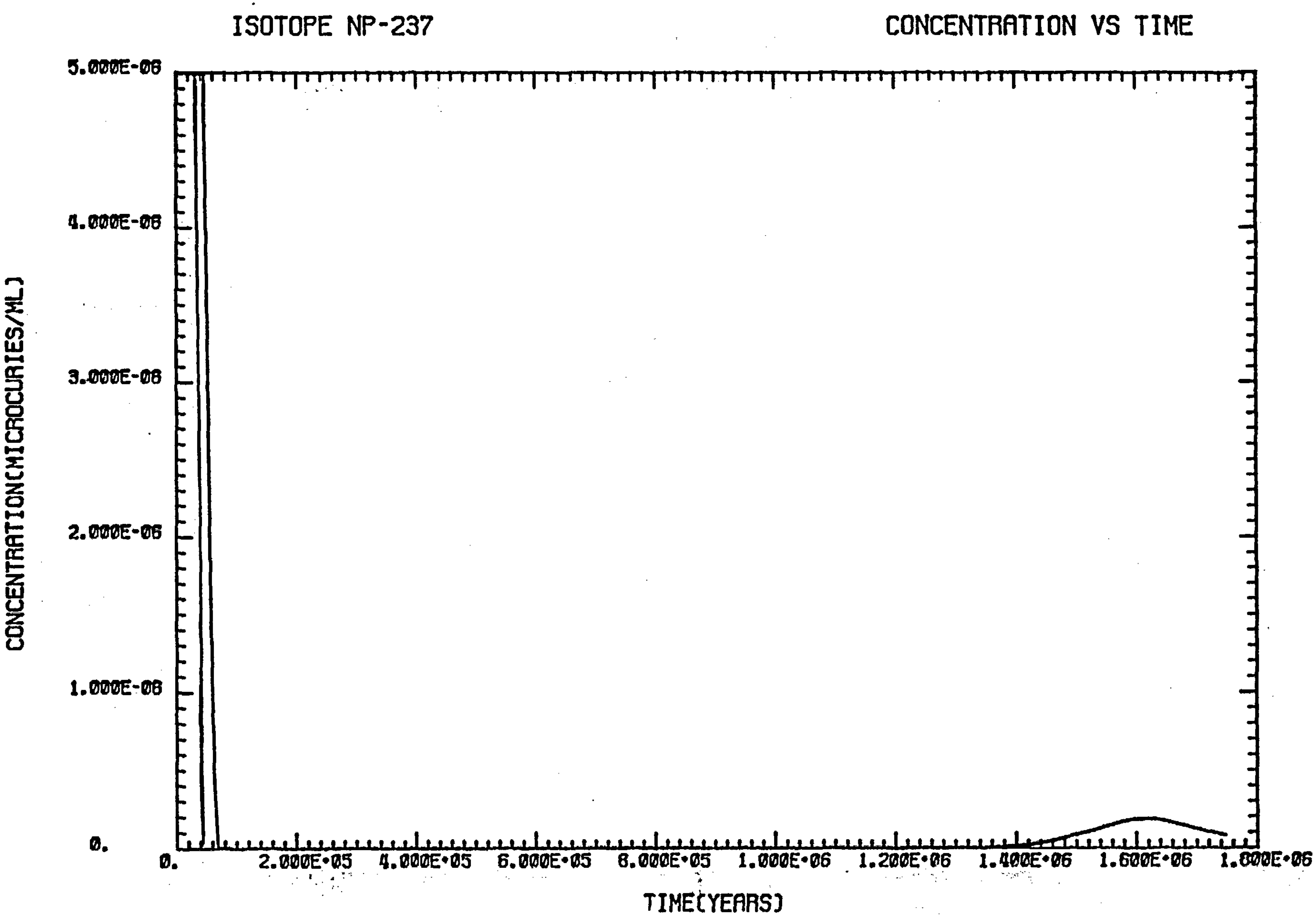

ISOTOPE U-236
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
7.000E-07
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
3.300E+05
3.500E+05
3.700E+05
3.900E+05
4.100E+05
4.300E+05
4.500E+05
4.700E+05
4.900E+05
5.100E+05
5.300E+05
TIME(YEARS)



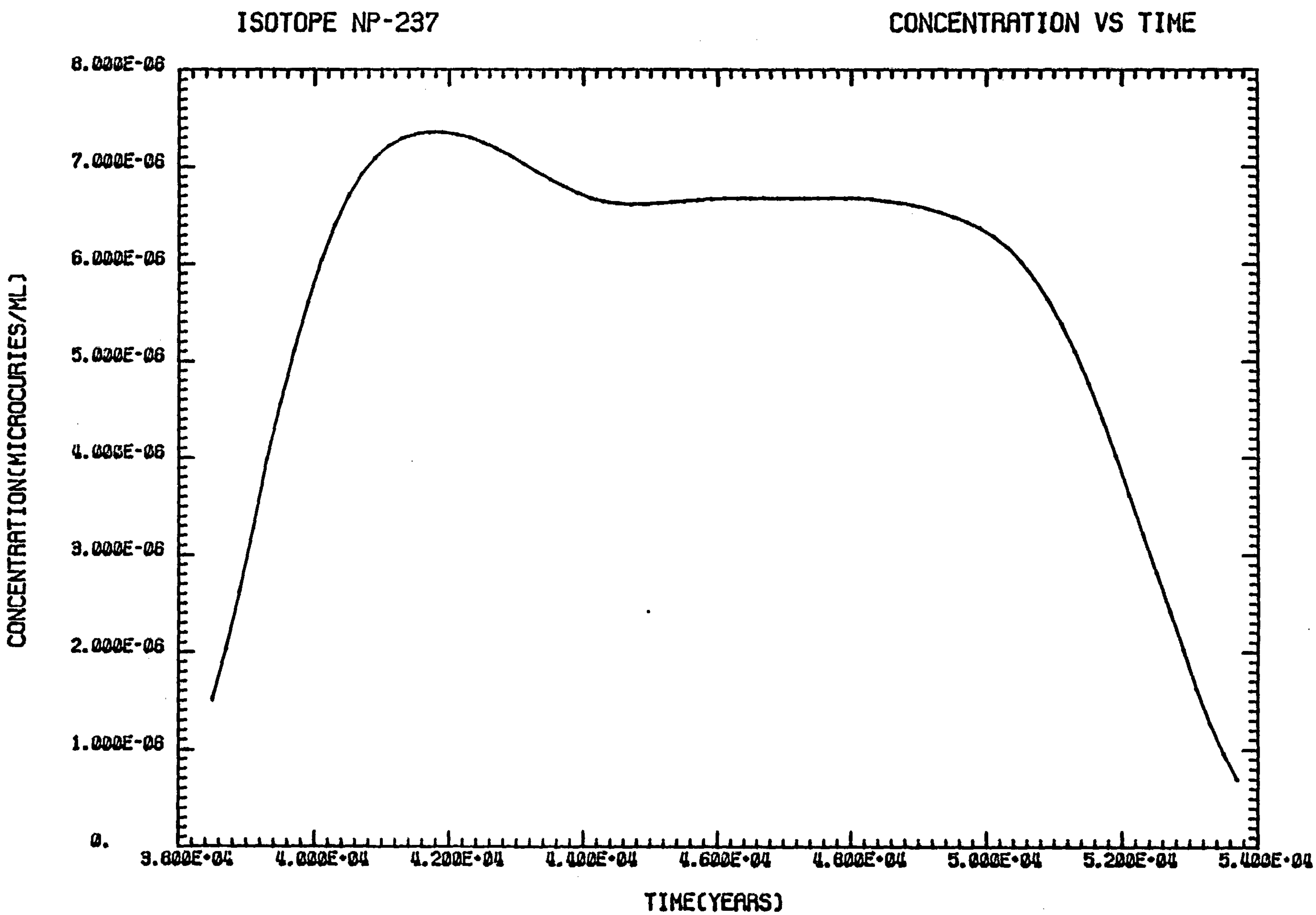
ISOTOPE TH-232
CONCENTRATION VS TIME
1.400E-13
1.200E-13
1.000E-13
8.000E-14
6.000E-14
4.000E-14
2.000E-14
0.
CONCENTRATION(MICROCURIES/ML)
3.000E+05
5.000E+05
7.000E+05
9.000E+05
1.100E+06
1.300E+06
1.500E+06
1.700E+06
1.900E+06
2.100E+06
TIME(YEARS)

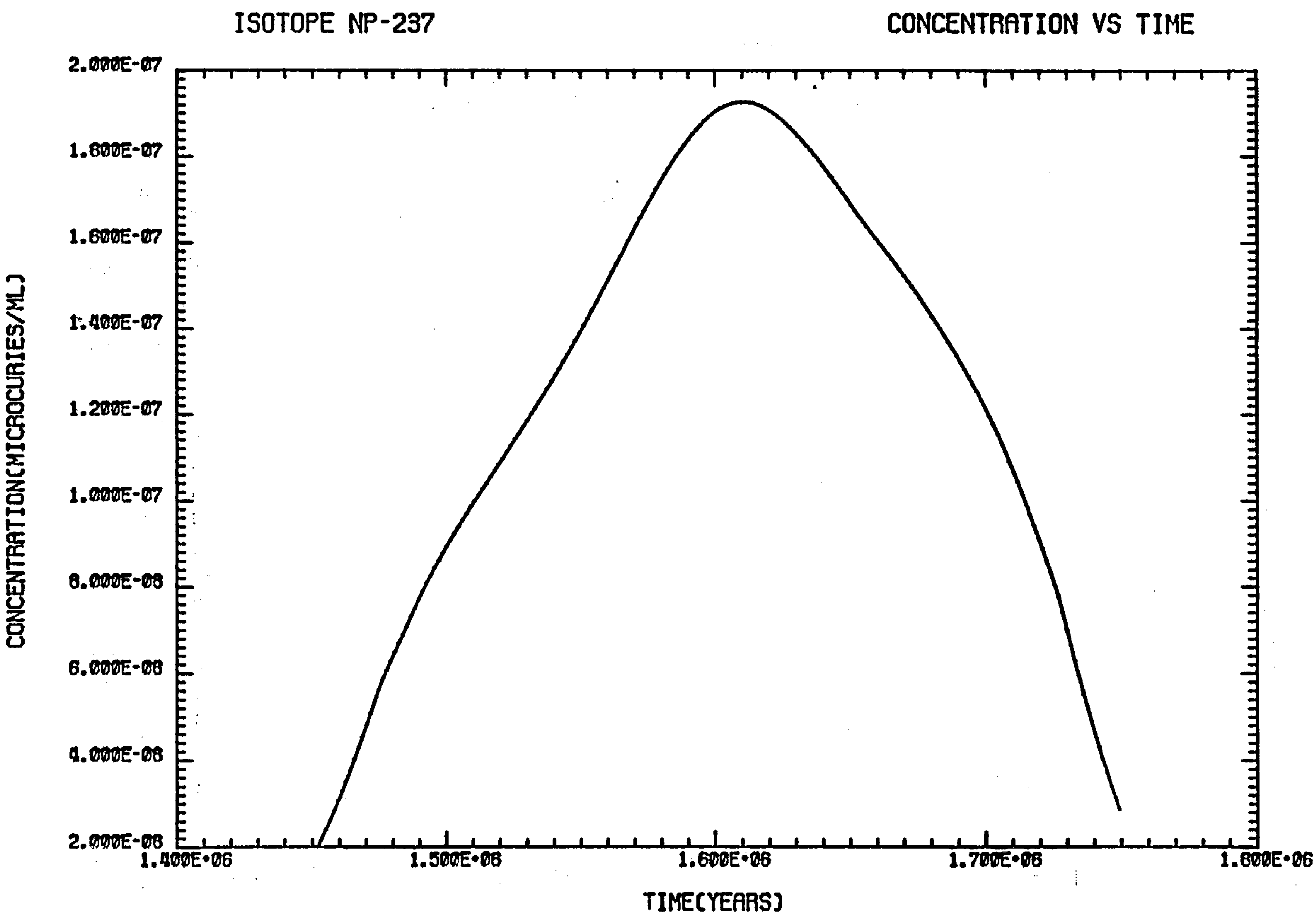


ISOTOPE TH-232
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
INVENTORY(CURIES)
,IN THE WATER=1.0155E-03
,ON SOIL=2.4373E-01,
CONCENTRATION (MICROCURIES/ML)
1.800E-13
1.600E-13
1.400E-13
1.200E-13
1.000E-13
8.000E-14
6.000E-14
4.000E-14
2.000E-14
0.
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.00
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE



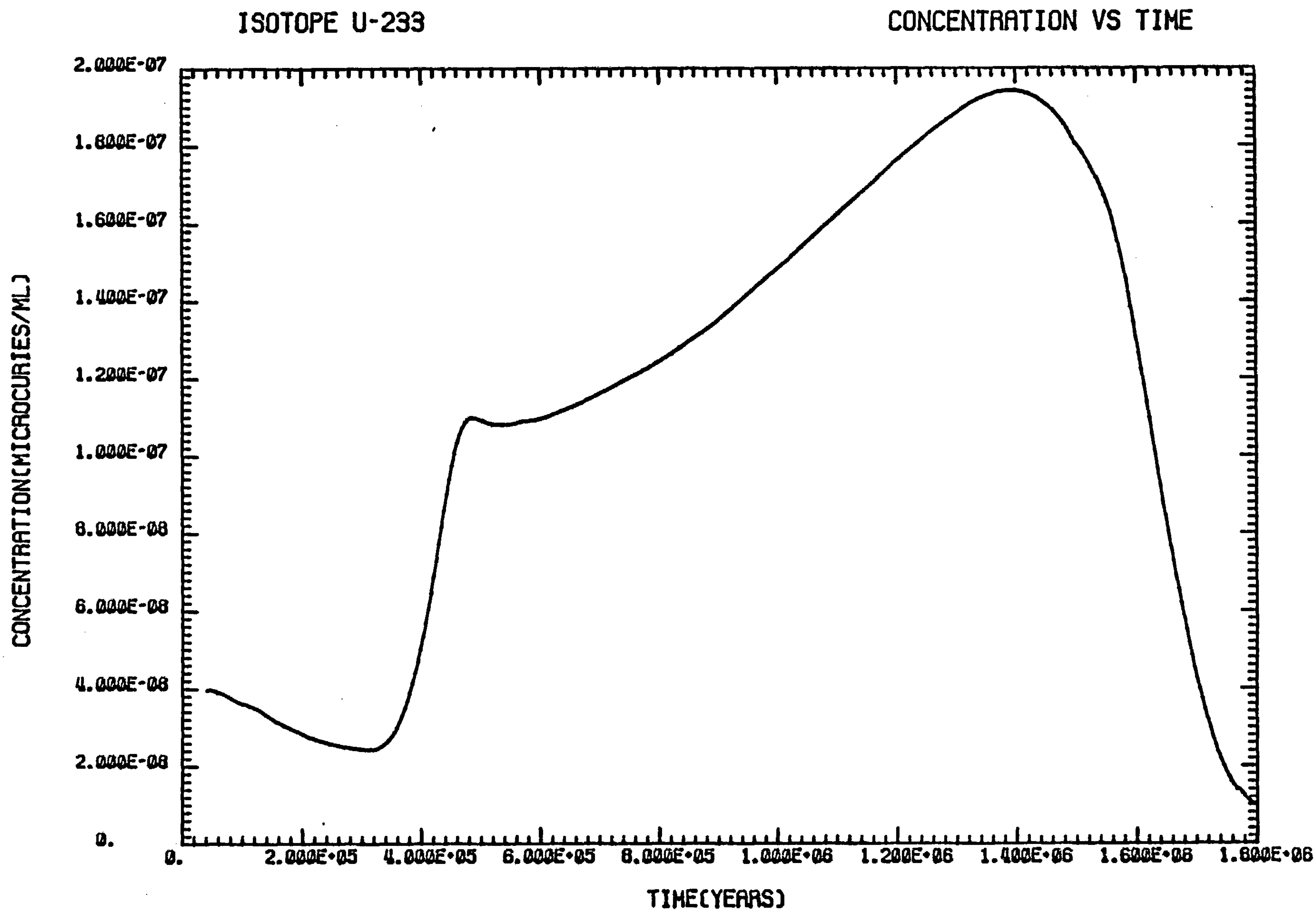
ISOTOPE NP-237
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
1.600E+06
1.800E+06
TIME(YEARS)

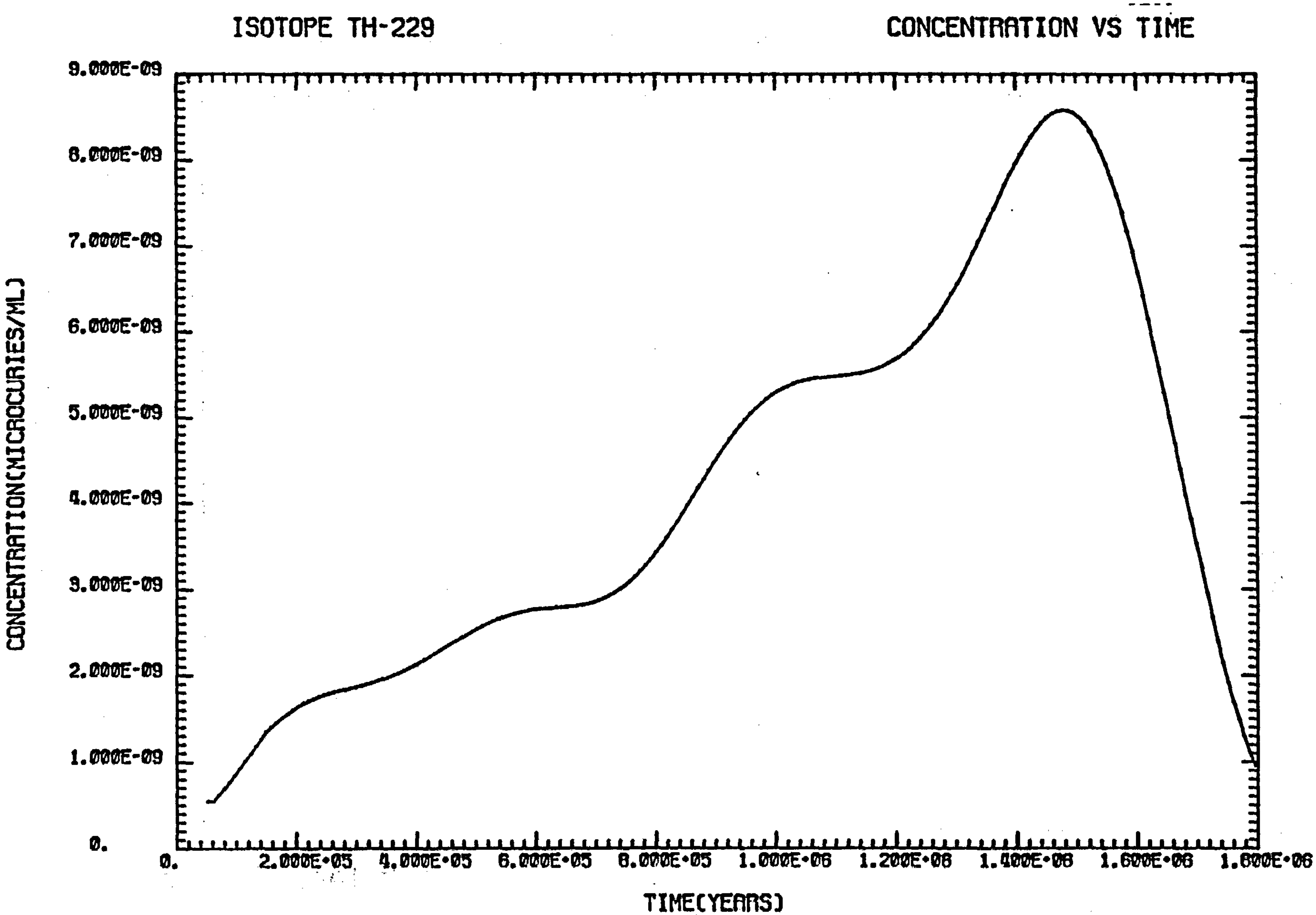

ISOTOPE NP-237
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
TIME(YEARS)
8.000E-06
7.000E-06
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
3.800E+04
4.000E+04
4.200E+04
4.400E+04
4.600E+04
4.800E+04
5.000E+04
5.200E+04
5.400E+04

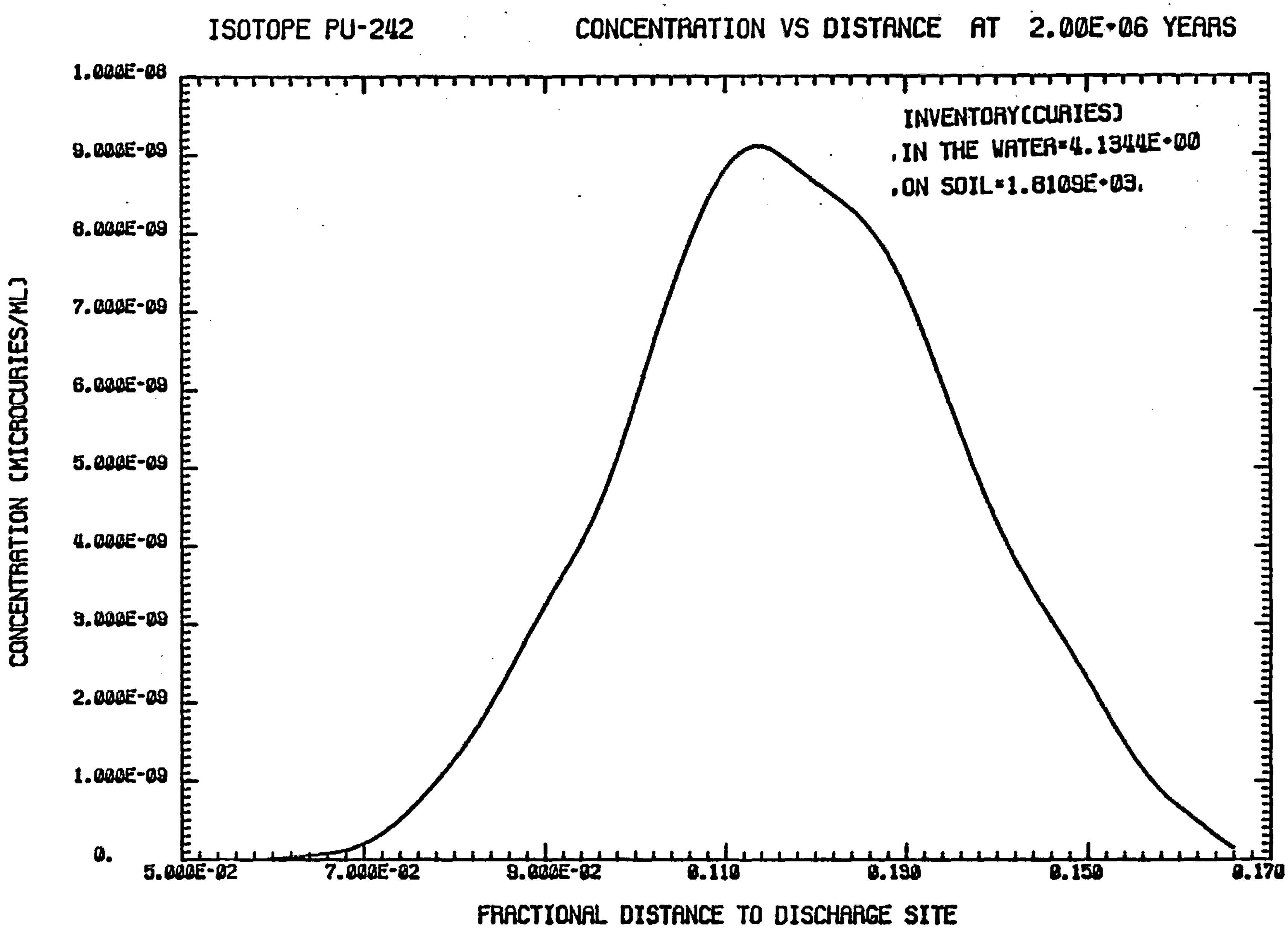


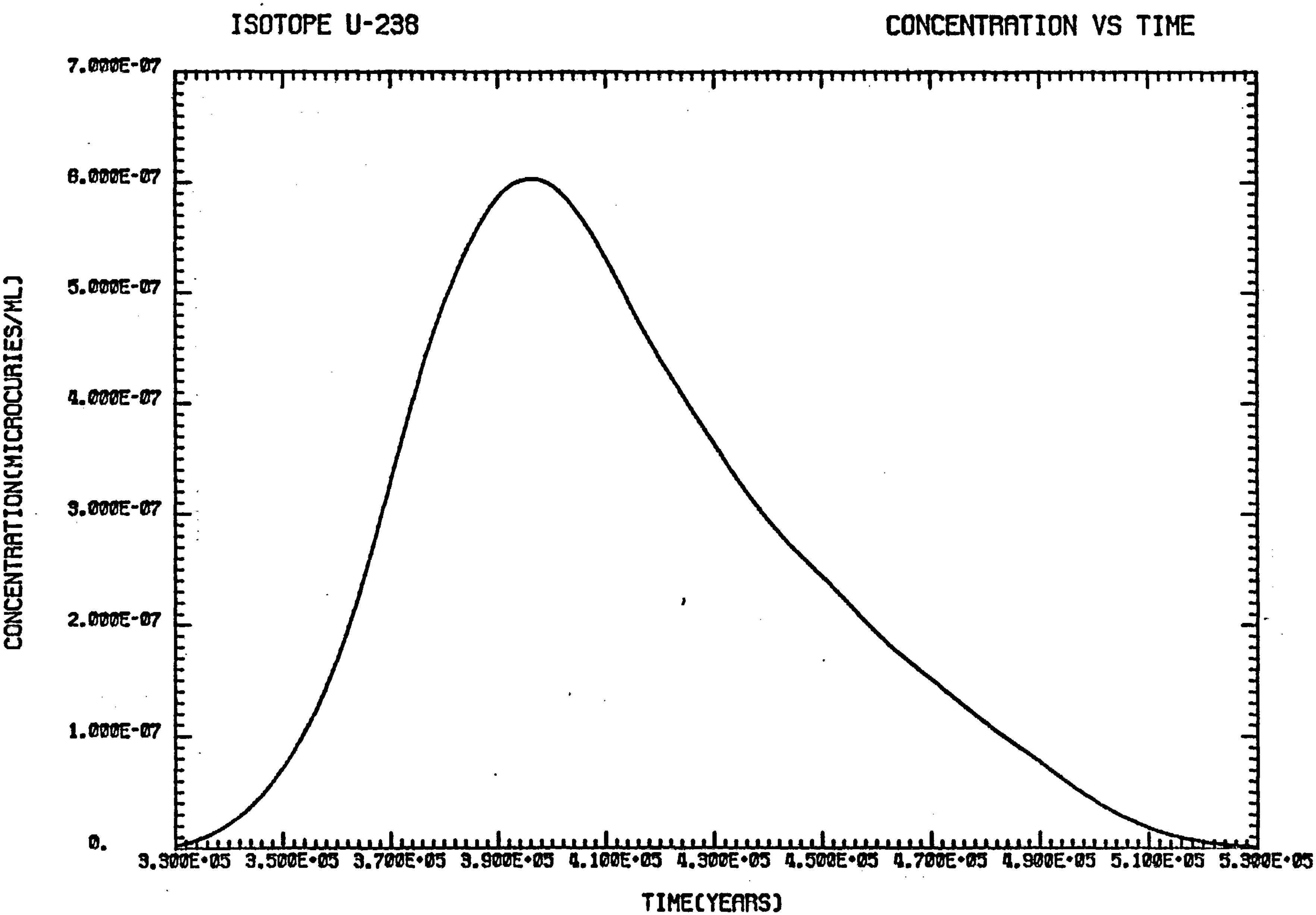
ISOTOPE NP-237
CONCENTRATION VS TIME
2.000E-07
1.800E-07
1.600E-07
1.400E-07
1.200E-07
1.000E-07
8.000E-08
6.000E-08
4.000E-08
2.000E-08
CONCENTRATION(MICROCURIES/ML)
1.400E+06
1.500E+06
1.600E+06
1.700E+06
1.800E+06
TIME(YEARS)

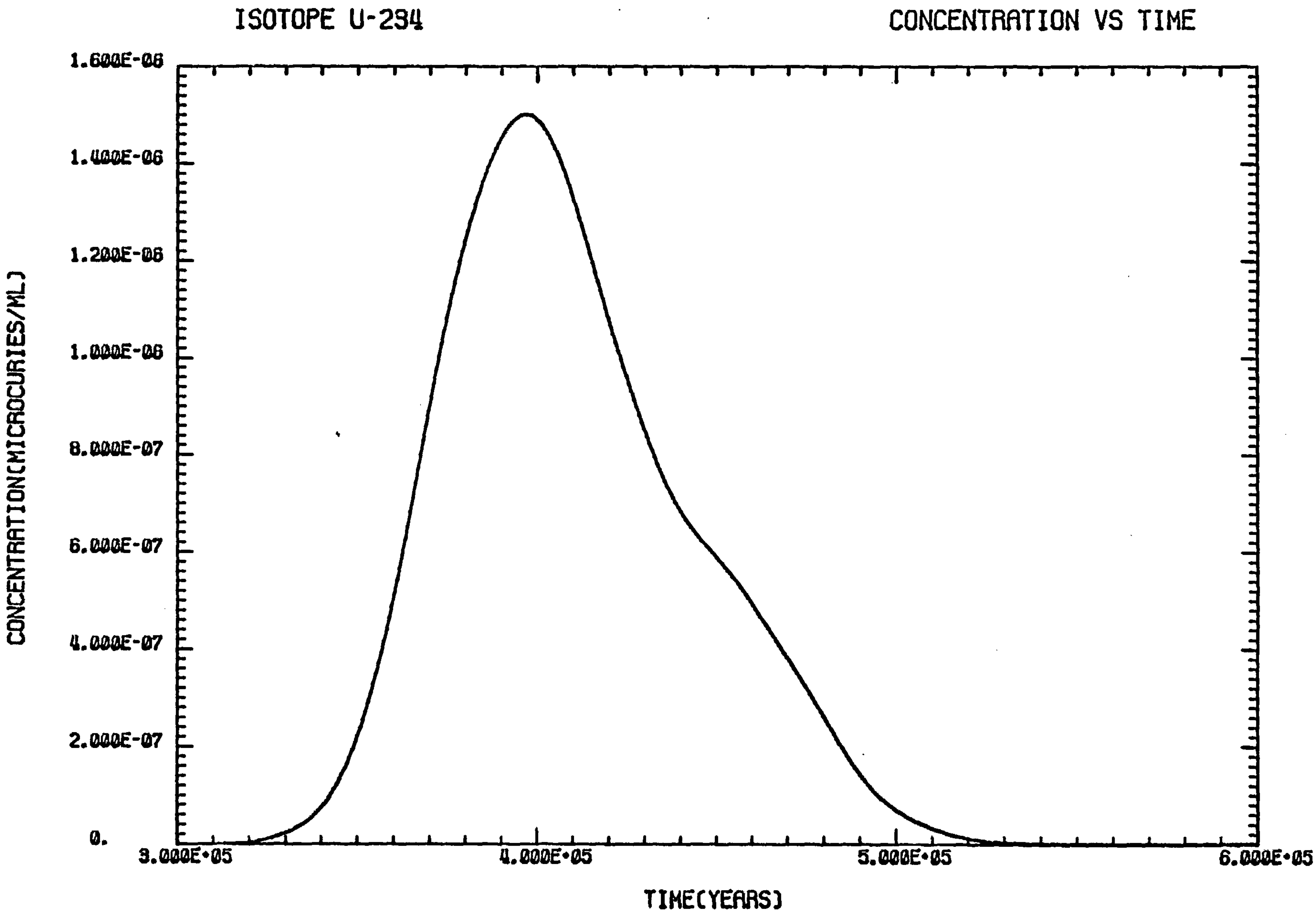
G.75


ISOTOPE U-233
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
TIME(YEARS)
2.000E-07
1.800E-07
1.600E-07
1.400E-07
1.200E-07
1.000E-07
8.000E-08
6.000E-08
4.000E-08
2.000E-08
0.
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
1.600E+06
1.800E+06

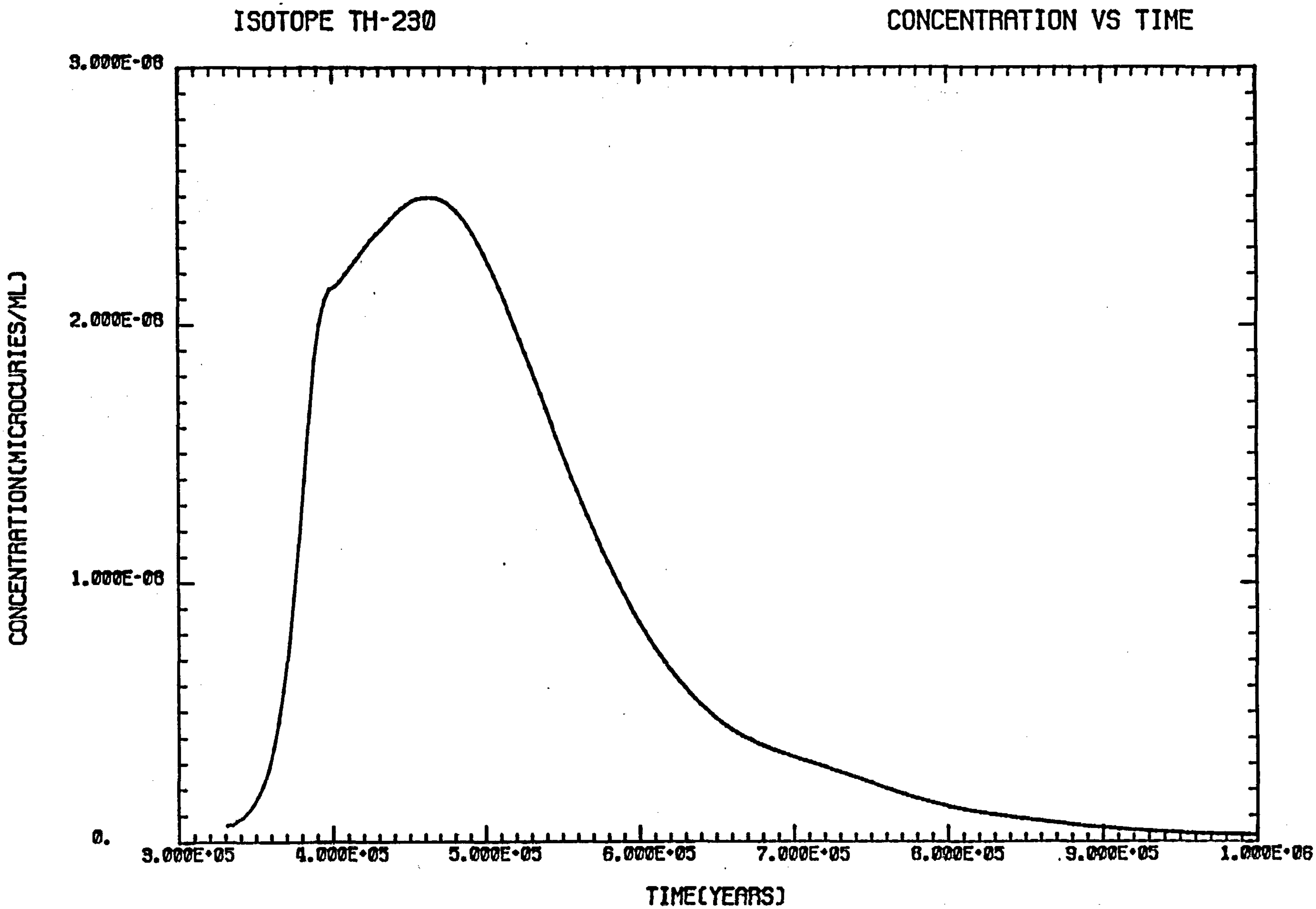

ISOTOPE TH-229
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
9.000E-09
8.000E-09
7.000E-09
6.000E-09
5.000E-09
4.000E-09
3.000E-09
2.000E-09
1.000E-09
0.
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
1.600E+06
1.800E+06
TIME(YEARS)

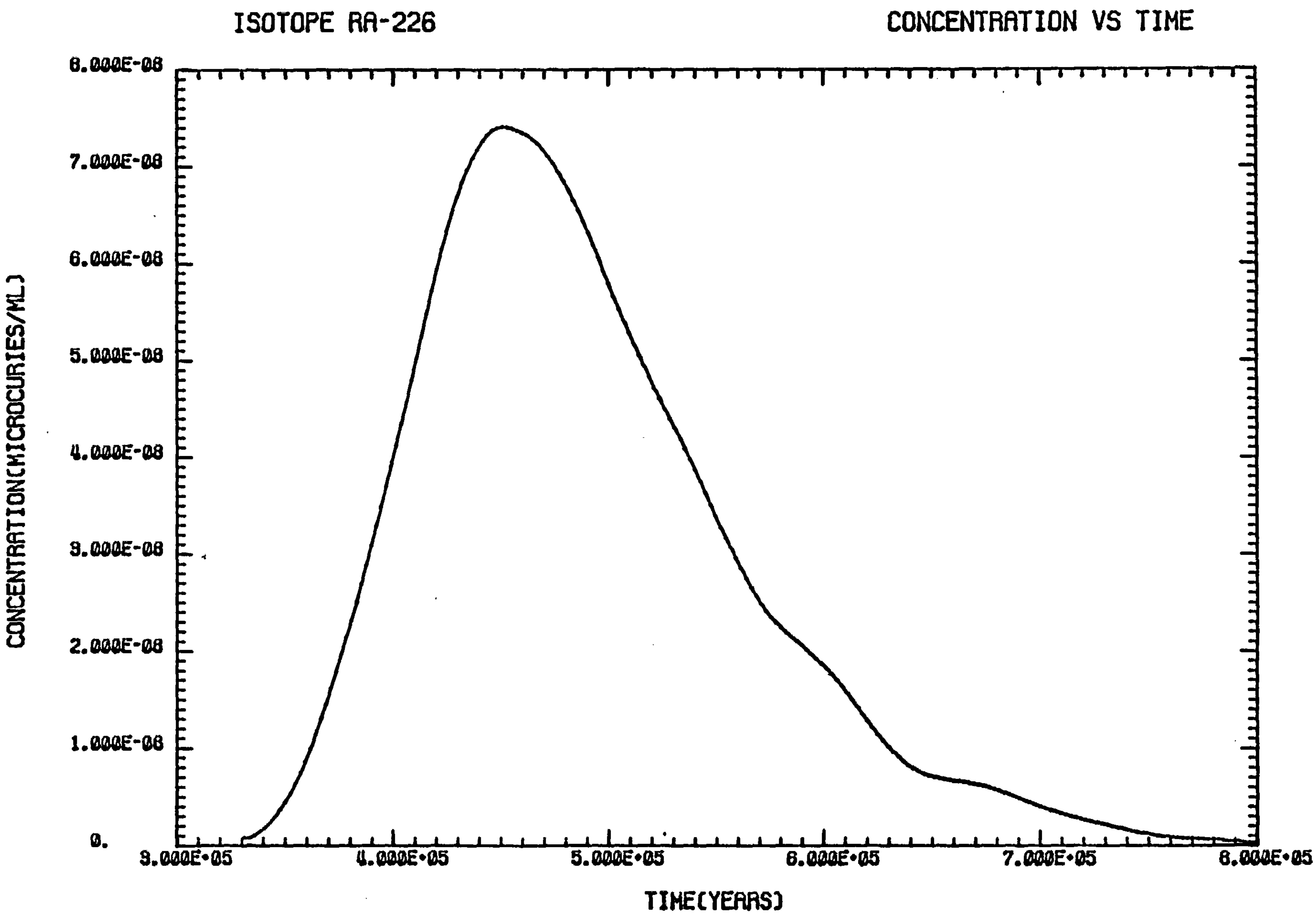

ISOTOPE PU-242
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
INVENTORY(CURIES)
,IN THE WATER=4.1344E+00
,ON SOIL=1.8109E+03,
1.000E-08
9.000E-09
8.000E-09
7.000E-09
6.000E-09
5.000E-09
4.000E-09
3.000E-09
2.000E-09
1.000E-09
0.
5.000E-02
7.000E-02
9.000E-02
0.110
0.130
0.150
0.170
CONCENTRATION (MICROCURIES/ML)
FRACTIONAL DISTANCE TO DISCHARGE SITE


ISOTOPE U-238
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
7.000E-07
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
3.300E+05
3.500E+05
3.700E+05
3.900E+05
4.100E+05
4.300E+05
4.500E+05
4.700E+05
4.900E+05
5.100E+05
5.300E+05
TIME(YEARS)

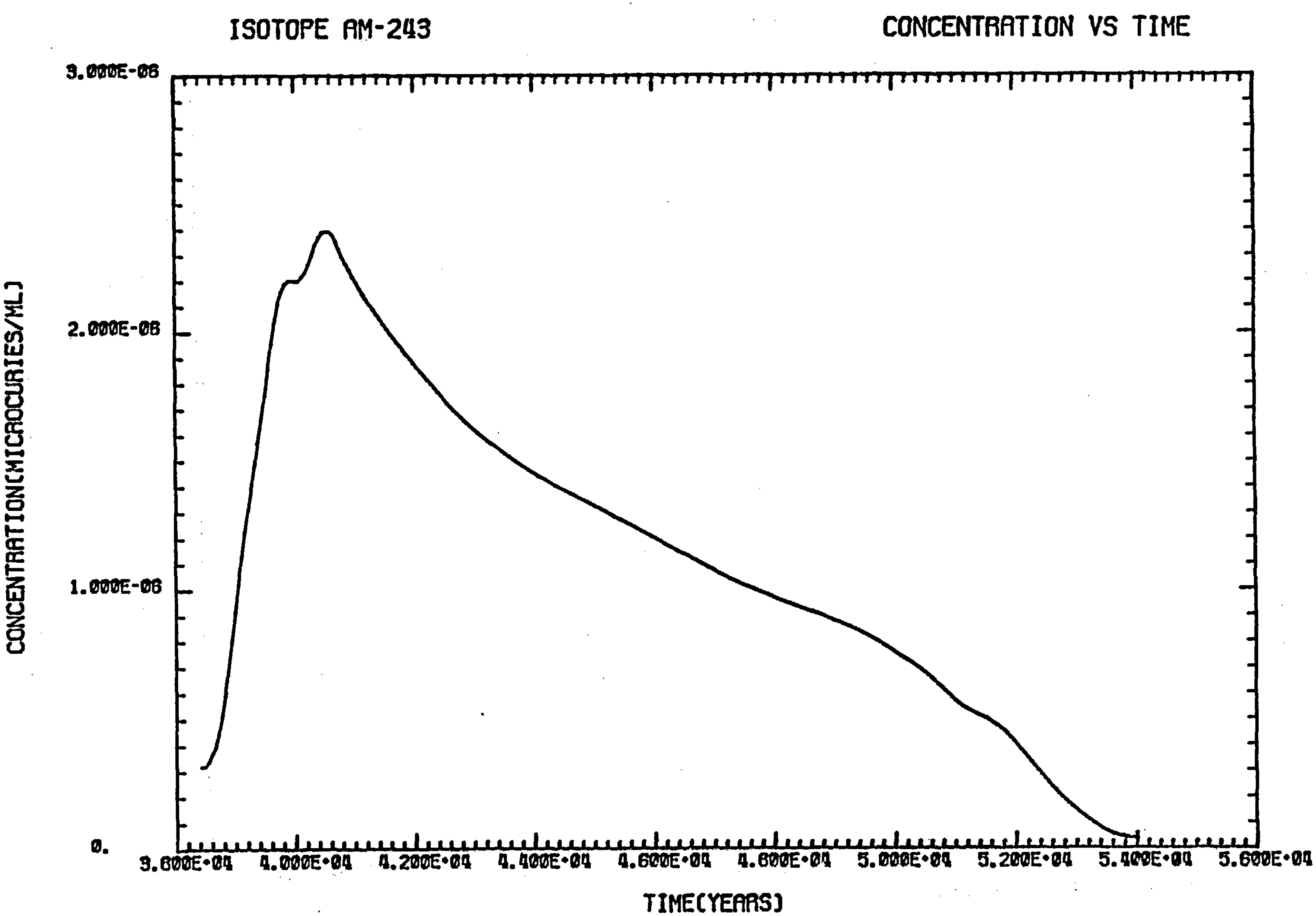


ISOTOPE U-234
CONCENTRATION VS TIME
1.600E-06
1.400E-06
1.200E-06
1.000E-06
8.000E-07
6.000E-07
4.000E-07
2.000E-07
0.
3.000E+05
4.000E+05
5.000E+05
6.000E+05
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

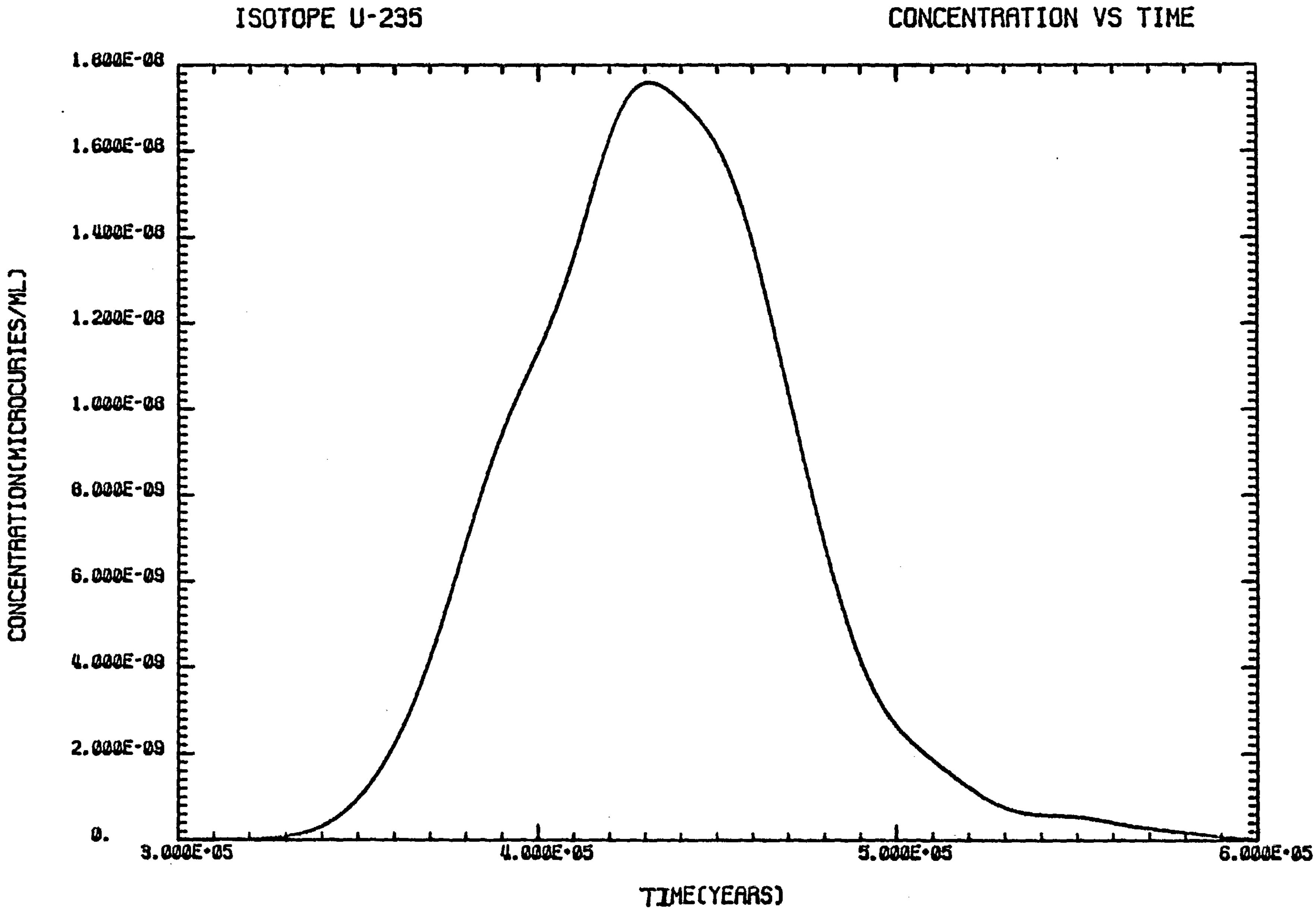

ISOTOPE TH-230
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
3.000E-08
2.000E-08
1.000E-08
0.
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
9.000E+05
1.000E+06
TIME(YEARS)


ISOTOPE RA-226
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
8.000E-08
7.000E-08
6.000E-08
5.000E-08
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
TIME(YEARS)

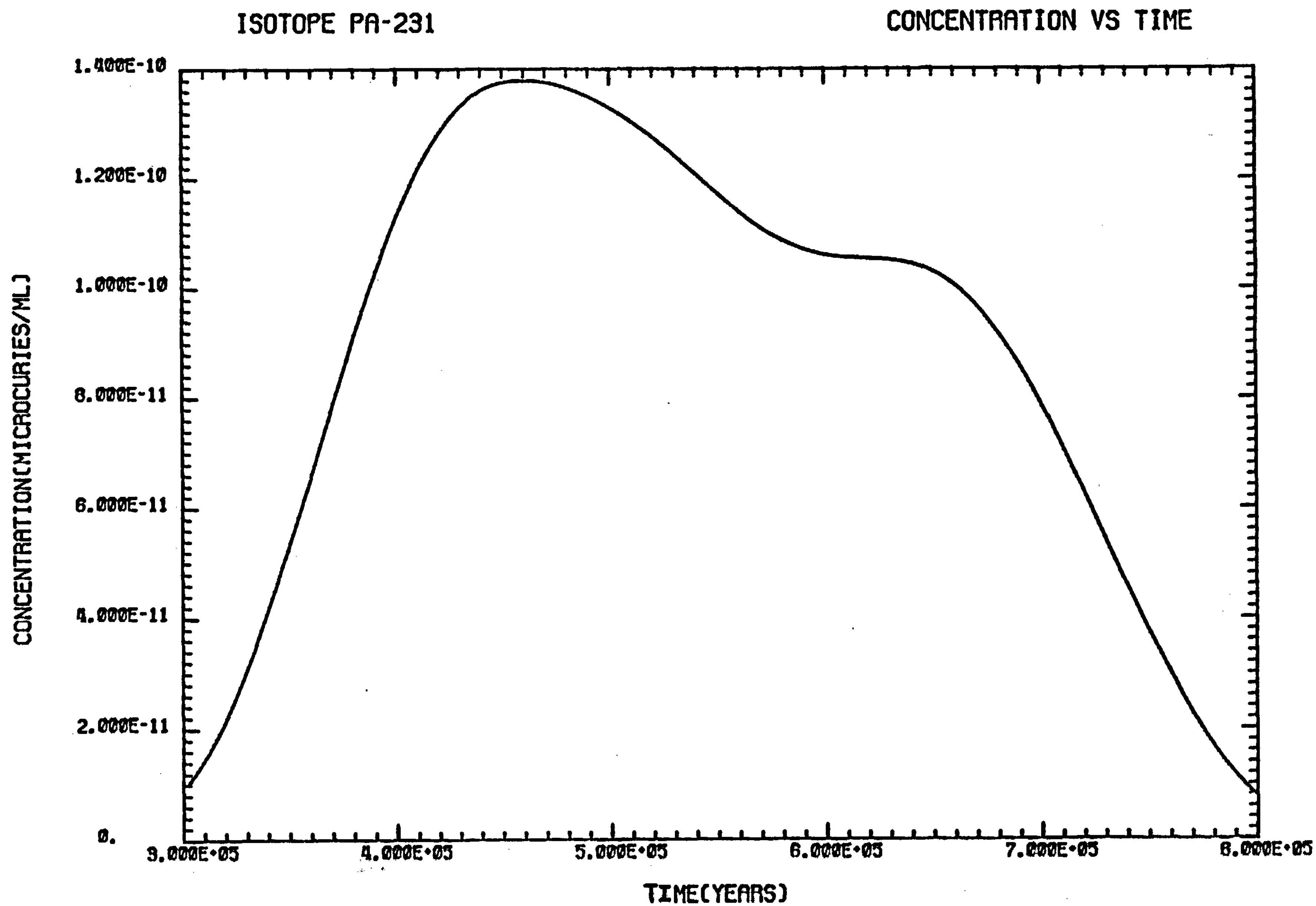
G.83



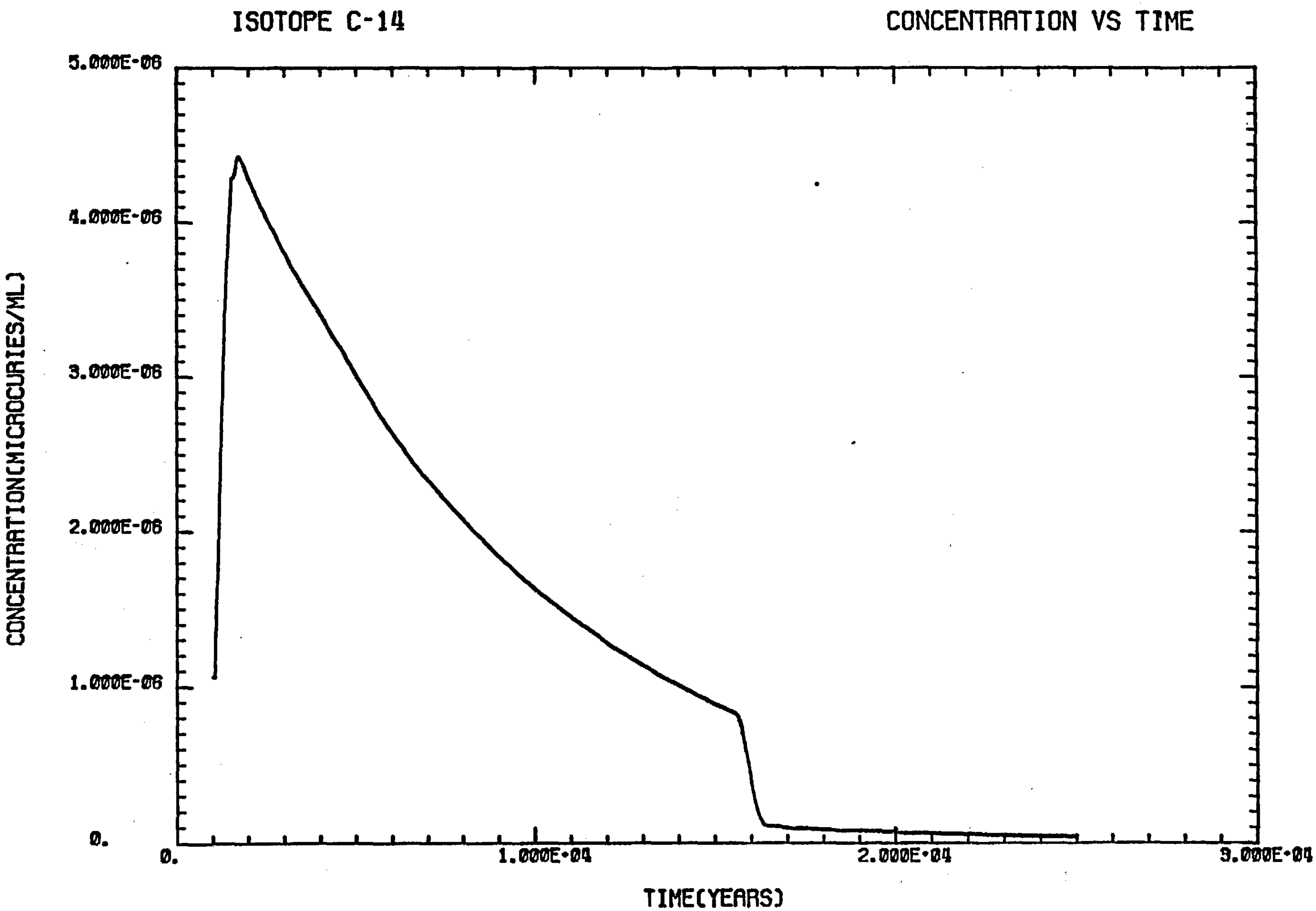
ISOTOPE AM-243
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
3.000E-06
2.000E-06
1.000E-06
0.
3.600E+04
4.000E+04
4.200E+04
4.400E+04
4.600E+04
4.800E+04
5.000E+04
5.200E+04
5.400E+04
5.600E+04
TIME(YEARS)

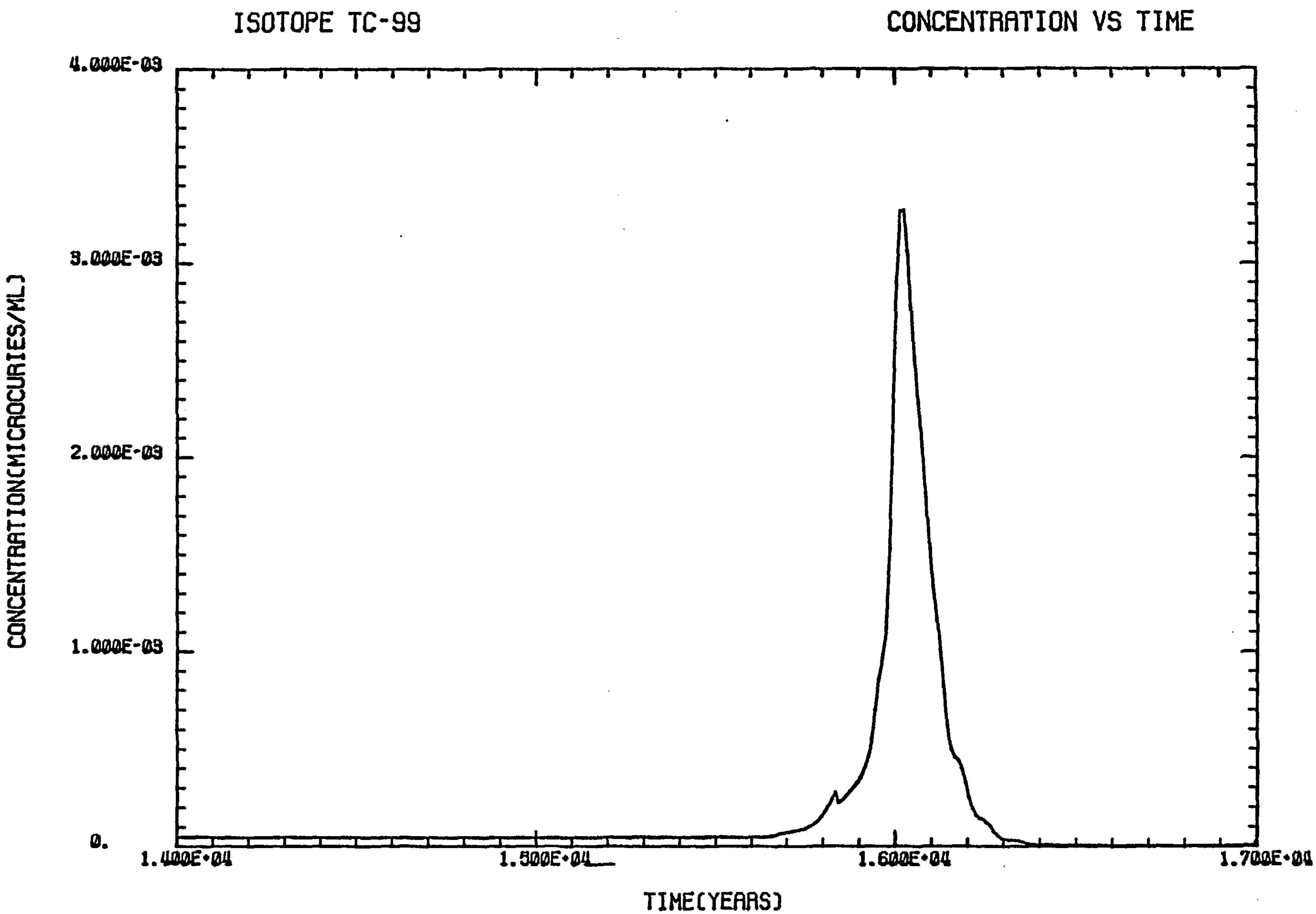


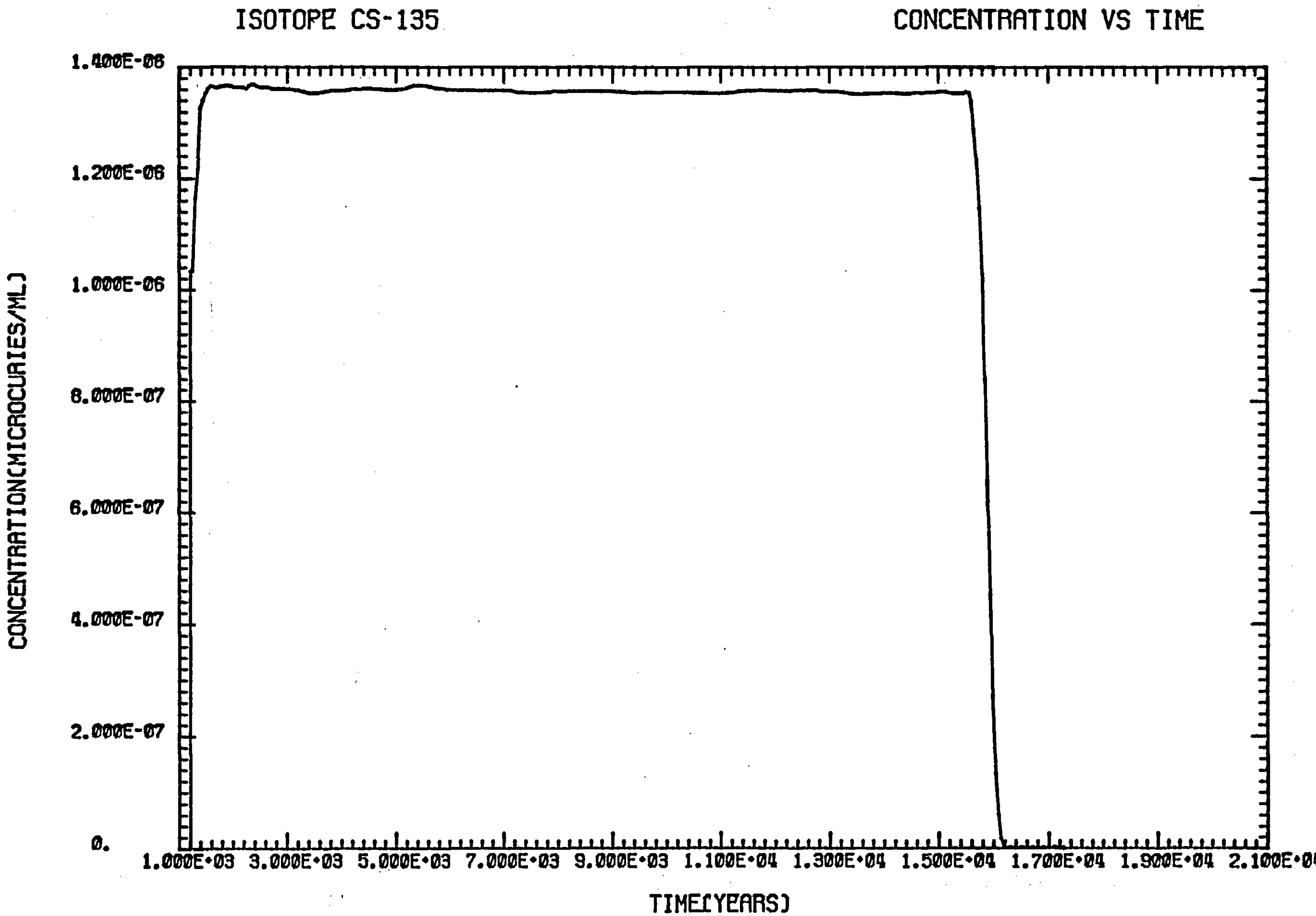
ISOTOPE U-235
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.800E-08
1.600E-08
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
3.000E+05
4.000E+05
5.000E+05
6.000E+05
TIME(YEARS)

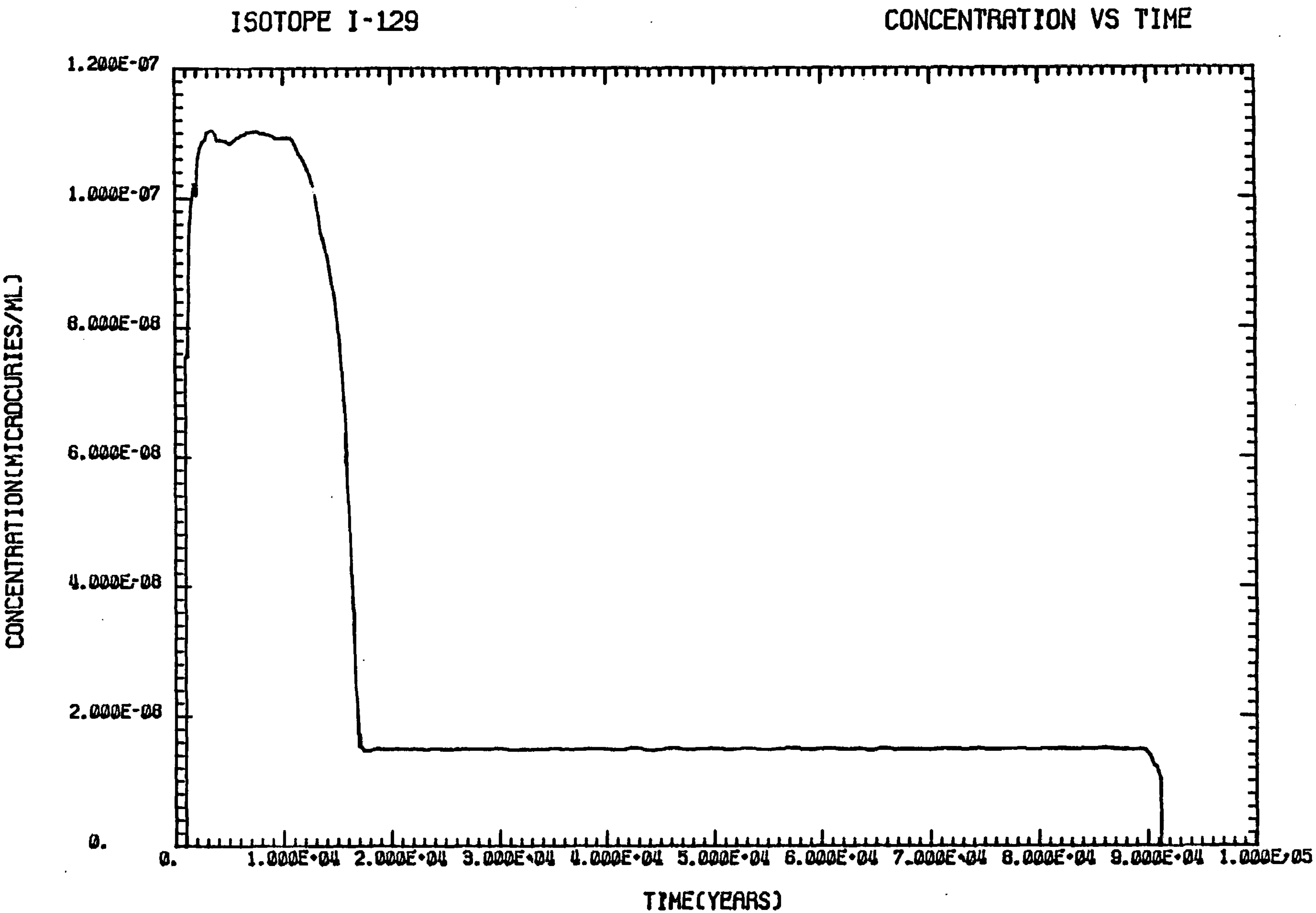

ISOTOPE PA-231
CONCENTRATION VS TIME
1.400E-10
1.200E-10
1.000E-10
8.000E-11
6.000E-11
4.000E-11
2.000E-11
0.
CONCENTRATION(MICROCURIES/ML)
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
TIME(YEARS)

Scenario 3. Well pumping case. Well located 6 km from salt dome. Release at 200 years. Simulation runs PIR4. (Concentration versus time)


ISOTOPE C-14
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
0.
1.000E+04
2.000E+04
3.000E+04
TIME(YEARS)

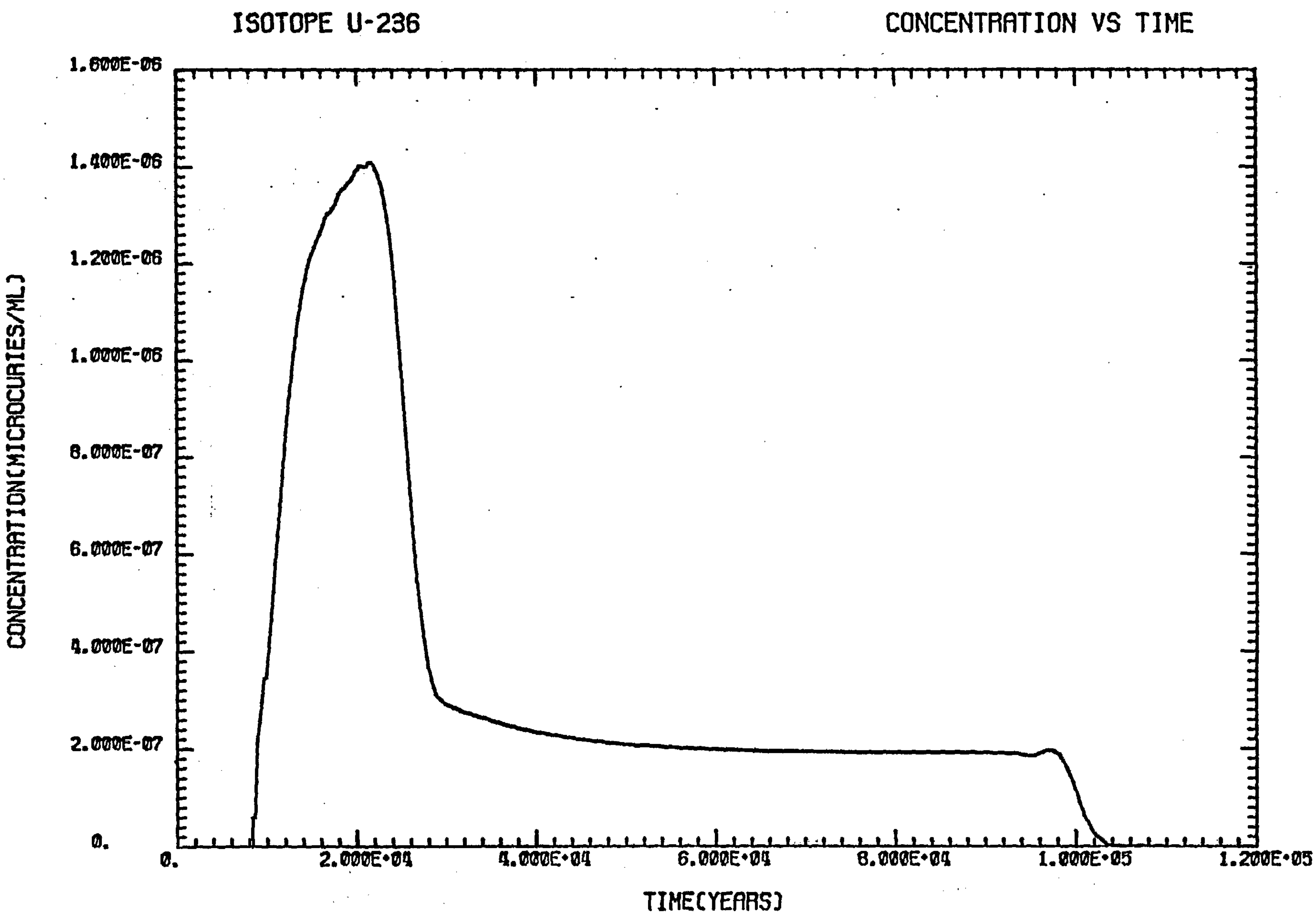

ISOTOPE TC-99
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
4.000E-03
3.000E-03
2.000E-03
1.000E-03
0.
1.400E+04
1.500E+04
1.600E+04
1.700E+04
TIME(YEARS)

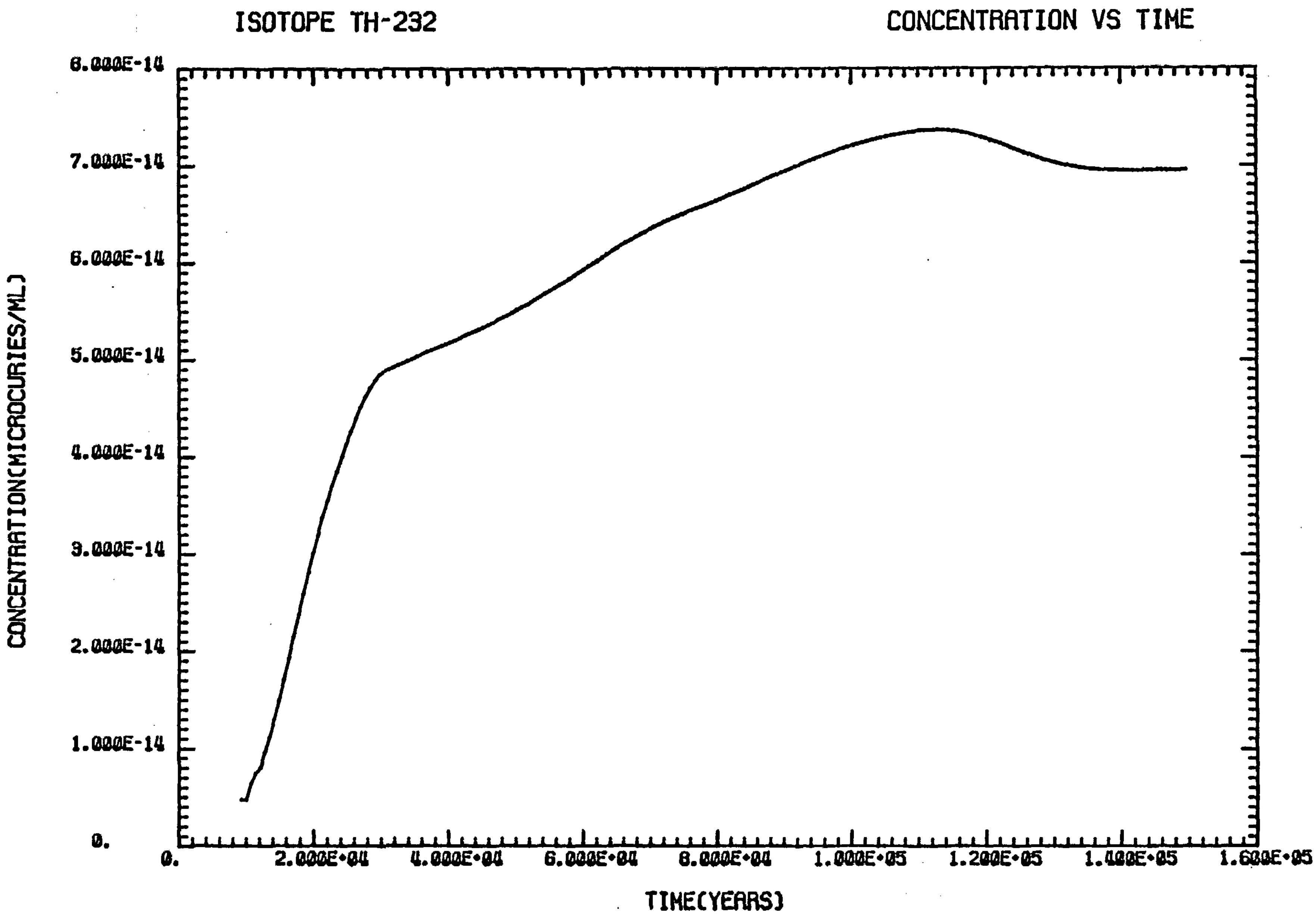

ISOTOPE CS-135
CONCENTRATION VS TIME
1.400E-06
1.200E-06
1.000E-06
8.000E-07
6.000E-07
4.000E-07
2.000E-07
0.
CONCENTRATION(MICROCURIES/ML)
1.000E+03
3.000E+03
5.000E+03
7.000E+03
9.000E+03
1.100E+04
1.300E+04
1.500E+04
1.700E+04
1.900E+04
2.100E+04
TIME(YEARS)

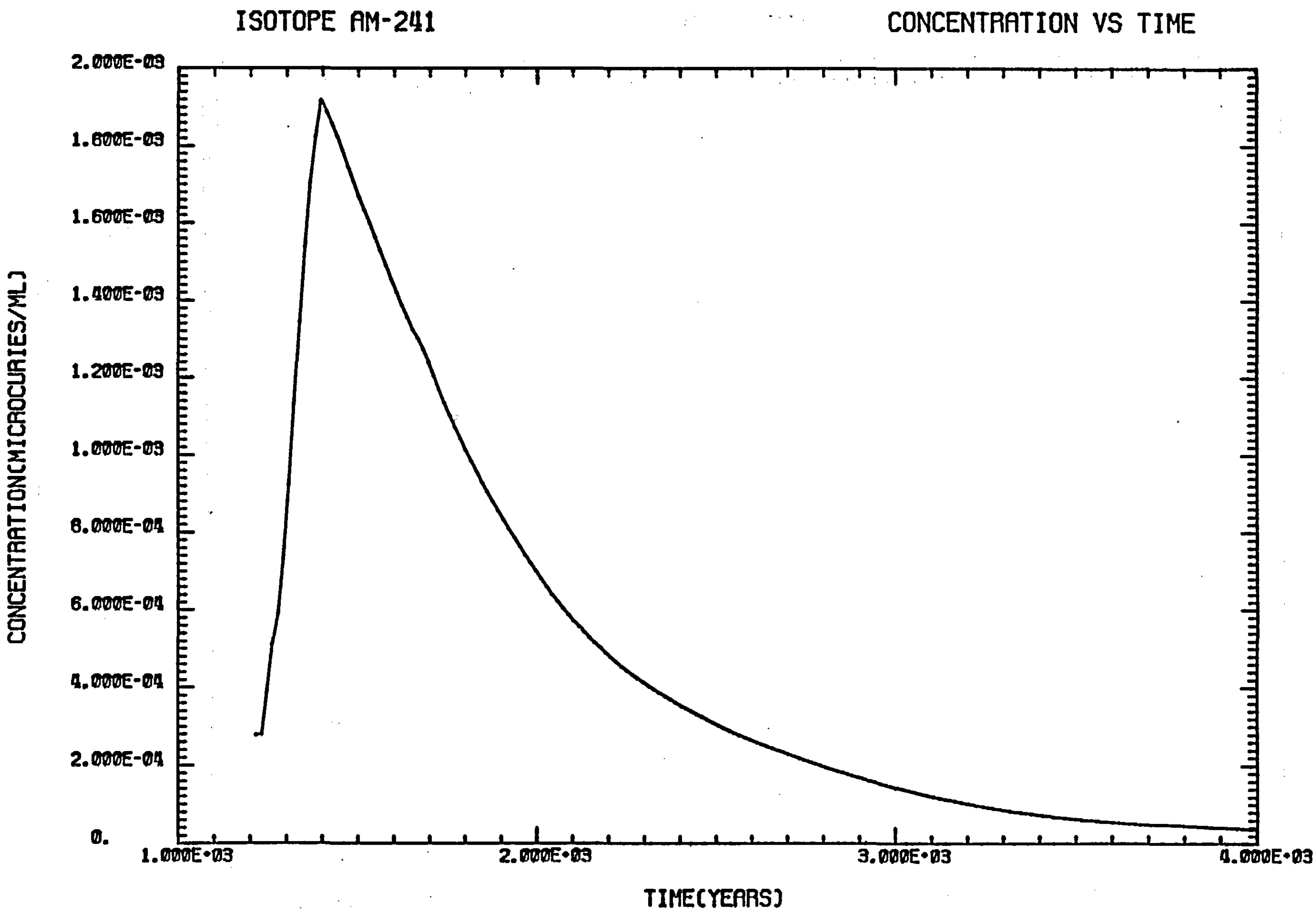


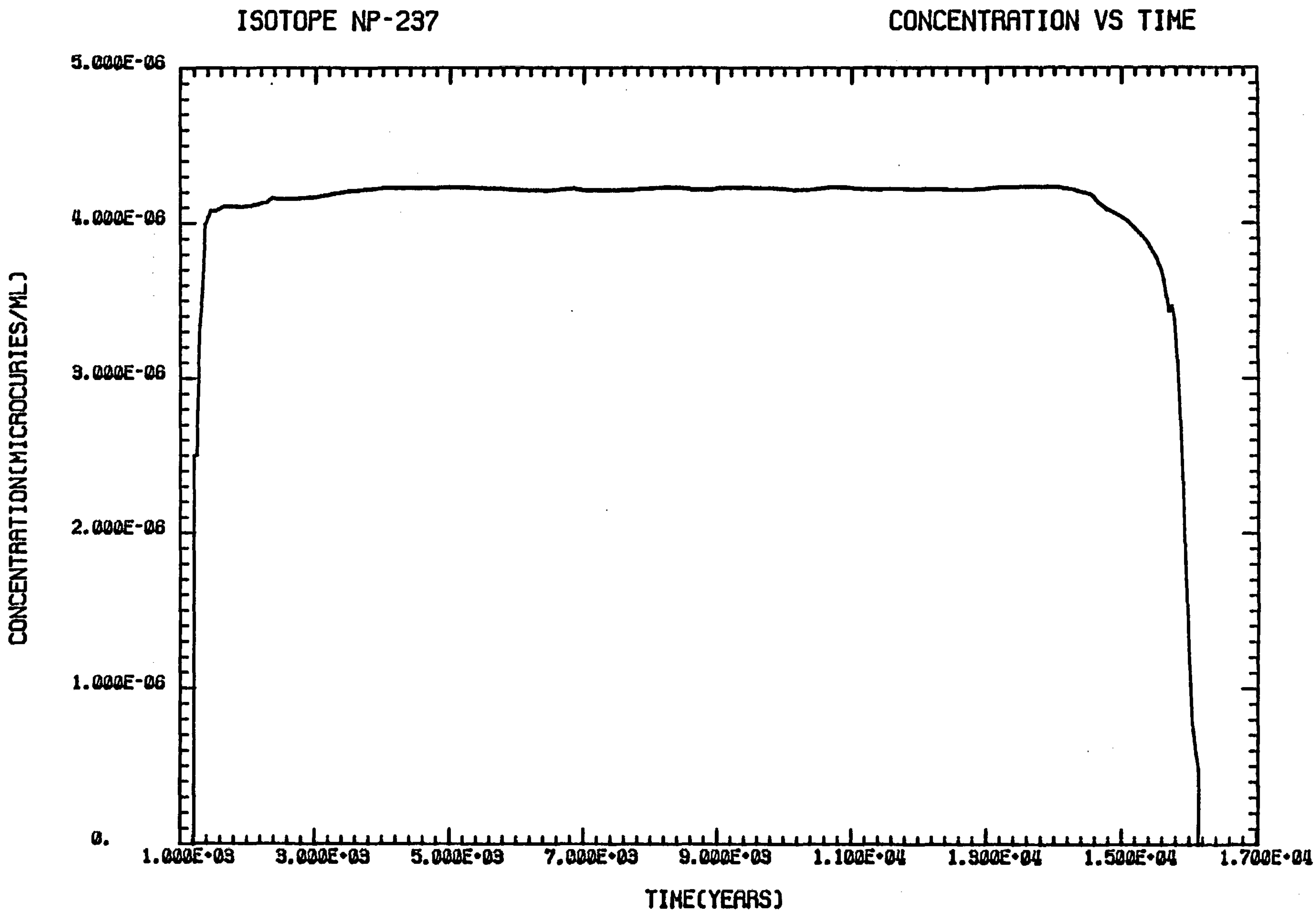
ISOTOPE I-129
CONCENTRATION VS TIME
1.200E-07
1.000E-07
8.000E-08
6.000E-08
4.000E-08
2.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
0.
1.000E+04
2.000E+04
3.000E+04
4.000E+04
5.000E+04
6.000E+04
7.000E+04
8.000E+04
9.000E+04
1.000E+05
TIME(YEARS)

G.90

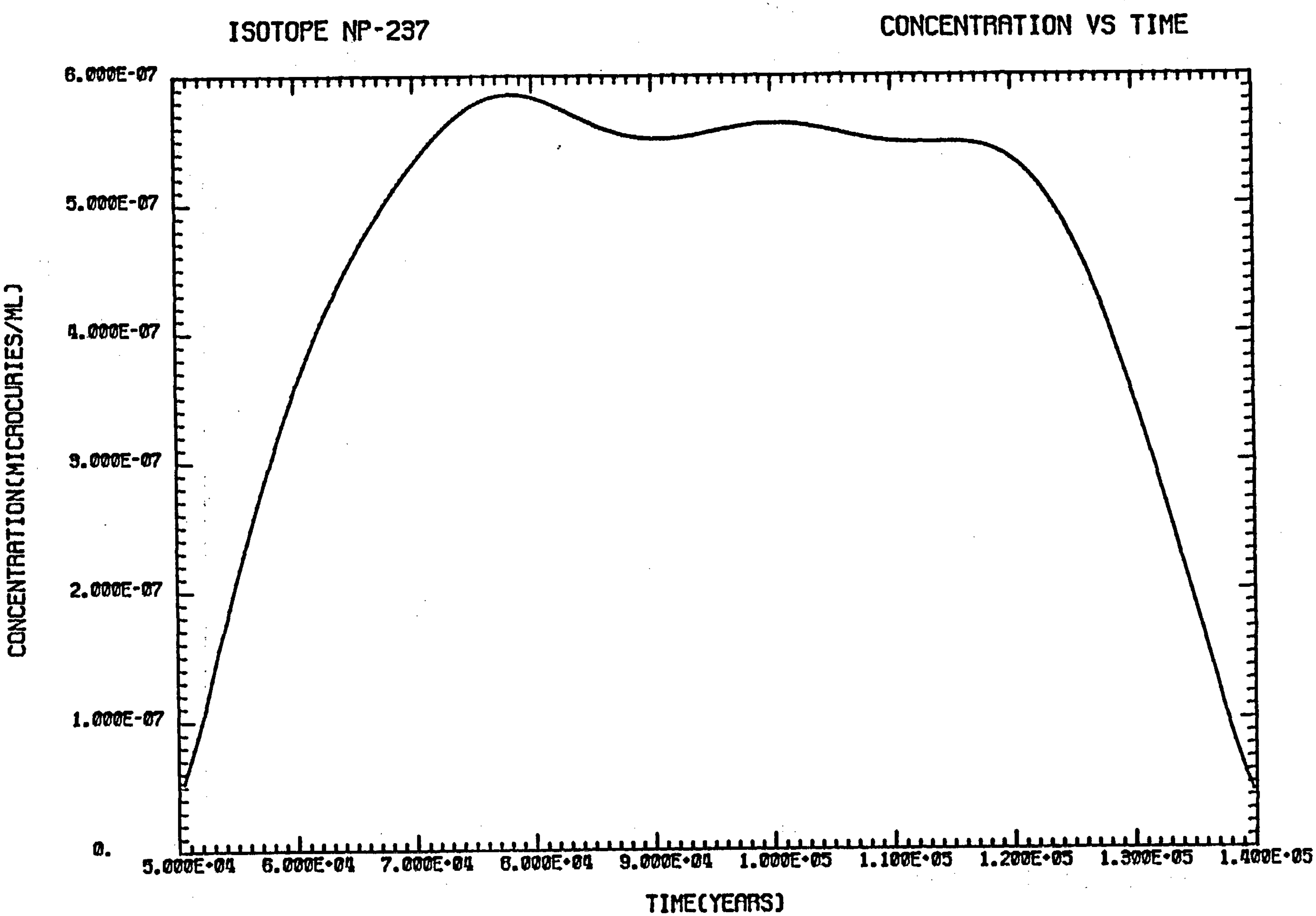

ISOTOPE U-236
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.600E-06
1.400E-06
1.200E-06
1.000E-06
8.000E-07
6.000E-07
4.000E-07
2.000E-07
0.
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
TIME(YEARS)

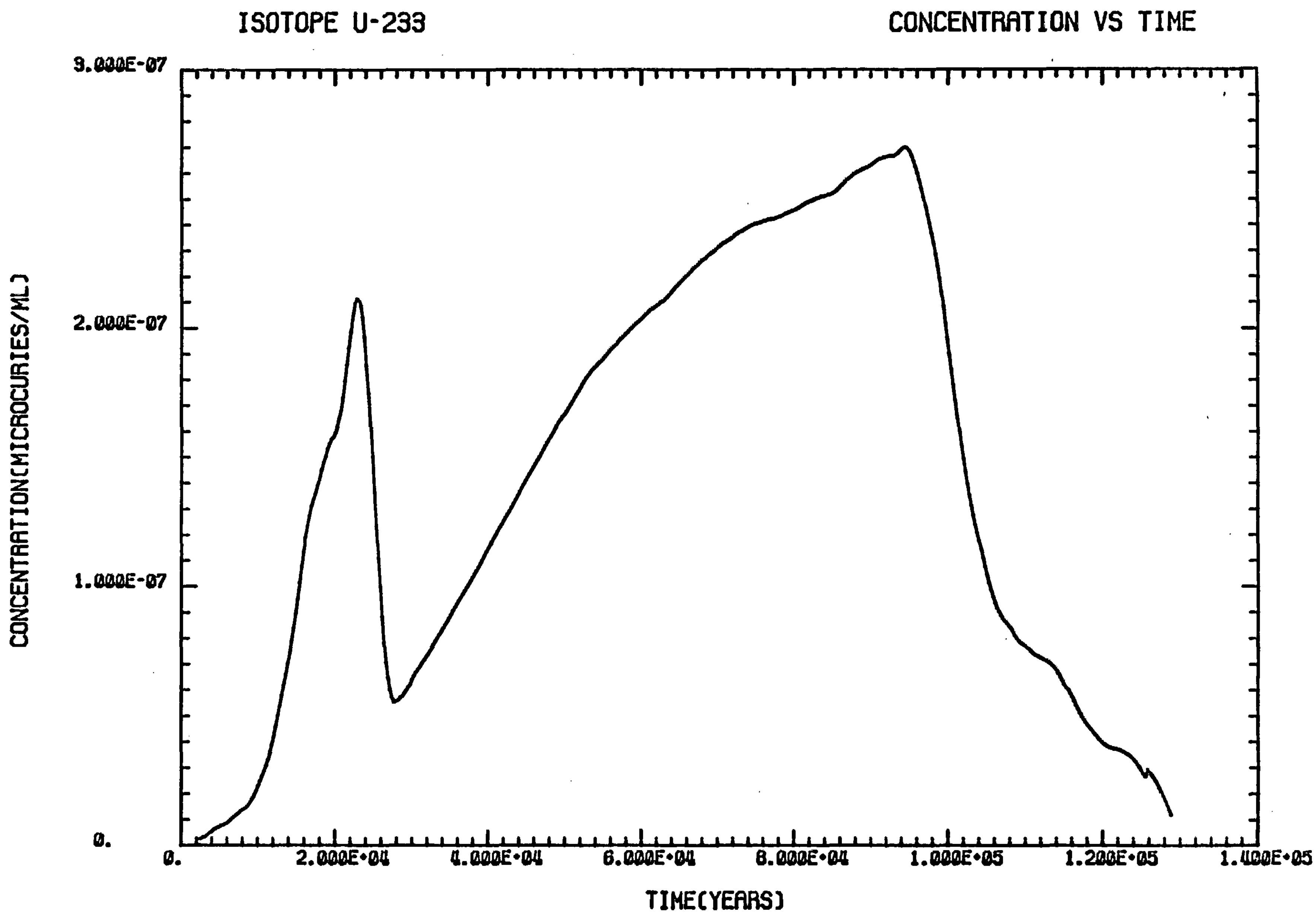

ISOTOPE TH-232
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
8.000E-14
7.000E-14
6.000E-14
5.000E-14
4.000E-14
3.000E-14
2.000E-14
1.000E-14
0.
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
1.400E+05
1.600E+05
TIME(YEARS)

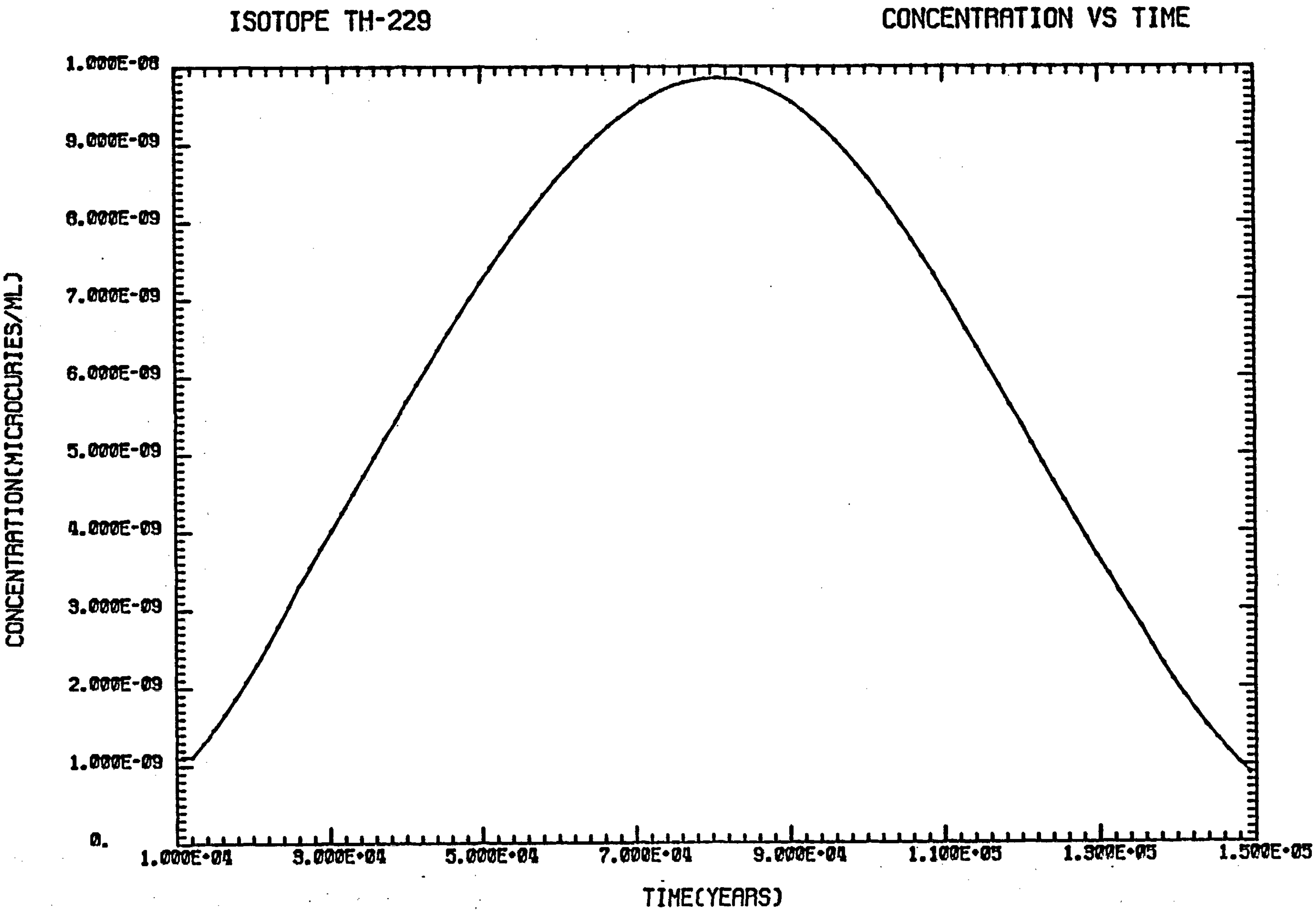

ISOTOPE AM-241
CONCENTRATION VS TIME
2.000E-03
1.800E-03
1.600E-03
1.400E-03
1.200E-03
1.000E-03
8.000E-04
6.000E-04
4.000E-04
2.000E-04
0.
1.000E+03
2.000E+03
3.000E+03
4.000E+03
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

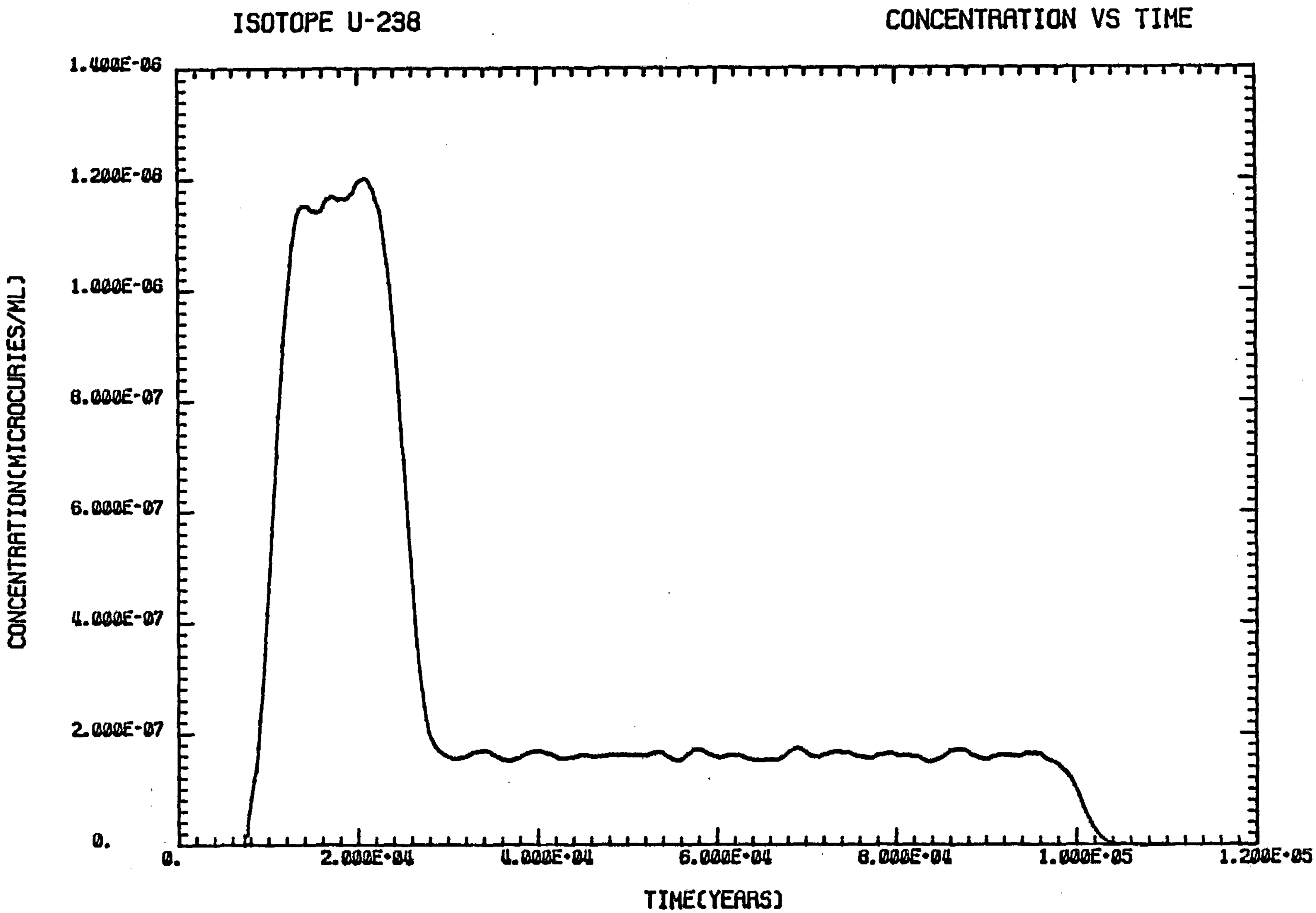


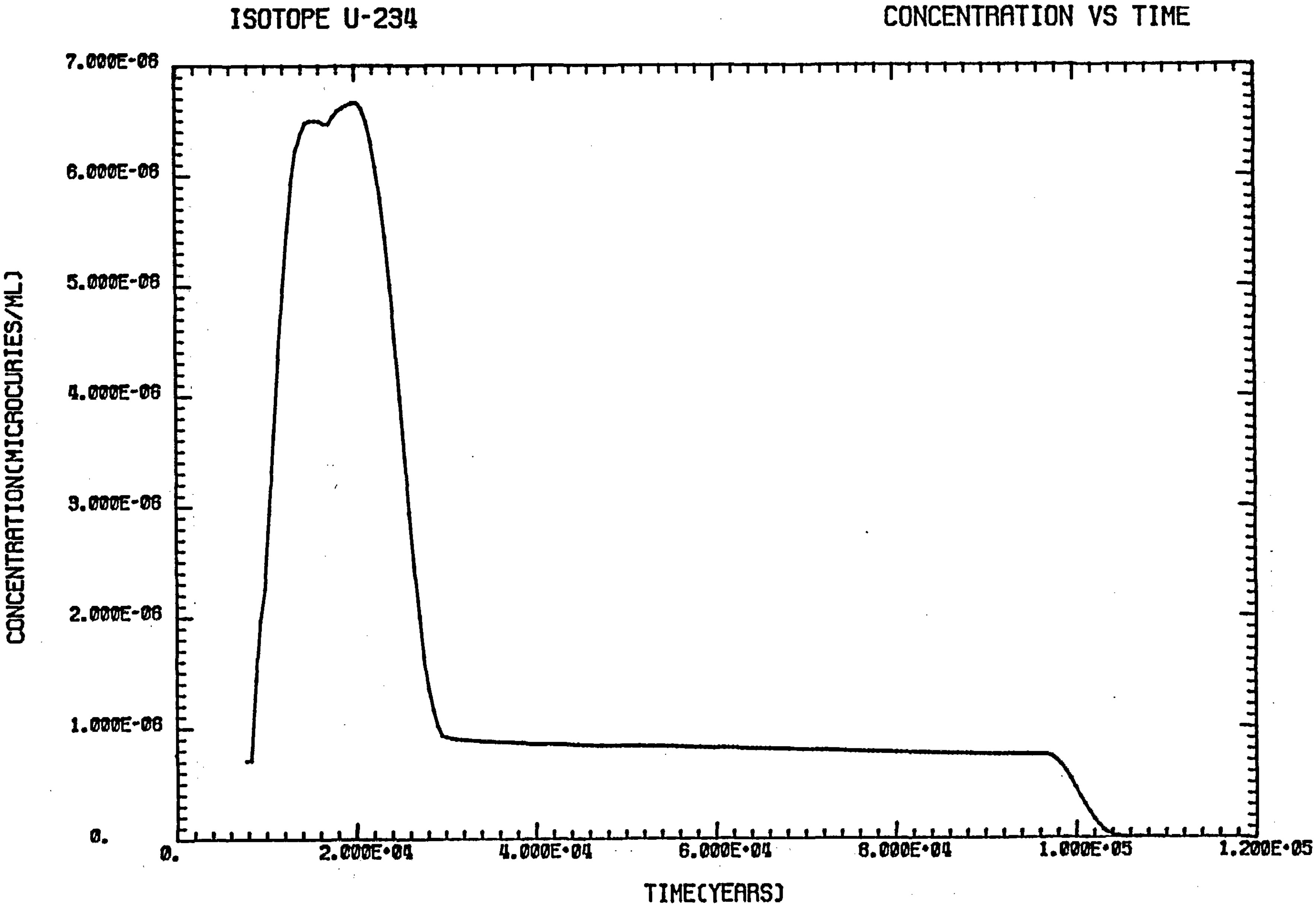
ISOTOPE NP-237
CONCENTRATION VS TIME
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
CONCENTRATION(MICROCURIES/ML)
1.000E+03
3.000E+03
5.000E+03
7.000E+03
9.000E+03
1.100E+04
1.300E+04
1.500E+04
1.700E+04
TIME(YEARS)

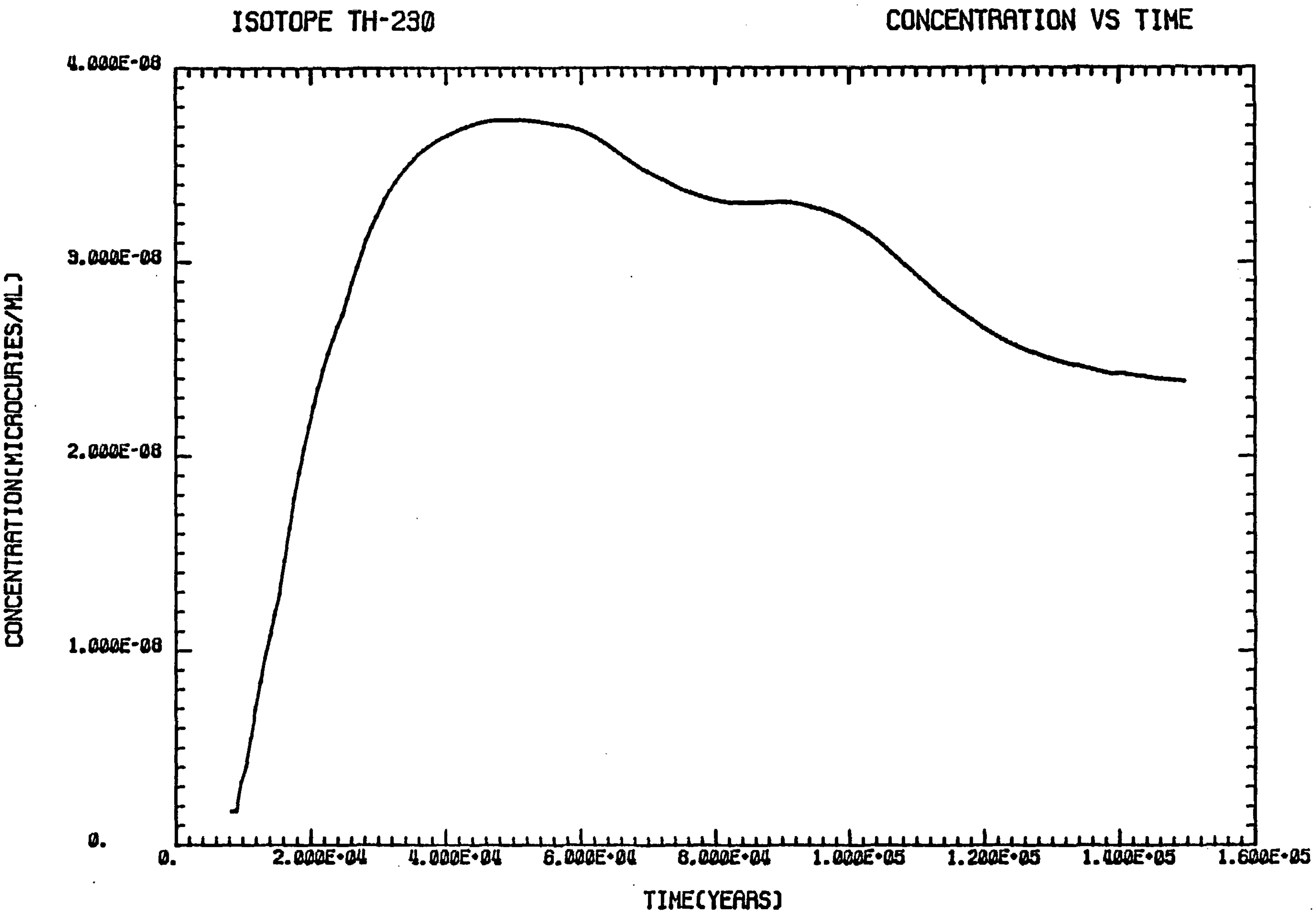

ISOTOPE NP-237
CONCENTRATION VS TIME
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
5.000E+04
6.000E+04
7.000E+04
8.000E+04
9.000E+04
1.000E+05
1.100E+05
1.200E+05
1.300E+05
1.400E+05
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

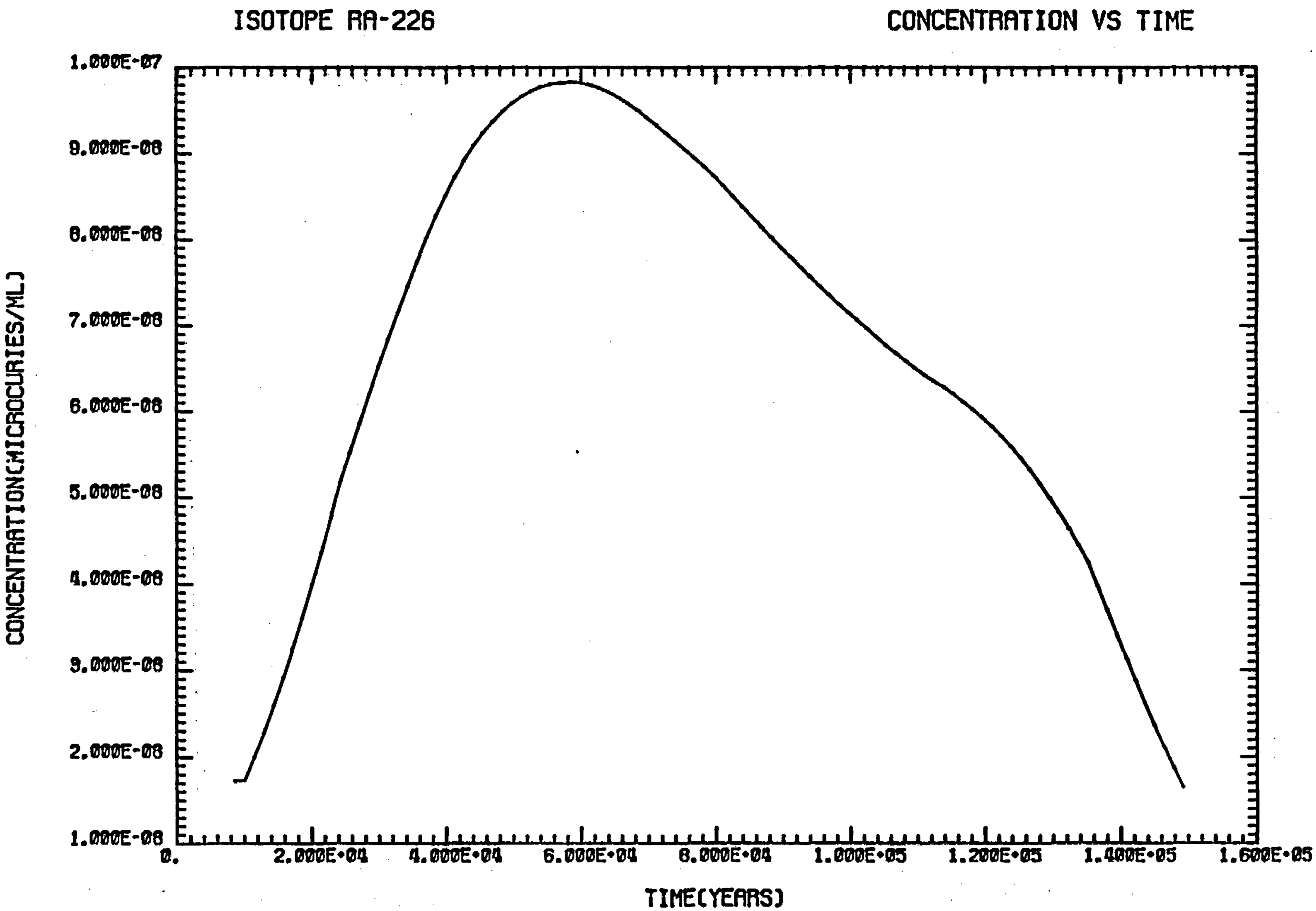

ISOTOPE U-233
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
3.000E-07
2.000E-07
1.000E-07
0.
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
1.400E+05
TIME(YEARS)


ISOTOPE TH-229
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.000E-08
9.000E-09
8.000E-09
7.000E-09
6.000E-09
5.000E-09
4.000E-09
3.000E-09
2.000E-09
1.000E-09
0.
1.000E+04
3.000E+04
5.000E+04
7.000E+04
9.000E+04
1.100E+05
1.300E+05
1.500E+05
TIME(YEARS)


ISOTOPE U-238
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.400E-06
1.200E-06
1.000E-06
8.000E-07
6.000E-07
4.000E-07
2.000E-07
0.
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
TIME(YEARS)

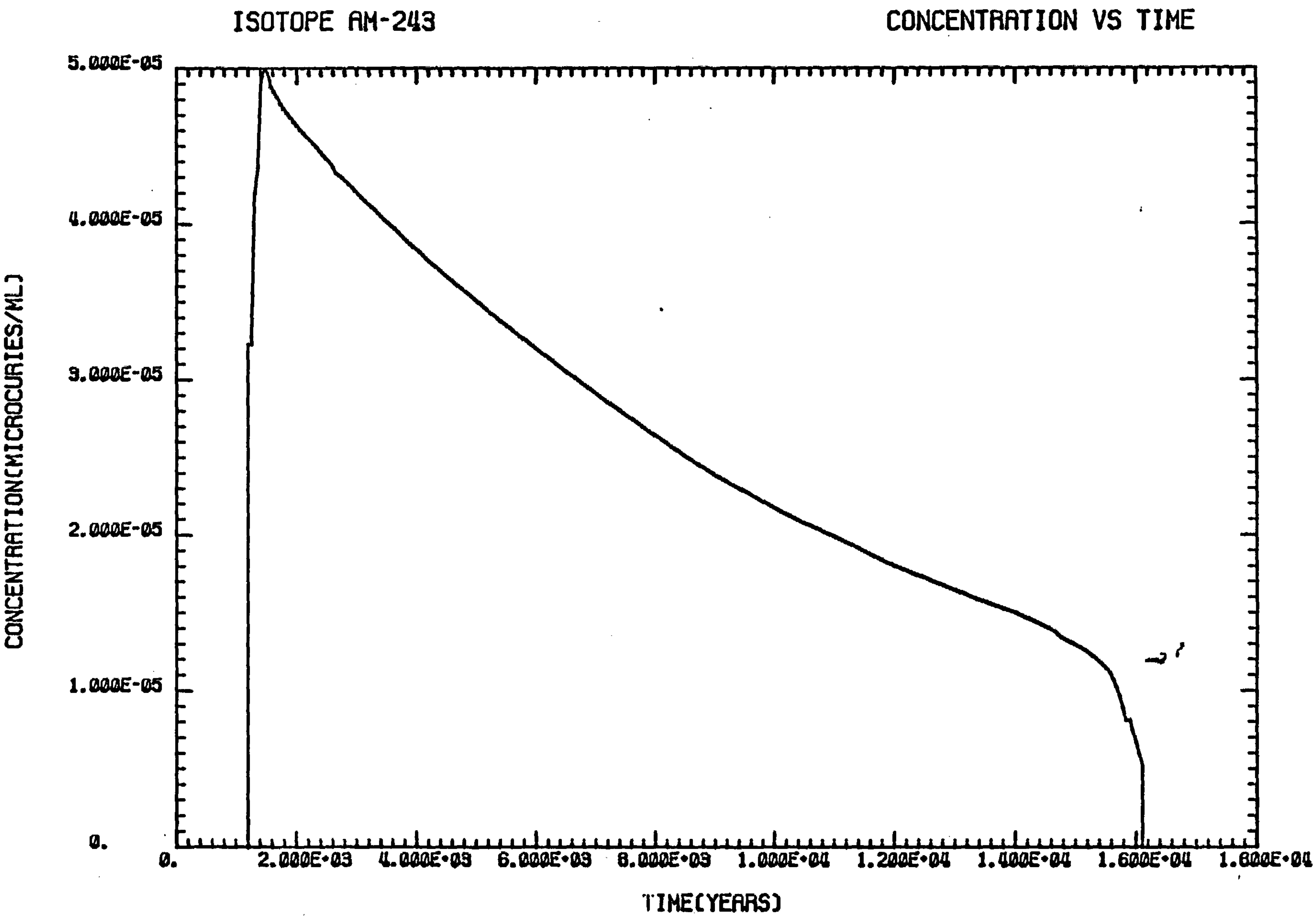

ISOTOPE U-234
CONCENTRATION VS TIME
7.000E-06
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

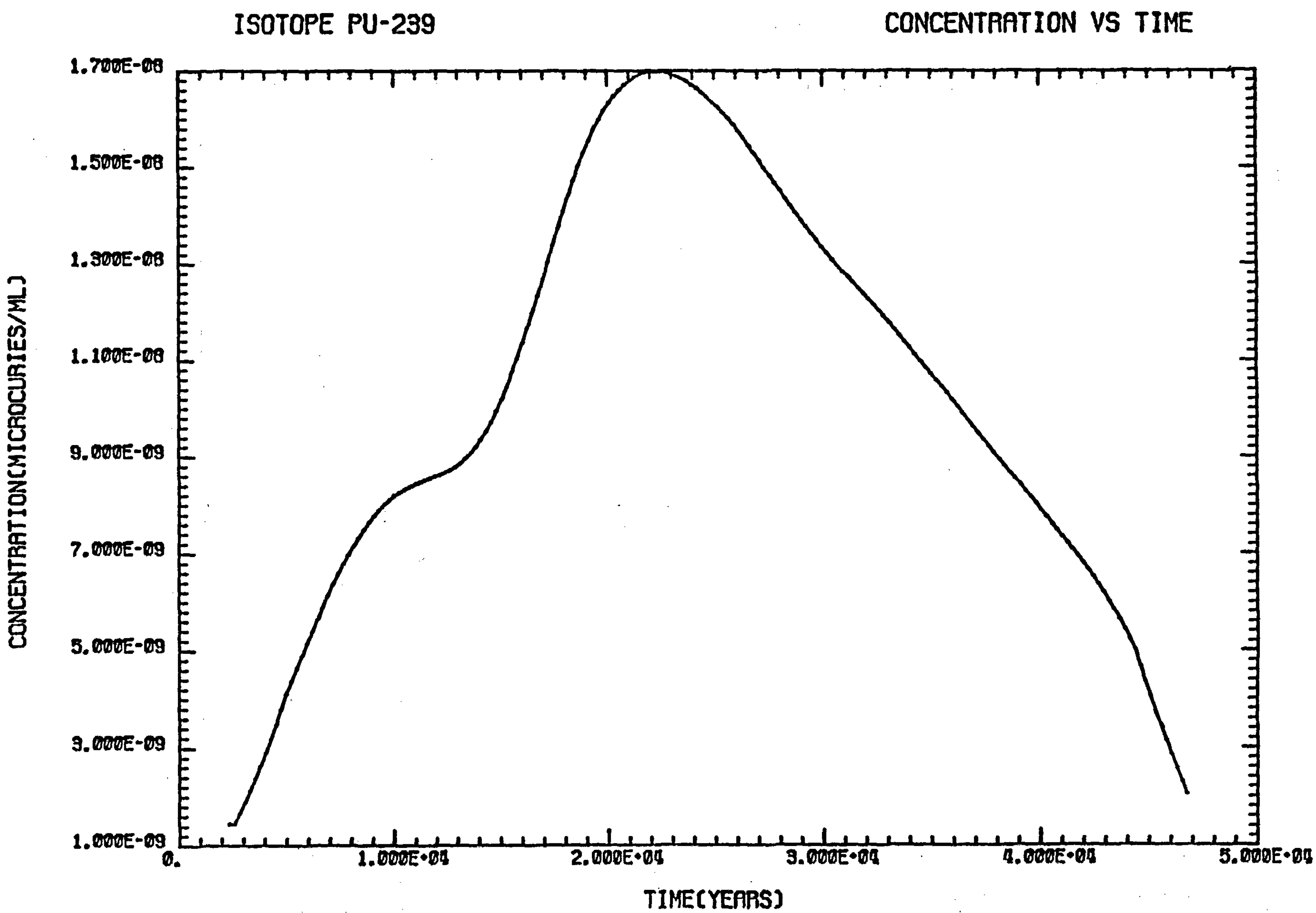

ISOTOPE TH-230
CONCENTRATION VS TIME
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
1.400E+05
1.600E+05
TIME(YEARS)

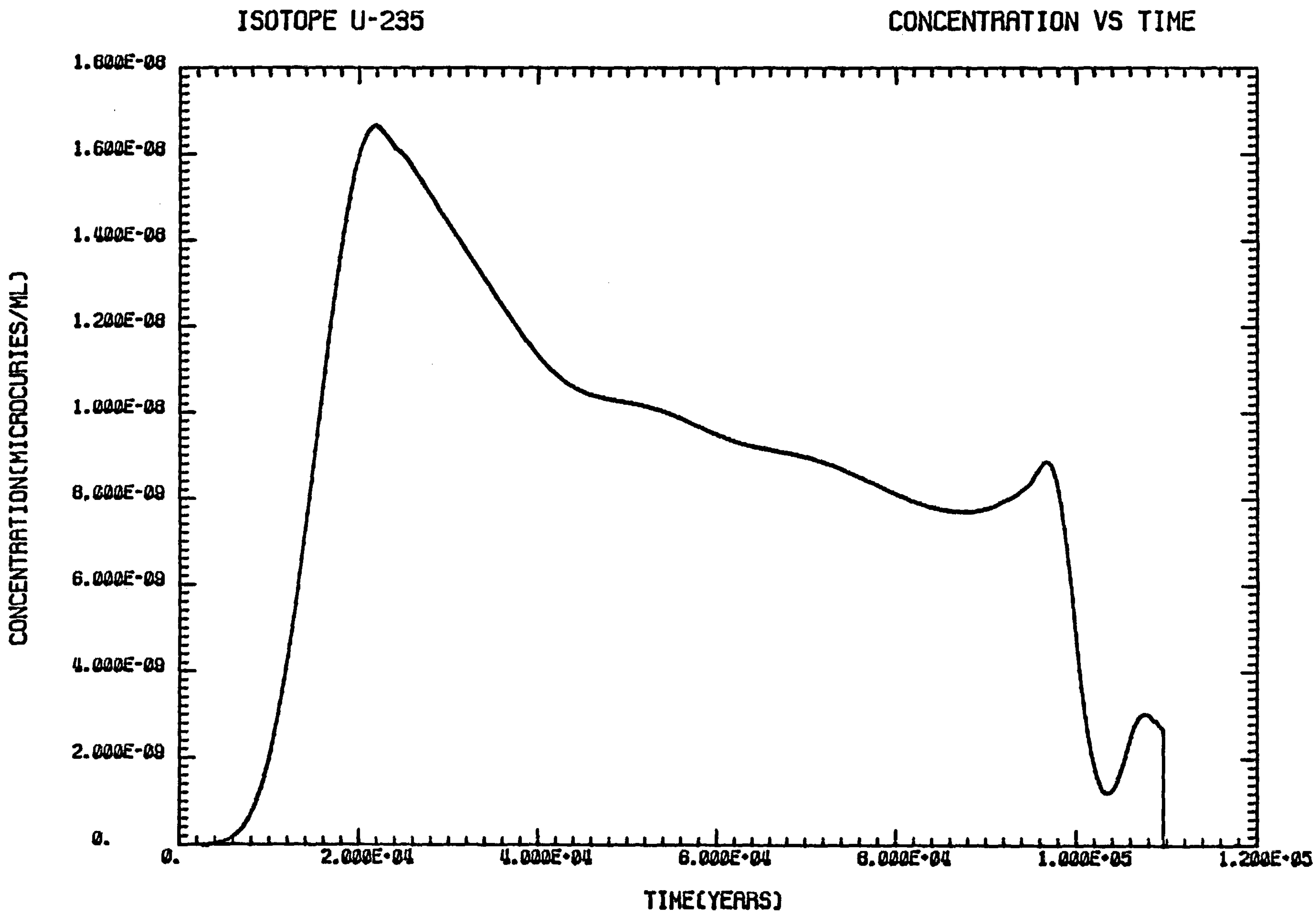


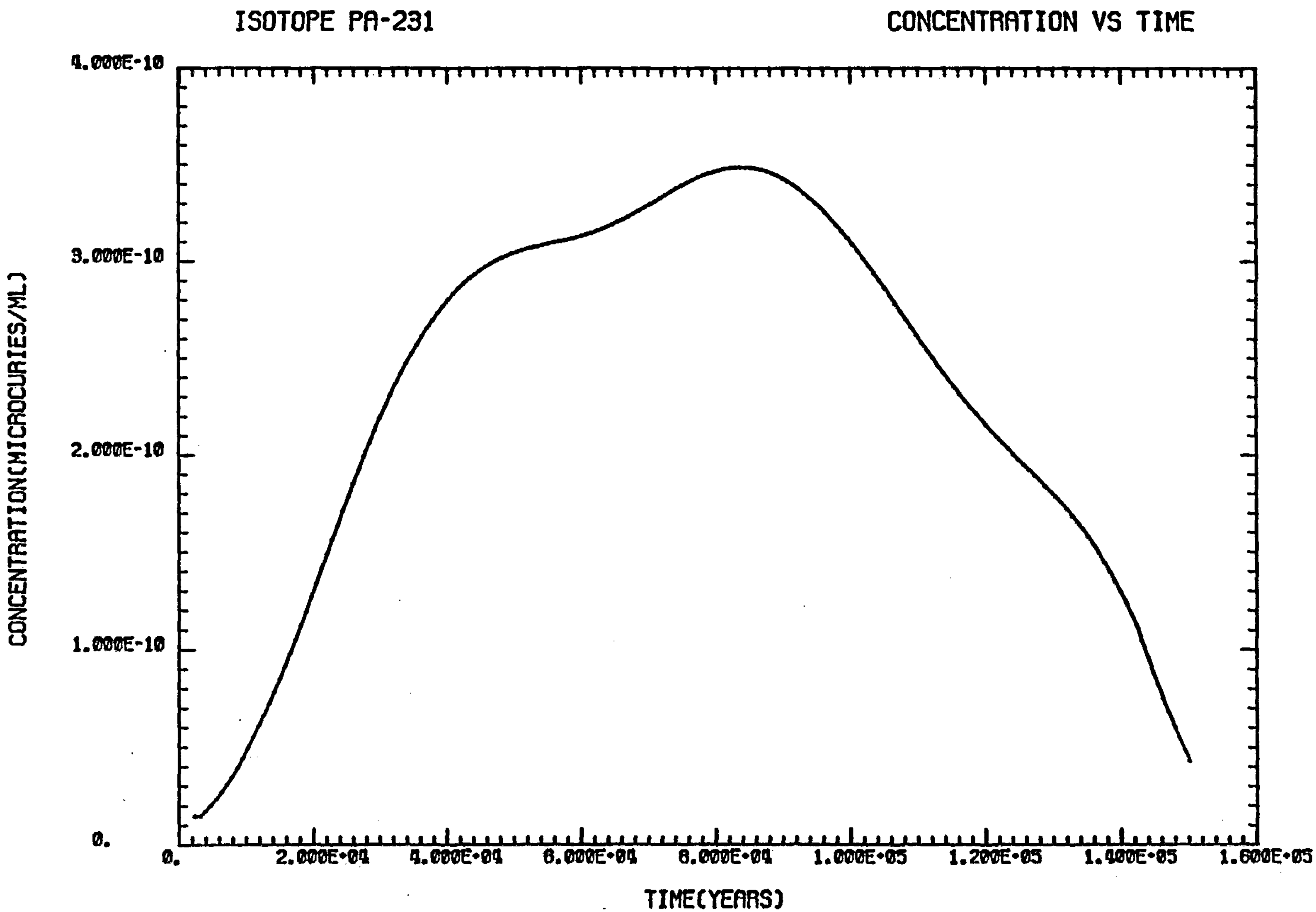
ISOTOPE RA-226
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.000E-07
9.000E-08
8.000E-08
7.000E-08
6.000E-08
5.000E-08
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
1.400E+05
1.600E+05
TIME(YEARS)

G.101


ISOTOPE AM-243
CONCENTRATION VS TIME
5.000E-05
4.000E-05
3.000E-05
2.000E-05
1.000E-05
0.
CONCENTRATION(MICROCURIES/ML)
0.
2.000E+03
4.000E+03
6.000E+03
8.000E+03
1.000E+04
1.200E+04
1.400E+04
1.600E+04
1.800E+04
TIME(YEARS)

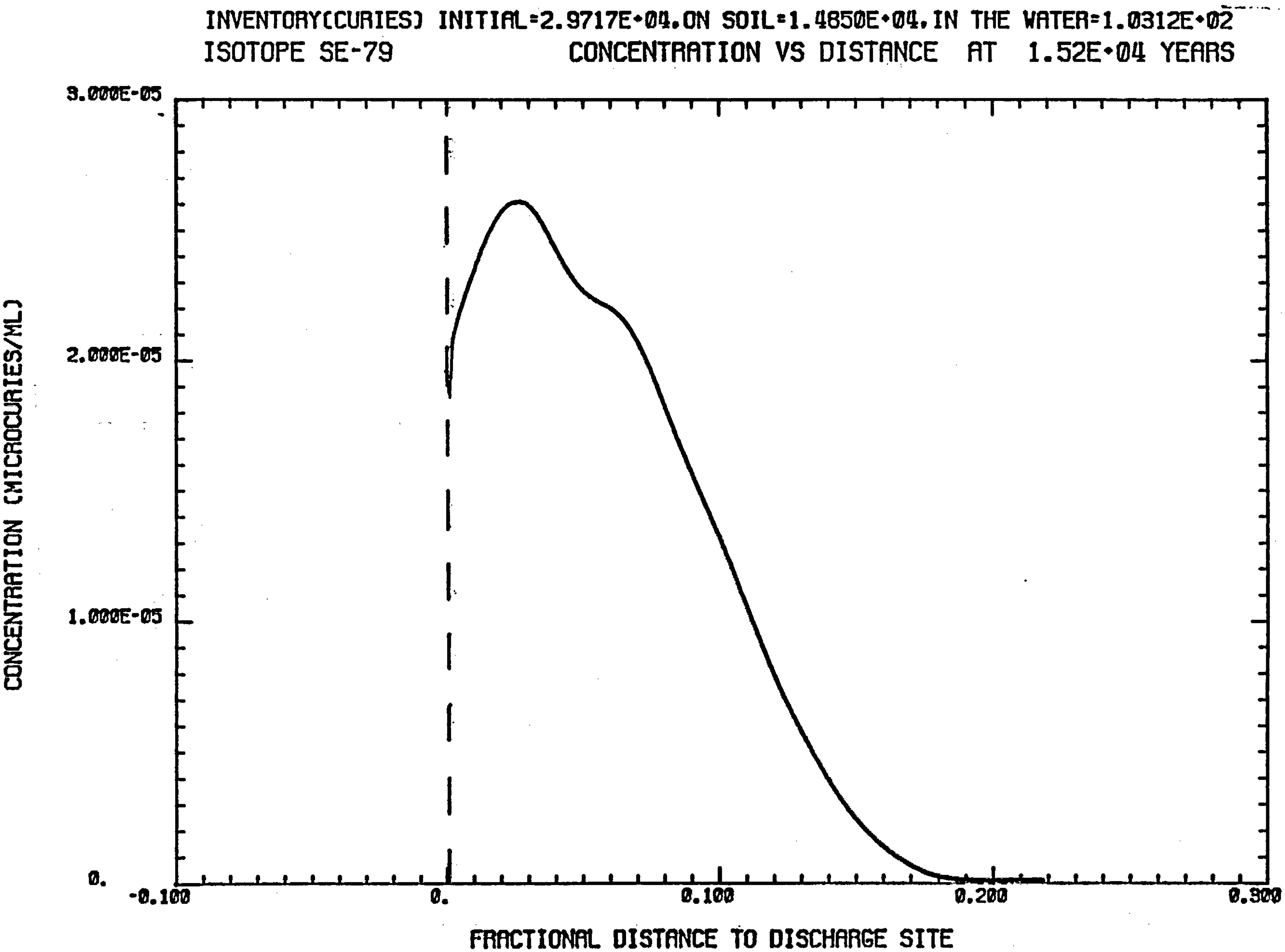

ISOTOPE PU-239
CONCENTRATION VS TIME
1.700E-08
1.500E-08
1.300E-08
1.100E-08
9.000E-09
7.000E-09
5.000E-09
3.000E-09
1.000E-09
CONCENTRATION(MICROCURIES/ML)
0.
1.000E+04
2.000E+04
3.000E+04
4.000E+04
5.000E+04
TIME(YEARS)

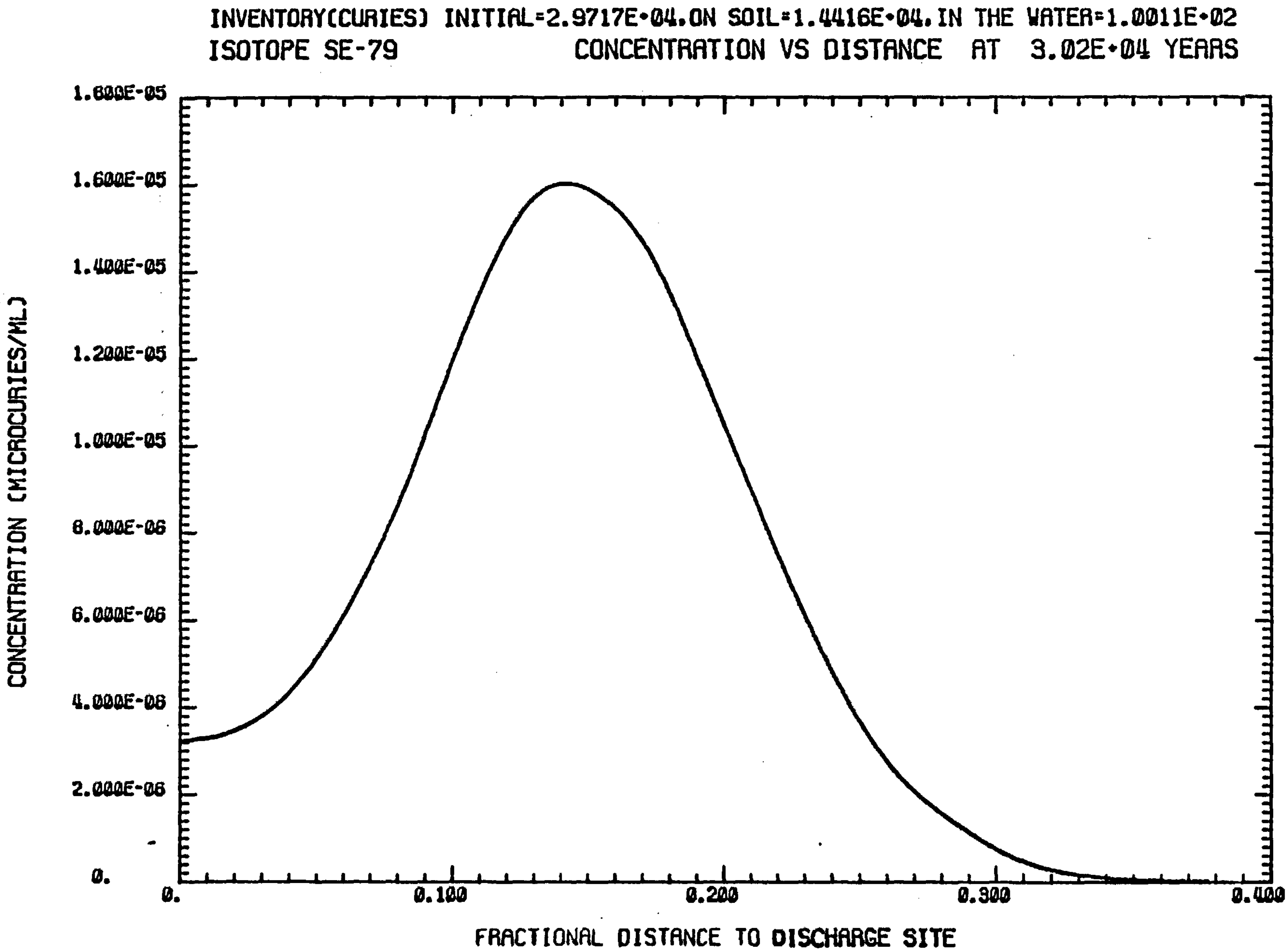

ISOTOPE U-235
CONCENTRATION VS TIME
1.800E-08
1.600E-08
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
CONCENTRATION(MICROCURIES/ML)
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
TIME(YEARS)

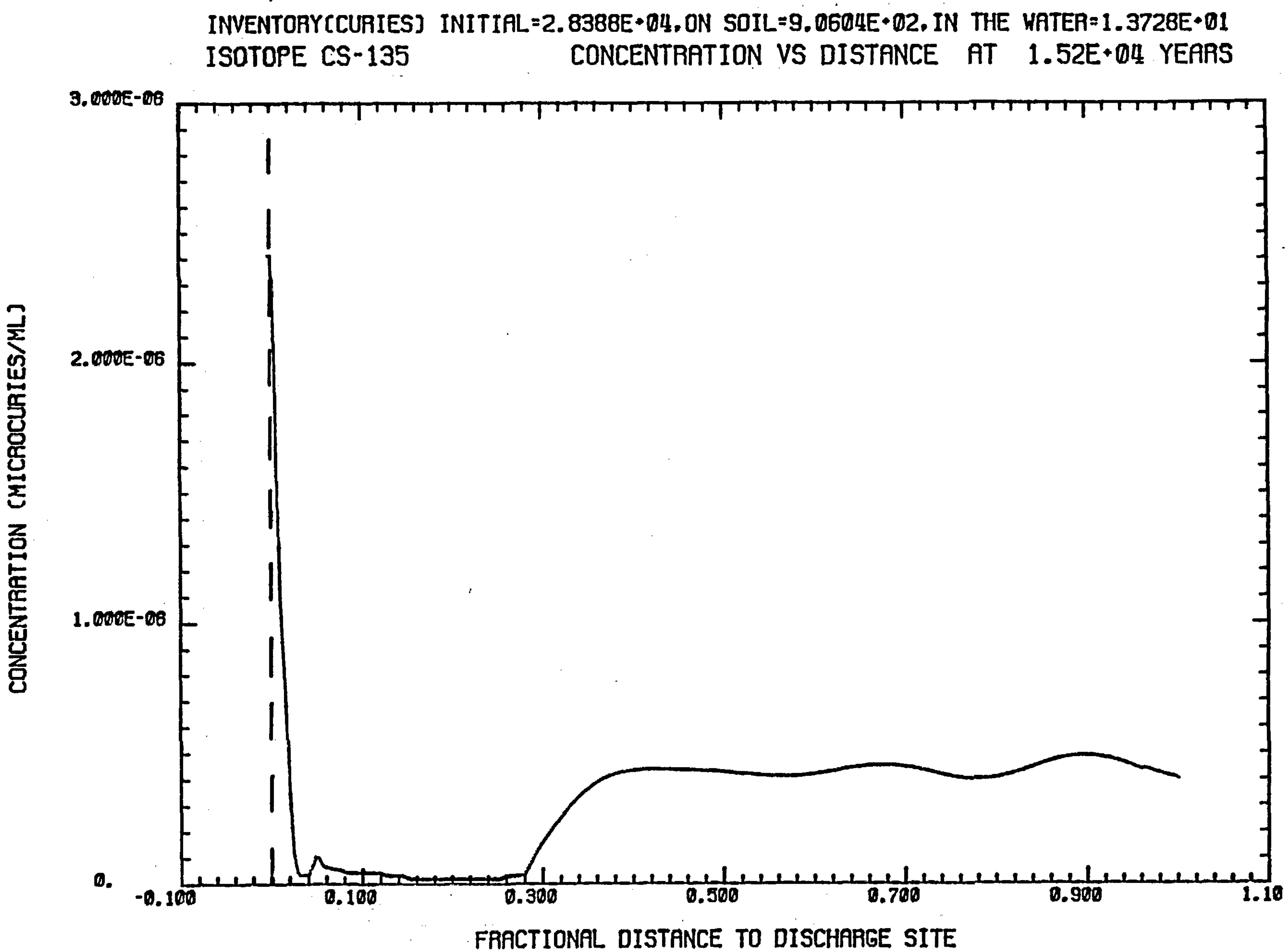


ISOTOPE PA-231
CONCENTRATION VS TIME
4.000E-10
3.000E-10
2.000E-10
1.000E-10
0.
CONCENTRATION(MICROCURIES/ML)
0.
2.000E+04
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
1.400E+05
1.600E+05
TIME(YEARS)

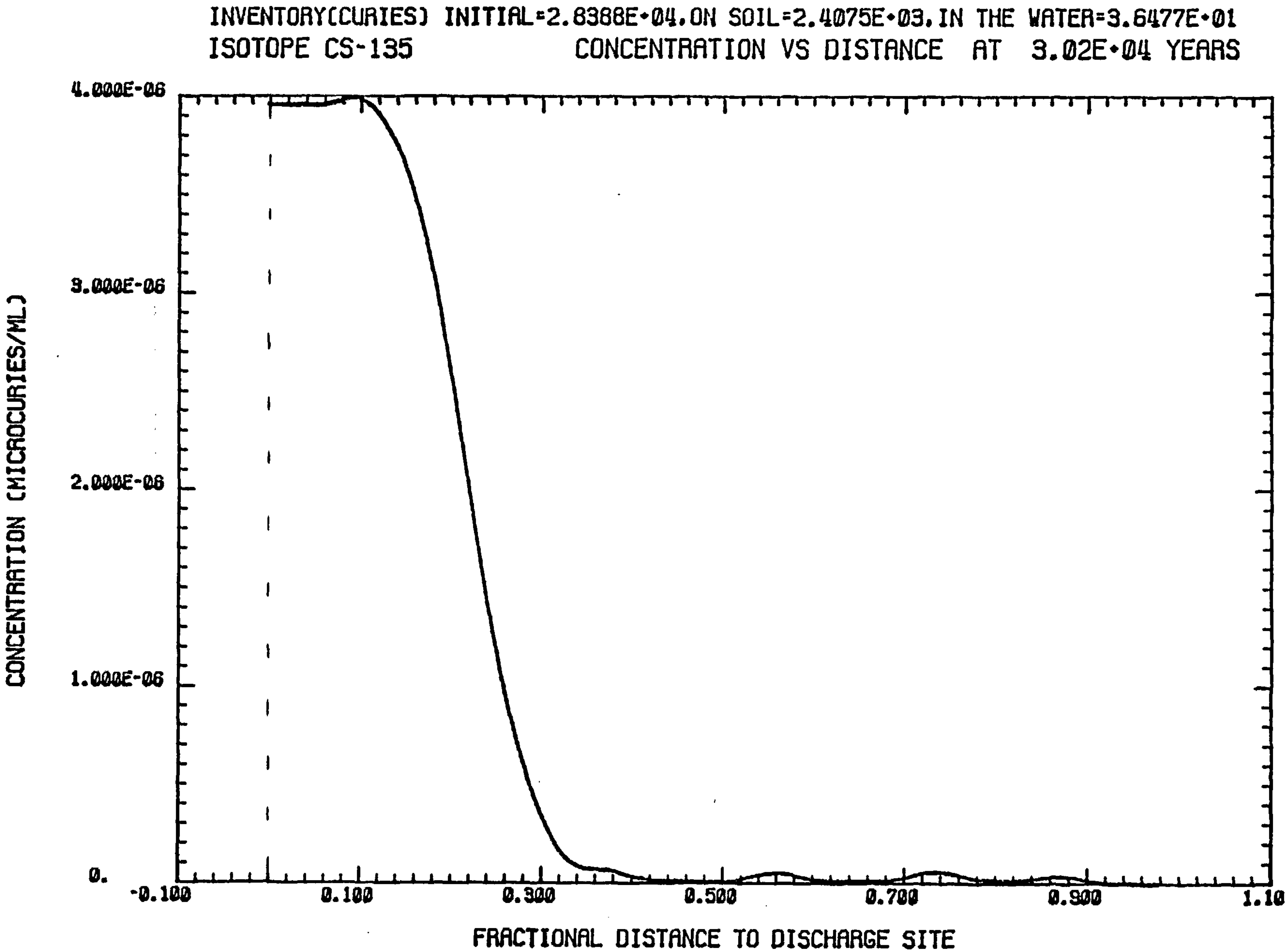
Scenario 3. (contd) Well pumping case at 15,000 and 30,000 years
(Concentration versus distance)

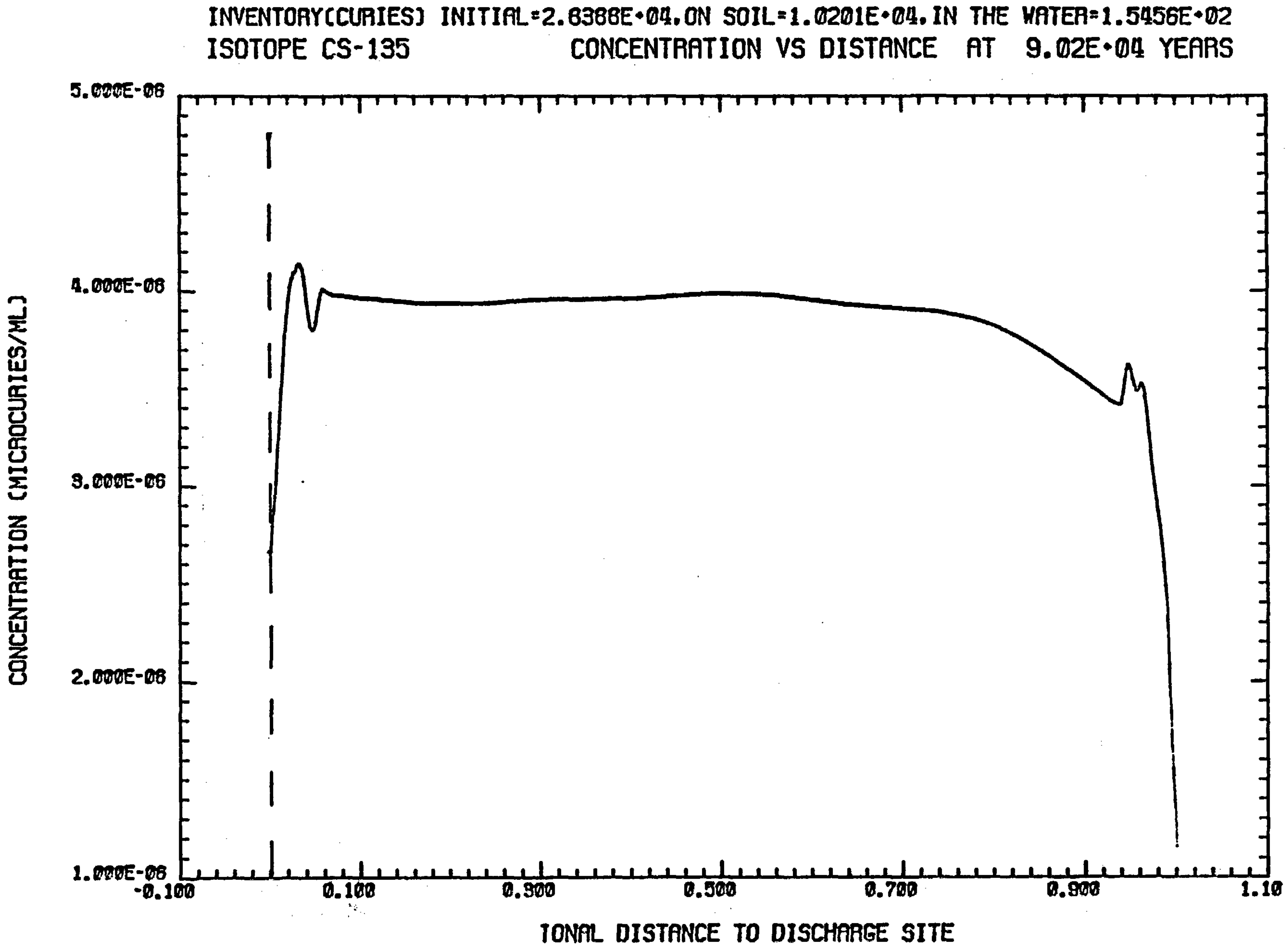

INVENTORY(CURIES) INITIAL=2.9717E+04.ON SOIL=1.4850E+04.IN THE WATER=1.0312E+02
ISOTOPE SE-79
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
CONCENTRATION (MICROCURIES/ML)
3.000E-05
2.000E-05
1.000E-05
0.
-0.100
0.
0.100
0.200
0.300
FRACTIONAL DISTANCE TO DISCHARGE SITE


INVENTORY(CURIES) INITIAL=2.9717E+04.ON SOIL=1.4416E+04.IN THE WATER=1.0011E+02
ISOTOPE SE-79
CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS
1.800E-05
1.600E-05
1.400E-05
1.200E-05
1.000E-05
8.000E-06
6.000E-06
4.000E-06
2.000E-06
0.
CONCENTRATION (MICROCURIES/ML)
0.
0.100
0.200
0.300
0.400
FRACTIONAL DISTANCE TO DISCHARGE SITE



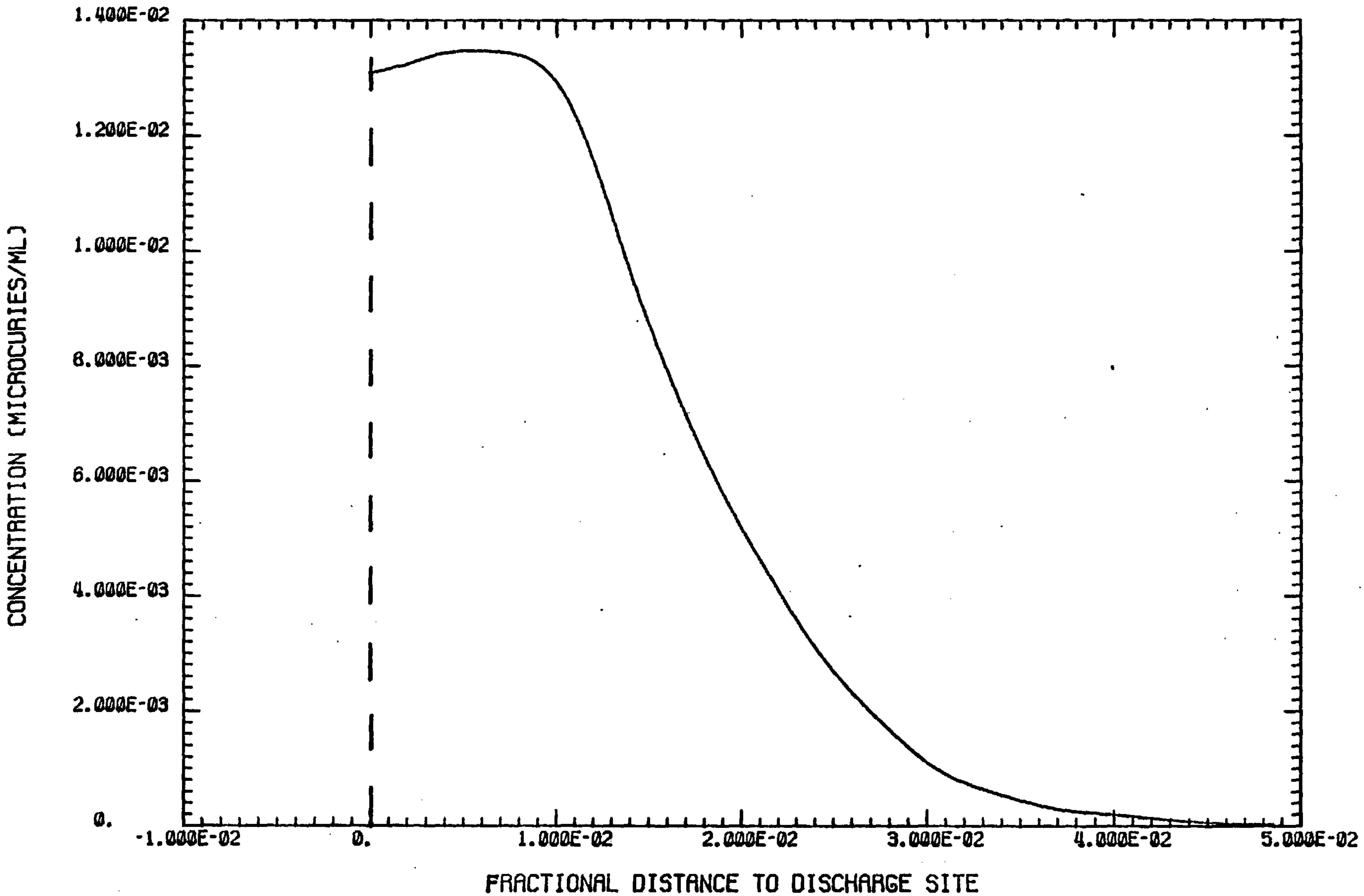
INVENTORY(CURIES) INITIAL=2.8388E+04,ON SOIL=9.0604E+02,IN THE WATER=1.3728E+01
ISOTOPE CS-135
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
3.000E-06
2.000E-06
1.000E-06
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
CONCENTRATION (MICROCURIES/ML)
FRACTIONAL DISTANCE TO DISCHARGE SITE


INVENTORY(CURIES) INITIAL=2.8388E+04,ON SOIL=2.4075E+03,IN THE WATER=3.6477E+01
ISOTOPE CS-135
CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS
CONCENTRATION (MICROCURIES/ML)
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE

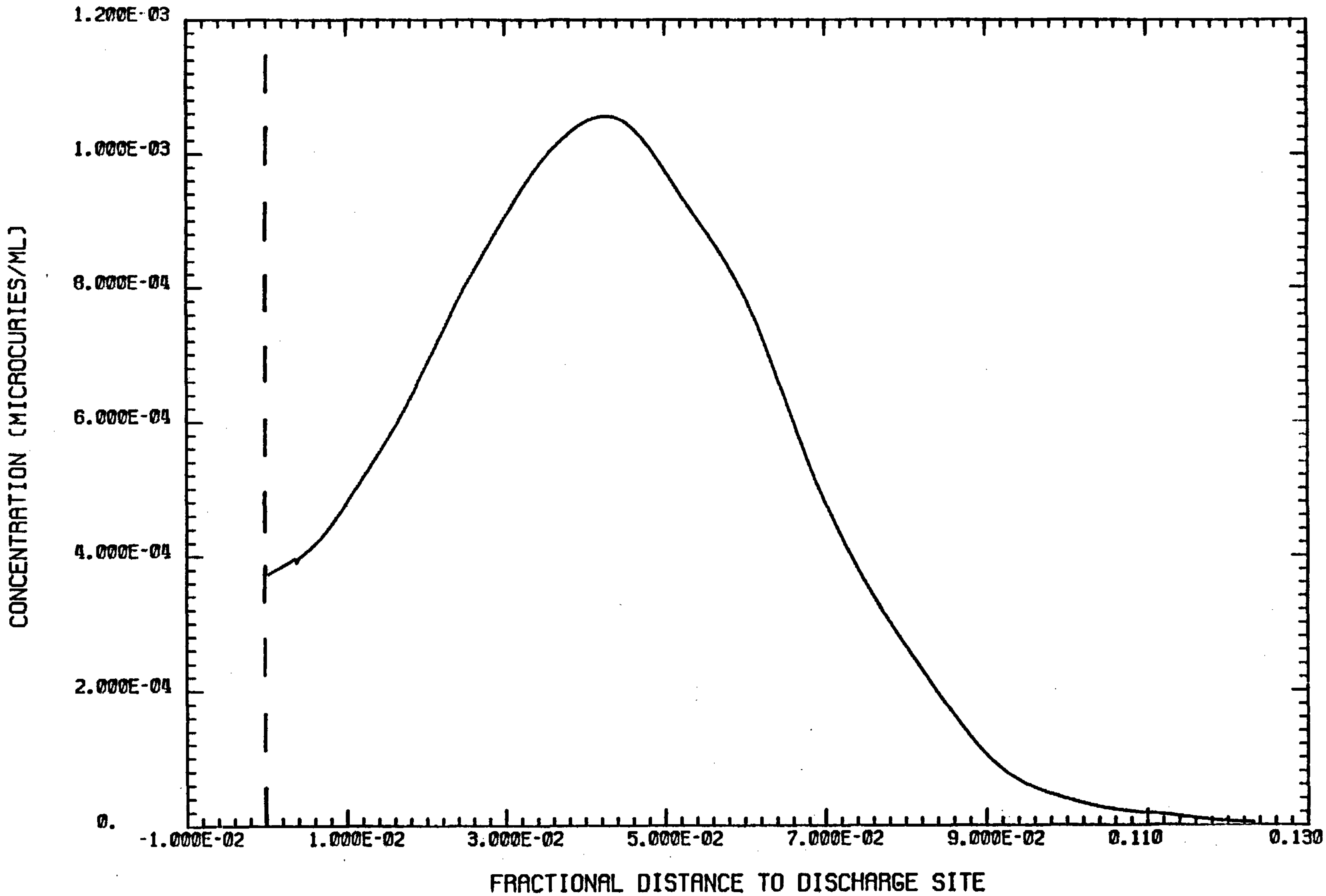

INVENTORY(CURIES) INITIAL=2.6368E+04,ON SOIL=1.0201E+04,IN THE WATER=1.5456E+02
ISOTOPE CS-135
CONCENTRATION VS DISTANCE AT 9.02E+04 YEARS
CONCENTRATION (MICROCURIES/ML)
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
TONAL DISTANCE TO DISCHARGE SITE

INVENTORY(CURIES) INITIAL=3.7732E+07,ON SOIL=4.5339E+06,IN THE WATER=1.0351E+04

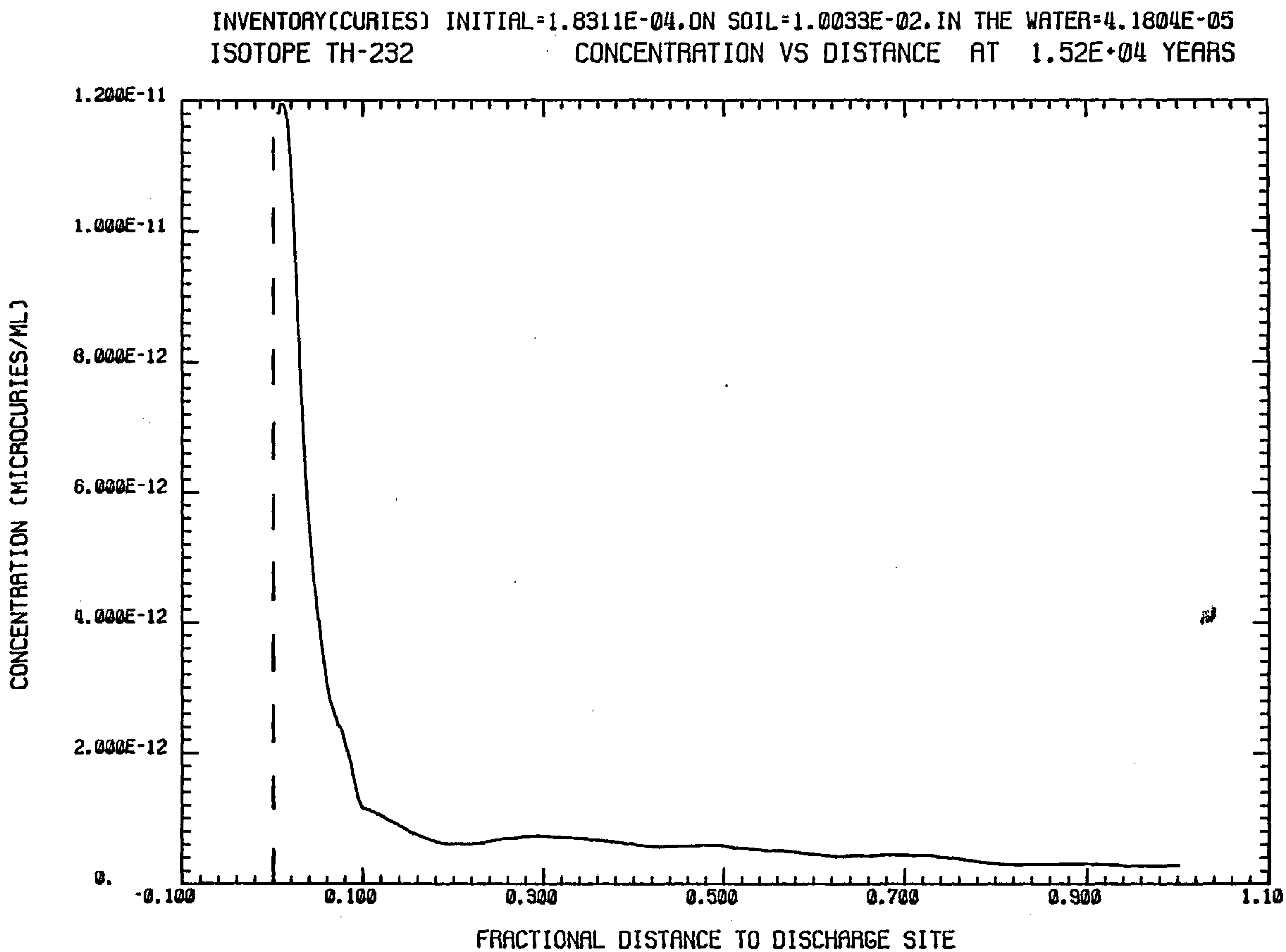
ISOTOPE PU-240 CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS

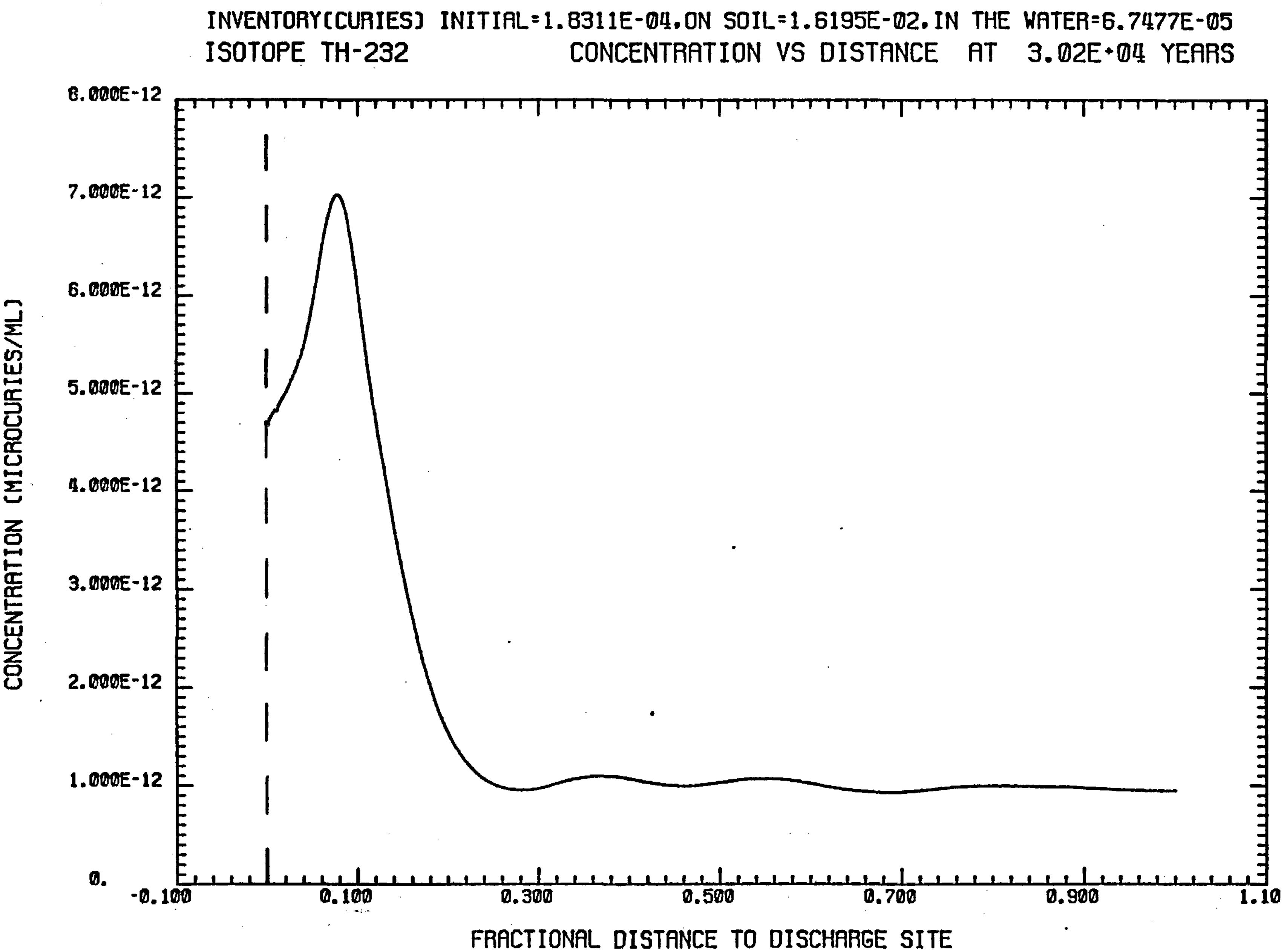


INVENTORY(CURIES) INITIAL=3.7732E+07,ON SOIL=1.0535E+06,IN THE WATER=2.4052E+03
ISOTOPE PU-240 CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS

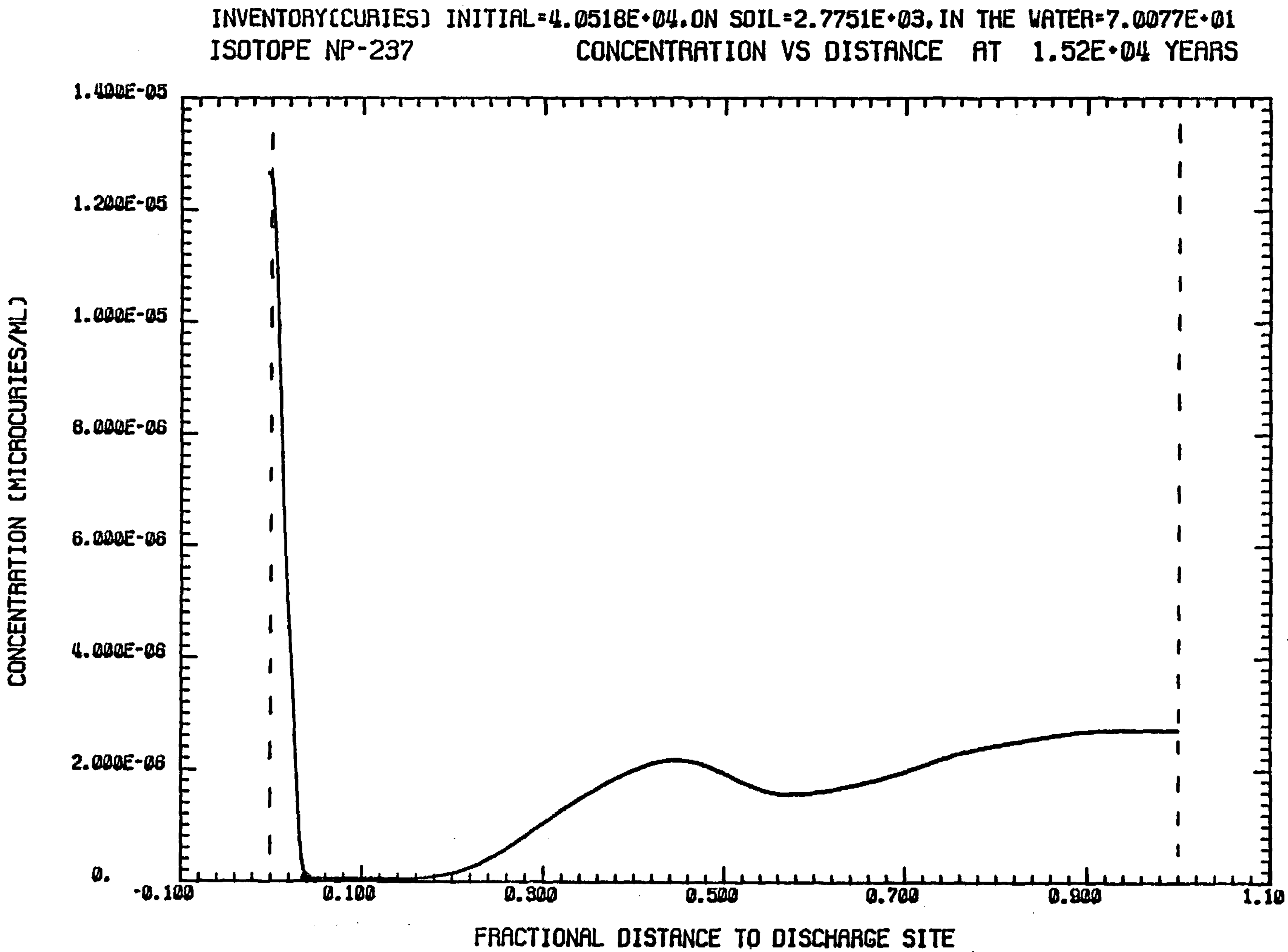


G.113

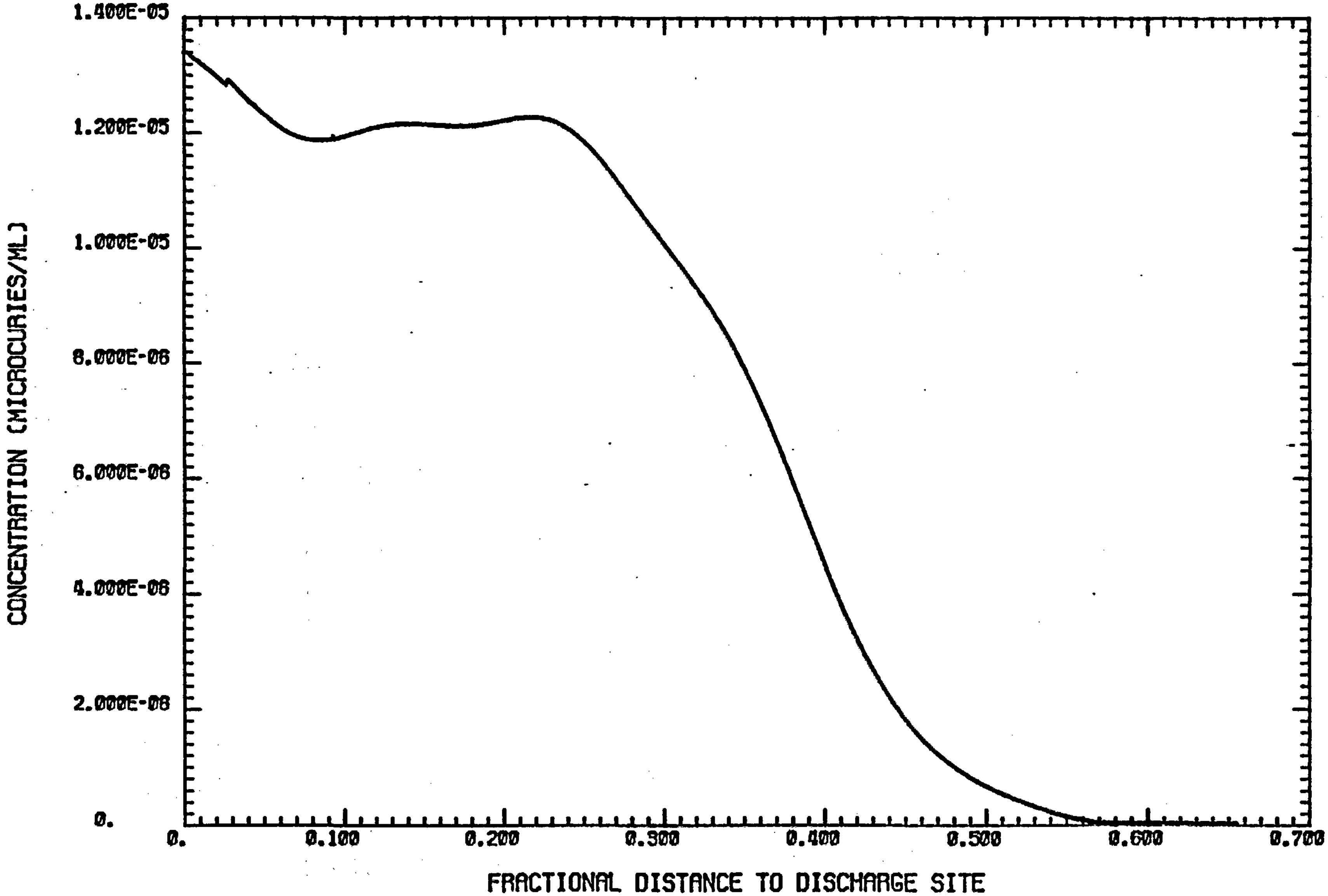

INVENTORY(CURIES) INITIAL=1.8311E-04,ON SOIL=1.0033E-02,IN THE WATER=4.1804E-05
ISOTOPE TH-232
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
1.200E-11
1.000E-11
8.000E-12
6.000E-12
4.000E-12
2.000E-12
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
CONCENTRATION (MICROCURIES/ML)
FRACTIONAL DISTANCE TO DISCHARGE SITE

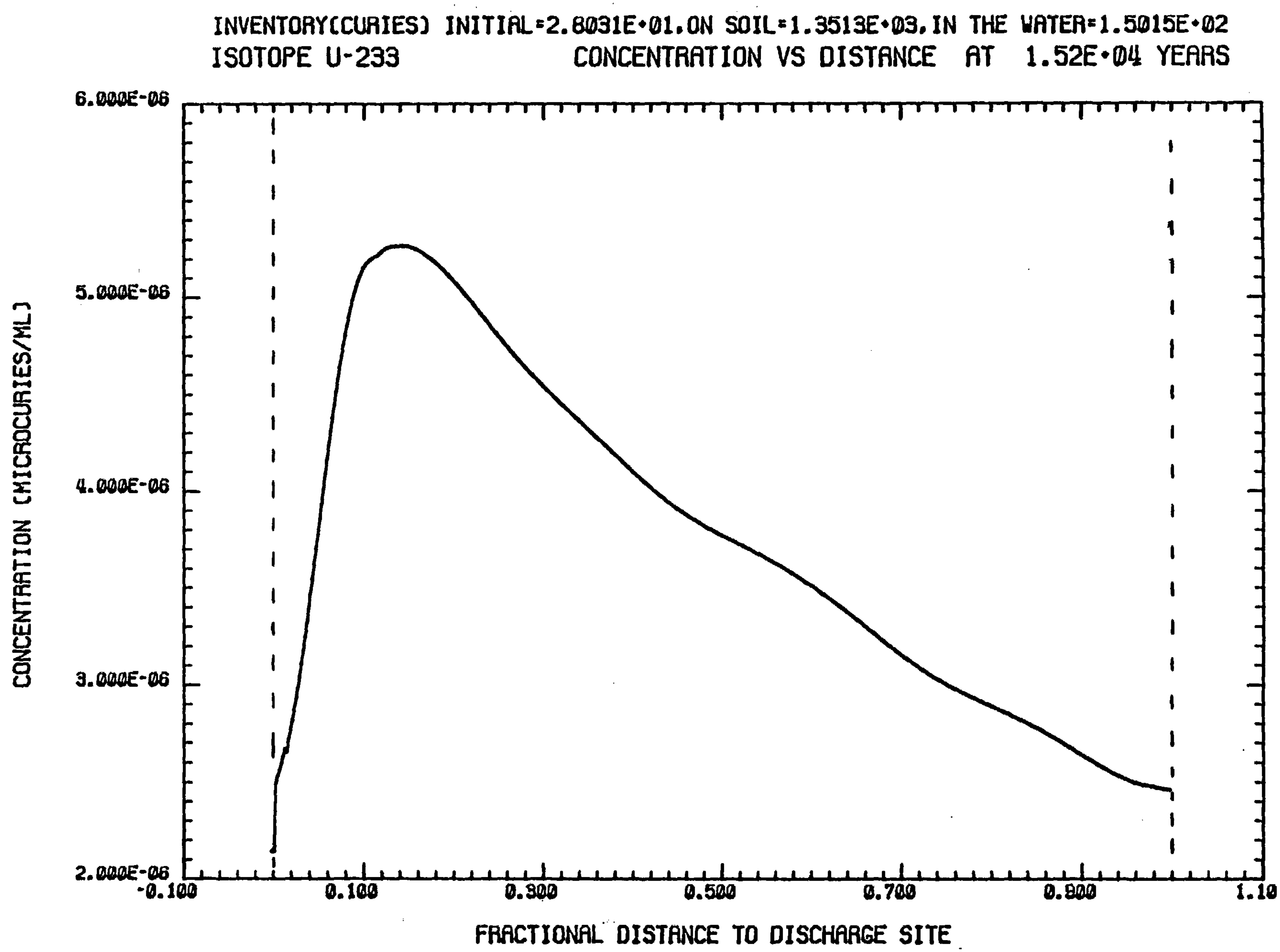

INVENTORY(CURIES) INITIAL=1.8311E-04.ON SOIL=1.6195E-02.IN THE WATER=6.7477E-05
ISOTOPE TH-232
CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS
8.000E-12
7.000E-12
6.000E-12
5.000E-12
4.000E-12
3.000E-12
2.000E-12
1.000E-12
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE
CONCENTRATION (MICROCURIES/ML)

G.115

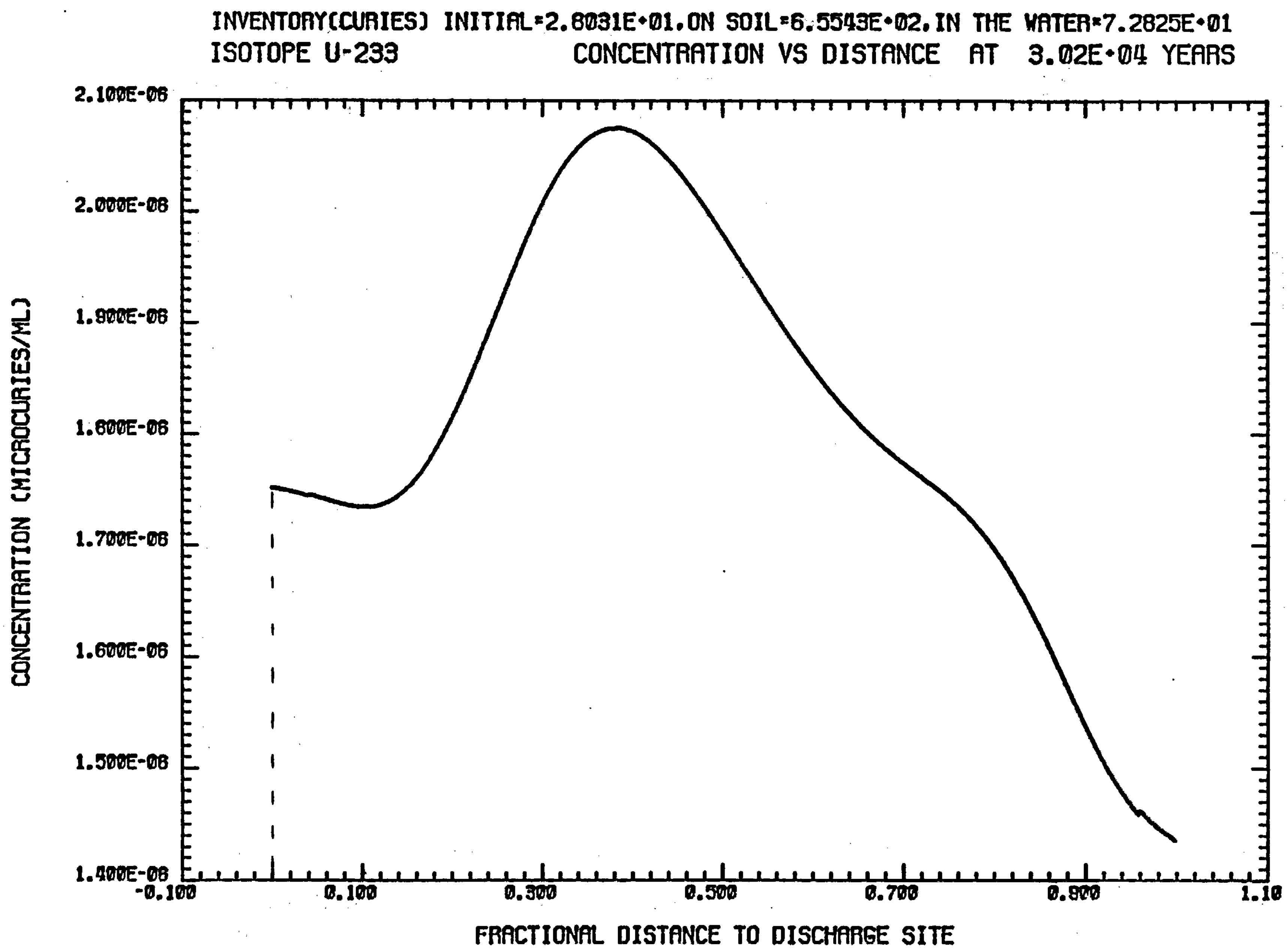

INVENTORY(CURIES) INITIAL=4.0518E+04.ON SOIL=2.7751E+03.IN THE WATER=7.0077E+01
ISOTOPE NP-237
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
CONCENTRATION (MICROCURIES/ML)
1.400E-05
1.200E-05
1.000E-05
8.000E-06
6.000E-06
4.000E-06
2.000E-06
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE

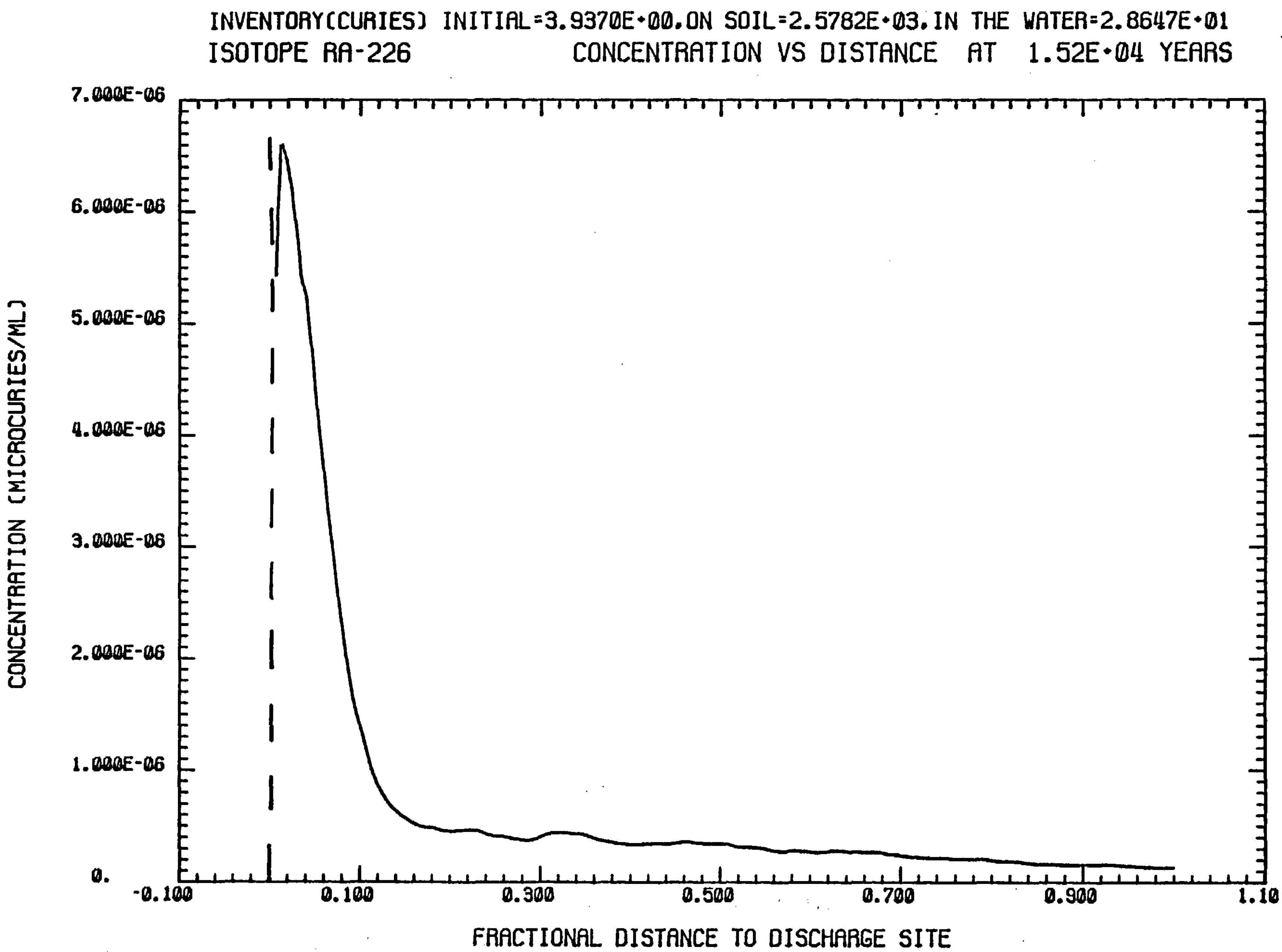
INVENTORY(CURIES) INITIAL=4.0516E+04.ON SOIL=7.3821E+03.IN THE WATER=1.8642E+02
ISOTOPE NP-237 CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS



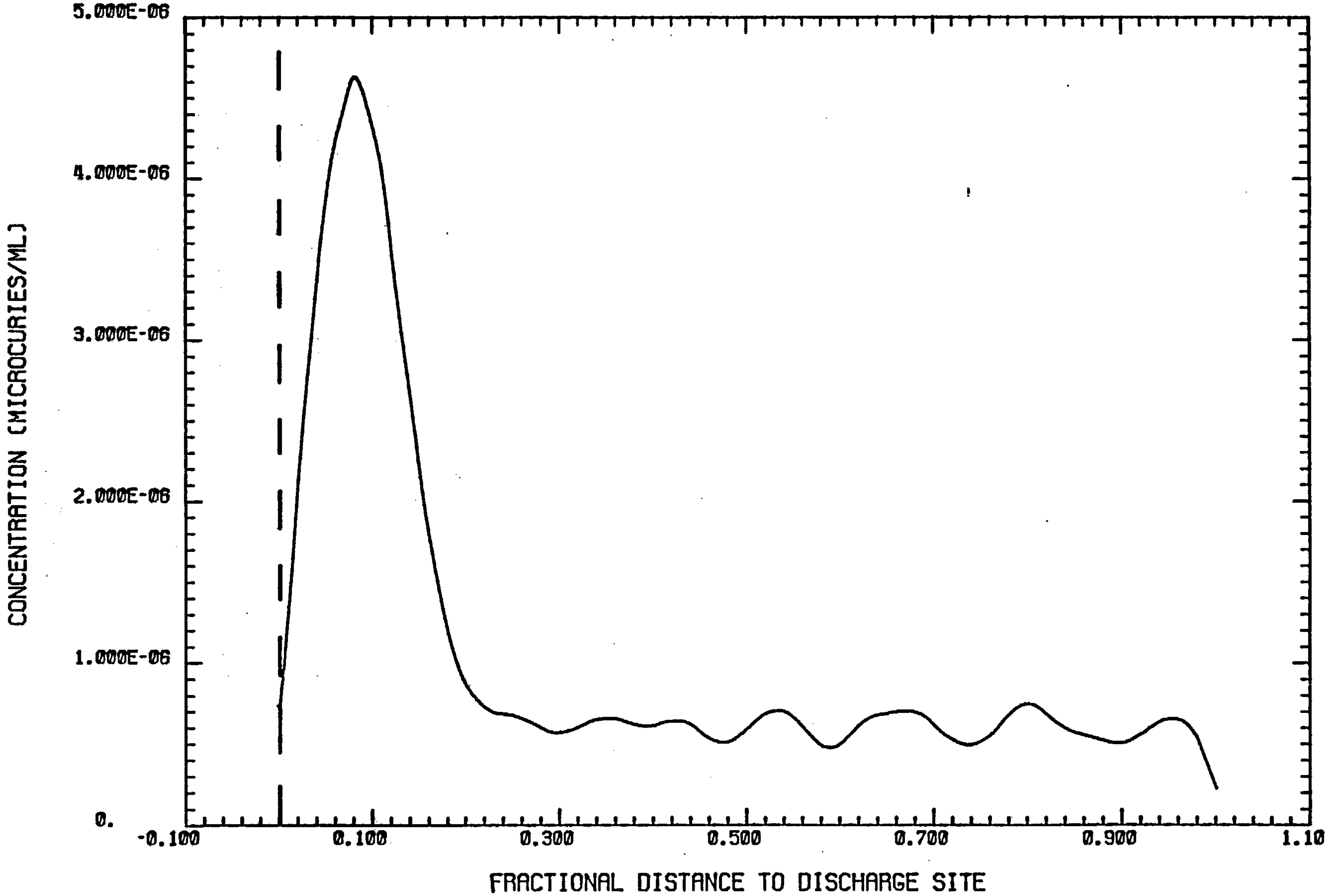


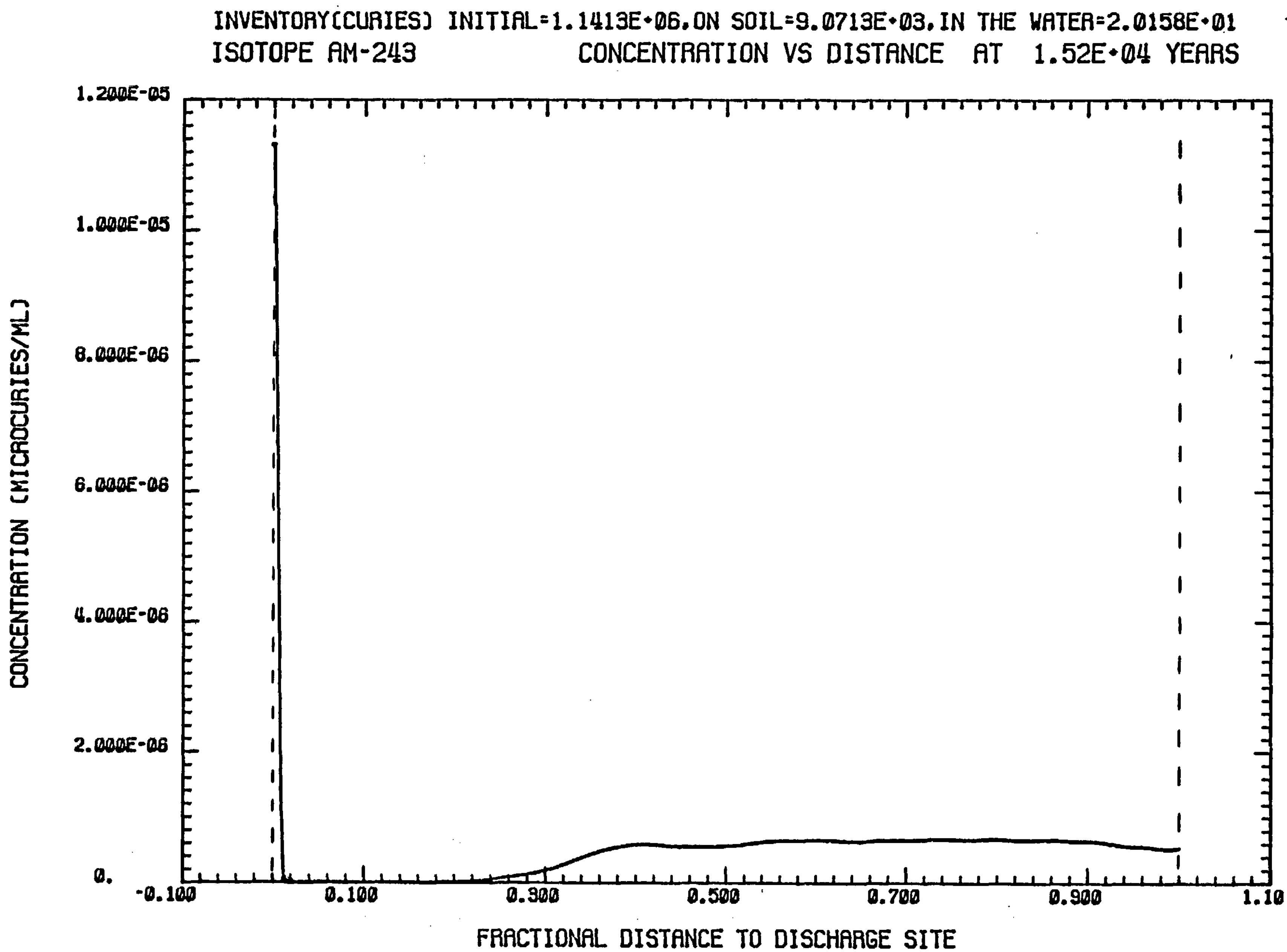
INVENTORY(CURIES) INITIAL=2.8031E+01,ON SOIL=1.3513E+03,IN THE WATER=1.5015E+02
ISOTOPE U-233
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
CONCENTRATION (MICROCURIES/ML)
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE


INVENTORY(CURIES) INITIAL=2.8031E+01,ON SOIL=6.5543E+02,IN THE WATER=7.2825E+01
ISOTOPE U-233
CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS
CONCENTRATION (MICROCURIES/ML)
2.100E-06
2.000E-06
1.900E-06
1.800E-06
1.700E-06
1.600E-06
1.500E-06
1.400E-06
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE


INVENTORY(CURIES) INITIAL=3.9370E+00,ON SOIL=2.5782E+03,IN THE WATER=2.8647E+01
ISOTOPE RA-226
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
CONCENTRATION (MICROCURIES/ML)
7.000E-06
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE

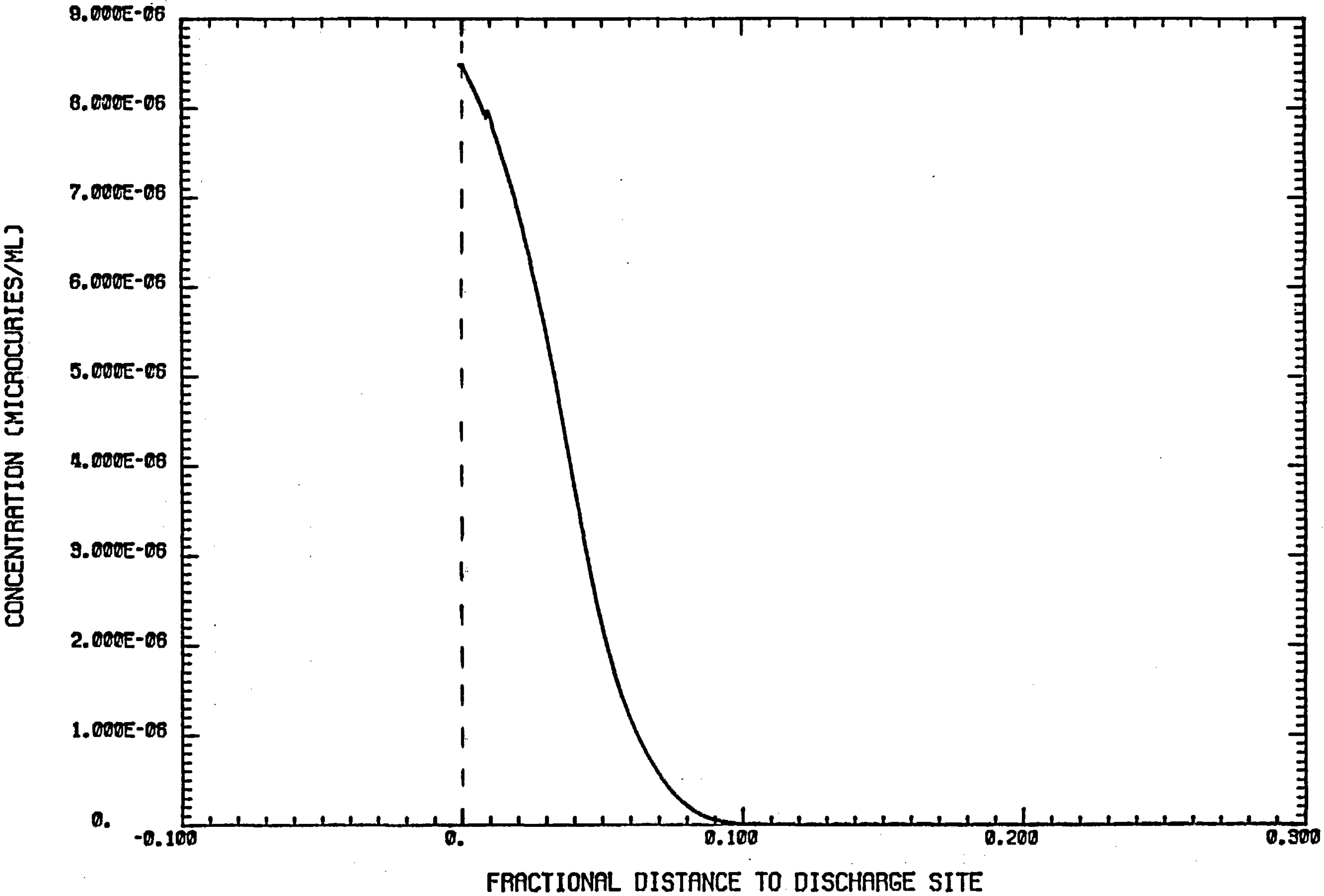
INVENTORY(CURIES) INITIAL=3.9370E+00,ON SOIL=3.9342E+03,IN THE WATER=4.3713E+01
ISOTOPE RA-226 CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS

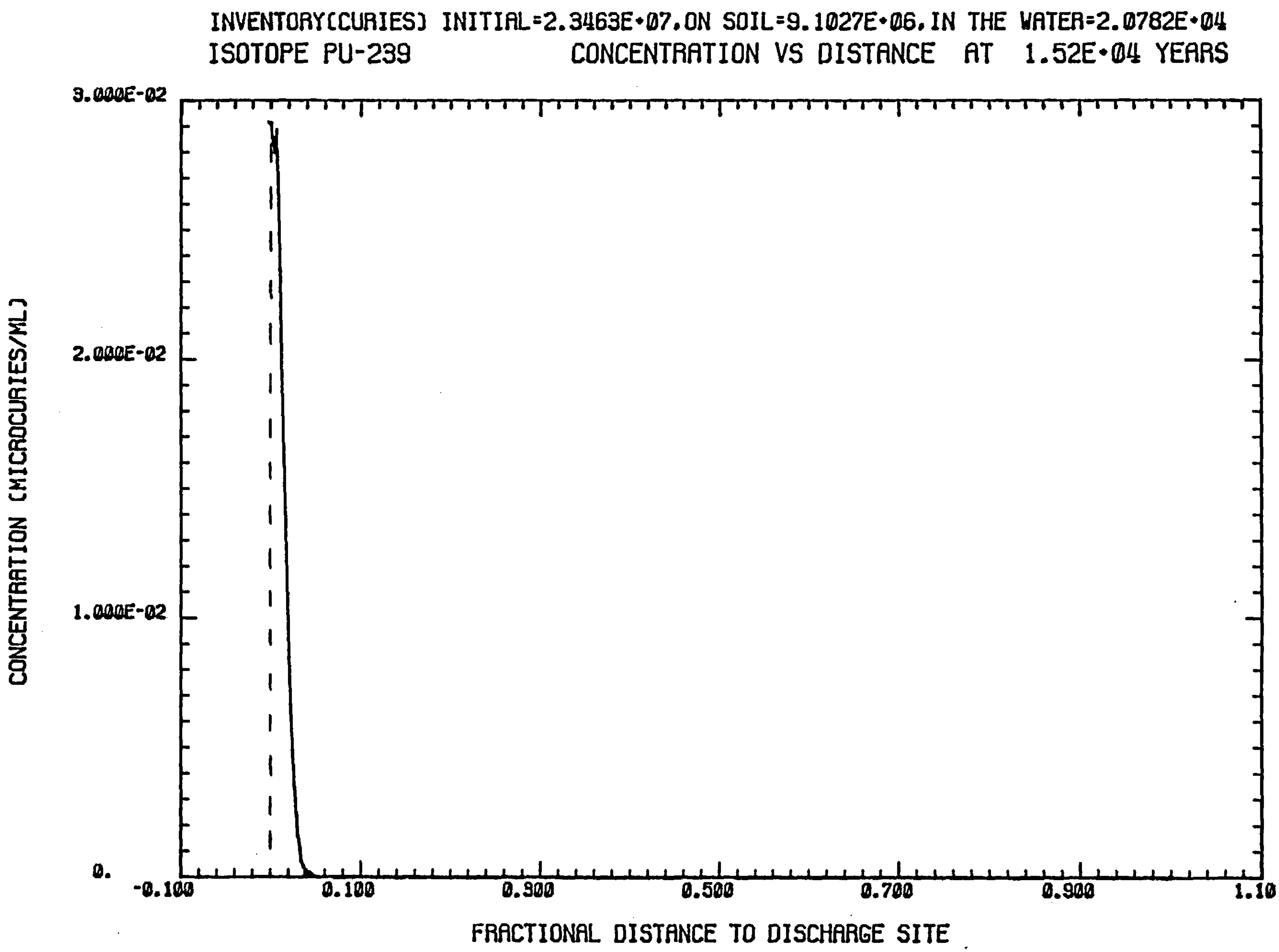




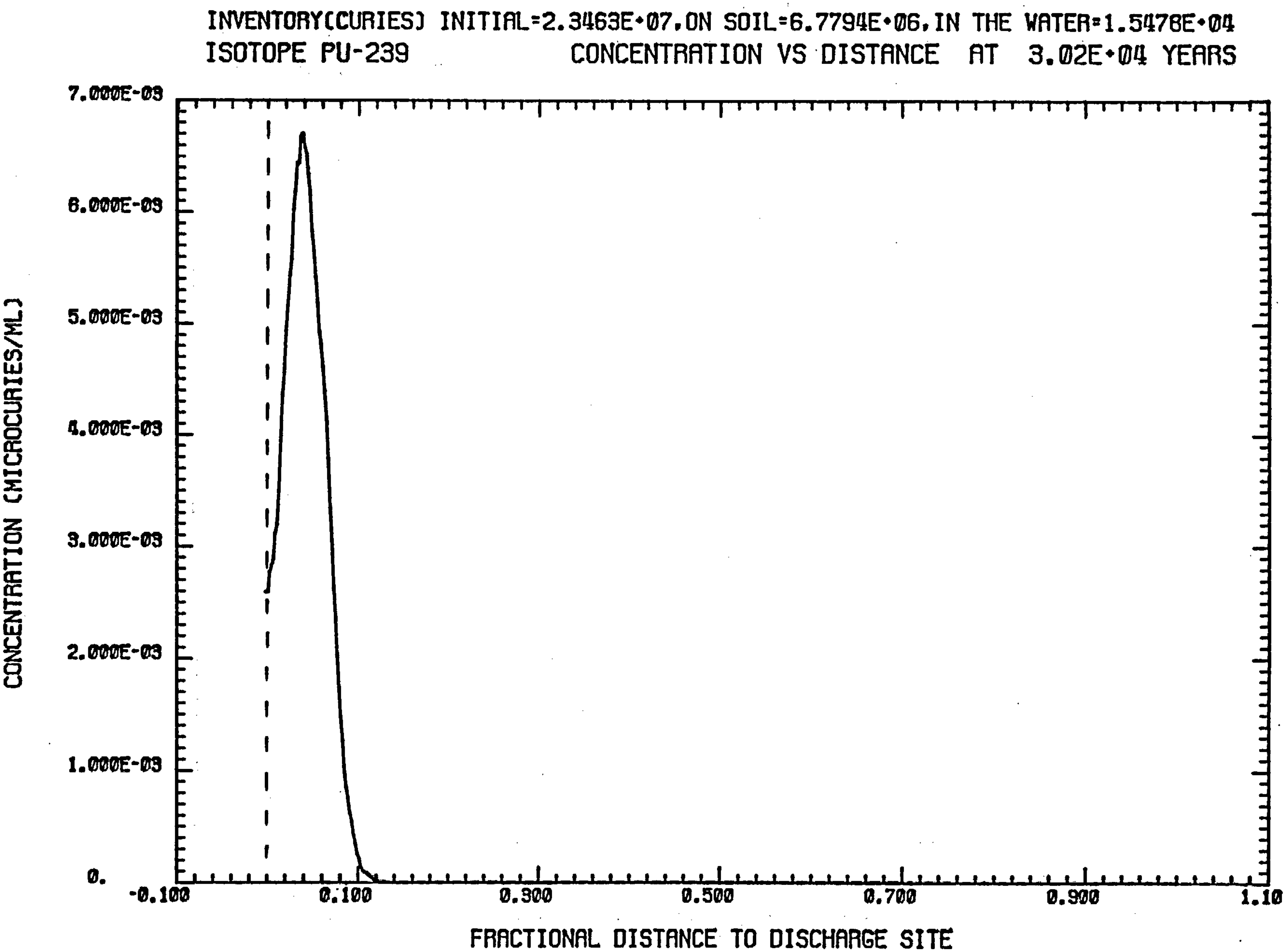
INVENTORY(CURIES) INITIAL=1.1413E+06,ON SOIL=9.0713E+03,IN THE WATER=2.0158E+01
ISOTOPE AM-243
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
CONCENTRATION (MICROCURIES/ML)
1.200E-05
1.000E-05
8.000E-06
6.000E-06
4.000E-06
2.000E-06
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE

INVENTORY(CURIES) INITIAL=1.1413E+06,ON SOIL=5.8805E+03,IN THE WATER=1.3068E+01
ISOTOPE AM-243 CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS

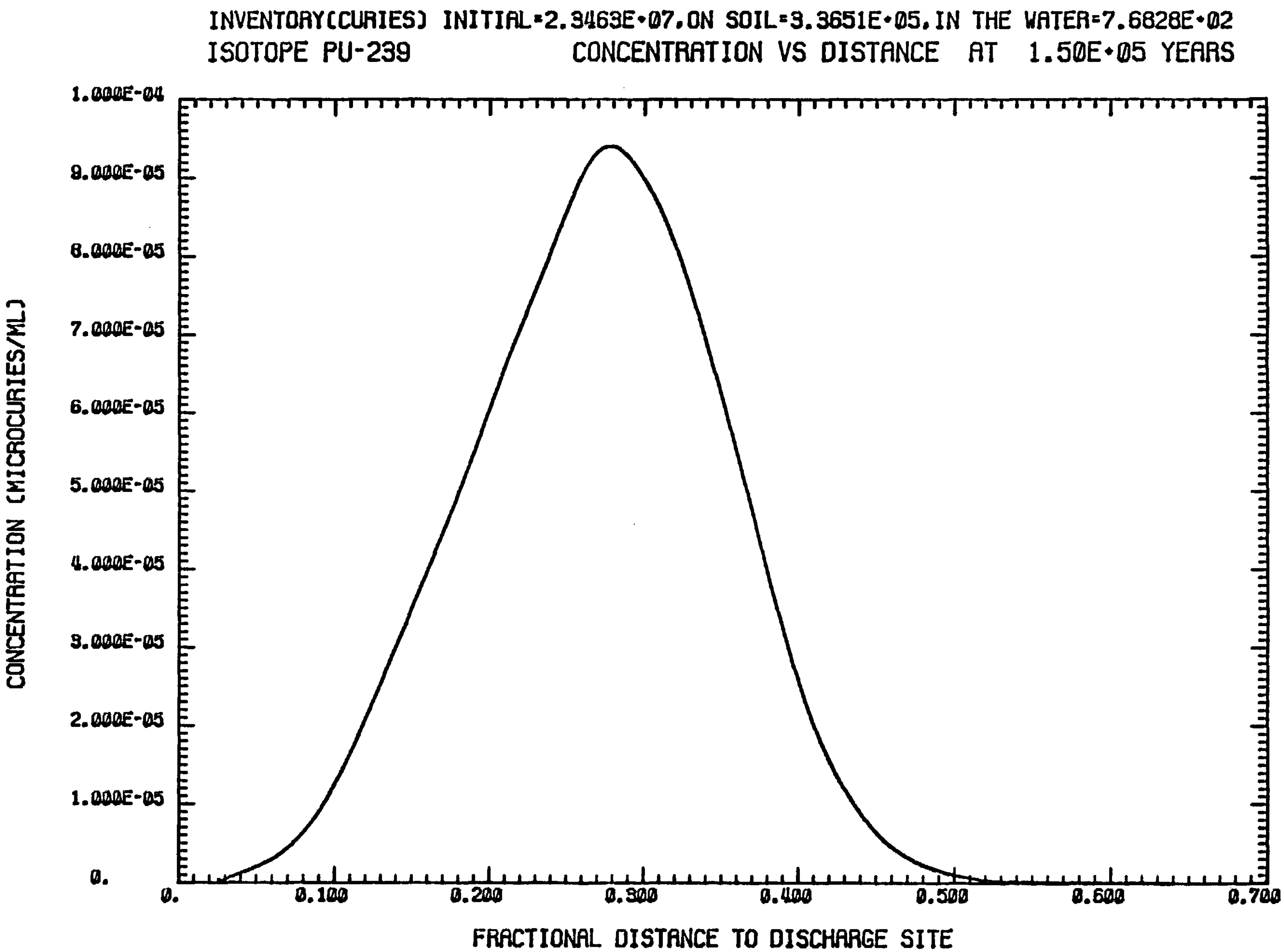


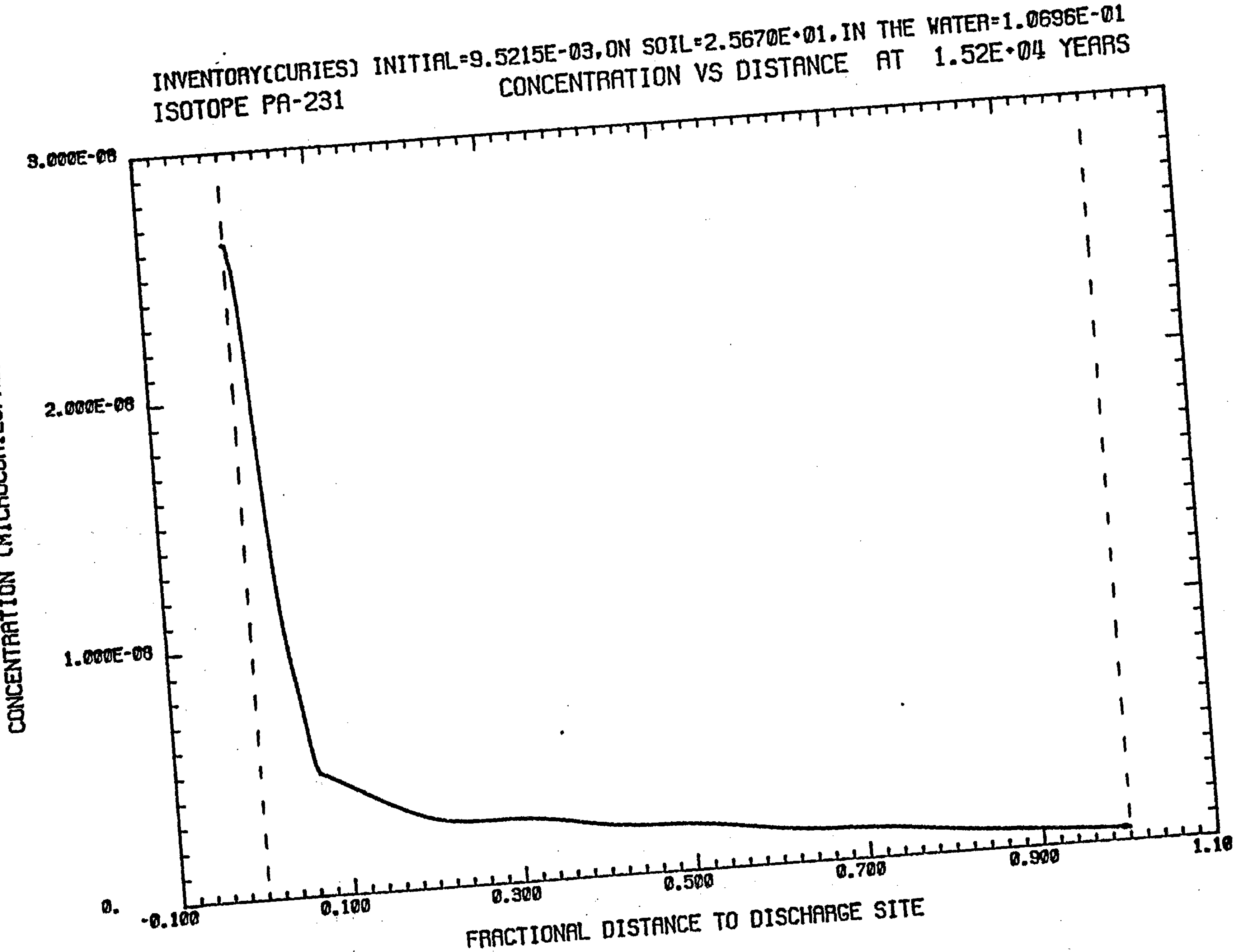


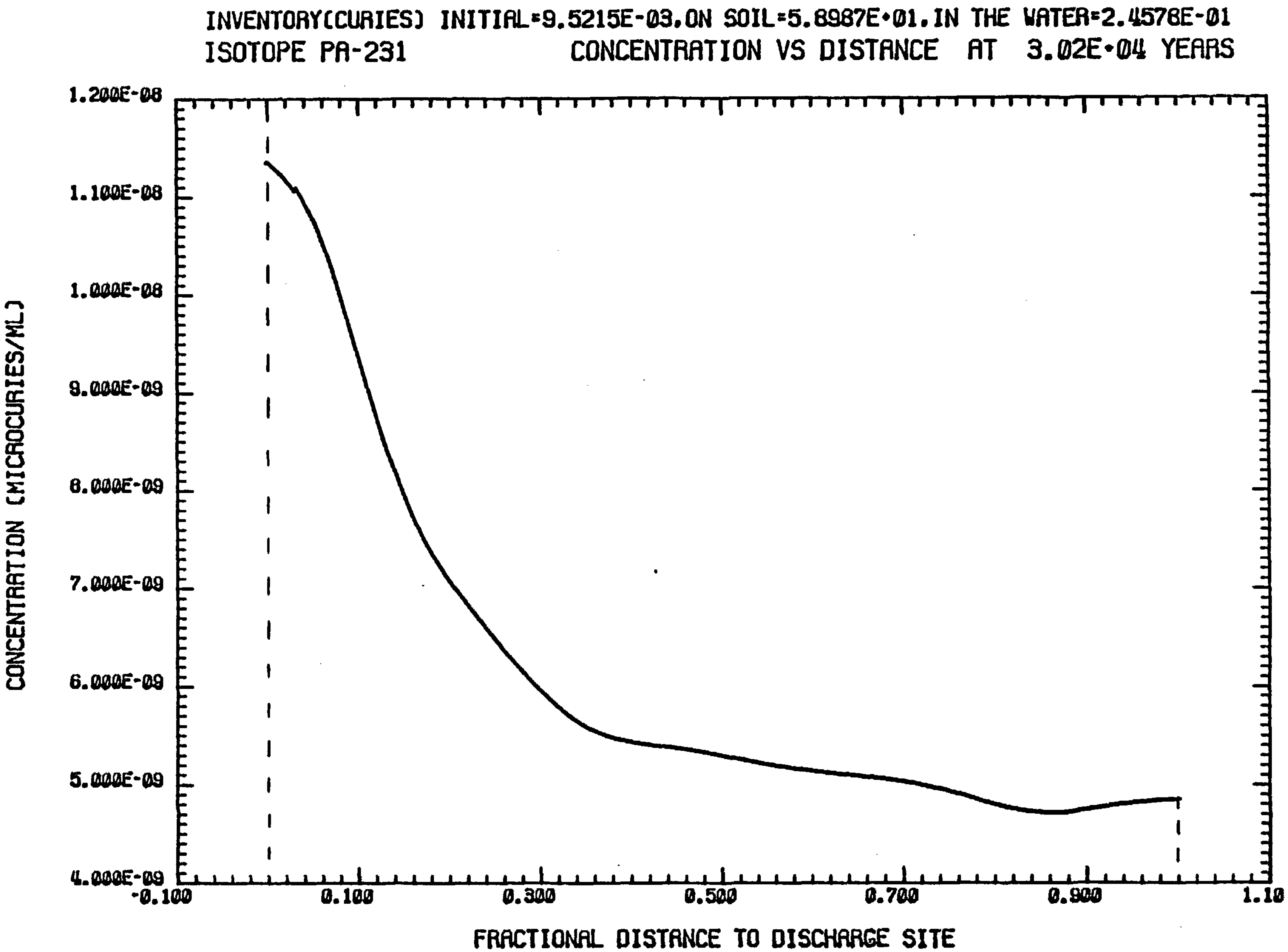
INVENTORY(CURIES) INITIAL=2.3463E+07,ON SOIL=9.1027E+06,IN THE WATER=2.0782E+04
ISOTOPE PU-239
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
3.000E-02
2.000E-02
1.000E-02
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE
CONCENTRATION (MICROCURIES/ML)

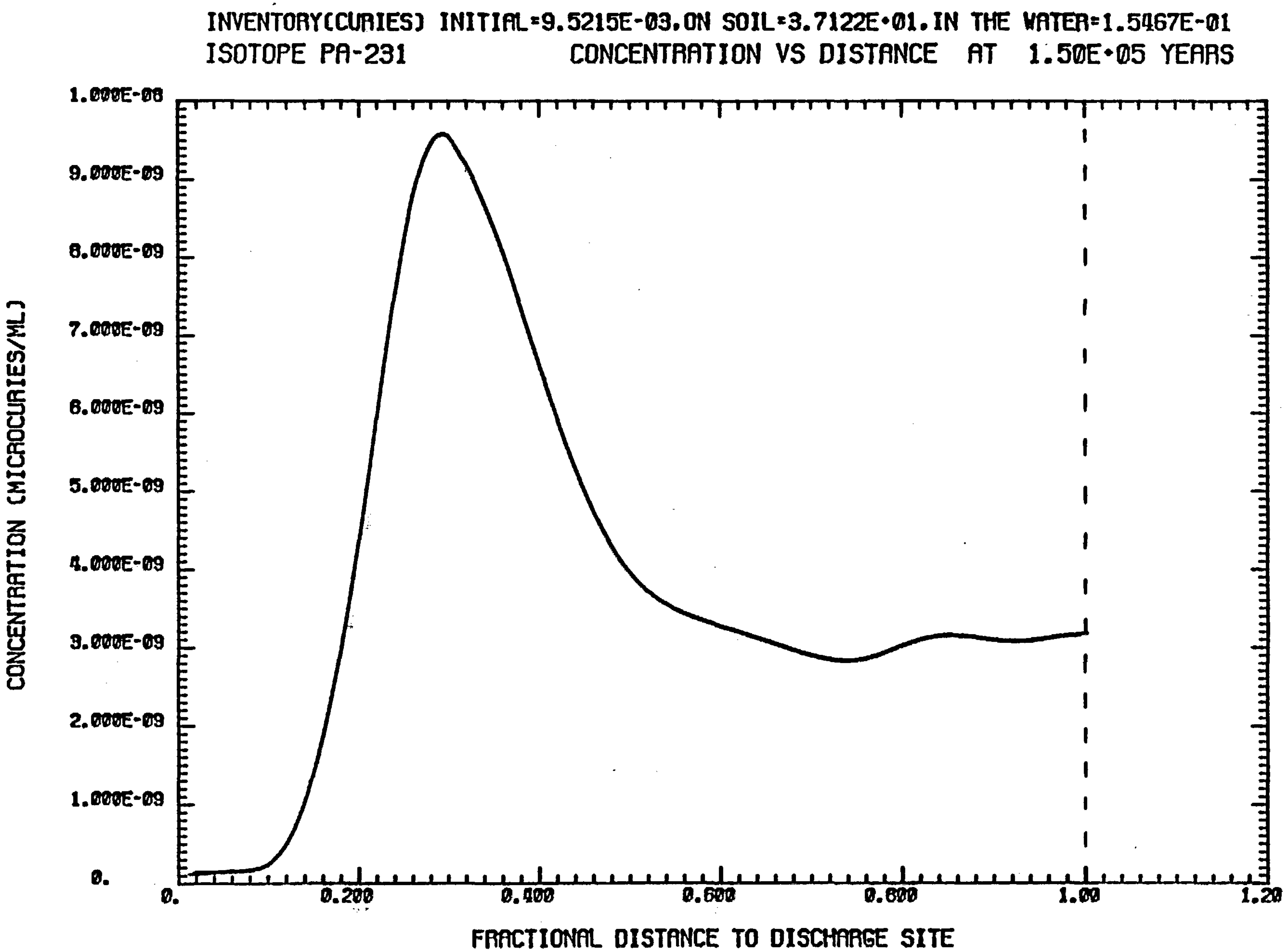

INVENTORY(CURIES) INITIAL=2.3463E+07,ON SOIL=6.7794E+06,IN THE WATER=1.5478E+04
ISOTOPE PU-239
CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS
7.000E-03
6.000E-03
5.000E-03
4.000E-03
3.000E-03
2.000E-03
1.000E-03
0.
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE
CONCENTRATION (MICROCURIES/ML)

G.125

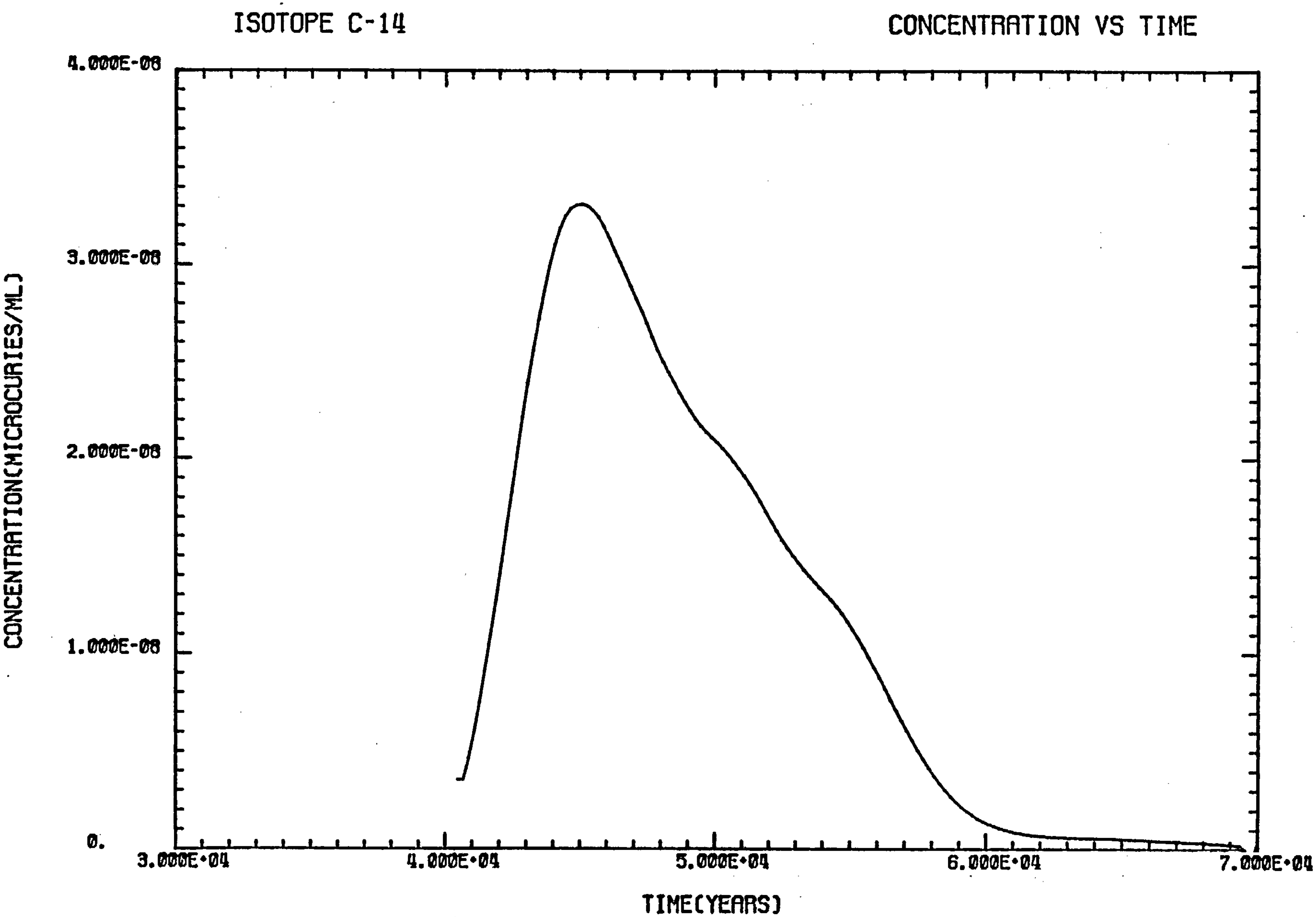

INVENTORY(CURIES) INITIAL=2.3463E+07,ON SOIL=3.3651E+05,IN THE WATER=7.6828E+02
ISOTOPE PU-239 CONCENTRATION VS DISTANCE AT 1.50E+05 YEARS
CONCENTRATION (MICROCURIES/ML)
1.000E-04
9.000E-05
8.000E-05
7.000E-05
6.000E-05
5.000E-05
4.000E-05
3.000E-05
2.000E-05
1.000E-05
0.
0.
0.100
0.200
0.300
0.400
0.500
0.600
0.700
FRACTIONAL DISTANCE TO DISCHARGE SITE


INVENTORY(CURIES) INITIAL=9.5215E-03,ON SOIL=2.5670E+01,IN THE WATER=1.0696E-01
ISOTOPE PA-231
CONCENTRATION VS DISTANCE AT 1.52E+04 YEARS
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION (MICROCURIES/ML)
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE

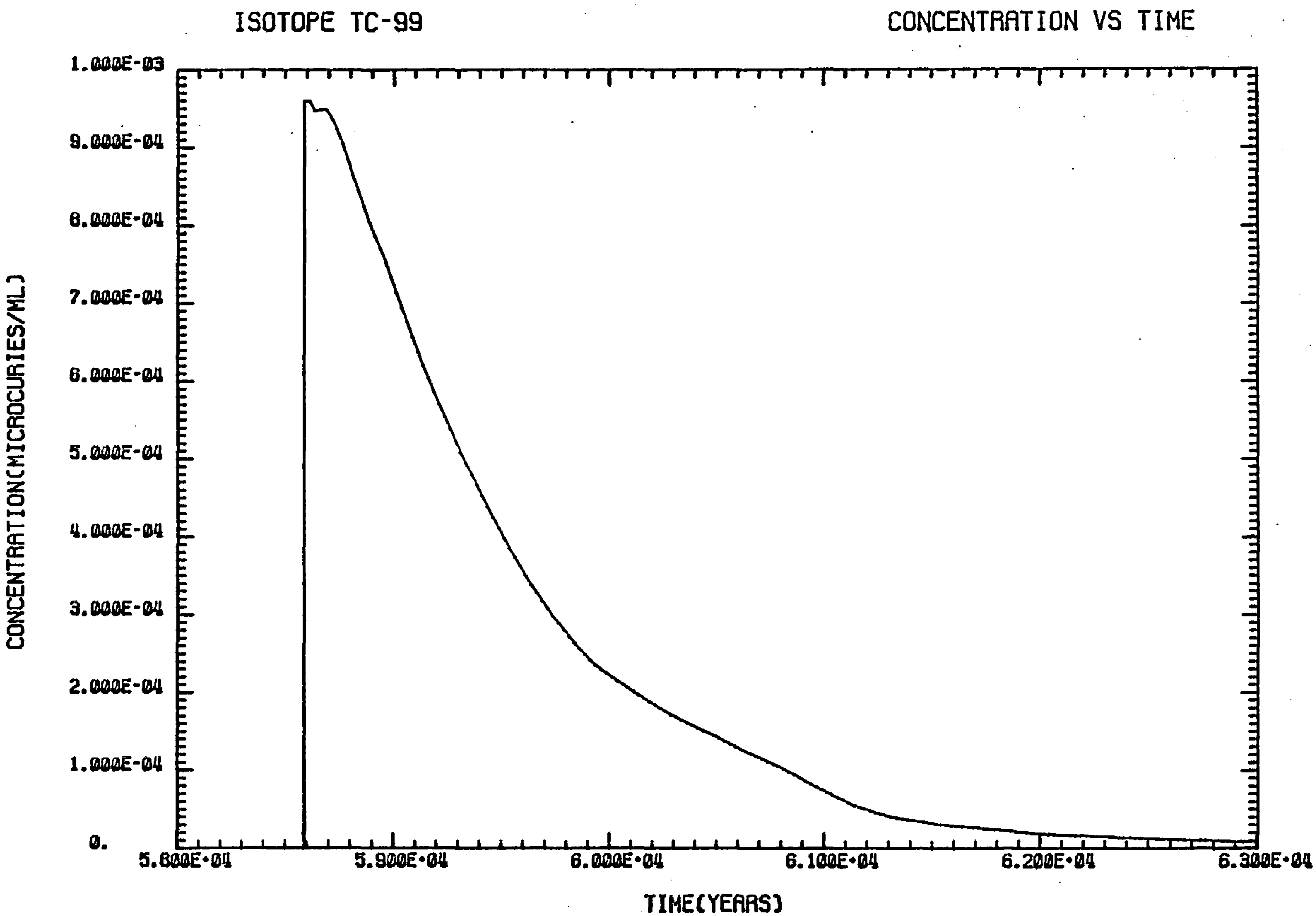

INVENTORY(CURIES) INITIAL=9.5215E-03,ON SOIL=5.8987E+01,IN THE WATER=2.4578E-01
ISOTOPE PA-231
CONCENTRATION VS DISTANCE AT 3.02E+04 YEARS
CONCENTRATION (MICROCURIES/ML)
1.200E-08
1.100E-08
1.000E-08
9.000E-09
8.000E-09
7.000E-09
6.000E-09
5.000E-09
4.000E-09
-0.100
0.100
0.300
0.500
0.700
0.900
1.10
FRACTIONAL DISTANCE TO DISCHARGE SITE


INVENTORY(CURIES) INITIAL=9.5215E-03,ON SOIL=3.7122E+01,IN THE WATER=1.5467E-01
ISOTOPE PA-231
CONCENTRATION VS DISTANCE AT 1.50E+05 YEARS
CONCENTRATION (MICROCURIES/ML)
1.000E-08
9.000E-09
8.000E-09
7.000E-09
6.000E-09
5.000E-09
4.000E-09
3.000E-09
2.000E-09
1.000E-09
0.
0.
0.200
0.400
0.600
0.800
1.00
1.20
FRACTIONAL DISTANCE TO DISCHARGE SITE

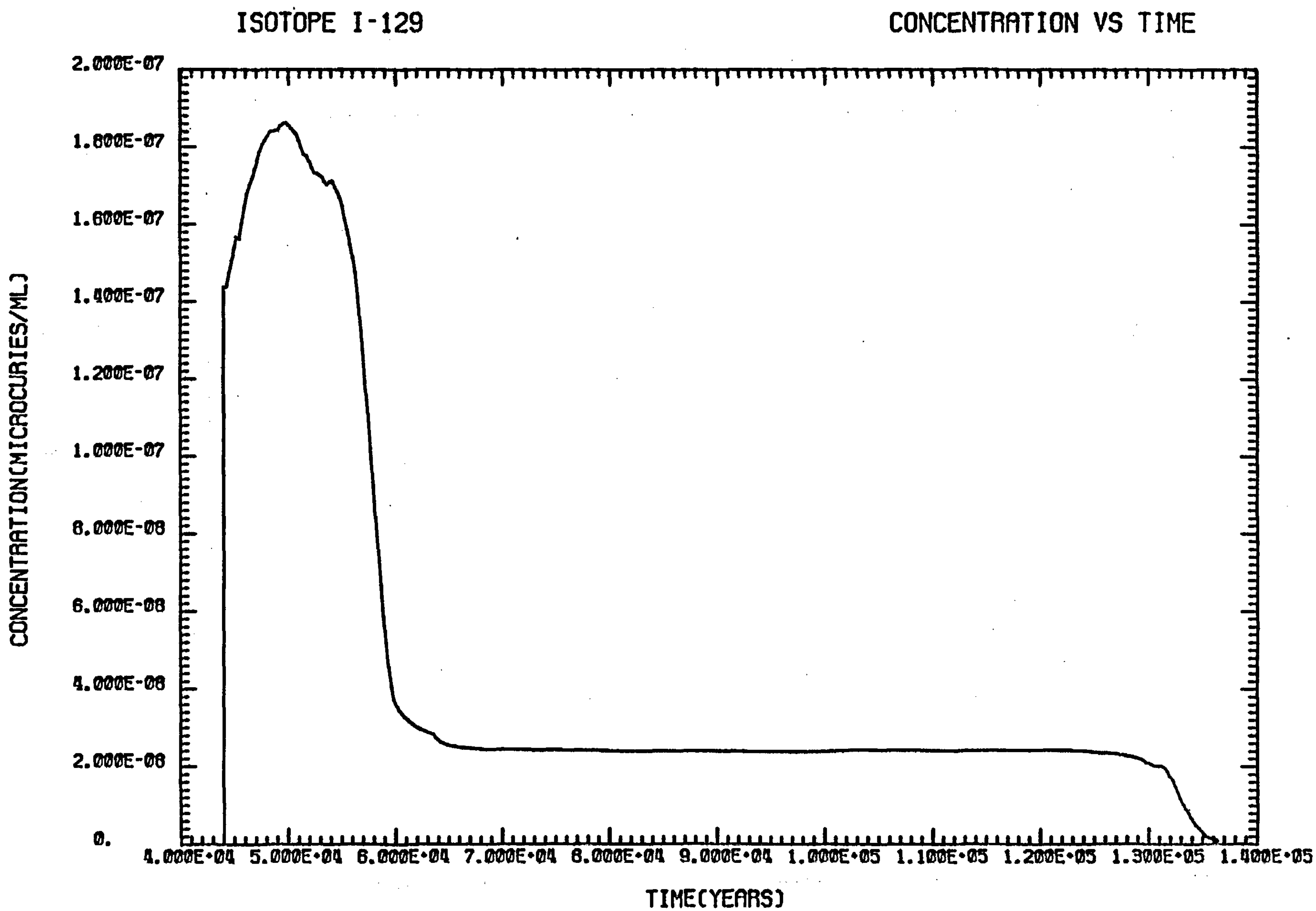
Scenario 4. Sabine River discharge of Scenario 2 with lower bound kd values. Simulation runs PIR5. (Concentration versus time)

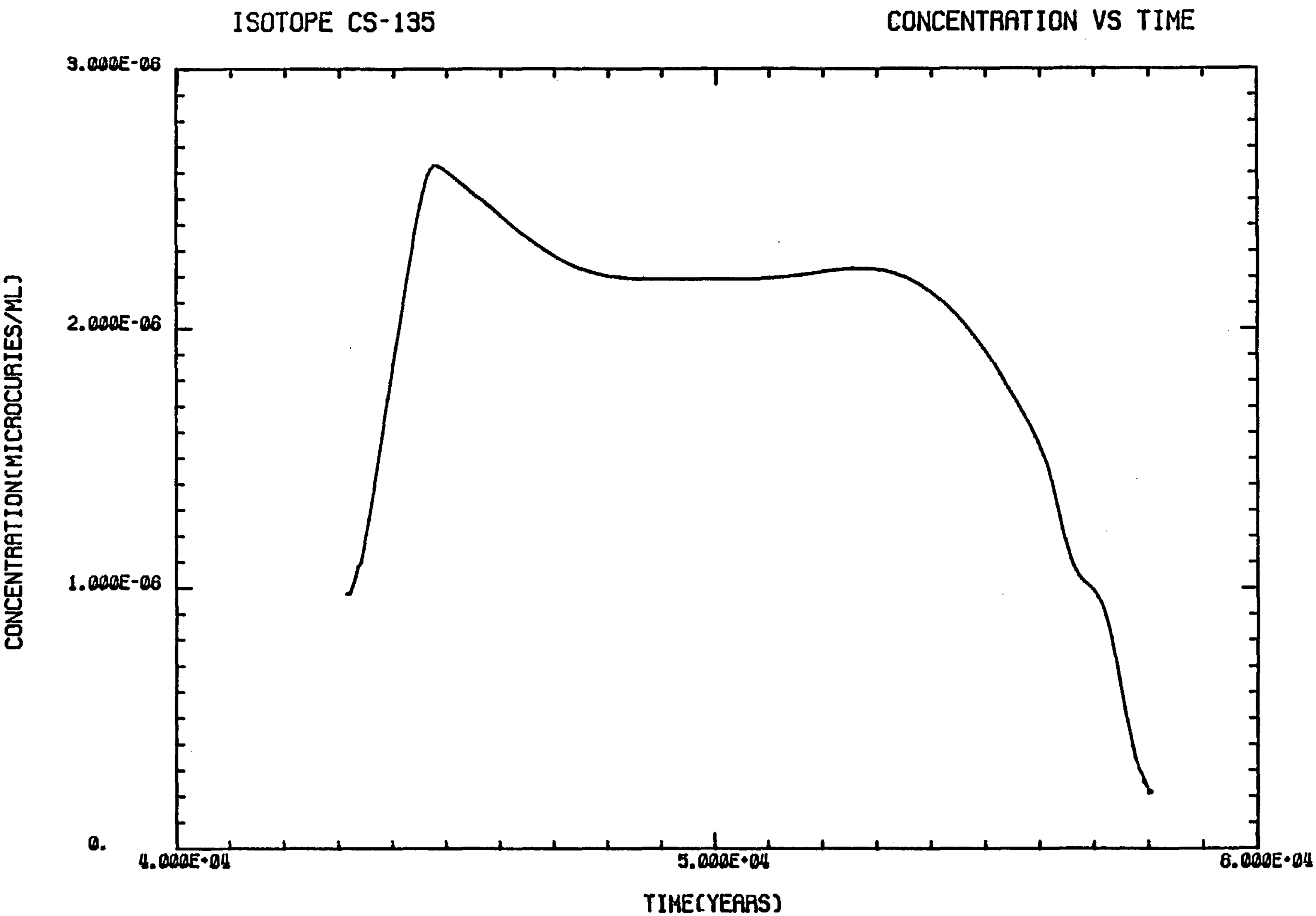


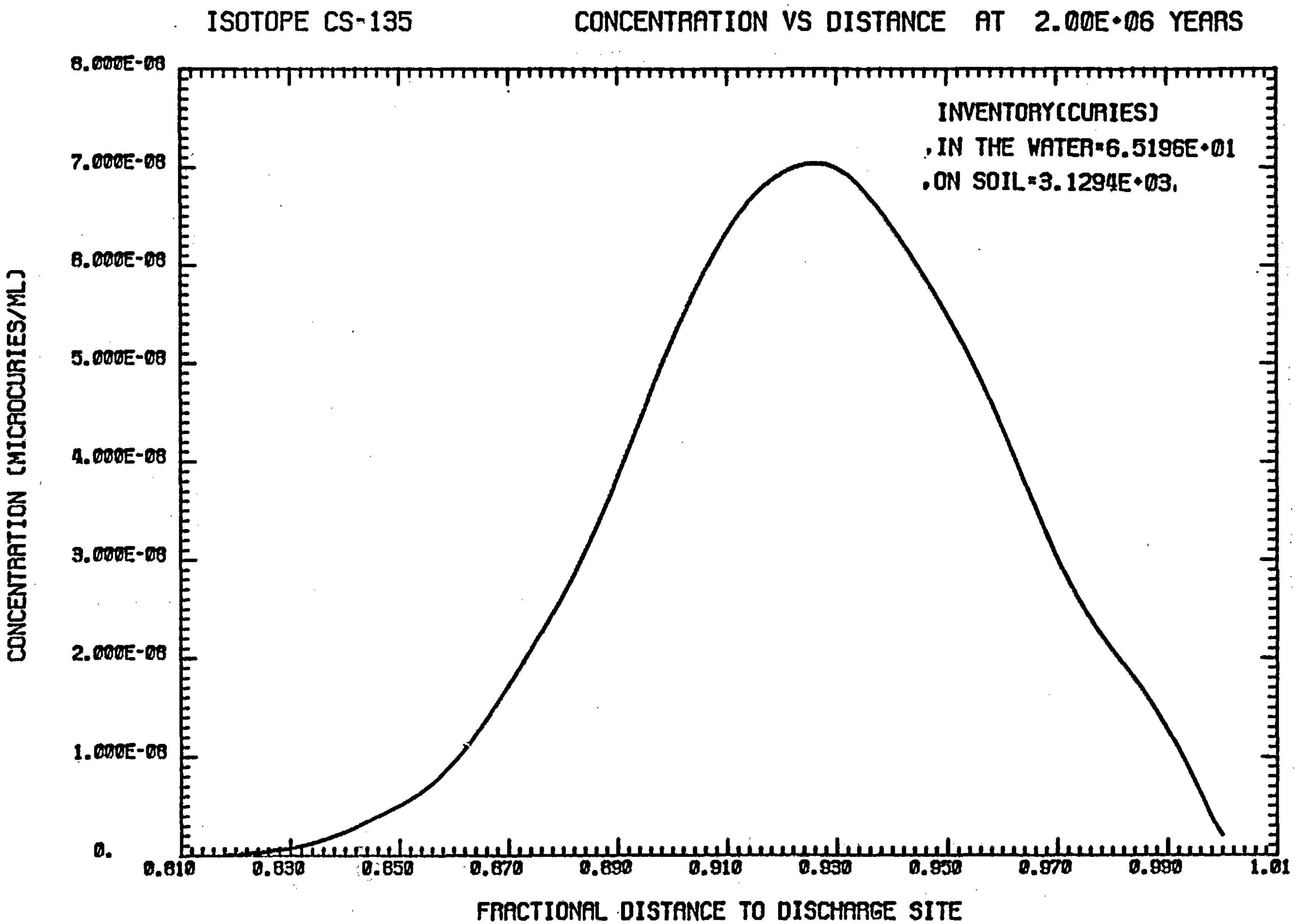
ISOTOPE C-14
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
3.000E+04
4.000E+04
5.000E+04
6.000E+04
7.000E+04
TIME(YEARS)



ISOTOPE TC-99
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.000E-03
9.000E-04
8.000E-04
7.000E-04
6.000E-04
5.000E-04
4.000E-04
3.000E-04
2.000E-04
1.000E-04
0.
5.800E+04
5.900E+04
6.000E+04
6.100E+04
6.200E+04
6.300E+04
TIME(YEARS)

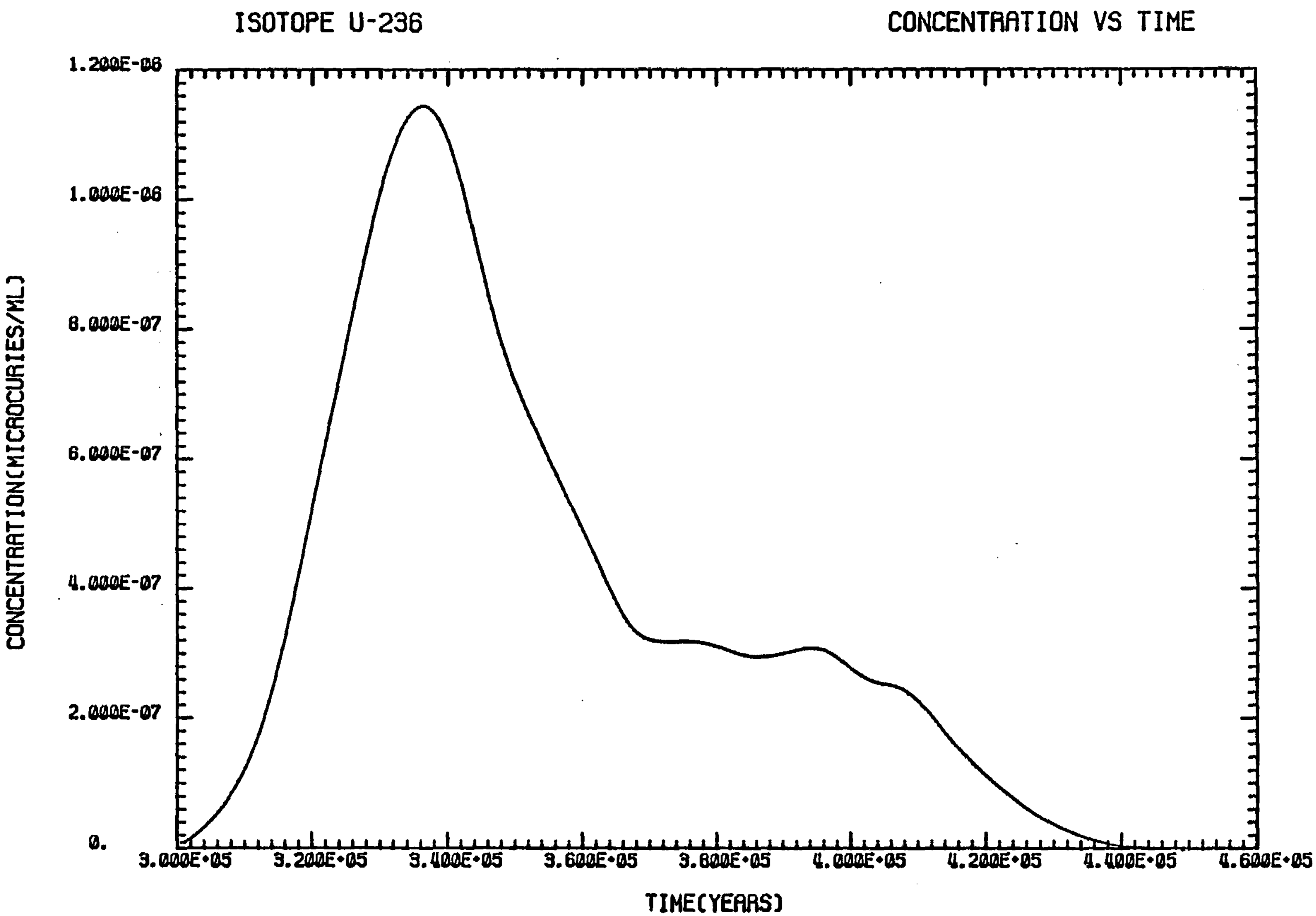

ISOTOPE I-129
CONCENTRATION VS TIME
2.000E-07
1.800E-07
1.600E-07
1.400E-07
1.200E-07
1.000E-07
8.000E-08
6.000E-08
4.000E-08
2.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
4.000E+04
5.000E+04
6.000E+04
7.000E+04
8.000E+04
9.000E+04
1.000E+05
1.100E+05
1.200E+05
1.300E+05
1.400E+05
TIME(YEARS)


ISOTOPE CS-135
CONCENTRATION VS TIME
3.000E-06
2.000E-06
1.000E-06
0.
4.000E+04
5.000E+04
6.000E+04
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

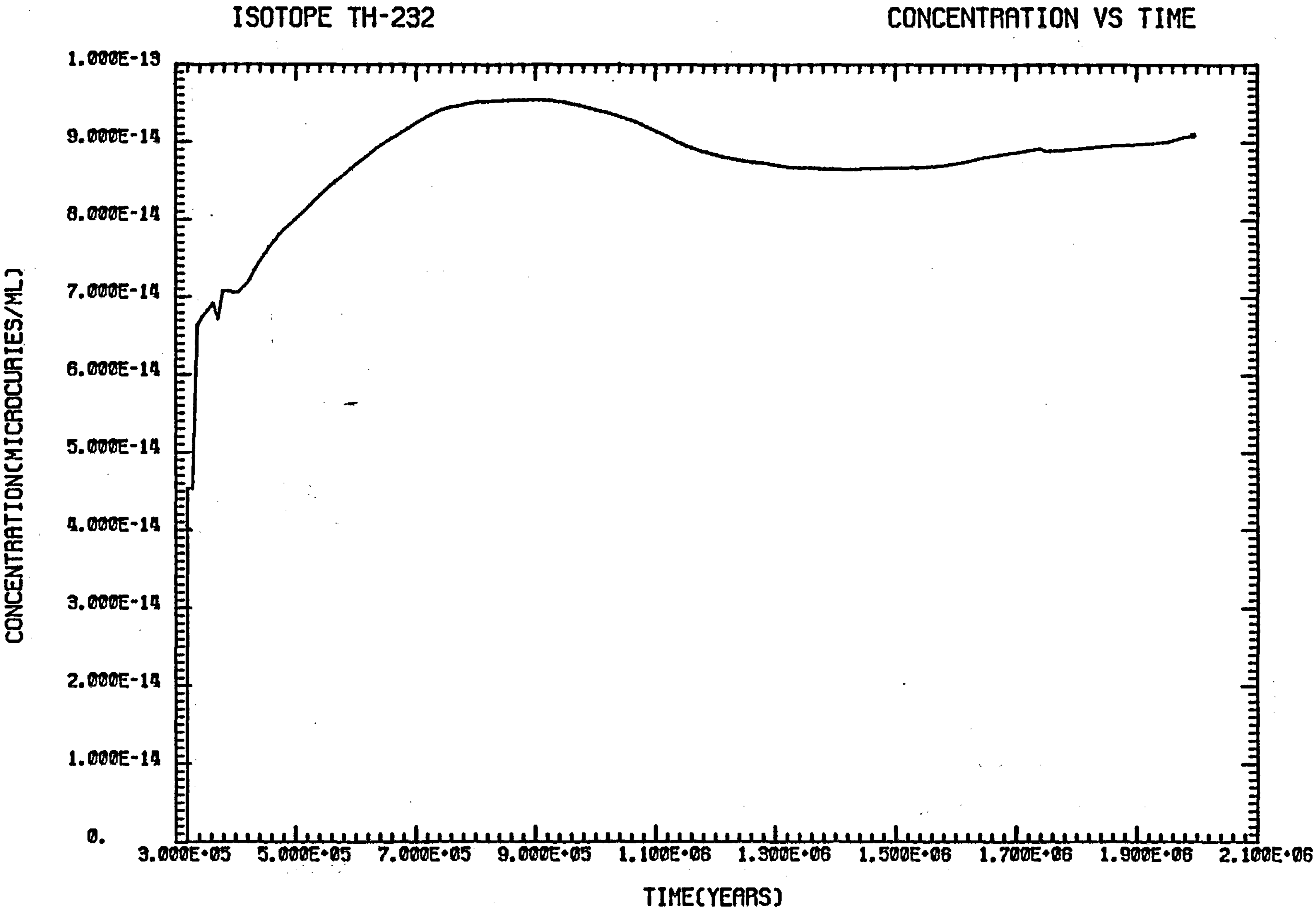


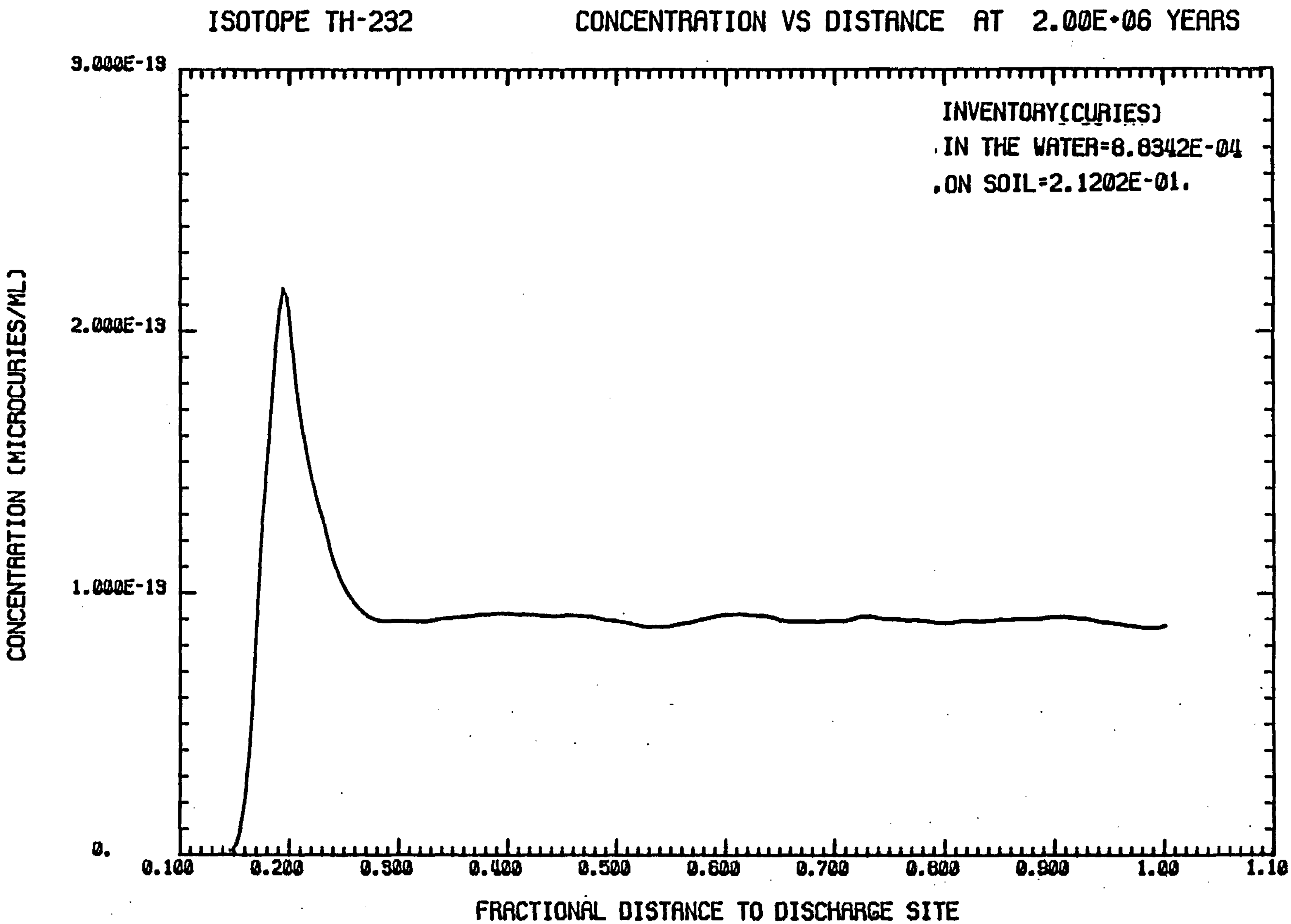
ISOTOPE CS-135
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
INVENTORY(CURIES)
,IN THE WATER=6.5196E+01
,ON SOIL=3.1294E+03,
8.000E-08
7.000E-08
6.000E-08
5.000E-08
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION (MICROCURIES/ML)
0.810
0.830
0.850
0.870
0.890
0.910
0.930
0.950
0.970
0.990
1.01
FRACTIONAL DISTANCE TO DISCHARGE SITE

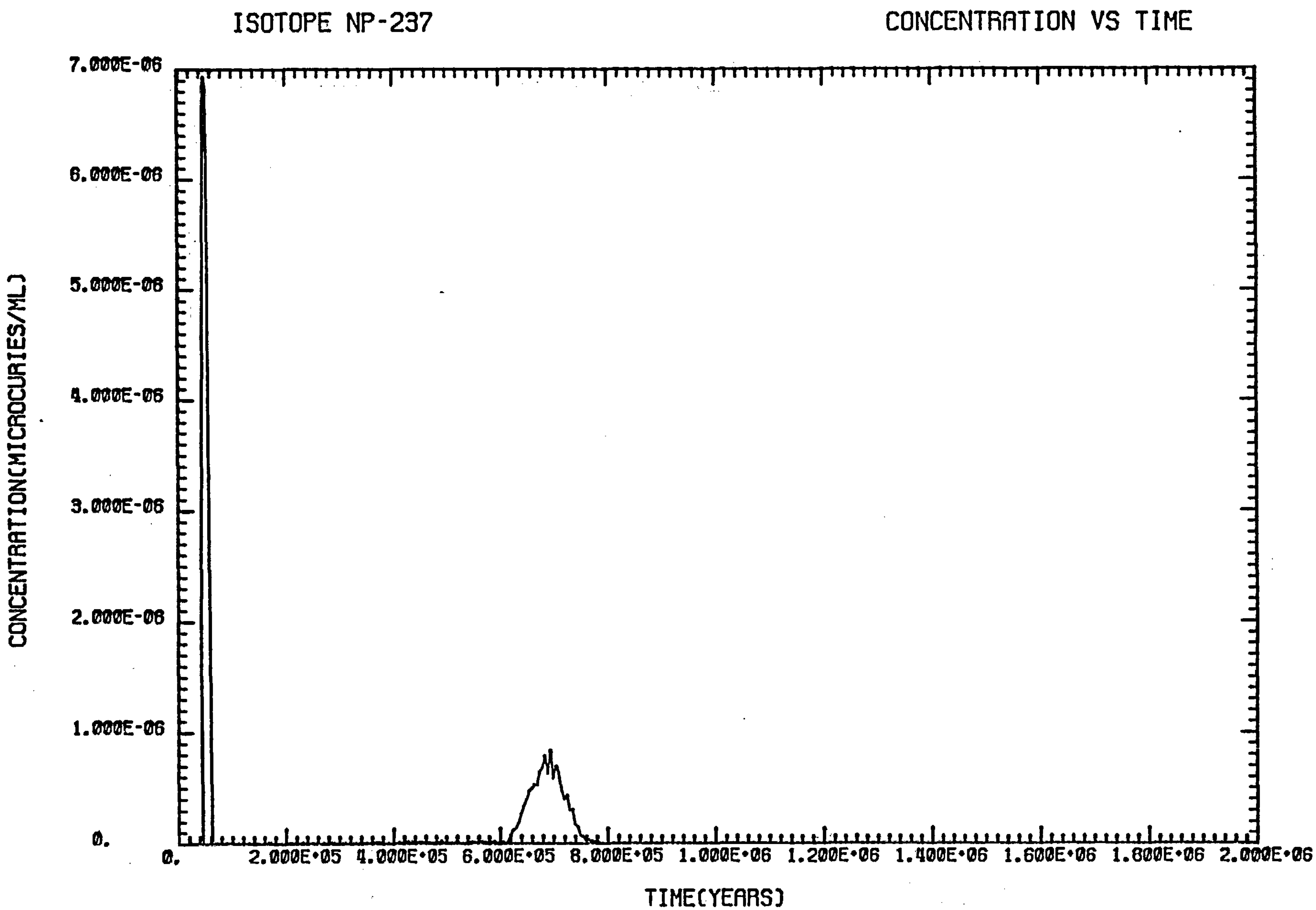
G.135

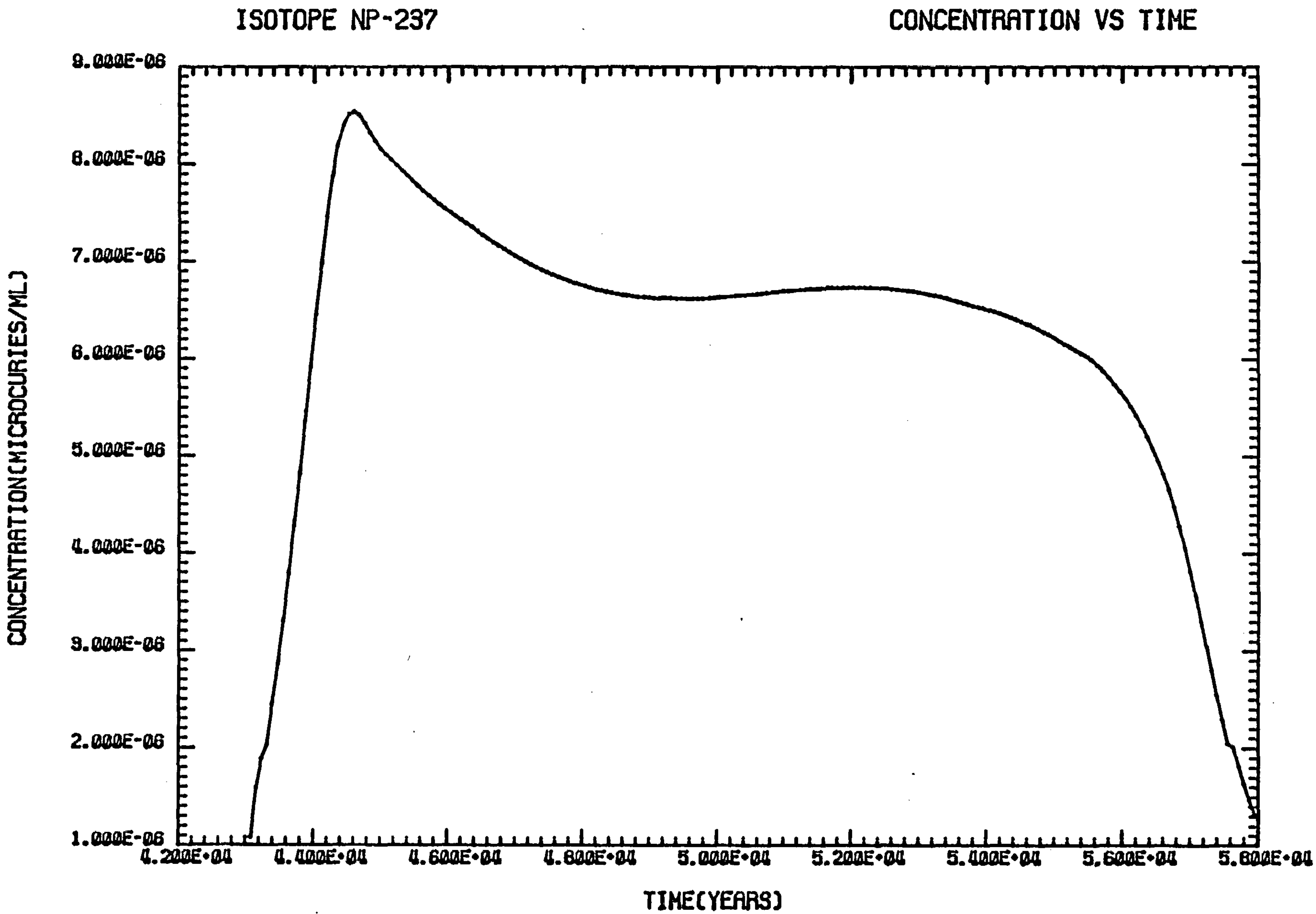

ISOTOPE U-236
CONCENTRATION VS TIME
1.200E-06
1.000E-06
8.000E-07
6.000E-07
4.000E-07
2.000E-07
0.
CONCENTRATION(MICROCURIES/ML)
3.000E+05
3.200E+05
3.400E+05
3.600E+05
3.800E+05
4.000E+05
4.200E+05
4.400E+05
4.600E+05
TIME(YEARS)

G.136

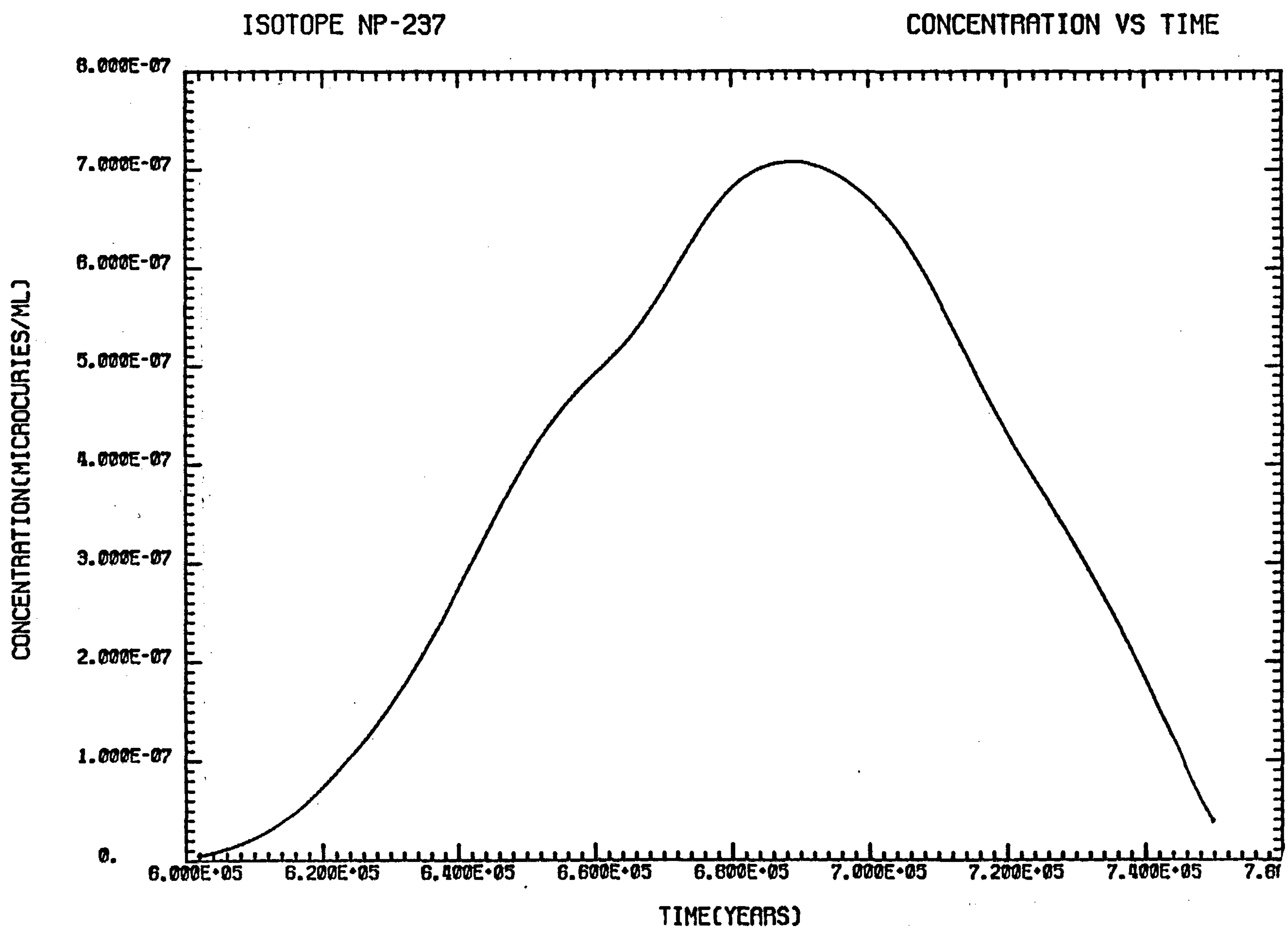

ISOTOPE TH-232
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.000E-13
9.000E-14
8.000E-14
7.000E-14
6.000E-14
5.000E-14
4.000E-14
3.000E-14
2.000E-14
1.000E-14
0.
3.000E+05
5.000E+05
7.000E+05
9.000E+05
1.100E+06
1.300E+06
1.500E+06
1.700E+06
1.900E+06
2.100E+06
TIME(YEARS)

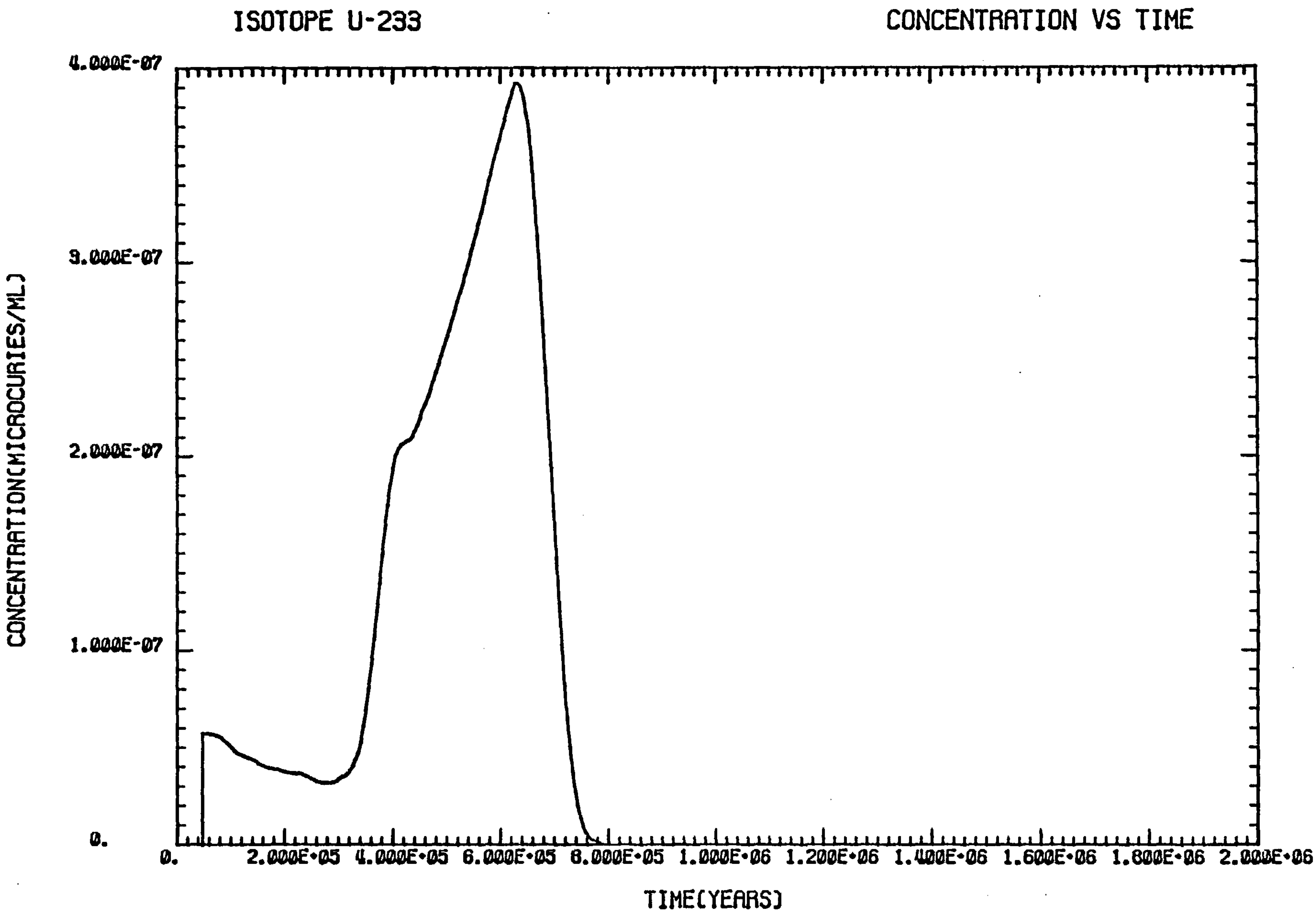

ISOTOPE TH-232
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
INVENTORY(CURIES)
IN THE WATER=8.8342E-04
ON SOIL=2.1202E-01
3.000E-13
2.000E-13
1.000E-13
0.
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.00
1.10
CONCENTRATION (MICROCURIES/ML)
FRACTIONAL DISTANCE TO DISCHARGE SITE


ISOTOPE NP-237
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
7.000E-06
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
0.
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
1.600E+06
1.800E+06
2.000E+06
TIME(YEARS)

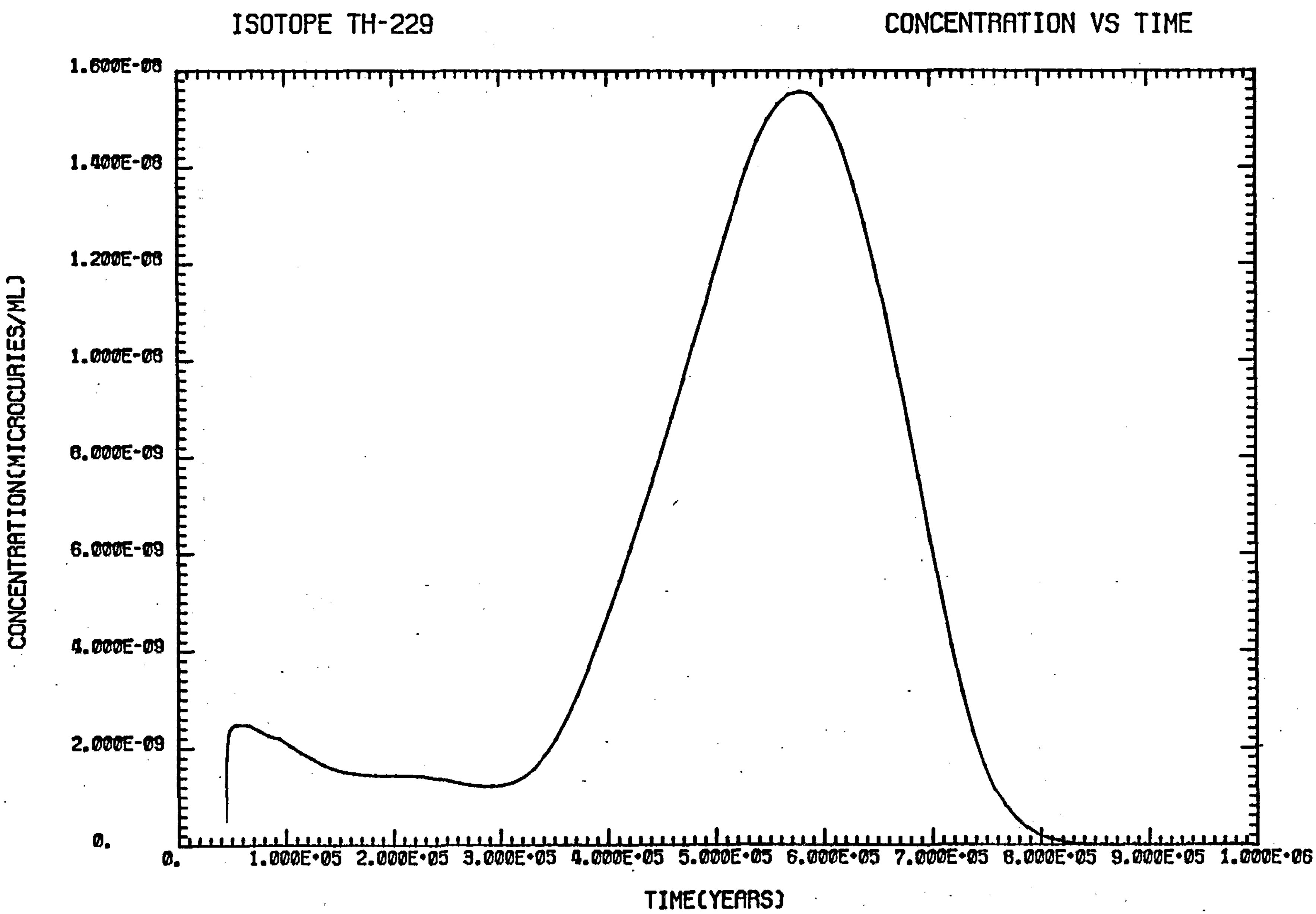

ISOTOPE NP-237
CONCENTRATION VS TIME
9.000E-06
8.000E-06
7.000E-06
6.000E-06
5.000E-06
4.000E-06
3.000E-06
2.000E-06
1.000E-06
CONCENTRATION(MICROCURIES/ML)
4.200E+04
4.400E+04
4.600E+04
4.800E+04
5.000E+04
5.200E+04
5.400E+04
5.600E+04
5.800E+04
TIME(YEARS)

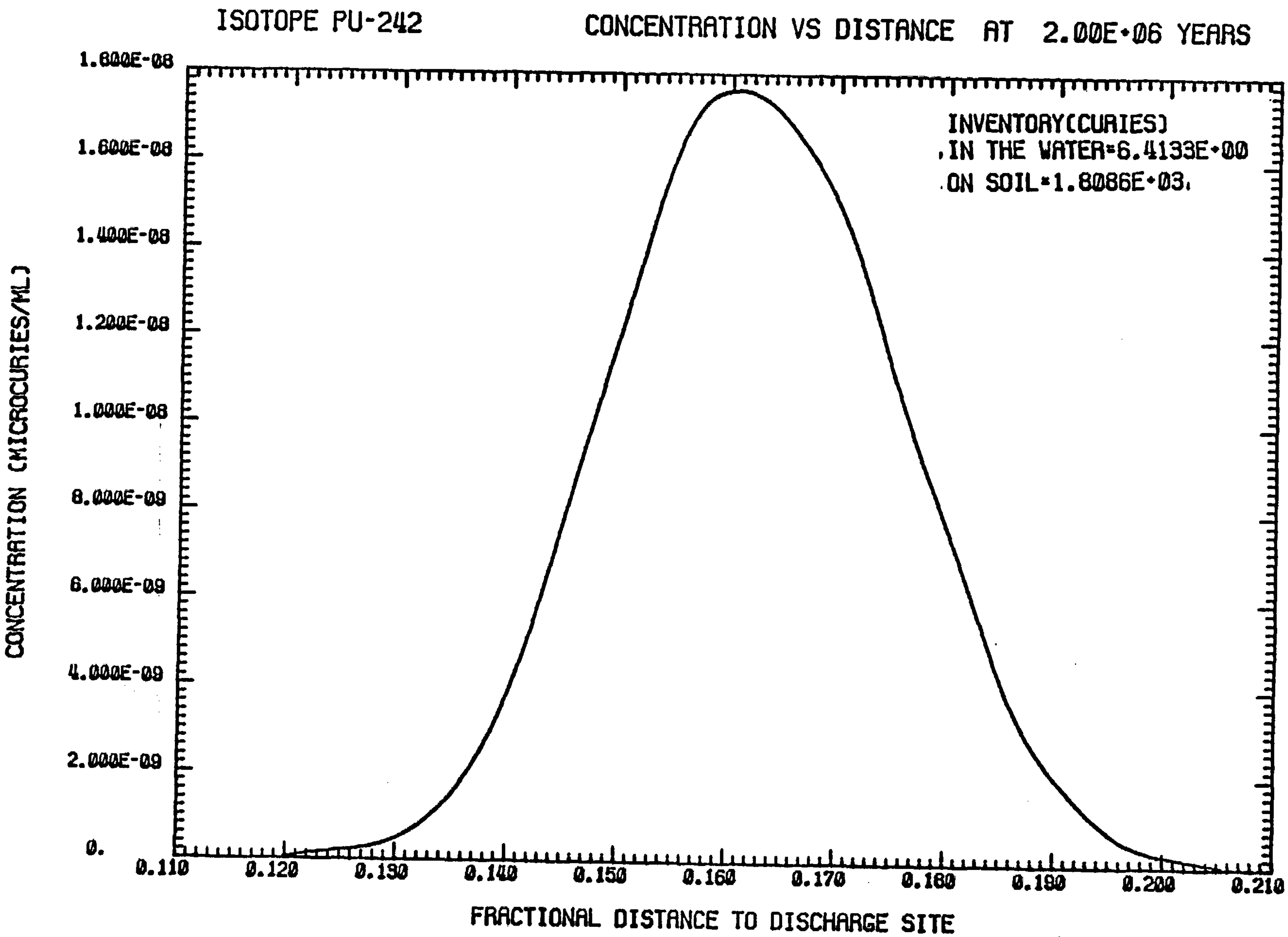
G.140


ISOTOPE NP-237
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
8.000E-07
7.000E-07
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
6.000E+05
6.200E+05
6.400E+05
6.600E+05
6.800E+05
7.000E+05
7.200E+05
7.400E+05
TIME(YEARS)

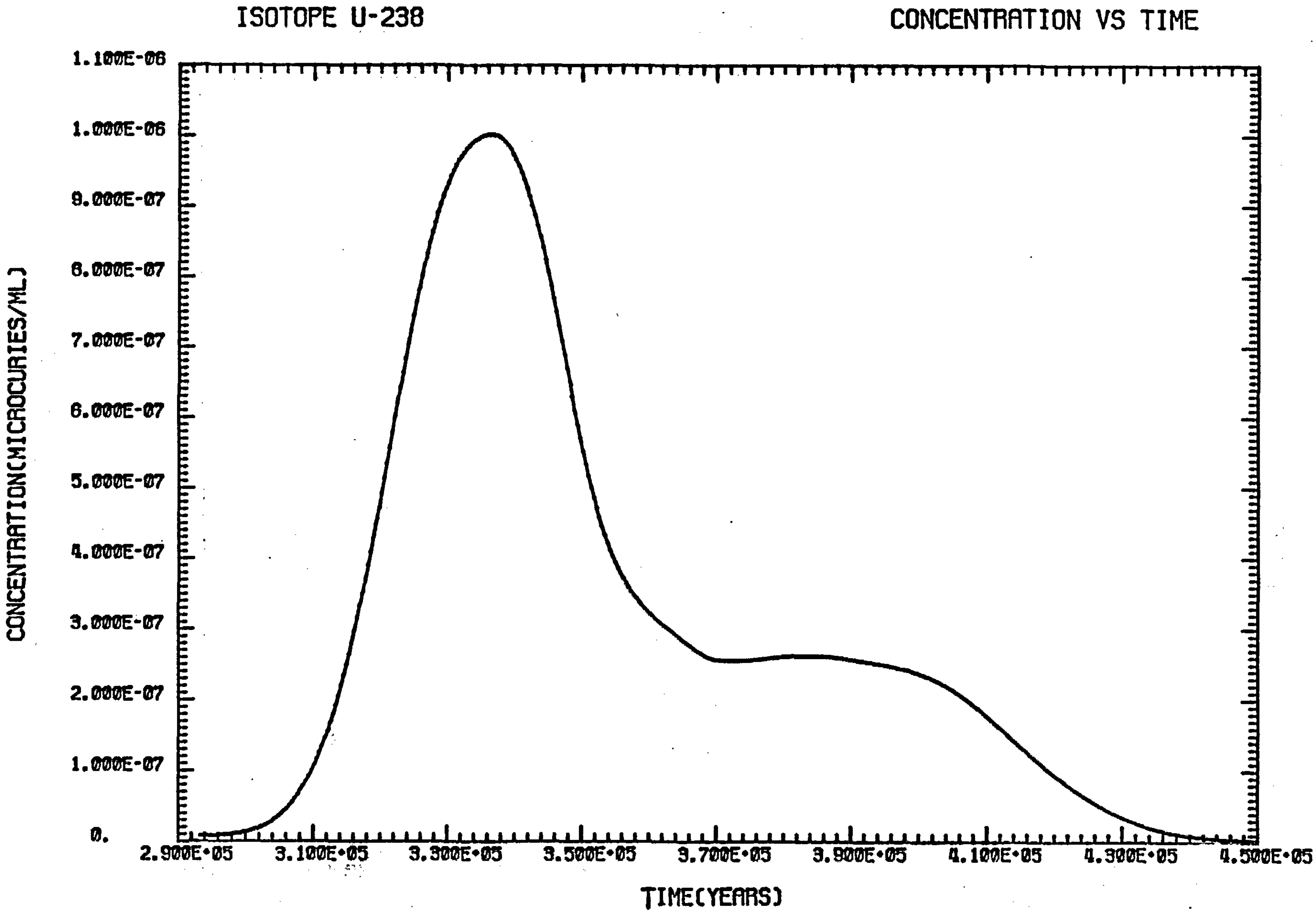


ISOTOPE U-233
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
0.
2.000E+05
4.000E+05
6.000E+05
8.000E+05
1.000E+06
1.200E+06
1.400E+06
1.600E+06
1.800E+06
2.000E+06
TIME(YEARS)

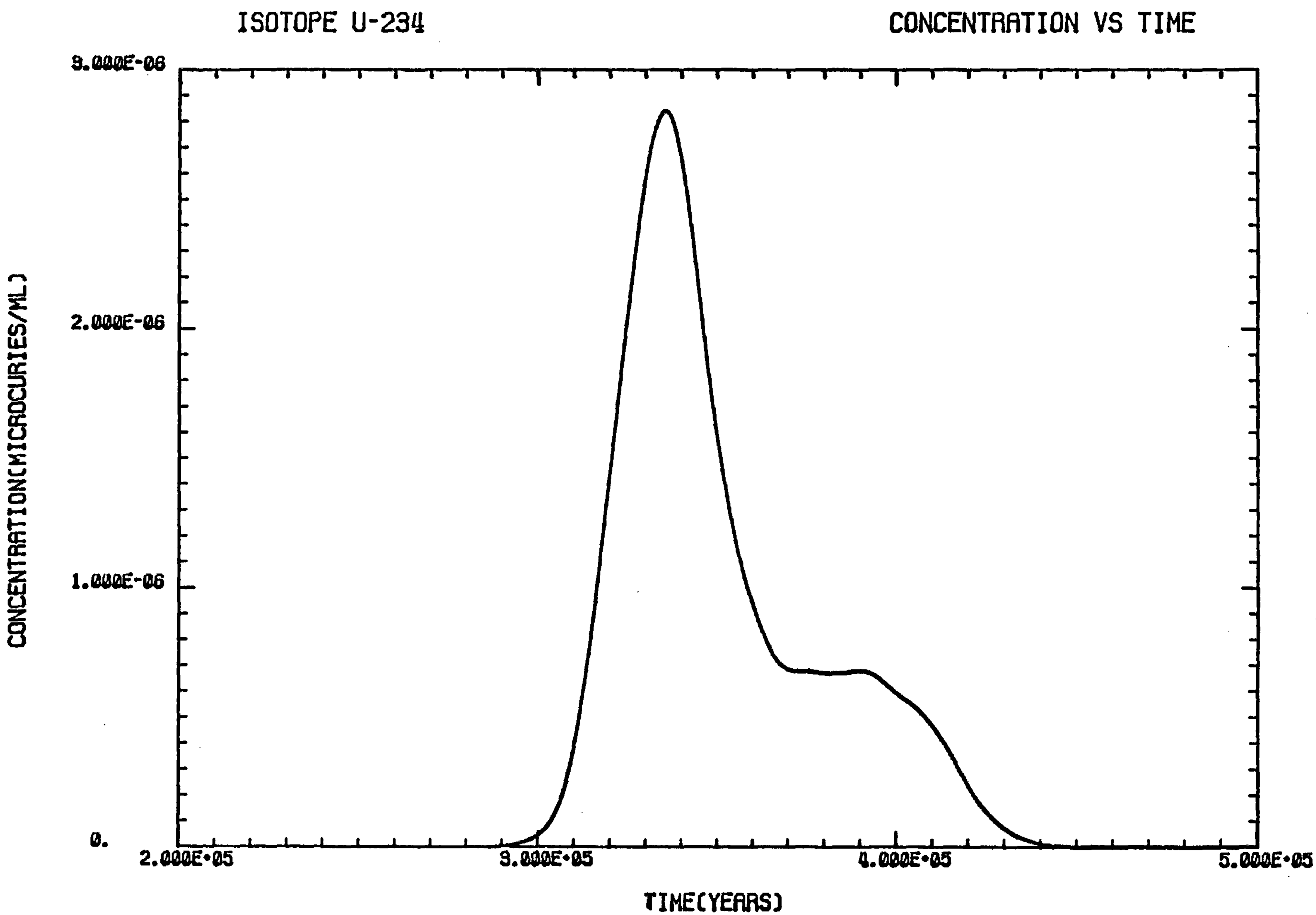

ISOTOPE TH-229
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
TIME(YEARS)
1.600E-08
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
0.
1.000E+05
2.000E+05
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
9.000E+05
1.000E+06

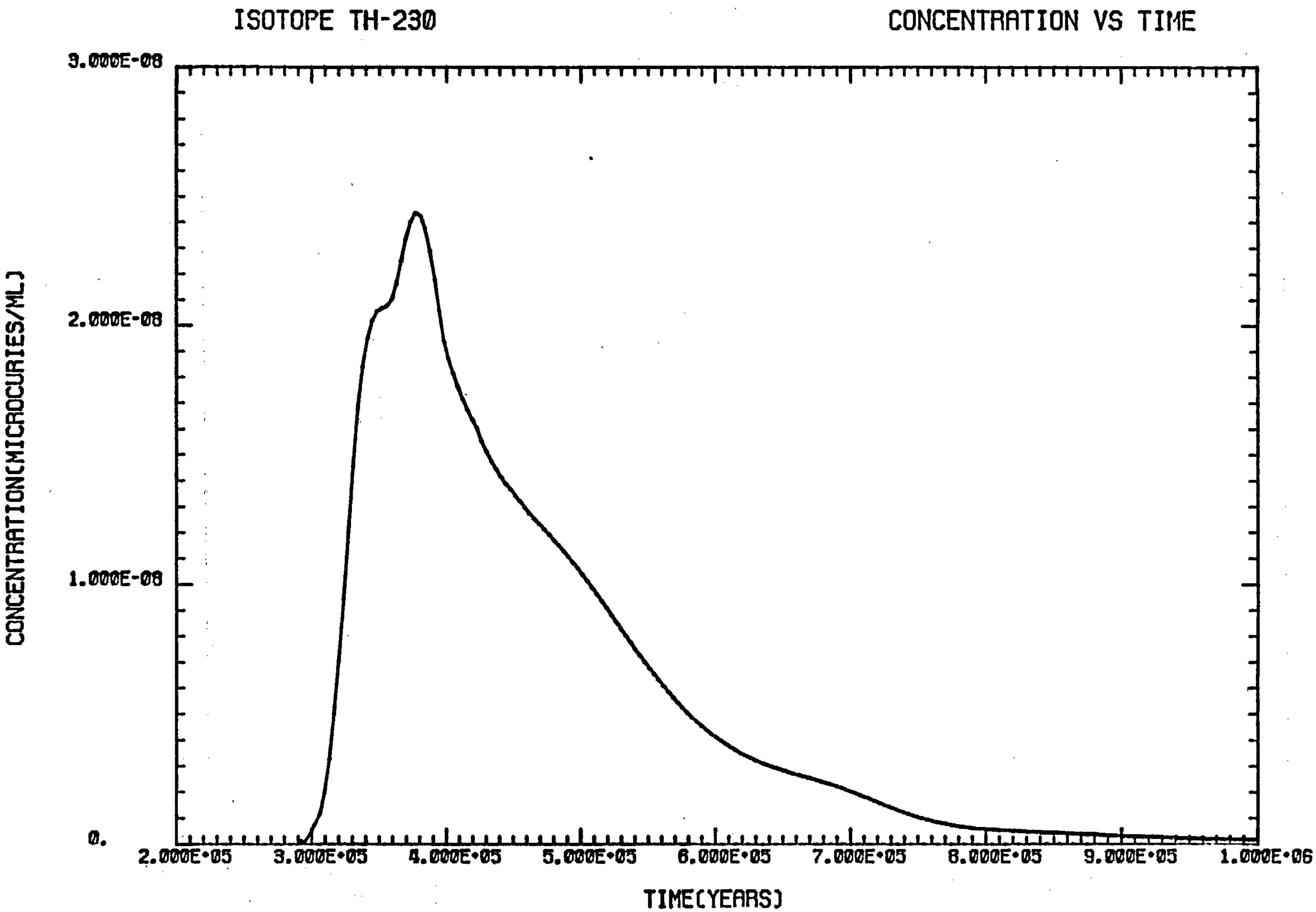


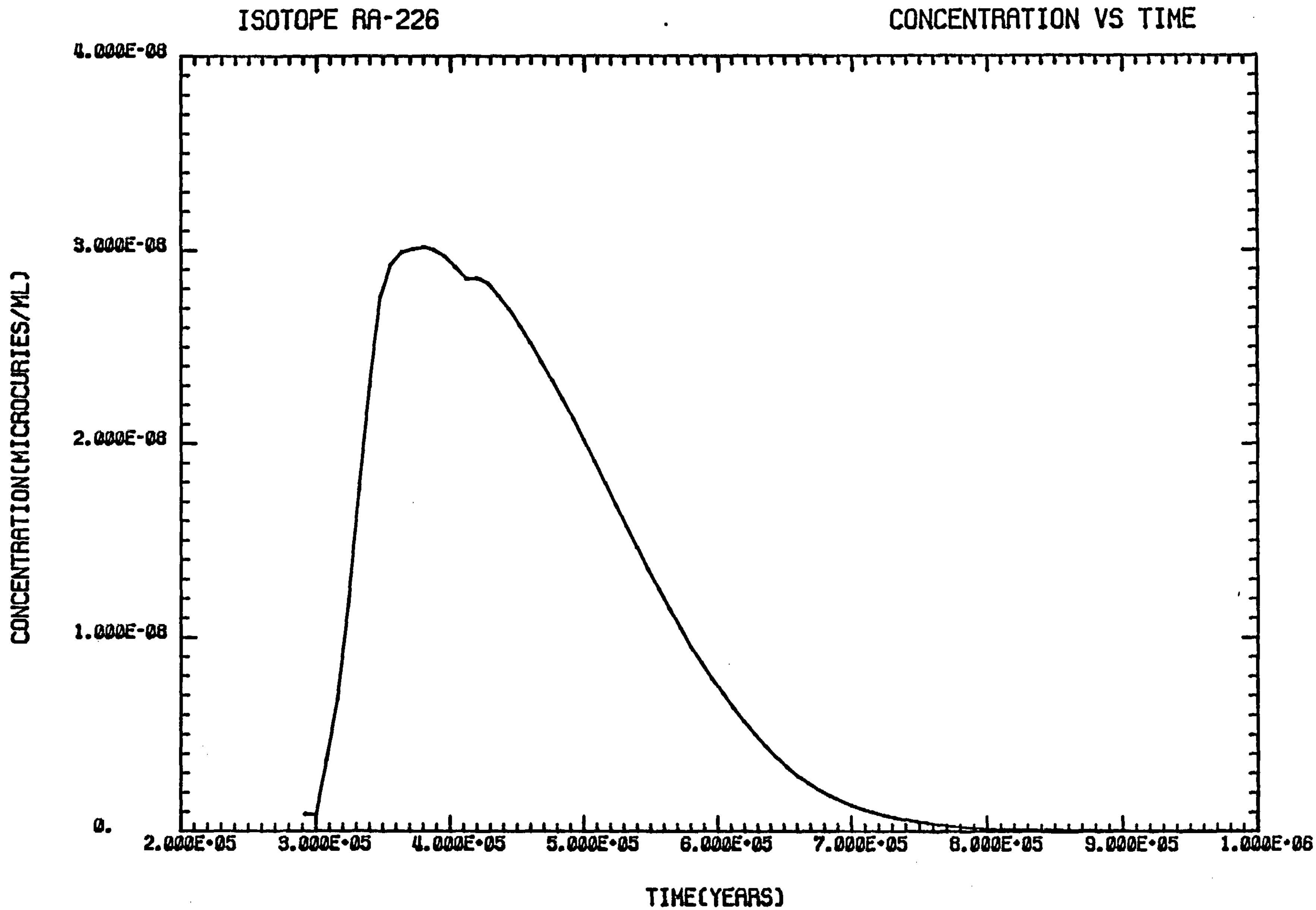
ISOTOPE PU-242
CONCENTRATION VS DISTANCE AT 2.00E+06 YEARS
INVENTORY(CURIES)
IN THE WATER=6.4133E+00
ON SOIL=1.8086E+03
CONCENTRATION (MICROCURIES/ML)
1.800E-08
1.600E-08
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
0.110
0.120
0.130
0.140
0.150
0.160
0.170
0.180
0.190
0.200
0.210
FRACTIONAL DISTANCE TO DISCHARGE SITE

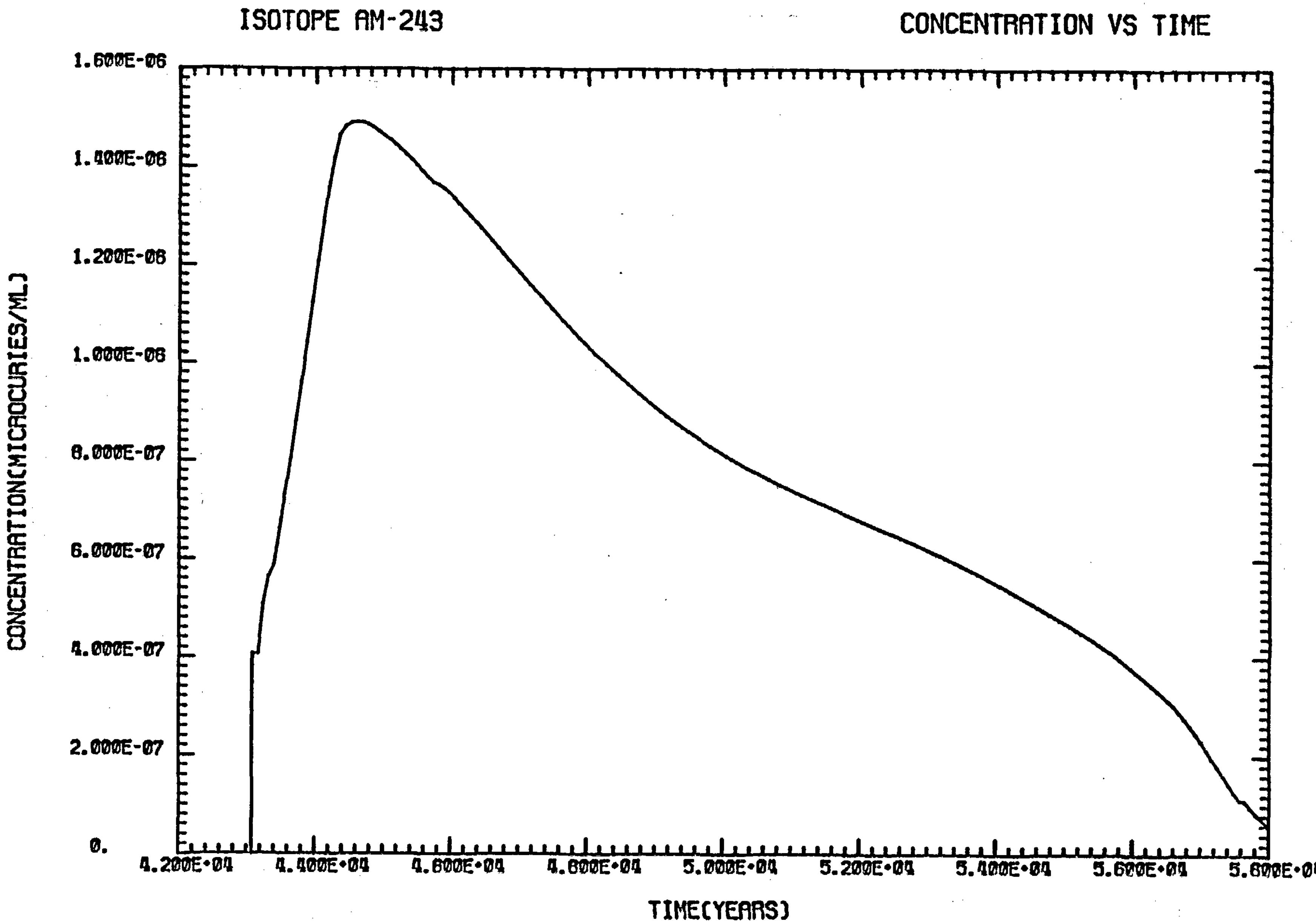

ISOTOPE U-238
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
1.100E-06
1.000E-06
9.000E-07
8.000E-07
7.000E-07
6.000E-07
5.000E-07
4.000E-07
3.000E-07
2.000E-07
1.000E-07
0.
2.900E+05
3.100E+05
3.300E+05
3.500E+05
3.700E+05
3.900E+05
4.100E+05
4.300E+05
4.500E+05
TIME(YEARS)

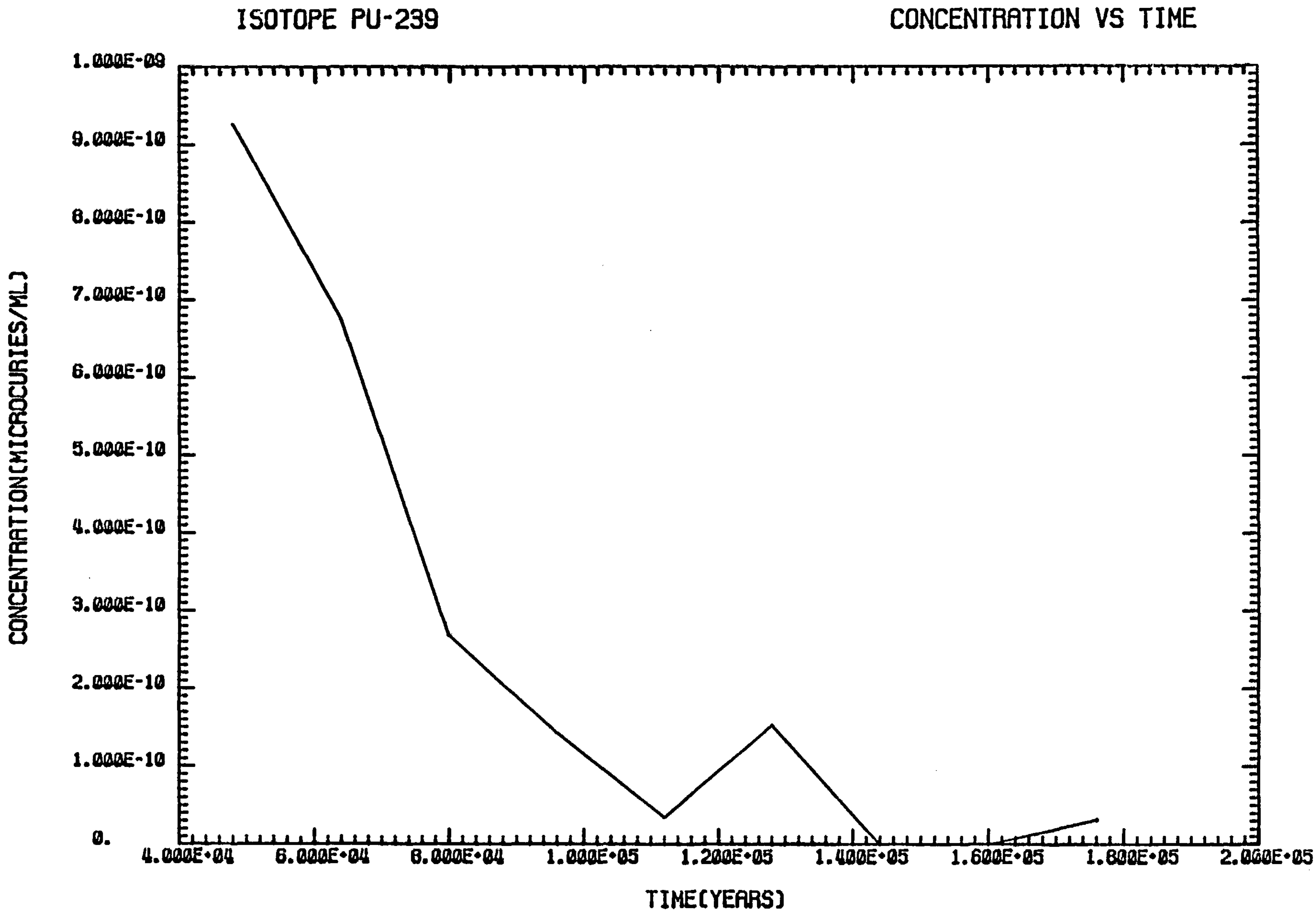
G.145


ISOTOPE U-234
CONCENTRATION VS TIME
3.000E-06
2.000E-06
1.000E-06
0.
2.000E+05
3.000E+05
4.000E+05
5.000E+05
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

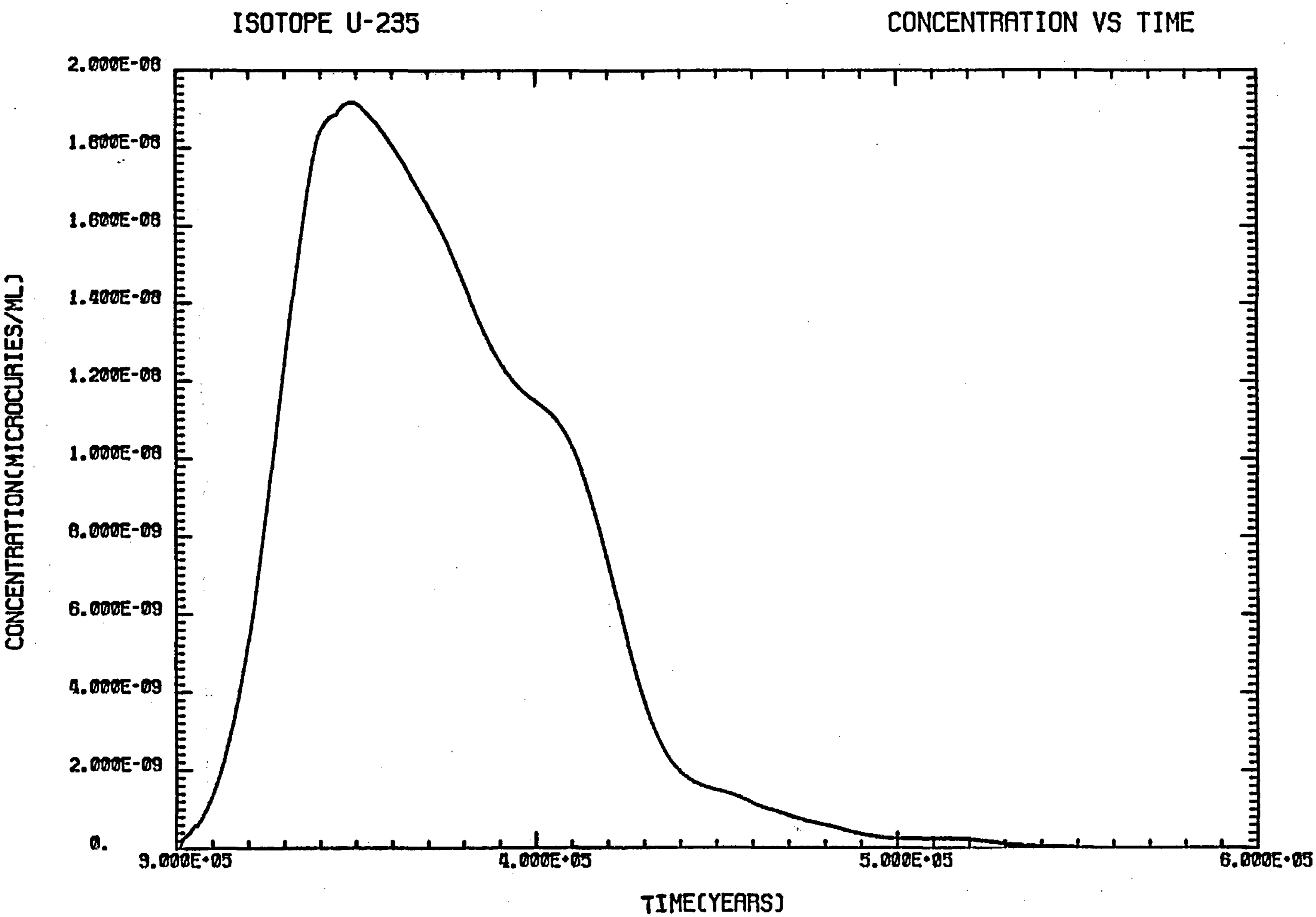

ISOTOPE TH-230
CONCENTRATION VS TIME
3.000E-08
2.000E-08
1.000E-08
0.
CONCENTRATION(MICROCURIES/ML)
2.000E+05
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
9.000E+05
1.000E+06
TIME(YEARS)

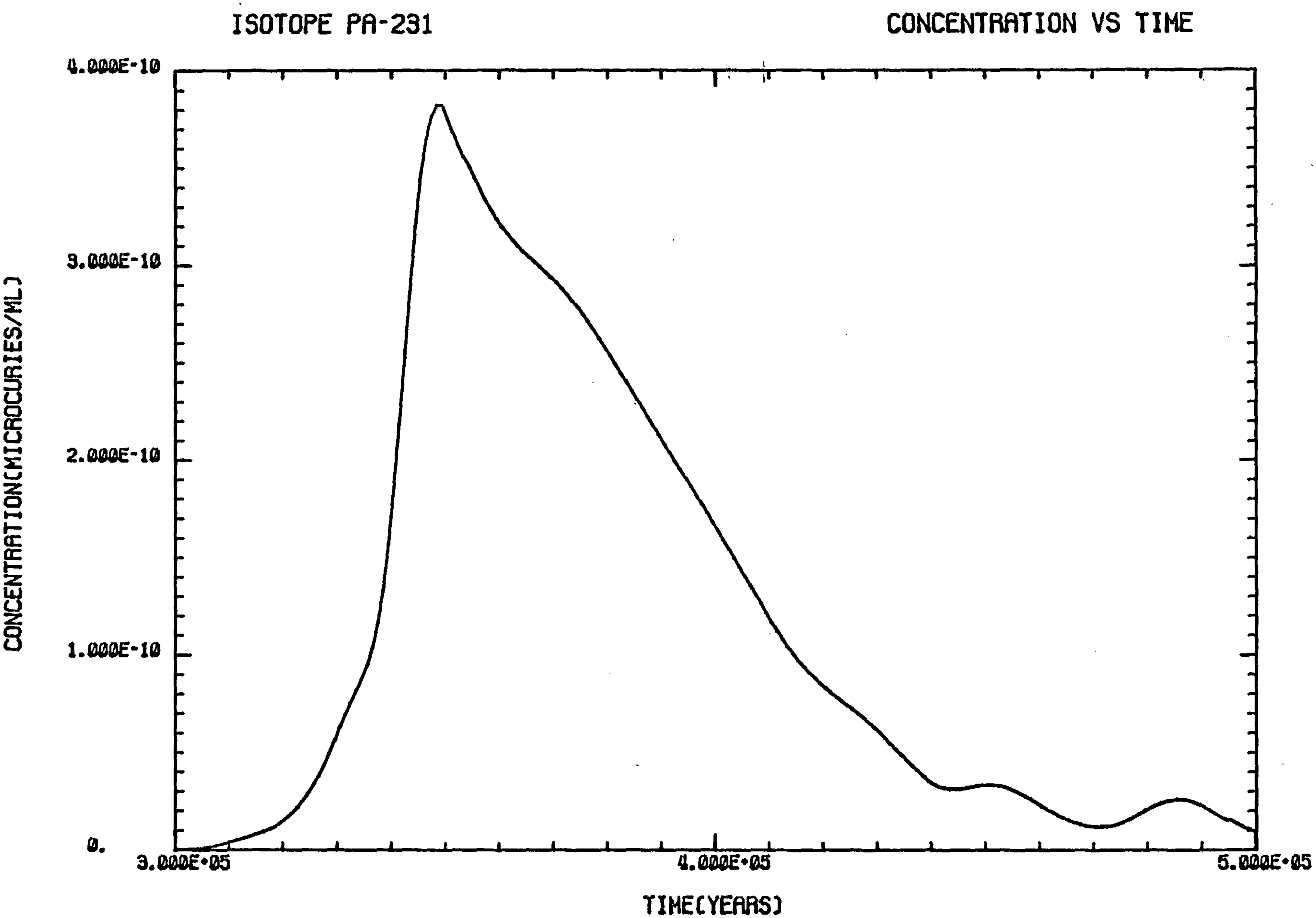

ISOTOPE RA-226
CONCENTRATION VS TIME
4.000E-08
3.000E-08
2.000E-08
1.000E-08
0.
2.000E+05
3.000E+05
4.000E+05
5.000E+05
6.000E+05
7.000E+05
8.000E+05
9.000E+05
1.000E+06
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)


ISOTOPE AM-243
CONCENTRATION VS TIME
1.600E-06
1.400E-06
1.200E-06
1.000E-06
8.000E-07
6.000E-07
4.000E-07
2.000E-07
0.
CONCENTRATION(MICROCURIES/ML)
4.200E+04
4.400E+04
4.600E+04
4.800E+04
5.000E+04
5.200E+04
5.400E+04
5.600E+04
5.800E+04
TIME(YEARS)


ISOTOPE PU-239
CONCENTRATION VS TIME
1.000E-09
9.000E-10
8.000E-10
7.000E-10
6.000E-10
5.000E-10
4.000E-10
3.000E-10
2.000E-10
1.000E-10
0.
4.000E+04
6.000E+04
8.000E+04
1.000E+05
1.200E+05
1.400E+05
1.600E+05
1.800E+05
2.000E+05
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

G.150


ISOTOPE U-235
CONCENTRATION VS TIME
CONCENTRATION(MICROCURIES/ML)
2.000E-08
1.800E-08
1.600E-08
1.400E-08
1.200E-08
1.000E-08
8.000E-09
6.000E-09
4.000E-09
2.000E-09
0.
3.000E+05
4.000E+05
5.000E+05
6.000E+05
TIME(YEARS)



ISOTOPE PA-231
CONCENTRATION VS TIME
4.000E-10
3.000E-10
2.000E-10
1.000E-10
0.
3.000E+05
4.000E+05
5.000E+05
TIME(YEARS)
CONCENTRATION(MICROCURIES/ML)

G.152

APPENDIX H

TABULAR LISTS OF DISCHARGE RATES FOR THE FIVE SIMULATION RUNS COMPRISING THE FOUR RELEASE SCENARIOS

APPENDIX H

TABULAR LISTS OF DISCHARGE RATES FOR THE FIVE SIMULATION RUNS COMPRISING THE FOUR RELEASE SCENARIOS

This appendix lists the concentration versus time outputs of the MMT simulations of geotransport of radioisotopes. The simulation run titles used in this appendix are:

Run 1: PIR1, base case solution mining at time 100

Run 2: PIR2, base case, but East Texas Oil field removed, Sabine River discharge

Run 3: PIR3, base case, but East Texas Oil field removed, Big Cypress discharge

Run 4: PIR4, well scenario at 6 km from dome

Run 5: PIR5, same as PIR2, but lower Kd values.

APPENDIX H.1: EAST TEXAS OIL FIELD DISCHARGE SITE

Simulation Run 1.

PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = C-14
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 4.000000E+04
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 7.500000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 7.6649E+04 MIN. TIME = 1.2729E+04
TOTAL WEIGHT = 5.2921E+03 TOTAL PARCELS = 1387.0
PEAK WEIGHT = 113.085 PEAK WEIGHT TIME = 1.7163E+04
PEAK PARCELS = 11.000 PEAK PARCELS TIME = 1.7163E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 4.0251E+01 NO. PARCELS HI = 2032.0
SMOOTHING WINDOW (CELLS)= 8

TOTAL INVENTORY (CURIES) = 5.332363E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 5.182494E+03
PERCENT OF TOTAL INVENTORY = 97.189

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.693750E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 9.718569E-07
MAXIMUM RATE (CURIES/YEAR) = 5.027392E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = C-14

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.2738E+04	4.1910E-02	2.6350E+04	1.7261E-01
1.3010E+04	6.3964E-02	2.6622E+04	1.6488E-01
1.3282E+04	1.0175E-01	2.6895E+04	1.5607E-01
1.3554E+04	1.4335E-01	2.7167E+04	1.5191E-01
1.3827E+04	1.8424E-01	2.7439E+04	1.4605E-01
1.4099E+04	2.2590E-01	2.7711E+04	1.4008E-01
1.4371E+04	2.6779E-01	2.7984E+04	1.3365E-01
1.4643E+04	3.0941E-01	2.8256E+04	1.2648E-01
1.4916E+04	3.4974E-01	2.8528E+04	1.1843E-01

1.5188E+04	3.8742E-01	2.8800E+04	1.0953E-01
1.5460E+04	4.2109E-01	2.9073E+04	9.9943E-02
1.5732E+04	4.4952E-01	2.9345E+04	8.9906E-02
1.6005E+04	4.7177E-01	2.9617E+04	7.9724E-02
1.6277E+04	4.8772E-01	2.9889E+04	6.9726E-02
1.6549E+04	4.9759E-01	3.0162E+04	6.0200E-02
1.6821E+04	5.0213E-01	3.0434E+04	5.1403E-02
1.7094E+04	5.0238E-01	3.0706E+04	4.3518E-02
1.7366E+04	4.9919E-01	3.0978E+04	3.6673E-02
1.7638E+04	4.9342E-01	3.1251E+04	3.0918E-02
1.7910E+04	4.8558E-01	3.1523E+04	2.6212E-02
1.8183E+04	4.7602E-01	3.1795E+04	2.2458E-02
1.8455E+04	4.6576E-01	3.2067E+04	1.9577E-02
1.8727E+04	4.5309E-01	3.2340E+04	1.7355E-02
1.8999E+04	4.4059E-01	3.2612E+04	1.5647E-02
1.9272E+04	4.2822E-01	3.2884E+04	1.4338E-02
1.9544E+04	4.1663E-01	3.3156E+04	1.3275E-02
1.9816E+04	4.0628E-01	3.3429E+04	1.2395E-02
2.0088E+04	3.9734E-01	3.3701E+04	1.1617E-02
2.0361E+04	3.8967E-01	3.3973E+04	1.0937E-02
2.0633E+04	3.8270E-01	3.4245E+04	1.0334E-02
2.0905E+04	3.7573E-01	3.4518E+04	9.8070E-03
2.1177E+04	3.6809E-01	3.4790E+04	9.3535E-03
2.1450E+04	3.5933E-01	3.5062E+04	8.9536E-03
2.1722E+04	3.4936E-01	3.5334E+04	8.6199E-03
2.1994E+04	3.3843E-01	3.5607E+04	8.3392E-03
2.2266E+04	3.2707E-01	3.5879E+04	8.1035E-03
2.2539E+04	3.1585E-01	3.6151E+04	7.8843E-03
2.2811E+04	3.0516E-01	3.6423E+04	7.6671E-03
2.3083E+04	2.9517E-01	3.6696E+04	7.4720E-03
2.3355E+04	2.8576E-01	3.6968E+04	7.2675E-03
2.3628E+04	2.7657E-01	3.7240E+04	7.0564E-03
2.3900E+04	2.6723E-01	3.7512E+04	6.8077E-03
2.4172E+04	2.5742E-01	3.7785E+04	6.5370E-03
2.4444E+04	2.4697E-01	3.8057E+04	6.2053E-03
2.4717E+04	2.3594E-01	3.8329E+04	5.8117E-03
2.4989E+04	2.2452E-01	3.8601E+04	5.3093E-03
2.5261E+04	2.1302E-01	3.8874E+04	4.7084E-03
2.5533E+04	2.0179E-01	3.9146E+04	3.9581E-03
2.5806E+04	1.9116E-01	3.9418E+04	3.0763E-03
2.6078E+04	1.8137E-01	3.9690E+04	2.0713E-03

PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = TC-99
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 2.800000E+04
TIME HIGH= 3.500000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 3.500000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.0885E+05 MIN. TIME = 2.96E+04
TOTAL WEIGHT = 5.4175E+05 TOTAL PARCELS = 1116.0
PEAK WEIGHT = 35229.297 PEAK WEIGHT TIME = 3.0118E+04
PEAK PARCELS = 59.000 PEAK PARCELS TIME = 3.0118E+04
WT. LOW = 1.3410E+03 NO. PARCELS LOW = 2.0
WT. HI = 2.9628E+05 NO. PARCELS HI = 3880.0
SMOOTHING WINDOW (CELLS)= 7

TOTAL INVENTORY (CURIES) = 6.393758E+05
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 5.585626E+05
PERCENT OF TOTAL INVENTORY = 66.545

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.011750E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.183251E-03
MAXIMUM RATE (CURIES/YEAR) = 6.120930E+02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = TC-99

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.9593E+04	4.5438E+00	3.1536E+04	1.1153E+02
2.9611E+04	4.5438E+00	3.1618E+04	1.0329E+02
2.9629E+04	4.5438E+00	3.1701E+04	9.5901E+01
2.9648E+04	4.5438E+00	3.1783E+04	8.9163E+01
2.9666E+04	4.7013E+00	3.1865E+04	8.5450E+01
2.9685E+04	5.4974E+00	3.1948E+04	8.2361E+01
2.9703E+04	7.7869E+00	3.2030E+04	7.8920E+01
2.9721E+04	1.3627E+01	3.2113E+04	7.4381E+01
2.9740E+04	2.1934E+01	3.2195E+04	6.9936E+01

2.9758E+04	3.4025E+01	3.2277E+04	6.5015E+01
2.9777E+04	4.8866E+01	3.2360E+04	5.8948E+01
2.9795E+04	6.6529E+01	3.2442E+04	5.3562E+01
2.9813E+04	8.1144E+01	3.2524E+04	4.8145E+01
2.9832E+04	9.3657E+01	3.2607E+04	4.2900E+01
2.9850E+04	1.0258E+02	3.2689E+04	3.7842E+01
2.9869E+04	1.0991E+02	3.2771E+04	3.3167E+01
2.9887E+04	1.1570E+02	3.2854E+04	3.0137E+01
2.9905E+04	1.2108E+02	3.2936E+04	2.6081E+01
2.9924E+04	1.3041E+02	3.3018E+04	2.3059E+01
2.9942E+04	1.4025E+02	3.3078E+04	2.1162E+01
2.9961E+04	1.5612E+02	3.3139E+04	1.9537E+01
2.9979E+04	1.7215E+02	3.3199E+04	1.8220E+01
2.9997E+04	1.8908E+02	3.3259E+04	1.7490E+01
3.0016E+04	2.1428E+02	3.3319E+04	1.7079E+01
3.0034E+04	2.7613E+02	3.3379E+04	1.6241E+01
3.0053E+04	3.4176E+02	3.3439E+04	1.6110E+01
3.0071E+04	4.1696E+02	3.3499E+04	1.5402E+01
3.0090E+04	4.9332E+02	3.3559E+04	1.4528E+01
3.0108E+04	5.7146E+02	3.3619E+04	1.3947E+01
3.0126E+04	6.0512E+02	3.3679E+04	1.3595E+01
3.0145E+04	5.9061E+02	3.3739E+04	1.2904E+01
3.0163E+04	5.5906E+02	3.3799E+04	1.1811E+01
3.0182E+04	5.1513E+02	3.3859E+04	1.0707E+01
3.0200E+04	4.8391E+02	3.3920E+04	9.9160E+00
3.0218E+04	4.5874E+02	3.3980E+04	9.1606E+00
3.0301E+04	4.0411E+02	3.4040E+04	8.8787E+00
3.0383E+04	3.6930E+02	3.4100E+04	8.5487E+00
3.0465E+04	3.2513E+02	3.4160E+04	8.2023E+00
3.0548E+04	3.0122E+02	3.4220E+04	7.8678E+00
3.0630E+04	2.7631E+02	3.4280E+04	7.8292E+00
3.0713E+04	2.5649E+02	3.4340E+04	7.9778E+00
3.0795E+04	2.3962E+02	3.4400E+04	8.0560E+00
3.0877E+04	2.2135E+02	3.4460E+04	7.9675E+00
3.0960E+04	2.0398E+02	3.4520E+04	7.8975E+00
3.1042E+04	1.9030E+02	3.4580E+04	7.8581E+00
3.1124E+04	1.7620E+02	3.4640E+04	7.9267E+00
3.1207E+04	1.6277E+02	3.4700E+04	7.9826E+00
3.1289E+04	1.4898E+02	3.4761E+04	7.9205E+00
3.1371E+04	1.3441E+02	3.4821E+04	7.8341E+00
3.1454E+04	1.2220E+02	3.4881E+04	7.7545E+00

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 PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE IFISSION PRODUCTS
CONTAMINANT = I-129
  TONS OF HEAVY METAL FACTOR =   1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   1.000000E+04
TIME HIGH=   1.100000E+05
NUMBER OF CELLS =           400
DELTA TIME INCREMENT =   2.500000E+02


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.0835E+05      MIN. TIME =  1.3101E+04
TOTAL WEIGHT =  2.2809E+03   TOTAL PARCELS =        4998.0
PEAK WEIGHT =        37.858   PEAK WEIGHT TIME =  2.5875E+04
PEAK PARCELS =       25.000   PEAK PARCELS TIME =  7.2875E+04
WT. LOW =  0.0000E-01         NO. PARCELS LOW =          0.0
WT. HI =  0.0000E-01          NO. PARCELS HI =           0.0
 SMOOTHING WINDOW (CELLS)=     20


TOTAL INVENTORY (CURIES) =   2.280878E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   2.304891E+03
PERCENT OF TOTAL INVENTORY = 101.053

TIME OF MAXIMUM CONCENTRATION (YEARS) =   1.887500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   1.841331E-07
MAXIMUM RATE (CURIES/YEAR) =   9.525160E-02
CONVERSION FACTOR RATE TO CONCENTRATION =   1.933123E-06


 CONTAMINANT = I-129

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.3125E+04	8.7238E-03	6.6000E+04	1.2510E-02
1.3697E+04	2.3351E-02	6.8000E+04	1.2527E-02
1.4269E+04	3.3044E-02	7.0000E+04	1.2562E-02
1.4841E+04	4.1077E-02	7.2000E+04	1.2553E-02
1.5413E+04	5.4786E-02	7.4000E+04	1.2468E-02
1.5985E+04	6.7074E-02	7.6000E+04	1.2455E-02
1.6557E+04	7.8984E-02	7.8000E+04	1.2393E-02
1.7129E+04	8.7454E-02	8.0000E+04	1.2350E-02
1.7701E+04	9.2464E-02	8.2000E+04	1.2394E-02
1.8273E+04	9.4410E-02	8.4000E+04	1.2460E-02

1,8845E+04	9,5206E-02	8,6000E+04	1,2472E-02
1,9417E+04	9,4433E-02	8,8000E+04	1,2516E-02
1,9989E+04	9,3718E-02	9,0000E+04	1,2581E-02
2,0561E+04	9,2351E-02	9,2000E+04	1,2572E-02
2,1133E+04	9,2090E-02	9,4000E+04	1,2607E-02
2,1705E+04	9,1905E-02	9,6000E+04	1,2555E-02
2,2277E+04	9,0081E-02	9,8000E+04	1,2542E-02
2,2848E+04	8,8605E-02	1,0000E+05	1,1614E-02
2,3420E+04	8,6585E-02	1,0025E+05	1,1043E-02
2,3992E+04	8,4180E-02	1,0051E+05	1,0740E-02
2,4564E+04	8,2606E-02	1,0076E+05	1,0639E-02
2,5136E+04	8,3479E-02	1,0102E+05	1,0862E-02
2,5708E+04	8,5300E-02	1,0127E+05	1,1372E-02
2,6280E+04	8,7152E-02	1,0152E+05	1,1709E-02
2,6852E+04	8,7862E-02	1,0178E+05	1,1887E-02
2,7424E+04	8,6137E-02	1,0203E+05	1,2123E-02
2,7996E+04	8,1462E-02	1,0228E+05	1,2199E-02
2,8568E+04	7,3061E-02	1,0254E+05	1,1768E-02
2,9140E+04	6,3629E-02	1,0279E+05	1,1287E-02
2,9712E+04	5,3674E-02	1,0305E+05	1,0728E-02
3,0284E+04	4,4221E-02	1,0330E+05	9,8102E-03
3,0856E+04	3,5260E-02	1,0355E+05	8,8227E-03
3,1428E+04	2,8451E-02	1,0381E+05	8,1512E-03
3,2000E+04	2,3756E-02	1,0406E+05	7,3115E-03
3,4000E+04	1,8441E-02	1,0431E+05	6,5603E-03
3,6000E+04	1,5678E-02	1,0457E+05	6,0461E-03
3,8000E+04	1,3477E-02	1,0482E+05	5,7280E-03
4,0000E+04	1,2745E-02	1,0508E+05	5,4057E-03
4,2000E+04	1,2499E-02	1,0533E+05	5,2315E-03
4,4000E+04	1,2483E-02	1,0558E+05	4,9641E-03
4,6000E+04	1,2532E-02	1,0584E+05	4,5290E-03
4,8000E+04	1,2579E-02	1,0609E+05	3,8188E-03
5,0000E+04	1,2598E-02	1,0634E+05	3,0262E-03
5,2000E+04	1,2573E-02	1,0660E+05	2,2630E-03
5,4000E+04	1,2530E-02	1,0685E+05	1,5799E-03
5,6000E+04	1,2453E-02	1,0711E+05	9,8465E-04
5,8000E+04	1,2426E-02	1,0736E+05	5,9967E-04
6,0000E+04	1,2411E-02	1,0761E+05	3,4775E-04
6,2000E+04	1,2397E-02	1,0787E+05	1,7440E-04
6,4000E+04	1,2471E-02	1,0812E+05	7,0188E-05

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 PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = CS-135
  TONS OF HEAVY METAL FACTOR =   1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   1.300000E+04
TIME HIGH=   3.200000E+04
NUMBER OF CELLS =              400
DELTA TIME INCREMENT =   4.750000E+01


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.3996E+06        MIN. TIME =  1.4940E+04
TOTAL WEIGHT =  1.5451E+04     TOTAL PARCELS =        760.0
PEAK WEIGHT =      142.435     PEAK WEIGHT TIME =  2.0481E+04
PEAK PARCELS =       7.000     PEAK PARCELS TIME =  2.0481E+04
WT. LOW =  0.0000E-01          NO. PARCELS LOW =          0.0
WT. HI =  9.4709E+03           NO. PARCELS HI =       4238.0
 SMOOTHING WINDOW (CELLS)=     30


TOTAL INVENTORY (CURIES) =   2.492221E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   1.478504E+04
PERCENT OF TOTAL INVENTORY =  59.325

TIME OF MAXIMUM CONCENTRATION (YEARS) =   1.962625E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   2.336063E-06
MAXIMUM RATE (CURIES/YEAR) =   1.208439E+00
CONVERSION FACTOR RATE TO CONCENTRATION =   1.933123E-06


CONTAMINANT = CS-135

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.4924E+04	7.6854E-01	2.1926E+04	1.1690E+00
1.4944E+04	7.6854E-01	2.2320E+04	1.1629E+00
1.4965E+04	7.6854E-01	2.2715E+04	1.1595E+00
1.4985E+04	7.4700E-01	2.3109E+04	1.1586E+00
1.5006E+04	7.1542E-01	2.3503E+04	1.1560E+00
1.5026E+04	6.9044E-01	2.3897E+04	1.1507E+00
1.5047E+04	6.7702E-01	2.4291E+04	1.1417E+00
1.5067E+04	6.6300E-01	2.4685E+04	1.1292E+00
1.5088E+04	6.3690E-01	2.5079E+04	1.1125E+00
1.5108E+04	6.1080E-01	2.5473E+04	1.0906E+00
1.5129E+04	5.9709E-01	2.5868E+04	1.0624E+00

1.5149E+04	5.8802E-01	2.6262E+04	1.0272E+00
1.5170E+04	5.8327E-01	2.6656E+04	9.8323E-01
1.5190E+04	5.8475E-01	2.7050E+04	9.3092E-01
1.5211E+04	5.8729E-01	2.7444E+04	8.6556E-01
1.5231E+04	6.0024E-01	2.7838E+04	7.8179E-01
1.5252E+04	6.1319E-01	2.8232E+04	7.0244E-01
1.5272E+04	6.2815E-01	2.8626E+04	5.9946E-01
1.5293E+04	6.4370E-01	2.9020E+04	4.4430E-01
1.5313E+04	6.5687E-01	2.9040E+04	4.3664E-01
1.5334E+04	6.6724E-01	2.9060E+04	4.2959E-01
1.5354E+04	6.7688E-01	2.9079E+04	4.2257E-01
1.5375E+04	6.8206E-01	2.9099E+04	4.1664E-01
1.5395E+04	6.8724E-01	2.9119E+04	4.1071E-01
1.5416E+04	6.8704E-01	2.9138E+04	4.0518E-01
1.5436E+04	6.8566E-01	2.9158E+04	3.9990E-01
1.5457E+04	6.8304E-01	2.9178E+04	3.9483E-01
1.5477E+04	6.7919E-01	2.9197E+04	3.9059E-01
1.5498E+04	6.7524E-01	2.9217E+04	3.8635E-01
1.5518E+04	6.7084E-01	2.9237E+04	3.8278E-01
1.5539E+04	6.6643E-01	2.9256E+04	3.7939E-01
1.5559E+04	6.6568E-01	2.9276E+04	3.7611E-01
1.5580E+04	6.6548E-01	2.9296E+04	3.7302E-01
1.5600E+04	6.6743E-01	2.9315E+04	3.6993E-01
1.5620E+04	6.7114E-01	2.9335E+04	3.6717E-01
1.6015E+04	[illegible]	2.9355E+04	3.6443E-01
1.6409E+04	9.0316E-01	2.9374E+04	3.6185E-01
1.6803E+04	9.7510E-01	2.9394E+04	3.5939E-01
1.7197E+04	1.0435E+00	2.9414E+04	3.5726E-01
1.7591E+04	1.1015E+00	2.9433E+04	3.5753E-01
1.7985E+04	1.1430E+00	2.9453E+04	3.5779E-01
1.8379E+04	1.1725E+00	2.9473E+04	3.5707E-01
1.8773E+04	1.1924E+00	2.9492E+04	3.5595E-01
1.9168E+04	1.2036E+00	2.9512E+04	3.5480E-01
1.9562E+04	1.2082E+00	2.9532E+04	3.5355E-01
1.9956E+04	1.2062E+00	2.9551E+04	3.5230E-01
2.0350E+04	1.1991E+00	2.9571E+04	3.5083E-01
2.0744E+04	1.1902E+00	2.9591E+04	3.4932E-01
2.1138E+04	1.1827E+00	2.9610E+04	3.4775E-01
2.1532E+04	1.1761E+00	2.9630E+04	3.4611E-01

PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = CS-135
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 8.000000E+05
TIME HIGH= 1.300000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 2.500000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.3996E+06 MIN. TIME = 1.4940E+04
TOTAL WEIGHT = 8.8067E+03 TOTAL PARCELS = 4180.0
PEAK WEIGHT = 135.226 PEAK WEIGHT TIME = 1.0763E+06
PEAK PARCELS = 62.000 PEAK PARCELS TIME = 1.0763E+06
WT. LOW = 1.6087E+00 NO. PARCELS LOW = 803.0
WT. HI = 2.8195E+01 NO. PARCELS HI = 15.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 2.492221E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 8.716415E+03
PERCENT OF TOTAL INVENTORY = 34.974

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.031250E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 6.983555E-08
MAXIMUM RATE (CURIES/YEAR) = 3.612576E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = CS-135

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
8.0125E+05	9.0705E-04	1.0500E+06	3.5453E-02
8.0623E+05	1.0491E-03	1.0550E+06	3.5065E-02
8.1120E+05	1.3664E-03	1.0600E+06	3.4595E-02
8.1618E+05	1.7354E-03	1.0649E+06	3.4047E-02
8.2115E+05	2.1535E-03	1.0699E+06	3.3425E-02
8.2613E+05	2.6260E-03	1.0749E+06	3.2734E-02
8.3110E+05	3.1176E-03	1.0799E+06	3.1981E-02
8.3608E+05	3.6081E-03	1.0848E+06	3.1172E-02
8.4105E+05	4.1343E-03	1.0898E+06	3.0312E-02
8.4603E+05	4.6959E-03	1.0948E+06	2.9408E-02
8.5100E+05	5.2925E-03	1.0998E+06	2.8466E-02

8.5598E+05	5.9237E-03	1.1047E+06	2.7494E-02
8.6095E+05	6.5942E-03	1.1097E+06	2.6499E-02
8.6593E+05	7.3073E-03	1.1147E+06	2.5487E-02
8.7090E+05	8.0645E-03	1.1197E+06	2.4464E-02
8.7588E+05	8.8672E-03	1.1246E+06	2.3437E-02
8.8085E+05	9.7160E-03	1.1296E+06	2.2409E-02
8.8583E+05	1.0611E-02	1.1346E+06	2.1385E-02
8.9080E+05	1.1552E-02	1.1396E+06	2.0367E-02
8.9578E+05	1.2536E-02	1.1445E+06	1.9360E-02
9.0075E+05	1.3563E-02	1.1495E+06	1.8367E-02
9.0573E+05	1.4628E-02	1.1545E+06	1.7389E-02
9.1070E+05	1.5729E-02	1.1595E+06	1.6428E-02
9.1568E+05	1.6858E-02	1.1644E+06	1.5486E-02
9.2065E+05	1.8013E-02	1.1694E+06	1.4565E-02
9.2563E+05	1.9185E-02	1.1744E+06	1.3666E-02
9.3060E+05	2.0369E-02	1.1794E+06	1.2790E-02
9.3558E+05	2.1558E-02	1.1843E+06	1.1941E-02
9.4055E+05	2.2746E-02	1.1893E+06	1.1121E-02
9.4553E+05	2.3926E-02	1.1943E+06	1.0331E-02
9.5050E+05	2.5090E-02	1.1993E+06	9.5726E-03
9.5548E+05	2.6231E-02	1.2042E+06	8.8487E-03
9.6045E+05	2.7341E-02	1.2092E+06	8.1590E-03
9.6543E+05	2.8415E-02	1.2142E+06	7.5052E-03
9.7040E+05	2.9443E-02	1.2192E+06	6.8882E-03
9.7538E+05	3.0421E-02	1.2241E+06	6.3065E-03
9.8035E+05	3.1340E-02	1.2291E+06	5.7617E-03
9.8533E+05	3.2195E-02	1.2341E+06	5.2511E-03
9.9030E+05	3.2977E-02	1.2391E+06	4.7718E-03
9.9528E+05	3.3682E-02	1.2440E+06	4.3234E-03
1.0003E+06	3.4303E-02	1.2490E+06	3.9035E-03
1.0052E+06	3.4839E-02	1.2540E+06	3.5056E-03
1.0102E+06	3.5284E-02	1.2590E+06	3.1280E-03
1.0152E+06	3.5637E-02	1.2639E+06	2.7715E-03
1.0202E+06	3.5894E-02	1.2689E+06	2.4335E-03
1.0251E+06	3.6056E-02	1.2739E+06	2.1144E-03
1.0301E+06	3.6121E-02	1.2789E+06	1.7634E-03
1.0351E+06	3.6091E-02	1.2838E+06	1.4485E-03
1.0401E+06	3.5968E-02	1.2888E+06	1.1670E-03
1.0450E+06	3.5755E-02	1.2938E+06	9.1724E-04

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 PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 1
CONTAMINANT = U-236
  TONS OF HEAVY METAL FACTOR =    1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =    2
TIME LOW =    1.000000E+05
TIME HIGH=   3.000000E+05
NUMBER OF CELLS =            200
DELTA TIME INCREMENT =   1.000000E+03


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  3.0456E+05       MIN. TIME =  1.1067E+05
TOTAL WEIGHT =  2.8984E+04    TOTAL PARCELS =        6556.0
PEAK WEIGHT =      636.435    PEAK WEIGHT TIME =  1.5350E+05
PEAK PARCELS =     124.000    PEAK PARCELS TIME =  1.5850E+05
WT. LOW =  0.0000E-01         NO. PARCELS LOW =          0.0
WT. HI =  3.2242E-04          NO. PARCELS HI =           1.0
 SMOOTHING WINDOW (CELLS)=      5


TOTAL INVENTORY (CURIES) =    2.896357E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   2.897827E+04
PERCENT OF TOTAL INVENTORY =  99.982

TIME OF MAXIMUM CONCENTRATION (YEARS) =    1.575000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) =    9.460819E-07
MAXIMUM RATE (CURIES/YEAR) =    4.894058E-01
CONVERSION FACTOR RATE TO CONCENTRATION =    1.933123E-06


 CONTAMINANT = U-236

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE    100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.1050E+05	1.2046E-03	2.0350E+05	1.6873E-01
1.1236E+05	1.7009E-03	2.0536E+05	1.6988E-01
1.1422E+05	3.3007E-03	2.0722E+05	1.7108E-01
1.1608E+05	5.8946E-03	2.0908E+05	1.7155E-01
1.1794E+05	9.6267E-03	2.1094E+05	1.7088E-01
1.1980E+05	1.4866E-02	2.1280E+05	1.6878E-01
1.2166E+05	2.2056E-02	2.1466E+05	1.6498E-01
1.2352E+05	3.1521E-02	2.1652E+05	1.5934E-01
1.2538E+05	4.3074E-02	2.1838E+05	1.5221E-01

1.2724E+05	5.9518E-02	2.2024E+05	1.4433E-01
1.2910E+05	7.9482E-02	2.2210E+05	1.3629E-01
1.3096E+05	1.0398E-01	2.2396E+05	1.2864E-01
1.3282E+05	1.3281E-01	2.2582E+05	1.2185E-01
1.3468E+05	1.6595E-01	2.2768E+05	1.1590E-01
1.3654E+05	2.0256E-01	2.2954E+05	1.1044E-01
1.3840E+05	2.4175E-01	2.3140E+05	1.0520E-01
1.4026E+05	2.8115E-01	2.3326E+05	9.9662E-02
1.4212E+05	3.1973E-01	2.3512E+05	9.3486E-02
1.4398E+05	3.5638E-01	2.3698E+05	8.6357E-02
1.4584E+05	3.8983E-01	2.3884E+05	7.8511E-02
1.4770E+05	4.1950E-01	2.4070E+05	7.0195E-02
1.4956E+05	4.4429E-01	2.4256E+05	6.1554E-02
1.5142E+05	4.6396E-01	2.4442E+05	5.3065E-02
1.5328E+05	4.7784E-01	2.4628E+05	4.5031E-02
1.5514E+05	4.8628E-01	2.4814E+05	3.7808E-02
1.5700E+05	4.8936E-01	2.5000E+05	3.1407E-02
1.5886E+05	4.8692E-01	2.5186E+05	2.5927E-02
1.6072E+05	4.7997E-01	2.5372E+05	2.1349E-02
1.6258E+05	4.6936E-01	2.5558E+05	1.7542E-02
1.6444E+05	4.5598E-01	2.5744E+05	1.4407E-02
1.6630E+05	4.3949E-01	2.5930E+05	1.1740E-02
1.6816E+05	4.2021E-01	2.6116E+05	9.4612E-03
1.7002E+05	3.9899E-01	2.6302E+05	7.4560E-03
1.7188E+05	3.7635E-01	2.6488E+05	5.7274E-03
1.7374E+05	3.5274E-01	2.6674E+05	4.2559E-03
1.7560E+05	3.2829E-01	2.6860E+05	3.0472E-03
1.7746E+05	3.0459E-01	2.7046E+05	2.1041E-03
1.7932E+05	2.8275E-01	2.7232E+05	1.4040E-03
1.8118E+05	2.6309E-01	2.7418E+05	9.4006E-04
1.8304E+05	2.4532E-01	2.7604E+05	6.6198E-04
1.8490E+05	2.2931E-01	2.7790E+05	5.1113E-04
1.8676E+05	2.1553E-01	2.7976E+05	4.2640E-04
1.8862E+05	2.0347E-01	2.8162E+05	3.7292E-04
1.9048E+05	1.9309E-01	2.8348E+05	3.4473E-04
1.9234E+05	1.8432E-01	2.8534E+05	2.9651E-04
1.9420E+05	1.7747E-01	2.8720E+05	2.2809E-04
1.9606E+05	1.7266E-01	2.8906E+05	1.5793E-04
1.9792E+05	1.6964E-01	2.9092E+05	9.8086E-05
1.9978E+05	1.6830E-01	2.9278E+05	5.3898E-05
2.0164E+05	1.6809E-01	2.9464E+05	2.2621E-05

PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 1
CONTAMINANT = TH-232
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+05
TIME HIGH= 2.000000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 9.500000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9999E+06 MIN. TIME = 1.1560E+05
TOTAL WEIGHT = 1.1469E-01 TOTAL PARCELS = 4641.0
PEAK WEIGHT = 0.001 PEAK WEIGHT TIME = 1.3873E+06
PEAK PARCELS = 50.000 PEAK PARCELS TIME = 1.3018E+06
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 1.146909E-01
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.137978E-01
PERCENT OF TOTAL INVENTORY = 99.221

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.995250E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.251273E-13
MAXIMUM RATE (CURIES/YEAR) = 6.472806E-08
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = TH-232

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.1425E+05	7.2454E-09	9.5554E+05	6.3559E-08
1.1685E+05	7.2454E-09	1.0026E+06	6.3710E-08
1.1945E+05	7.2454E-09	1.0497E+06	6.3815E-08
1.2205E+05	7.2454E-09	1.0967E+06	6.3913E-08
1.2464E+05	7.8217E-09	1.1438E+06	6.3949E-08
1.2724E+05	9.4967E-09	1.1908E+06	6.3920E-08
1.2984E+05	1.1172E-08	1.2379E+06	6.3862E-08
1.3244E+05	1.2847E-08	1.2850E+06	6.3712E-08
1.3504E+05	1.4060E-08	1.3320E+06	6.3466E-08
1.3764E+05	1.5114E-08	1.3791E+06	6.3205E-08

1,4023E+05	1,6147E-08	1,4261E+06	6,2956E-08
1,4283E+05	1,7209E-08	1,4732E+06	6,2713E-08
1,4543E+05	1,9120E-08	1,5202E+06	6,2521E-08
1,4803E+05	2,1032E-08	1,5673E+06	6,2376E-08
1,5063E+05	2,2944E-08	1,6144E+06	6,2252E-08
1,5323E+05	2,4823E-08	1,6614E+06	6,2250E-08
1,5583E+05	2,6649E-08	1,7085E+06	6,2393E-08
1,5842E+05	2,8475E-08	1,7555E+06	6,2499E-08
1,6102E+05	3,0300E-08	1,8026E+06	6,2727E-08
1,6362E+05	3,2039E-08	1,8085E+06	6,2774E-08
1,6622E+05	3,3745E-08	1,8144E+06	6,2821E-08
1,6882E+05	3,5450E-08	1,8203E+06	6,2874E-08
1,7142E+05	3,7130E-08	1,8263E+06	6,2927E-08
1,7402E+05	3,8430E-08	1,8322E+06	6,2982E-08
1,7661E+05	3,9729E-08	1,8381E+06	6,3043E-08
1,7921E+05	4,1029E-08	1,8440E+06	6,3106E-08
1,8181E+05	4,2186E-08	1,8499E+06	6,3174E-08
1,8441E+05	4,3134E-08	1,8558E+06	6,3243E-08
1,8701E+05	4,4082E-08	1,8618E+06	6,3314E-08
1,8961E+05	4,5031E-08	1,8677E+06	6,3393E-08
1,9220E+05	4,5736E-08	1,8736E+06	6,3474E-08
1,9480E+05	4,6362E-08	1,8795E+06	6,3560E-08
1,9740E+05	4,6987E-08	1,8854E+06	6,3649E-08
2,0000E+05	4,7588E-08	1,8913E+06	6,3737E-08
2,0260E+05	4,7959E-08	1,8973E+06	6,3824E-08
2,4966E+05	5,2529E-08	1,9032E+06	6,3833E-08
2,9672E+05	5,4825E-08	1,9091E+06	6,3763E-08
3,4377E+05	5,6534E-08	1,9150E+06	6,3821E-08
3,9083E+05	5,8120E-08	1,9209E+06	6,3894E-08
4,3789E+05	5,9550E-08	1,9268E+06	6,3964E-08
4,8095E+05	6,0491E-08	1,9328E+06	6,4032E-08
5,3201E+05	6,1216E-08	1,9387E+06	6,4099E-08
5,7907E+05	6,1795E-08	1,9446E+06	6,4162E-08
6,2613E+05	6,2207E-08	1,9505E+06	6,4221E-08
6,7319E+05	6,2495E-08	1,9564E+06	6,4277E-08
7,2025E+05	6,2708E-08	1,9623E+06	6,4331E-08
7,6730E+05	6,2902E-08	1,9683E+06	6,4387E-08
8,1436E+05	6,3066E-08	1,9742E+06	6,4447E-08
8,6142E+05	6,3212E-08	1,9801E+06	6,4513E-08
9,0848E+05	6,3375E-08	1,9860E+06	6,4584E-08

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PLTCVT PROGRAM DATA SUMMARY
PIR 1  Chain 2
CONTAMINANT = NP-237
  TONS OF HEAVY METAL FACTOR =   1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   1.000000E+04
TIME HIGH=   8.100000E+05
NUMBER OF CELLS =            400
DELTA TIME INCREMENT =   2.000000E+03

 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  8.7924E+05       MIN. TIME =  1.4905E+04
TOTAL WEIGHT =  8.0537E+04    TOTAL PARCELS =       8132.0
PEAK WEIGHT =     7291.560    PEAK WEIGHT TIME =  1.9000E+04
PEAK PARCELS =    1728.000    PEAK PARCELS TIME =  1.7000E+04
WT. LOW =  0.0000E-01         NO. PARCELS LOW =          0.0
WT. HI =  1.9153E+02          NO. PARCELS HI =          13.0
 SMOOTHING WINDOW (CELLS)=      1

TOTAL INVENTORY (CURIES) =   8.072884E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   8.384621E+04
PERCENT OF TOTAL INVENTORY = 103.864

TIME OF MAXIMUM CONCENTRATION (YEARS) =   2.100000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   6.948634E-06
MAXIMUM RATE (CURIES/YEAR) =   3.594511E+00
CONVERSION FACTOR RATE TO CONCENTRATION =   1.933123E-06
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TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.5000E+04	3.4136E+00	3.0000E+05	8.4404E-03
1.7576E+04	3.4355E+00	3.1176E+05	3.6403E-03
2.0152E+04	3.5500E+00	3.2353E+05	5.3503E-03
2.2727E+04	3.5374E+00	3.3529E+05	1.3238E-03
2.5303E+04	3.3176E+00	3.4706E+05	6.8067E-03
2.7879E+04	2.2955E+00	3.5882E+05	8.2788E-04
3.0455E+04	8.8328E-01	3.7059E+05	4.8505E-03
3.3030E+04	1.8368E-03	3.8235E+05	7.7804E-03
3.5606E+04	2.3947E-03	3.9412E+05	2.8930E-03
3.8182E+04	3.6012E-03	4.0588E+05	4.8276E-03
4.0758E+04	3.4404E-03	4.1765E+05	3.6440E-03
4.3333E+04	1.4644E-03	4.2941E+05	8.6316E-03
4.5909E+04	1.4660E-03	4.4118E+05	2.1253E-03
4.8485E+04	2.0067E-03	4.5294E+05	1.5594E-03

5,1061E+04	2,9855E-03	4,6471E+05	7,2801E-03
5,3636E+04	4,5832E-03	4,7647E+05	5,6052E-03
5,6212E+04	3,4015E-03	4,8824E+05	4,6393E-03
5,8788E+04	1,1368E-03	5,0000E+05	1,0455E-02
6,1364E+04	9,0931E-04	5,0930E+05	1,6218E-02
6,3939E+04	9,0996E-04	5,1861E+05	1,6605E-02
6,6515E+04	9,0754E-04	5,2791E+05	1,6004E-02
6,9091E+04	1,0072E-03	5,3721E+05	2,8282E-02
7,1667E+04	3,7344E-03	5,4652E+05	4,6924E-02
7,4242E+04	5,2555E-03	5,5582E+05	6,3299E-02
7,6818E+04	3,5635E-03	5,6512E+05	6,7202E-02
7,9394E+04	1,4464E-03	5,7442E+05	7,1991E-02
8,1970E+04	1,4491E-03	5,8373E+05	1,5054E-01
8,4545E+04	2,9392E-03	5,9303E+05	1,0902E-01
8,7121E+04	5,4183E-03	6,0233E+05	1,3821E-01
8,9697E+04	6,6689E-03	6,1164E+05	1,8995E-01
9,2273E+04	4,5955E-03	6,2094E+05	1,6476E-01
9,4848E+04	2,5250E-03	6,3024E+05	1,7406E-01
9,7424E+04	3,9197E-03	6,3955E+05	1,4275E-01
1,0000E+05	3,4025E-03	6,4885E+05	2,3700E-01
1,1176E+05	1,7451E-03	6,5815E+05	1,9734E-01
1,2353E+05	3,3045E-03	6,6745E+05	2,3281E-01
1,3529E+05	4,0136E-03	6,7676E+05	1,5423E-01
1,4706E+05	2,3442E-03	6,8606E+05	1,3030E-01
1,5882E+05	1,7654E-03	6,9536E+05	1,4606E-01
1,7059E+05	3,5185E-03	7,0467E+05	1,1922E-01
1,8235E+05	4,4238E-03	7,1397E+05	1,0621E-01
1,9412E+05	2,3269E-03	7,2327E+05	9,5282E-02
2,0588E+05	1,7389E-03	7,3258E+05	9,0719E-02
2,1765E+05	7,1606E-03	7,4188E+05	4,0213E-02
2,2941E+05	3,3096E-03	7,5118E+05	3,7798E-02
2,4118E+05	1,0039E-03	7,6048E+05	4,0074E-02
2,5294E+05	5,0911E-03	7,6979E+05	2,5457E-02
2,6471E+05	2,2768E-03	7,7909E+05	2,6157E-02
2,7647E+05	3,3794E-03	7,8839E+05	1,2959E-02
2,8824E+05	6,7763E-03	7,9770E+05	7,8676E-03

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PLTCVT PROGRAM DATA SUMMARY
PIR 1  Chain 2
CONTAMINANT = NP-237
  TONS OF HEAVY METAL FACTOR =   1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   1.000000E+04
TIME HIGH=   4.000000E+04
NUMBER OF CELLS =            200
DELTA TIME INCREMENT =   1.500000E+02

 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  8.7924E+05        MIN. TIME =  1.4905E+04
TOTAL WEIGHT =  4.8509E+04     TOTAL PARCELS =       6128.0
PEAK WEIGHT =      738.427     PEAK WEIGHT TIME =  2.3875E+04
PEAK PARCELS =     191.000     PEAK PARCELS TIME =  1.5325E+04
WT. LOW =  0.0000E-01          NO. PARCELS LOW =          0.0
WT. HI =  3.2220E+04           NO. PARCELS HI =       2017.0
 SMOOTHING WINDOW (CELLS)=     15

TOTAL INVENTORY (CURIES) =   8.072869E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   4.849314E+04
PERCENT OF TOTAL INVENTORY =  60.069

TIME OF MAXIMUM CONCENTRATION (YEARS) =   2.162500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   6.864691E-06
MAXIMUM RATE (CURIES/YEAR) =   3.551088E+00
CONVERSION FACTOR RATE TO CONCENTRATION =   1.933123E-06
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TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.4875E+04	2.6154E+00	2.1750E+04	3.5503E+00
1.4894E+04	2.6154E+00	2.2118E+04	3.5469E+00
1.4913E+04	2.6154E+00	2.2485E+04	3.5371E+00
1.4932E+04	2.6154E+00	2.2853E+04	3.5234E+00
1.4951E+04	2.6154E+00	2.3221E+04	3.5126E+00
1.4970E+04	2.6154E+00	2.3588E+04	3.4998E+00
1.4989E+04	2.6154E+00	2.3956E+04	3.4770E+00
1.5008E+04	2.6154E+00	2.4324E+04	3.4494E+00
1.5027E+04	2.6179E+00	2.4691E+04	3.4179E+00
1.5045E+04	2.6500E+00	2.5059E+04	3.3759E+00
1.5064E+04	2.6820E+00	2.5426E+04	3.3329E+00

1.5083E+04	2.7140E+00	2.5794E+04	3.2845E+00
1.5102E+04	2.7461E+00	2.6162E+04	3.2369E+00
1.5121E+04	2.7781E+00	2.6529E+04	3.1875E+00
1.5140E+04	2.8102E+00	2.6897E+04	3.1279E+00
1.5159E+04	2.8422E+00	2.7265E+04	3.0537E+00
1.5178E+04	2.8755E+00	2.7632E+04	2.9776E+00
1.5197E+04	2.9154E+00	2.8000E+04	2.9110E+00
1.5216E+04	2.9553E+00	2.8368E+04	2.8166E+00
1.5235E+04	2.9952E+00	2.8720E+04	2.3685E+00
1.5254E+04	3.0350E+00	2.9072E+04	1.7319E+00
1.5273E+04	3.0749E+00	2.9424E+04	1.1490E+00
1.5292E+04	3.1148E+00	2.9777E+04	5.4471E-01
1.5311E+04	3.1547E+00	3.0129E+04	1.2409E-01
1.5330E+04	3.1924E+00	3.0481E+04	2.1065E-03
1.5348E+04	3.2235E+00	3.0834E+04	2.0710E-03
1.5367E+04	3.2545E+00	3.1186E+04	2.0633E-03
1.5386E+04	3.2855E+00	3.1538E+04	2.1025E-03
1.5405E+04	3.3165E+00	3.1890E+04	2.1077E-03
1.5424E+04	3.3475E+00	3.2243E+04	2.0948E-03
1.5443E+04	3.3785E+00	3.2595E+04	2.0816E-03
1.5462E+04	3.4095E+00	3.2947E+04	2.0776E-03
1.5481E+04	3.4344E+00	3.3299E+04	2.1026E-03
1.5500E+04	3.4463E+00	3.3652E+04	2.0830E-03
1.5868E+04	3.5062E+00	3.4004E+04	2.0776E-03
1.6235E+04	3.4739E+00	3.4356E+04	2.0814E-03
1.6603E+04	3.4763E+00	3.4709E+04	2.1077E-03
1.6971E+04	3.4773E+00	3.5061E+04	2.0820E-03
1.7338E+04	3.4773E+00	3.5413E+04	2.0523E-03
1.7706E+04	3.4934E+00	3.5765E+04	2.0915E-03
1.8074E+04	3.4980E+00	3.6118E+04	2.0892E-03
1.8441E+04	3.4925E+00	3.6470E+04	2.4308E-03
1.8809E+04	3.5002E+00	3.6822E+04	3.4999E-03
1.9176E+04	3.5115E+00	3.7174E+04	4.6659E-03
1.9544E+04	3.5209E+00	3.7527E+04	5.1790E-03
1.9912E+04	3.5261E+00	3.7879E+04	5.1489E-03
2.0279E+04	3.5334E+00	3.8231E+04	5.1615E-03
2.0647E+04	3.5411E+00	3.8584E+04	5.1489E-03
2.1015E+04	3.5442E+00	3.8936E+04	5.1432E-03
2.1382E+04	3.5483E+00	3.9288E+04	5.1563E-03

PLTCVT PROGRAM DATA SUMMARY
PIR 1 Chain 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.500000E+05
TIME HIGH= 8.000000E+05
NUMBER OF CELLS = 300
DELTA TIME INCREMENT = 1.166667E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 8.7924E+05 MIN. TIME = 1.4905E+04
TOTAL WEIGHT = 3.0379E+04 TOTAL PARCELS = 1883.0
PEAK WEIGHT = 361.549 PEAK WEIGHT TIME = 6.6408E+05
PEAK PARCELS = 22.000 PEAK PARCELS TIME = 6.6408E+05
WT. LOW = 5.0075E+04 NO. PARCELS LOW = 6243.0
WT. HI = 2.7506F+02 NO. PARCELS HI = 19.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 8.072870E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.040654E+04
PERCENT OF TOTAL INVENTORY = 37.665

TIME OF MAXIMUM CONCENTRATION (YEARS) = 6.535833E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 3.826608E-07
MAXIMUM RATE (CURIES/YEAR) = 1.979495E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.5408E+05	6.3858E-03	6.5148E+05	1.9777E-01
4.5851E+05	6.4641E-03	6.5442E+05	1.9791E-01
4.6293E+05	6.6004E-03	6.5736E+05	1.9736E-01
4.6735E+05	6.7227E-03	6.6030E+05	1.9607E-01
4.7177E+05	6.9970E-03	6.6324E+05	1.9405E-01
4.7619E+05	7.3661E-03	6.6619E+05	1.9135E-01
4.8061E+05	7.9394E-03	6.6913E+05	1.8806E-01
4.8504E+05	8.6910E-03	6.7207E+05	1.8428E-01
4.8946E+05	9.6655E-03	6.7501E+05	1.8011E-01
4.9388E+05	1.0877E-02	6.7795E+05	1.7567E-01
4.9830E+05	1.2315E-02	6.8089E+05	1.7107E-01
5.0272E+05	1.3952E-02	6.8383E+05	1.6638E-01

5,0714E+05	1,5779E-02	6,8677E+05	1,6163E-01
5,1157E+05	1,7798E-02	6,8972E+05	1,5684E-01
5,1599E+05	2,0032E-02	6,9266E+05	1,5201E-01
5,2041E+05	2,2547E-02	6,9560E+05	1,4712E-01
5,2483E+05	2,5431E-02	6,9854E+05	1,4214E-01
5,2925E+05	2,8763E-02	7,0148E+05	1,3706E-01
5,3367E+05	3,2596E-02	7,0442E+05	1,3184E-01
5,3810E+05	3,6968E-02	7,0736E+05	1,2651E-01
5,4252E+05	4,1901E-02	7,1031E+05	1,2105E-01
5,4694E+05	4,7382E-02	7,1325E+05	1,1549E-01
5,5136E+05	5,3413E-02	7,1619E+05	1,0985E-01
5,5578E+05	6,0027E-02	7,1913E+05	1,0415E-01
5,6020E+05	6,7255E-02	7,2207E+05	9,8416E-02
5,6463E+05	7,5114E-02	7,2502E+05	9,2690E-02
5,6905E+05	8,3579E-02	7,2796E+05	8,7004E-02
5,7347E+05	9,2570E-02	7,3090E+05	8,1390E-02
5,7789E+05	1,0193E-01	7,3384E+05	7,5893E-02
5,8231E+05	1,1146E-01	7,3678E+05	7,0553E-02
5,8673E+05	1,2098E-01	7,3973E+05	6,5414E-02
5,9116E+05	1,3026E-01	7,4267E+05	6,0519E-02
5,9558E+05	1,3912E-01	7,4561E+05	5,5894E-02
6,0000E+05	1,4742E-01	7,4855E+05	5,1575E-02
6,0442E+05	1,5504E-01	7,5149E+05	4,7573E-02
6,0736E+05	1,5967E-01	7,5444E+05	4,3902E-02
6,1030E+05	1,6394E-01	7,5738E+05	4,0541E-02
6,1324E+05	1,6784E-01	7,6032E+05	3,7493E-02
6,1619E+05	1,7141E-01	7,6326E+05	3,4708E-02
6,1913E+05	1,7465E-01	7,6620E+05	3,2205E-02
6,2207E+05	1,7763E-01	7,6914E+05	2,9921E-02
6,2501E+05	1,8036E-01	7,7209E+05	2,7859E-02
6,2795E+05	1,8292E-01	7,7503E+05	2,6018E-02
6,3089E+05	1,8536E-01	7,7797E+05	2,4405E-02
6,3383E+05	1,8773E-01	7,8091E+05	2,2966E-02
6,3677E+05	1,9000E-01	7,8385E+05	2,1684E-02
6,3972E+05	1,9214E-01	7,8680E+05	2,1201E-02
6,4266E+05	1,9408E-01	7,8974E+05	2,0252E-02
6,4560E+05	1,9574E-01	7,9268E+05	1,9450E-02
6,4854E+05	1,9700E-01	7,9562E+05	1,8775E-02

PLTCVT PROGRAM DATA SUMMARY
PIR 1 Chain 2
CONTAMINANT = U-233
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 8.000000E+05
NUMBER OF CELLS = 500
DELTA TIME INCREMENT = 1.580000E+03

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 8.7037E+05	MIN. TIME = 1.6584E+04
TOTAL WEIGHT = 7.3028E+04	TOTAL PARCELS = 27225.0
PEAK WEIGHT = 464.687	PEAK WEIGHT TIME = 4.6741E+05
PEAK PARCELS = 373.000	PEAK PARCELS TIME = 1.4509E+05
WT. LOW = 0.0000E-01	NO. PARCELS LOW = 0.0
WT. HI = 3.7536E+01	NO. PARCELS HI = 621.0

SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 7.306534E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 7.309506E+04
PERCENT OF TOTAL INVENTORY = 100.041

TIME OF MAXIMUM CONCENTRATION (YEARS) = 5.084900E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.918823E-07
MAXIMUM RATE (CURIES/YEAR) = 1.509900E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.7110E+04	1.4075E-02	4.0000E+05	1.3975E-01
2.3258E+04	1.5852E-02	4.1059E+05	1.4099E-01
2.9406E+04	1.9529E-02	4.2118E+05	1.4229E-01
3.5555E+04	2.1658E-02	4.3177E+05	1.4367E-01
4.1703E+04	2.1571E-02	4.4235E+05	1.4508E-01
4.7851E+04	2.1640E-02	4.5294E+05	1.4649E-01
5.3999E+04	2.2545E-02	4.6353E+05	1.4782E-01
6.0147E+04	2.2539E-02	4.7412E+05	1.4901E-01
6.6295E+04	2.1228E-02	4.8471E+05	1.4998E-01
7.2444E+04	2.0370E-02	4.9529E+05	1.5065E-01
7.8592E+04	2.0995E-02	5.0588E+05	1.5096E-01

8.4740E+04	2.2075E-02	5.1647E+05	1.5089E-01
9.0888E+04	2.2532E-02	5.2706E+05	1.5037E-01
9.7036E+04	2.2509E-02	5.3765E+05	1.4944E-01
1.0318E+05	2.2336E-02	5.4824E+05	1.4806E-01
1.0933E+05	2.2106E-02	5.5882E+05	1.4619E-01
1.1548E+05	2.2018E-02	5.6941E+05	1.4415E-01
1.2163E+05	2.2472E-02	5.8000E+05	1.4126E-01
1.2778E+05	2.4099E-02	5.8664E+05	1.3778E-01
1.3393E+05	2.7610E-02	5.9329E+05	1.3332E-01
1.4007E+05	3.3275E-02	5.9993E+05	1.2858E-01
1.4622E+05	4.0167E-02	6.0657E+05	1.2416E-01
1.5237E+05	4.6535E-02	6.1321E+05	1.2005E-01
1.5852E+05	5.1505E-02	6.1986E+05	1.1540E-01
1.6467E+05	5.7087E-02	6.2650E+05	1.0941E-01
1.7081E+05	6.6169E-02	6.3314E+05	1.0217E-01
1.7696E+05	7.6540E-02	6.3979E+05	9.4531E-02
1.8311E+05	8.4411E-02	6.4643E+05	8.7321E-02
1.8926E+05	9.2704E-02	6.5307E+05	8.0652E-02
1.9541E+05	1.0597E-01	6.5971E+05	7.3999E-02
2.0156E+05	1.2261E-01	6.6636E+05	6.6898E-02
2.0770E+05	1.3759E-01	6.7300E+05	5.9455E-02
2.1385E+05	1.4711E-01	6.7964E+05	5.2310E-02
2.2000E+05	1.4998E-01	6.8628E+05	4.5932E-02
2.3059E+05	1.4737E-01	6.9293E+05	4.0332E-02
2.4118E+05	1.4455E-01	6.9957E+05	3.5210E-02
2.5176E+05	1.4202E-01	7.0621E+05	3.0336E-02
2.6235E+05	1.3949E-01	7.1286E+05	2.5727E-02
2.7294E+05	1.3733E-01	7.1950E+05	2.1559E-02
2.8353E+05	1.3560E-01	7.2614E+05	1.7948E-02
2.9412E+05	1.3434E-01	7.3278E+05	1.4884E-02
3.0471E+05	1.3357E-01	7.3943E+05	1.2298E-02
3.1529E+05	1.3327E-01	7.4607E+05	1.0120E-02
3.2588E+05	1.3338E-01	7.5271E+05	8.3108E-03
3.3647E+05	1.3382E-01	7.5935E+05	6.7892E-03
3.4706E+05	1.3452E-01	7.6600E+05	5.4859E-03
3.5765E+05	1.3540E-01	7.7264E+05	4.3971E-03
3.6824E+05	1.3639E-01	7.7928E+05	3.5139E-03
3.7882E+05	1.3746E-01	7.8593E+05	2.8443E-03
3.8941E+05	1.3858E-01	7.9257E+05	2.4541E-03

PLTCVT PROGRAM DATA SUMMARY
PIR 1 Chain 2
CONTAMINANT = TH-229
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 8.000000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 1.975000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.0512E+06 MIN. TIME = 1.5814E+04
TOTAL WEIGHT = 4.0226E+03 TOTAL PARCELS = 29241.0
PEAK WEIGHT = 50.002 PEAK WEIGHT TIME = 3.7439E+05
PEAK PARCELS = 183.000 PEAK PARCELS TIME = 1.6306E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 3.2539E+00 NO. PARCELS HI = 9691.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 4.025886E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.002529E+03
PERCENT OF TOTAL INVENTORY = 99.420

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.909125E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.587910E-08
MAXIMUM RATE (CURIES/YEAR) = 8.214217E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.4938E+04	2.3525E-04	4.0000E+05	7.7212E-03
2.1152E+04	4.0416E-04	4.1059E+05	7.8421E-03
2.7366E+04	6.3299E-04	4.2118E+05	7.9456E-03
3.3580E+04	9.1661E-04	4.3176E+05	8.0301E-03
3.9794E+04	1.1315E-03	4.4235E+05	8.0961E-03
4.6008E+04	1.2540E-03	4.5294E+05	8.1448E-03
5.2222E+04	1.3307E-03	4.6353E+05	8.1790E-03
5.8436E+04	1.3653E-03	4.7412E+05	8.2010E-03
6.4650E+04	1.3819E-03	4.8471E+05	8.2123E-03
7.0864E+04	1.3356E-03	4.9529E+05	8.2133E-03
7.7078E+04	1.2921E-03	5.0588E+05	8.2019E-03

8.3292E+04	1.2851E-03	5.1647E+05	8.1740E-03
8.9506E+04	1.3124E-03	5.2706E+05	8.1310E-03
9.5720E+04	1.3451E-03	5.3765E+05	8.0666E-03
1.0193E+05	1.3590E-03	5.4824E+05	7.9628E-03
1.0815E+05	1.3613E-03	5.5882E+05	7.8628E-03
1.1436E+05	1.3677E-03	5.6941E+05	7.7312E-03
1.2058E+05	1.3764E-03	5.6000E+05	7.5325E-03
1.2679E+05	1.3936E-03	5.8664E+05	7.2976E-03
1.3300E+05	1.4565E-03	5.9327E+05	7.0442E-03
1.3922E+05	1.6095E-03	5.9991E+05	6.8253E-03
1.4543E+05	1.8694E-03	6.0655E+05	6.6571E-03
1.5165E+05	2.2200E-03	6.1318E+05	6.5057E-03
1.5786E+05	2.6346E-03	6.1982E+05	6.3192E-03
1.6407E+05	3.1014E-03	6.2646E+05	6.0728E-03
1.7029E+05	3.6120E-03	6.3309E+05	5.7811E-03
1.7650E+05	4.1145E-03	6.3973E+05	5.4943E-03
1.8272E+05	4.5067E-03	6.4637E+05	5.2483E-03
1.8893E+05	4.7399E-03	6.5300E+05	5.0449E-03
1.9514E+05	4.9691E-03	6.5964E+05	4.8431E-03
2.0136E+05	5.4795E-03	6.6628E+05	4.5949E-03
2.0757E+05	6.3562E-03	6.7291E+05	4.2715E-03
2.1379E+05	7.2963E-03	6.7955E+05	3.8806E-03
2.2000E+05	7.8099E-03	6.8619E+05	3.4502E-03
2.3059E+05	7.8471E-03	6.9283E+05	3.0071E-03
2.4118E+05	7.7483E-03	6.9946E+05	2.5726E-03
2.5176E+05	7.6103E-03	7.0610E+05	2.1627E-03
2.6235E+05	7.5206E-03	7.1274E+05	1.7963E-03
2.7294E+05	7.3766E-03	7.1937E+05	1.4870E-03
2.8353E+05	7.2402E-03	7.2601E+05	1.2403E-03
2.9412E+05	7.1269E-03	7.3265E+05	1.0500E-03
3.0471E+05	7.0387E-03	7.3928E+05	8.9874E-04
3.1529E+05	6.9873E-03	7.4592E+05	7.7003E-04
3.2588E+05	6.9783E-03	7.5256E+05	6.5459E-04
3.3647E+05	7.0106E-03	7.5919E+05	5.4848E-04
3.4706E+05	7.0814E-03	7.6583E+05	4.5410E-04
3.5765E+05	7.1834E-03	7.7247E+05	3.7456E-04
3.6824E+05	7.3083E-03	7.7910E+05	3.1094E-04
3.7882E+05	7.4461E-03	7.8574E+05	2.6508E-04
3.8941E+05	7.5868E-03	7.9238E+05	2.3962E-04

PLTCVT PROGRAM DATA SUMMARY
PIRI (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-238
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+05
TIME HIGH= 3.000000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 5.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9999E+06 MIN. TIME = 1.1281E+05
TOTAL WEIGHT = 2.4460E+04 TOTAL PARCELS = 10735.0
PEAK WEIGHT = 282.065 PEAK WEIGHT TIME = 1.5125E+05
PEAK PARCELS = 70.000 PEAK PARCELS TIME = 1.5125E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 8.1773E+00 NO. PARCELS HI = 13228.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 2.446779E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.445368E+04
PERCENT OF TOTAL INVENTORY = 99.942

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.562500E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 8.614734E-07
MAXIMUM RATE (CURIES/YEAR) = 4.456380E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = U-238

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.1225E+05	7.8678E-04	2.0600E+05	1.3976E-01
1.1413E+05	1.6477E-03	2.0788E+05	1.3823E-01
1.1600E+05	3.6103E-03	2.0975E+05	1.3627E-01
1.1788E+05	6.7275E-03	2.1163E+05	1.3472E-01
1.1975E+05	1.1390E-02	2.1350E+05	1.3425E-01
1.2163E+05	1.7719E-02	2.1538E+05	1.3449E-01
1.2350E+05	2.5657E-02	2.1725E+05	1.3390E-01
1.2538E+05	3.5531E-02	2.1913E+05	1.3050E-01
1.2725E+05	4.8275E-02	2.2100E+05	1.2367E-01
1.2913E+05	6.5240E-02	2.2288E+05	1.1448E-01
1.3100E+05	8.7275E-02	2.2475E+05	1.0522E-01
1.3288E+05	1.1432E-01	2.2663E+05	9.7939E-02
1.3475E+05	1.4558E-01	2.2850E+05	9.3392E-02

1,3663E+05	1,7999E-01	2,3038E+05	9,0629E-02
1,3850E+05	2,1656E-01	2,3225E+05	8,7901E-02
1,4038E+05	2,5409E-01	2,3413E+05	8,3724E-02
1,4225E+05	2,9101E-01	2,3600E+05	7,7821E-02
1,4413E+05	3,2556E-01	2,3788E+05	7,0585E-02
1,4600E+05	3,5687E-01	2,3975E+05	6,2472E-02
1,4788E+05	3,8456E-01	2,4163E+05	5,3898E-02
1,4975E+05	4,0815E-01	2,4350E+05	4,5606E-02
1,5163E+05	4,2652E-01	2,4538E+05	3,8541E-02
1,5350E+05	4,3889E-01	2,4725E+05	3,3159E-02
1,5538E+05	4,4495E-01	2,4913E+05	2,9074E-02
1,5725E+05	4,4471E-01	2,5100E+05	2,5374E-02
1,5913E+05	4,3828E-01	2,5288E+05	2,1551E-02
1,6100E+05	4,2626E-01	2,5475E+05	1,7713E-02
1,6288E+05	4,0979E-01	2,5663E+05	1,4186E-02
1,6475E+05	3,9001E-01	2,5850E+05	1,1138E-02
1,6663E+05	3,6791E-01	2,6038E+05	8,4762E-03
1,6850E+05	3,4421E-01	2,6225E+05	6,2103E-03
1,7038E+05	3,1962E-01	2,6413E+05	4,4131E-03
1,7225E+05	2,9460E-01	2,6600E+05	3,1861E-03
1,7413E+05	2,6929E-01	2,6788E+05	2,4531E-03
1,7600E+05	2,4396E-01	2,6975E+05	2,0212E-03
1,7788E+05	2,1991E-01	2,7163E+05	1,7191E-03
1,7975E+05	1,9942E-01	2,7350E+05	1,4848E-03
1,8163E+05	1,8454E-01	2,7538E+05	1,3164E-03
1,8350E+05	1,7505E-01	2,7725E+05	1,1969E-03
1,8538E+05	1,6875E-01	2,7913E+05	1,0661E-03
1,8725E+05	1,6293E-01	2,8100E+05	8,7697E-04
1,8913E+05	1,5612E-01	2,8288E+05	6,3138E-04
1,9100E+05	1,4877E-01	2,8475E+05	3,9144E-04
1,9288E+05	1,4224E-01	2,8663E+05	2,0325E-04
1,9475E+05	1,3786E-01	2,8850E+05	9,0332E-05
1,9663E+05	1,3613E-01	2,9038E+05	3,5756E-05
1,9850E+05	1,3663E-01	2,9225E+05	2,2583E-05
2,0038E+05	1,3824E-01	2,9413E+05	1,7878E-05
2,0225E+05	1,3975E-01	2,9600E+05	1,6937E-05
2,0413E+05	1,4033E-01	2,9788E+05	1,1292E-05

PLTCVT PROGRAM DATA SUMMARY
PIR1(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-234
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+05
TIME HIGH= 3.000000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 5.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 2.0000E+06 MIN. TIME = 1.0747E+05
TOTAL WEIGHT = 9.6430E+04 TOTAL PARCELS = 20565.0
PEAK WEIGHT = 1133.024 PEAK WEIGHT TIME = 1.5125E+05
PEAK PARCELS = 115.000 PEAK PARCELS TIME = 1.5125E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 2.5367E+00 NO. PARCELS HI = 8512.0
SMOOTHING WINDOW (CELLS)= 7

TOTAL INVENTORY (CURIES) = 9.643279E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 9.642510E+04
PERCENT OF TOTAL INVENTORY = 99.992

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.542500E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 3.420995E-06
MAXIMUM RATE (CURIES/YEAR) = 1.769672E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = U-234

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.0725E+05	2.3010E-03	2.0350E+05	5.1171E-01
1.0918E+05	4.2666E-03	2.0543E+05	5.0518E-01
1.1110E+05	6.5708E-03	2.0735E+05	4.9884E-01
1.1303E+05	1.4638E-02	2.0928E+05	4.9225E-01
1.1495E+05	2.3950E-02	2.1120E+05	4.8462E-01
1.1688E+05	3.6620E-02	2.1313E+05	4.7594E-01
1.1880E+05	5.3689E-02	2.1505E+05	4.6668E-01
1.2073E+05	7.6939E-02	2.1698E+05	4.5620E-01
1.2265E+05	1.0867E-01	2.1890E+05	4.4388E-01
1.2458E+05	1.5198E-01	2.2083E+05	4.2935E-01

1,2650E+05	2,1040E-01	2,2275E+05	4,1191E-01
1,2843E+05	2,8625E-01	2,2468E+05	3,9159E-01
1,3035E+05	3,8069E-01	2,2660E+05	3,6890E-01
1,3228E+05	4,9255E-01	2,2853E+05	3,4364E-01
1,3420E+05	6,1899E-01	2,3045E+05	3,1704E-01
1,3613E+05	7,5597E-01	2,3238E+05	2,9001E-01
1,3805E+05	8,9930E-01	2,3430E+05	2,6362E-01
1,3998E+05	1,0468E+00	2,3623E+05	2,3879E-01
1,4190E+05	1,1952E+00	2,3815E+05	2,1493E-01
1,4383E+05	1,3408E+00	2,4008E+05	1,9144E-01
1,4575E+05	1,4774E+00	2,4200E+05	1,6779E-01
1,4768E+05	1,5942E+00	2,4393E+05	1,4429E-01
1,4960E+05	1,6837E+00	2,4585E+05	1,2224E-01
1,5153E+05	1,7410E+00	2,4778E+05	1,0267E-01
1,5345E+05	1,7666E+00	2,4970E+05	8,6085E-02
1,5538E+05	1,7672E+00	2,5163E+05	7,2269E-02
1,5730E+05	1,7480E+00	2,5355E+05	6,0327E-02
1,5923E+05	1,7132E+00	2,5548E+05	4,9678E-02
1,6115E+05	1,6637E+00	2,5740E+05	4,0193E-02
1,6308E+05	1,5988E+00	2,5933E+05	3,1847E-02
1,6500E+05	1,5192E+00	2,6125E+05	2,4826E-02
1,6693E+05	1,4270E+00	2,6318E+05	1,9310E-02
1,6885E+05	1,3275E+00	2,6510E+05	1,5257E-02
1,7078E+05	1,2271E+00	2,6703E+05	1,2573E-02
1,7270E+05	1,1310E+00	2,6895E+05	1,0894E-02
1,7463E+05	1,0426E+00	2,7088E+05	9,6015E-03
1,7655E+05	9,6159E-01	2,7280E+05	8,2247E-03
1,7848E+05	8,8543E-01	2,7473E+05	6,5272E-03
1,8040E+05	8,1335E-01	2,7665E+05	4,6280E-03
1,8233E+05	7,4614E-01	2,7858E+05	2,8575E-03
1,8425E+05	6,8648E-01	2,8050E+05	1,4679E-03
1,8618E+05	6,3830E-01	2,8243E+05	6,4512E-04
1,8810E+05	6,0286E-01	2,8435E+05	2,3185E-04
1,9003E+05	5,7906E-01	2,8628E+05	6,1727E-05
1,9195E+05	5,6430E-01	2,8820E+05	6,0221E-05
1,9388E+05	5,5448E-01	2,9013E+05	4,1402E-05
1,9580E+05	5,4622E-01	2,9205E+05	3,0111E-05
1,9773E+05	5,3762E-01	2,9398E+05	8,2804E-06
1,9965E+05	5,2848E-01	2,9590E+05	1,5055E-05
2,0158E+05	5,1945E-01	2,9783E+05	0,0000E-01

PLTCVT PROGRAM DATA SUMMARY
PIRI(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = TH-230
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+05
TIME HIGH= 7.000000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 1.500000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9998E+06 MIN. TIME = 1.1130E+05
TOTAL WEIGHT = 4.2971E+03 TOTAL PARCELS = 9657.0
PEAK WEIGHT = 59.522 PEAK WEIGHT TIME = 1.9375E+05
PEAK PARCELS = 61.000 PEAK PARCELS TIME = 5.3575E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 3.1003E+01 NO. PARCELS HI = 13620.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 4.328140E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.324328E+03
PERCENT OF TOTAL INVENTORY = 99.912

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.937500E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 5.410652E-08
MAXIMUM RATE (CURIES/YEAR) = 2.798917E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = TH-230

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.1125E+05	3.6420E-05	2.9681E+05	1.1555E-02
1.1394E+05	1.2185E-04	3.0269E+05	1.1164E-02
1.1663E+05	2.5791E-04	3.0857E+05	1.0789E-02
1.1932E+05	4.3231E-04	3.1445E+05	1.0409E-02
1.2201E+05	6.6718E-04	3.2034E+05	9.9916E-03
1.2470E+05	1.0420E-03	3.2622E+05	9.5196E-03
1.2739E+05	1.5294E-03	3.3210E+05	9.0021E-03
1.3008E+05	2.1360E-03	3.3798E+05	8.4908E-03
1.3277E+05	2.8837E-03	3.4387E+05	7.9983E-03
1.3545E+05	3.7468E-03	3.4975E+05	7.5560E-03

1.3814E+05	4.6894E-03	3.5563E+05	7.1174E-03
1.4083E+05	5.7447E-03	3.6151E+05	6.7231E-03
1.4352E+05	6.9584E-03	3.6740E+05	6.3704E-03
1.4621E+05	8.3166E-03	3.7328E+05	6.0297E-03
1.4890E+05	9.7395E-03	3.7916E+05	5.6748E-03
1.5159E+05	1.1231E-02	3.8504E+05	5.3532E-03
1.5428E+05	1.2841E-02	3.9092E+05	5.0564E-03
1.5697E+05	1.4522E-02	3.9681E+05	4.7652E-03
1.5966E+05	1.6163E-02	4.0269E+05	4.4799E-03
1.6235E+05	1.7690E-02	4.1176E+05	4.0730E-03
1.6504E+05	1.9154E-02	4.2083E+05	3.6894E-03
1.6773E+05	2.0519E-02	4.2989E+05	3.3462E-03
1.7042E+05	2.1728E-02	4.3896E+05	3.0558E-03
1.7311E+05	2.2785E-02	4.4803E+05	2.8078E-03
1.7580E+05	2.3770E-02	4.5710E+05	2.6024E-03
1.7848E+05	2.4734E-02	4.6617E+05	2.4235E-03
1.8117E+05	2.5609E-02	4.7523E+05	2.2789E-03
1.8386E+05	2.6412E-02	4.8430E+05	2.1569E-03
1.8655E+05	2.7115E-02	4.9337E+05	2.0453E-03
1.8924E+05	2.7661E-02	5.0244E+05	1.9225E-03
1.9193E+05	2.7947E-02	5.1151E+05	1.7826E-03
1.9462E+05	2.7954E-02	5.2058E+05	1.6296E-03
1.9731E+05	2.7731E-02	5.2964E+05	1.4825E-03
2.0000E+05	2.7319E-02	5.3871E+05	1.3485E-03
2.0269E+05	2.6760E-02	5.4778E+05	1.2276E-03
2.0857E+05	2.5617E-02	5.5685E+05	1.1208E-03
2.1445E+05	2.4481E-02	5.6592E+05	1.0282E-03
2.2034E+05	2.3465E-02	5.7498E+05	9.5034E-04
2.2622E+05	2.2549E-02	5.8405E+05	8.7940E-04
2.3210E+05	2.1604E-02	5.9312E+05	8.0902E-04
2.3798E+05	2.0656E-02	6.0219E+05	7.3901E-04
2.4387E+05	1.9662E-02	6.1126E+05	6.7360E-04
2.4975E+05	1.8557E-02	6.2033E+05	6.1849E-04
2.5563E+05	1.7353E-02	6.2939E+05	5.7015E-04
2.6151E+05	1.6163E-02	6.3846E+05	5.2606E-04
2.6740E+05	1.5043E-02	6.4753E+05	4.7843E-04
2.7328E+05	1.4057E-02	6.5660E+05	4.2869E-04
2.7916E+05	1.3196E-02	6.6567E+05	3.8289E-04
2.8504E+05	1.2505E-02	6.7473E+05	3.4523E-04
2.9092E+05	1.1968E-02	6.8380E+05	3.1877E-04

PLTCVT PROGRAM DATA SUMMARY
PIRI(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = RA-226
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+05
TIME HIGH= 7.000000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 3.000000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9996E+06 MIN. TIME = 1.0955E+05
TOTAL WEIGHT = 9.3993E+03 TOTAL PARCELS = 5314.0
PEAK WEIGHT = 271.119 PEAK WEIGHT TIME = 1.7950E+05
PEAK PARCELS = 119.000 PEAK PARCELS TIME = 2.1850E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 7.8388E+01 NO. PARCELS HI = 1455.0
SMOOTHING WINDOW (CELLS)= 7

TOTAL INVENTORY (CURIES) = 9.477718E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 9.227598E+03
PERCENT OF TOTAL INVENTORY = 97.361

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.975000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.237114E-07
MAXIMUM RATE (CURIES/YEAR) = 6.399560E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = RA-226

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.1050E+05	6.7199E-05	2.5000E+05	4.6187E-02
1.1230E+05	6.7199E-05	2.5471E+05	4.3406E-02
1.1411E+05	8.7273E-05	2.5941E+05	4.0643E-02
1.1591E+05	1.4699E-04	2.6412E+05	3.7932E-02
1.1771E+05	2.2553E-04	2.6882E+05	3.5315E-02
1.1952E+05	3.1411E-04	2.7353E+05	3.2838E-02
1.2132E+05	5.0441E-04	2.7824E+05	3.0550E-02
1.2312E+05	7.3226E-04	2.8294E+05	2.8511E-02
1.2492E+05	1.0316E-03	2.8765E+05	2.6686E-02
1.2673E+05	1.4696E-03	2.9235E+05	2.5031E-02
1.2853E+05	1.9768E-03	2.9706E+05	2.3471E-02

1,3033E+05	2,7240E-03	3,0176E+05	2,2022E-02
1,3214E+05	3,5628E-03	3,0647E+05	2,0644E-02
1,3394E+05	4,5693E-03	3,1118E+05	1,9307E-02
1,3574E+05	5,7871E-03	3,1588E+05	1,8023E-02
1,3755E+05	7,1108E-03	3,2059E+05	1,6791E-02
1,3935E+05	8,8399E-03	3,2529E+05	1,5587E-02
1,4115E+05	1,0687E-02	3,3000E+05	1,4399E-02
1,4295E+05	1,2741E-02	3,3471E+05	1,3236E-02
1,4476E+05	1,5016E-02	3,4587E+05	1,0803E-02
1,4656E+05	1,7399E-02	3,5704E+05	8,9876E-03
1,4836E+05	2,0122E-02	3,6821E+05	7,7168E-03
1,5017E+05	2,2978E-02	3,7937E+05	6,8080E-03
1,5197E+05	2,6060E-02	3,9054E+05	6,1307E-03
1,5377E+05	2,9284E-02	4,0171E+05	5,6332E-03
1,5558E+05	3,2575E-02	4,1287E+05	5,3648E-03
1,5738E+05	3,6048E-02	4,2404E+05	5,4183E-03
1,5918E+05	3,9539E-02	4,3521E+05	5,7473E-03
1,6098E+05	4,3060E-02	4,4637E+05	5,8543E-03
1,6279E+05	4,6341E-02	4,5754E+05	5,5829E-03
1,6459E+05	4,9496E-02	4,6871E+05	4,8615E-03
1,6639E+05	5,2112E-02	4,7987E+05	3,7162E-03
1,6820E+05	5,4255E-02	4,9104E+05	2,6846E-03
1,7000E+05	5,5648E-02	5,0221E+05	1,8875E-03
1,7471E+05	5,8221E-02	5,1337E+05	1,3795E-03
1,7941E+05	6,0008E-02	5,2454E+05	1,2054E-03
1,8412E+05	6,1446E-02	5,3571E+05	1,1729E-03
1,8882E+05	6,3060E-02	5,4687E+05	1,2257E-03
1,9353E+05	6,3746E-02	5,5804E+05	1,3083E-03
1,9824E+05	6,3992E-02	5,6921E+05	1,3199E-03
2,0294E+05	6,3857E-02	5,8037E+05	1,2570E-03
2,0765E+05	6,3409E-02	5,9154E+05	1,1291E-03
2,1235E+05	6,2588E-02	6,0271E+05	9,5477E-04
2,1706E+05	6,1404E-02	6,1387E+05	8,0642E-04
2,2176E+05	5,9969E-02	6,2504E+05	6,8263E-04
2,2647E+05	5,8263E-02	6,3621E+05	5,8233E-04
2,3118E+05	5,6297E-02	6,4737E+05	5,0193E-04
2,3588E+05	5,4050E-02	6,5854E+05	4,3042E-04
2,4059E+05	5,1563E-02	6,6971E+05	3,7325E-04
2,4529E+05	4,8915E-02	6,8087E+05	3,3943E-04

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PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = AM-243
  TONS OF HEAVY METAL FACTOR =    1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =    2
TIME LOW =    1.400000E+04
TIME HIGH=    3.200000E+04
NUMBER OF CELLS =            200
DELTA TIME INCREMENT =    9.000000E+01


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  3.0167E+04       MIN. TIME =  1.4907E+04
TOTAL WEIGHT =  8.7575E+04    TOTAL PARCELS =        1523.0
PEAK WEIGHT =    1474.076     PEAK WEIGHT TIME =  1.6205E+04
PEAK PARCELS =      18.000    PEAK PARCELS TIME =  2.1785E+04
WT. LOW =  0.0000E-01         NO. PARCELS LOW =          0.0
WT. HI =  0.0000E-01          NO. PARCELS HI =          0.0
 SMOOTHING WINDOW (CELLS)=     20


TOTAL INVENTORY (CURIES) =    8.757455E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =    8.875613E+04
PERCENT OF TOTAL INVENTORY = 101.349

TIME OF MAXIMUM CONCENTRATION (YEARS) =    1.494500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =    2.071308E-05
MAXIMUM RATE (CURIES/YEAR) =    1.071482E+01
CONVERSION FACTOR RATE TO CONCENTRATION =    1.933123E-06


 CONTAMINANT = AM-243

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE    100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.4945E+04	1.0715E+01	2.1500E+04	6.1842E+00
1.4977E+04	1.0715E+01	2.1824E+04	5.9977E+00
1.5009E+04	1.0715E+01	2.2147E+04	5.7817E+00
1.5041E+04	1.0712E+01	2.2471E+04	5.5797E+00
1.5073E+04	1.0697E+01	2.2794E+04	5.3993E+00
1.5105E+04	1.0682E+01	2.3118E+04	5.2254E+00
1.5137E+04	1.0666E+01	2.3441E+04	5.0704E+00
1.5169E+04	1.0658E+01	2.3765E+04	4.9273E+00
1.5201E+04	1.0648E+01	2.4088E+04	4.7961E+00

1,5233E+04	1,0644E+01	2,4412E+04	4,6608E+00
1,5265E+04	1,0646E+01	2,4735E+04	4,5312E+00
1,5297E+04	1,0647E+01	2,5059E+04	4,4266E+00
1,5329E+04	1,0641E+01	2,5382E+04	4,3095E+00
1,5361E+04	1,0633E+01	2,5706E+04	4,1846E+00
1,5393E+04	1,0625E+01	2,6029E+04	4,0460E+00
1,5425E+04	1,0607E+01	2,6353E+04	3,9423E+00
1,5457E+04	1,0589E+01	2,6676E+04	3,8123E+00
1,5488E+04	1,0570E+01	2,7000E+04	3,6415E+00
1,5520E+04	1,0541E+01	2,7324E+04	3,3636E+00
1,5552E+04	1,0513E+01	2,7419E+04	3,2713E+00
1,5584E+04	1,0485E+01	2,7515E+04	3,1726E+00
1,5616E+04	1,0460E+01	2,7610E+04	3,0655E+00
1,5648E+04	1,0436E+01	2,7706E+04	2,9524E+00
1,5680E+04	1,0402E+01	2,7802E+04	2,8329E+00
1,5712E+04	1,0358E+01	2,7897E+04	2,7054E+00
1,5744E+04	1,0314E+01	2,7993E+04	2,5836E+00
1,5776E+04	1,0270E+01	2,8088E+04	2,4670E+00
1,5808E+04	1,0225E+01	2,8184E+04	2,3517E+00
1,5840E+04	1,0180E+01	2,8280E+04	2,2379E+00
1,5872E+04	1,0134E+01	2,8375E+04	2,1231E+00
1,5904E+04	1,0088E+01	2,8471E+04	2,0161E+00
1,5936E+04	1,0042E+01	2,8566E+04	1,9091E+00
1,5968E+04	1,0008E+01	2,8662E+04	1,8045E+00
1,6000E+04	9,9733E+00	2,8758E+04	1,7006E+00
1,6324E+04	9,7789E+00	2,8853E+04	1,6040E+00
1,6647E+04	9,5532E+00	2,8949E+04	1,5106E+00
1,6971E+04	9,3328E+00	2,9044E+04	1,4178E+00
1,7294E+04	9,1144E+00	2,9140E+04	1,3255E+00
1,7618E+04	8,8634E+00	2,9236E+04	1,2339E+00
1,7941E+04	8,6186E+00	2,9331E+04	1,2561E+00
1,8265E+04	8,4064E+00	2,9427E+04	1,1952E+00
1,8588E+04	8,1886E+00	2,9522E+04	1,1189E+00
1,8912E+04	7,9531E+00	2,9618E+04	1,0465E+00
1,9235E+04	7,7199E+00	2,9714E+04	9,7971E-01
1,9559E+04	7,4946E+00	2,9809E+04	9,1663E-01
1,9882E+04	7,2670E+00	2,9905E+04	8,5670E-01
2,0206E+04	7,0397E+00	3,0000E+04	8,0112E-01
2,0529E+04	6,8122E+00	3,0096E+04	7,4688E-01
2,0853E+04	6,5882E+00	3,0192E+04	6,9174E-01
2,1176E+04	6,3872E+00	3,0287E+04	6,3659E-01

PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = PU-239
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 1.700000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 8.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 4.2632E+05	MIN. TIME = 1.6733E+04
TOTAL WEIGHT = 2.7583E+02	TOTAL PARCELS = 24.0
PEAK WEIGHT = 80.281	PEAK WEIGHT TIME = 4.1600E+04
PEAK PARCELS = 2.000	PEAK PARCELS TIME = 4.2400E+04
WT. LOW = 0.0000E-01	NO. PARCELS LOW = 0.0
WT. HI = 4.9434E+00	NO. PARCELS HI = 23.0

SMOOTHING WINDOW (CELLS)= 3

TOTAL INVENTORY (CURIES) = 2.807703E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.442220E+02
PERCENT OF TOTAL INVENTORY = 86.983

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.920000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.906475E-08
MAXIMUM RATE (CURIES/YEAR) = 1.503512E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = PU-239

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.6800E+04	2.0327E-03	8.9600E+04	9.4184E-05
1.8256E+04	2.4710E-03	9.1056E+04	2.0855E-04
1.9712E+04	3.2106E-03	9.2512E+04	4.0458E-04
2.1168E+04	2.9981E-03	9.3968E+04	6.7272E-04
2.2624E+04	2.1901E-03	9.5424E+04	9.0960E-04
2.4080E+04	1.2365E-03	9.6880E+04	1.0048E-03
2.5536E+04	5.8176E-04	9.8336E+04	9.3806E-04
2.6992E+04	2.5954E-04	9.9792E+04	7.2225E-04
2.8448E+04	1.8930E-04	1.0125E+05	4.8451E-04

2.9904E+04	5.3458E-04	1.0270E+05	3.1627E-04
3.1360E+04	1.5163E-03	1.0416E+05	2.3183E-04
3.2816E+04	3.4076E-03	1.0562E+05	2.3103E-04
3.4272E+04	6.4067E-03	1.0707E+05	2.7980E-04
3.5728E+04	9.8393E-03	1.0853E+05	3.4751E-04
3.7184E+04	1.2993E-02	1.0998E+05	4.2106E-04
3.8640E+04	1.4756E-02	1.1144E+05	4.8749E-04
4.0096E+04	1.4796E-02	1.1290E+05	5.3440E-04
4.1552E+04	1.2913E-02	1.1435E+05	5.5938E-04
4.3008E+04	9.8332E-03	1.1581E+05	5.6651E-04
4.4464E+04	6.4779E-03	1.1726E+05	5.5829E-04
4.5920E+04	3.6404E-03	1.1872E+05	5.3589E-04
4.7376E+04	2.2615E-03	1.2018E+05	4.9705E-04
4.8832E+04	2.3483E-03	1.2163E+05	4.4855E-04
5.0288E+04	3.6321E-03	1.2309E+05	4.0340E-04
5.1744E+04	5.5464E-03	1.2454E+05	3.6648E-04
5.3200E+04	6.6484E-03	1.2600E+05	3.4126E-04
5.4656E+04	6.5858E-03	1.2746E+05	3.0939E-04
5.6112E+04	5.3986E-03	1.2891E+05	2.5831E-04
5.7568E+04	3.3646E-03	1.3037E+05	1.9279E-04
5.9024E+04	1.7630E-03	1.3182E+05	1.1847E-04
6.0480E+04	7.8818E-04	1.3328E+05	6.0986E-05
6.1936E+04	4.3409E-04	1.3474E+05	2.6674E-05
6.3392E+04	4.2745E-04	1.3619E+05	1.0686E-05
6.4848E+04	4.6006E-04	1.3765E+05	8.0864E-06
6.6304E+04	4.3894E-04	1.3910E+05	8.1381E-06
6.7760E+04	3.7742E-04	1.4056E+05	8.1275E-06
6.9216E+04	3.0164E-04	1.4202E+05	8.0875E-06
7.0672E+04	2.3395E-04	1.4347E+05	8.1158E-06
7.2128E+04	1.8914E-04	1.4493E+05	8.1111E-06
7.3584E+04	1.6761E-04	1.4638E+05	8.1152E-06
7.5040E+04	1.5201E-04	1.4784E+05	8.1099E-06
7.6496E+04	1.3434E-04	1.4930E+05	8.1228E-06
7.7952E+04	1.1108E-04	1.5075E+05	8.1899E-06
7.9408E+04	8.4141E-05	1.5221E+05	9.4008E-06
8.0864E+04	6.4426E-05	1.5366E+05	1.2973E-05
8.2320E+04	5.3111E-05	1.5512E+05	2.0504E-05
8.3776E+04	4.8945E-05	1.5658E+05	3.1964E-05
8.5232E+04	4.9911E-05	1.5803E+05	4.3419E-05
8.6688E+04	5.2628E-05	1.5949E+05	4.9256E-05
8.8144E+04	5.8154E-05	1.6094E+05	4.2437E-05

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PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = U-235
  TONS OF HEAVY METAL FACTOR =    1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =    2
TIME LOW =    1.000000E+05
TIME HIGH=    3.000000E+05
NUMBER OF CELLS =           400
DELTA TIME INCREMENT =    5.000000E+02


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  5.7310E+05        MIN. TIME =  1.6258E+04
TOTAL WEIGHT =  8.1607E+02     TOTAL PARCELS =       15775.0
PEAK WEIGHT =         21.727   PEAK WEIGHT TIME =  1.6625E+05
PEAK PARCELS =       136.000   PEAK PARCELS TIME =  1.4725E+05
WT. LOW =  6.6448E-01          NO. PARCELS LOW =       4560.0
WT. HI =  1.1963E+01           NO. PARCELS HI =         235.0
 SMOOTHING WINDOW (CELLS)=      10


TOTAL INVENTORY (CURIES) =    8.287018E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =    8.132722E+02
PERCENT OF TOTAL INVENTORY =  98.138

TIME OF MAXIMUM CONCENTRATION (YEARS) =    1.787500E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) =    1.876288E-08
MAXIMUM RATE (CURIES/YEAR) =    9.705989E-03
CONVERSION FACTOR RATE TO CONCENTRATION =    1.933123E-06


 CONTAMINANT = U-235

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE    100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.0025E+05	6.2154E-06	2.0000E+05	7.7098E-03
1.0225E+05	9.6859E-06	2.0200E+05	7.5751E-03
1.0424E+05	1.6123E-05	2.0399E+05	7.4757E-03
1.0624E+05	2.5145E-05	2.0599E+05	7.4008E-03
1.0823E+05	3.6932E-05	2.0798E+05	7.3364E-03
1.1023E+05	5.3475E-05	2.0998E+05	7.2657E-03
1.1222E+05	7.6745E-05	2.1197E+05	7.1737E-03
1.1422E+05	1.0948E-04	2.1397E+05	7.0484E-03
1.1621E+05	1.5504E-04	2.1596E+05	6.8834E-03
1.1821E+05	2.1748E-04	2.1796E+05	6.6778E-03

1,2020E+05	3,0150E-04	2,1995E+05	6,4357E-03
1,2220E+05	4,1231E-04	2,2195E+05	6,1646E-03
1,2419E+05	5,5538E-04	2,2394E+05	5,8740E-03
1,2619E+05	7,3608E-04	2,2594E+05	5,5729E-03
1,2818E+05	9,5908E-04	2,2793E+05	5,2690E-03
1,3018E+05	1,2278E-03	2,2993E+05	4,9681E-03
1,3217E+05	1,5437E-03	2,3192E+05	4,6734E-03
1,3417E+05	1,9056E-03	2,3392E+05	4,3861E-03
1,3616E+05	2,3095E-03	2,3591E+05	4,1065E-03
1,3816E+05	2,7484E-03	2,3791E+05	3,8339E-03
1,4015E+05	3,2130E-03	2,3990E+05	3,5675E-03
1,4215E+05	3,6924E-03	2,4190E+05	3,3066E-03
1,4414E+05	4,1754E-03	2,4389E+05	3,0508E-03
1,4614E+05	4,6522E-03	2,4589E+05	2,8004E-03
1,4813E+05	5,1155E-03	2,4788E+05	2,5567E-03
1,5013E+05	5,5612E-03	2,4988E+05	2,3205E-03
1,5212E+05	5,9885-03	2,5187E+05	2,0947E-03
1,5412E+05	6,3992E-03	2,5387E+05	1,8824E-03
1,5611E+05	6,7967E-03	2,5586E+05	1,6866E-03
1,5811E+05	7,1839E-03	2,5786E+05	1,5110E-03
1,6010E+05	7,5622E-03	2,5985E+05	1,3584E-03
1,6210E+05	7,9302E-03	2,6185E+05	1,2304E-03
1,6409E+05	8,2835E-03	2,6384E+05	1,1273E-03
1,6609E+05	8,6153E-03	2,6584E+05	1,0477E-03
1,6808E+05	8,9167E-03	2,6783E+05	9,8827E-04
1,7008E+05	9,1791E-03	2,6983E+05	9,4466E-04
1,7207E+05	9,3943E-03	2,7182E+05	9,1144E-04
1,7407E+05	9,5561E-03	2,7382E+05	8,8263E-04
1,7606E+05	9,6601E-03	2,7581E+05	8,5390E-04
1,7806E+05	9,7043E-03	2,7781E+05	8,2033E-04
1,8005E+05	9,6885E-03	2,7980E+05	7,8009E-04
1,8205E+05	9,6145E-03	2,8180E+05	7,3133E-04
1,8404E+05	9,4861E-03	2,8379E+05	6,7428E-04
1,8604E+05	9,3095E-03	2,8579E+05	6,1008E-04
1,8803E+05	9,2935E-03	2,8778E+05	5,3996E-04
1,9003E+05	8,8496E-03	2,8978E+05	4,6611E-04
1,9202E+05	8,5918E-03	2,9177E+05	3,8889E-04
1,9402E+05	8,3352E-03	2,9377E+05	3,1135E-04
1,9601E+05	8,0951E-03	2,9576E+05	2,2977E-04
1,9801E+05	7,8839E-03	2,9776E+05	1,5368E-04

PLTCVT PROGRAM DATA SUMMARY
PIR 1 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = PA-231
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 3.500000E+05
NUMBER OF CELLS = 20
DELTA TIME INCREMENT = 1.700000E+04

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.6579E+06 MIN. TIME = 2.1407E+04
TOTAL WEIGHT = 2.9273E+01 TOTAL PARCELS = 1134.0
PEAK WEIGHT = 6.991 PEAK WEIGHT TIME = 1.8850E+05
PEAK PARCELS = 78.000 PEAK PARCELS TIME = 1.8850E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 4.8969E+00 NO. PARCELS HI = 1146.0
SMOOTHING WINDOW (CELLS)= 3

TOTAL INVENTORY (CURIES) = 3.417012E+01
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.202435E+01
PERCENT OF TOTAL INVENTORY = 93.720

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.885000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7.949189E-10
MAXIMUM RATE (CURIES/YEAR) = 4.112096E-04
CONVERSION FACTOR RATE TO CONCENTRATION = 1.933123E-06

CONTAMINANT = PA-231

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.8500E+04	5.6201E-08	2.5000E+05	1.5366E-04
2.4000E+04	5.6201E-08	2.5294E+05	1.4426E-04
2.9500E+04	5.6201E-08	2.5588E+05	1.3492E-04
3.5000E+04	5.6201E-08	2.5882E+05	1.2775E-04
4.0500E+04	8.7547E-08	2.6176E+05	1.2118E-04
4.6000E+04	1.2223E-07	2.6471E+05	1.1462E-04
5.1500E+04	1.5651E-07	2.6765E+05	1.0806E-04
5.7000E+04	1.7458E-07	2.7059E+05	1.0150E-04
6.2500E+04	1.8941E-07	2.7353E+05	9.4961E-05
6.8000E+04	2.0344E-07	2.7647E+05	9.0638E-05

7.3500E+04	2.5129E-07	2.7941E+05	8.6314E-05
7.9000E+04	3.1168E-07	2.8235E+05	8.1991E-05
8.4500E+04	3.7206E-07	2.8529E+05	7.7667E-05
9.0000E+04	3.8779E-07	2.8824E+05	7.3344E-05
9.5500E+04	3.7801E-07	2.9118E+05	6.9531E-05
1.0100E+05	3.6823E-07	2.9412E+05	6.7429E-05
1.0650E+05	6.8862E-07	2.9706E+05	6.5326E-05
1.1200E+05	1.2841E-06	3.0000E+05	6.3224E-05
1.1750E+05	1.8797E-06	3.0126E+05	6.2325E-05
1.2300E+05	5.0538E-06	3.0252E+05	6.1426E-05
1.2850E+05	1.1322E-05	3.0377E+05	6.0527E-05
1.3400E+05	1.7591E-05	3.0503E+05	5.9628E-05
1.3950E+05	2.1066E-05	3.0629E+05	5.8730E-05
1.4500E+05	1.9653E-05	3.0755E+05	5.7822E-05
1.5050E+05	1.8234E-05	3.0880E+05	5.6674E-05
1.5600E+05	4.1535E-05	3.1006E+05	5.5527E-05
1.6150E+05	1.3072E-04	3.1132E+05	5.4380E-05
1.6700E+05	2.1991E-04	3.1258E+05	5.3233E-05
1.7250E+05	2.9484E-04	3.1383E+05	5.2086E-05
1.7600E+05	3.3812E-04	3.1509E+05	5.0938E-05
1.6350E+05	3.7641E-04	3.1635E+05	4.9791E-05
1.8900E+05	4.0791E-04	3.1761E+05	4.8644E-05
1.9450E+05	3.7158E-04	3.1886E+05	4.7497E-05
2.0000E+05	3.3526E-04	3.2012E+05	4.6349E-05
2.0294E+05	3.1583E-04	3.2138E+05	4.5202E-05
2.0588E+05	2.9732E-04	3.2264E+05	4.4055E-05
2.0882E+05	2.8495E-04	3.2389E+05	4.2908E-05
2.1176E+05	2.7259E-04	3.2515E+05	4.1719E-05
2.1471E+05	2.6022E-04	3.2641E+05	4.0491E-05
2.1765E+05	2.4785E-04	3.2767E+05	3.9264E-05
2.2059E+05	2.3549E-04	3.2892E+05	3.8036E-05
2.2353E+05	2.2501E-04	3.3018E+05	3.6808E-05
2.2647E+05	2.1604E-04	3.3144E+05	3.5581E-05
2.2941E+05	2.1107E-04	3.3270E+05	3.4353E-05
2.3235E+05	2.0410E-04	3.3395E+05	3.3126E-05
2.3529E+05	1.9713E-04	3.3521E+05	3.1898E-05
2.3824E+05	1.9016E-04	3.3647E+05	3.0670E-05
2.4118E+05	1.8181E-04	3.3773E+05	2.9443E-05
2.4412E+05	1.7243E-04	3.3898E+05	2.8215E-05
2.4706E+05	1.6305E-04	3.4024E+05	2.6987E-05

APPENDIX H.2: EAST TEXAS OIL FIELD REMOVED

Sabine River Discharge Site - Run 2.

Big Cypress Bayou Discharge Site - Run 3.

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = C-14
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+04
TIME HIGH= 7.000000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 2.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 7.5405E+04 MIN. TIME = 3.9636E+04
TOTAL WEIGHT = 8.8997E+01 TOTAL PARCELS = 2114.0
PEAK WEIGHT = 3.218 PEAK WEIGHT TIME = 4.4300E+04
PEAK PARCELS = 29.000 PEAK PARCELS TIME = 4.7900E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 2.6141E-01 NO. PARCELS HI = 356.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 8.925854E+01
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 8.828895E+01
PERCENT OF TOTAL INVENTORY = 98.914

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.510000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 3.396670E-08
MAXIMUM RATE (CURIES/YEAR) = 8.813480E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = C-14

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.9700E+04	4.1114E-04	5.4800E+04	2.9598E-03
4.0002E+04	4.8049E-04	5.5102E+04	2.8228E-03
4.0304E+04	7.1487E-04	5.5404E+04	2.6765E-03
4.0606E+04	1.0239E-03	5.5706E+04	2.5206E-03
4.0908E+04	1.4030E-03	5.6008E+04	2.3602E-03
4.1210E+04	1.8283E-03	5.6310E+04	2.1987E-03
4.1512E+04	2.3337E-03	5.6612E+04	2.0322E-03
4.1814E+04	2.9316E-03	5.6914E+04	1.8596E-03
4.2116E+04	3.5913E-03	5.7216E+04	1.6772E-03
4.2418E+04	4.3007E-03	5.7518E+04	1.4921E-03

4.2720E+04	5.0416E-03	5.7820E+04	1.3087E-03
4.3022E+04	5.7990E-03	5.8122E+04	1.1297E-03
4.3324E+04	6.5394E-03	5.8424E+04	9.5755E-04
4.3626E+04	7.1974E-03	5.8726E+04	7.9673E-04
4.3928E+04	7.7624E-03	5.9028E+04	6.5525E-04
4.4230E+04	8.2066E-03	5.9330E+04	5.3466E-04
4.4532E+04	8.5384E-03	5.9632E+04	4.3632E-04
4.4834E+04	8.7380E-03	5.9934E+04	3.5654E-04
4.5136E+04	8.8109E-03	6.0236E+04	2.9515E-04
4.5438E+04	8.7553E-03	6.0538E+04	2.4958E-04
4.5740E+04	8.6285E-03	6.0840E+04	2.1793E-04
4.6042E+04	8.4478E-03	6.1142E+04	1.9533E-04
4.6344E+04	8.2282E-03	6.1444E+04	1.7936E-04
4.6646E+04	7.9882E-03	6.1746E+04	1.6831E-04
4.6948E+04	7.7428E-03	6.2048E+04	1.6094E-04
4.7250E+04	7.4943E-03	6.2350E+04	1.5588E-04
4.7552E+04	7.2575E-03	6.2652E+04	1.5200E-04
4.7854E+04	7.0246E-03	6.2954E+04	1.4849E-04
4.8156E+04	6.7848E-03	6.3256E+04	1.4495E-04
4.8458E+04	6.5423E-03	6.3558E+04	1.4113E-04
4.8760E+04	6.2886E-03	6.3860E+04	1.3656E-04
4.9062E+04	6.0250E-03	6.4162E+04	1.3186E-04
4.9364E+04	5.7686E-03	6.4464E+04	1.2732E-04
4.9666E+04	5.5203E-03	6.4766E+04	1.2285E-04
4.9968E+04	5.2852E-03	6.5068E+04	1.1845E-04
5.0270E+04	5.0608E-03	6.5370E+04	1.1417E-04
5.0572E+04	4.8545E-03	6.5672E+04	1.1015E-04
5.0874E+04	4.6698E-03	6.5974E+04	1.0675E-04
5.1176E+04	4.5081E-03	6.6276E+04	1.0379E-04
5.1478E+04	4.3605E-03	6.6578E+04	1.0105E-04
5.1780E+04	4.2244E-03	6.6880E+04	9.8184E-05
5.2082E+04	4.0906E-03	6.7182E+04	9.5432E-05
5.2384E+04	3.9636E-03	6.7484E+04	9.2485E-05
5.2686E+04	3.8401E-03	6.7786E+04	8.9142E-05
5.2988E+04	3.7174E-03	6.8088E+04	8.4679E-05
5.3290E+04	3.5974E-03	6.8390E+04	7.8661E-05
5.3592E+04	3.4800E-03	6.8692E+04	7.1296E-05
5.3894E+04	3.3560E-03	6.8994E+04	6.1647E-05
5.4196E+04	3.2275E-03	6.9296E+04	4.9598E-05
5.4498E+04	3.0956E-03	6.9598E+04	3.8112E-05

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = TC-99
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 5.800000E+04
TIME HIGH= 6.300000E+04
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 1.250000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.3568E+05 MIN. TIME = 4.1253E+04
TOTAL WEIGHT = 2.4568E+05 TOTAL PARCELS = 1639.0
PEAK WEIGHT = 3936.116 PEAK WEIGHT TIME = 5.8756E+04
PEAK PARCELS = 22.000 PEAK PARCELS TIME = 5.8756E+04
WT. LOW = 5.6738E+02 NO. PARCELS LOW = 3.0
WT. HI = 1.3635E+05 NO. PARCELS HI = 4628.0
SMOOTHING WINDOW (CELLS)= 30

TOTAL INVENTORY (CURIES) = 3.825980E+05
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.511531E+05
PERCENT OF TOTAL INVENTORY = 65.644

TIME OF MAXIMUM CONCENTRATION (YEARS) = 5.860625E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7.677078E-04
MAXIMUM RATE (CURIES/YEAR) = 1.992003E+02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = TC-99

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
5.8606E+04	1.9920E+02	5.8816E+04	1.9088E+02
5.8608E+04	1.9920E+02	5.8826E+04	1.8997E+02
5.8609E+04	1.9920E+02	5.8837E+04	1.8907E+02
5.8610E+04	1.9920E+02	5.8847E+04	1.8816E+02
5.8612E+04	1.9920E+02	5.8857E+04	1.8725E+02
5.8613E+04	1.9920E+02	5.8867E+04	1.8633E+02
5.8614E+04	1.9920E+02	5.8878E+04	1.8542E+02
5.8616E+04	1.9920E+02	5.8888E+04	1.8445E+02
5.8617E+04	1.9920E+02	5.8898E+04	1.8345E+02
5.8618E+04	1.9920E+02	5.8909E+04	1.8245E+02

5.8619E+04	1.9909E+02	5.8919E+04	1.8139E+02
5.8621E+04	1.9888E+02	5.8929E+04	1.8028E+02
5.8622E+04	1.9868E+02	5.8939E+04	1.7918E+02
5.8623E+04	1.9848E+02	5.8950E+04	1.7805E+02
5.8625E+04	1.9827E+02	5.8960E+04	1.7692E+02
5.8626E+04	1.9807E+02	5.8970E+04	1.7581E+02
5.8627E+04	1.9787E+02	5.8981E+04	1.7473E+02
5.8629E+04	1.9766E+02	5.8991E+04	1.7368E+02
5.8630E+04	1.9746E+02	5.9001E+04	1.7266E+02
5.8631E+04	1.9730E+02	5.9122E+04	1.6081E+02
5.8633E+04	1.9744E+02	5.9243E+04	1.4663E+02
5.8634E+04	1.9758E+02	5.9364E+04	1.3201E+02
5.8635E+04	1.9771E+02	5.9485E+04	1.1772E+02
5.8637E+04	1.9785E+02	5.9606E+04	1.0383E+02
5.8638E+04	1.9799E+02	5.9727E+04	9.1249E+01
5.8639E+04	1.9813E+02	5.9848E+04	7.9170E+01
5.8641E+04	1.9827E+02	5.9969E+04	6.9407E+01
5.8642E+04	1.9840E+02	6.0090E+04	6.1134E+01
5.8643E+04	1.9854E+02	6.0211E+04	5.4173E+01
5.8645E+04	1.9853E+02	6.0332E+04	4.7902E+01
5.8646E+04	1.9846E+02	6.0454E+04	4.1977E+01
5.8647E+04	1.9838E+02	6.0575E+04	3.6909E+01
5.8649E+04	1.9830E+02	6.0696E+04	3.2155E+01
5.8650E+04	1.9822E+02	6.0817E+04	2.7998E+01
5.8651E+04	1.9815E+02	6.0938E+04	2.3716E+01
5.8662E+04	1.9791E+02	6.1059E+04	1.9916E+01
5.8672E+04	1.9817E+02	6.1180E+04	1.7151E+01
5.8682E+04	1.9876E+02	6.1301E+04	1.4779E+01
5.8692E+04	1.9878E+02	6.1422E+04	1.2883E+01
5.8703E+04	1.9844E+02	6.1543E+04	1.1007E+01
5.8713E+04	1.9780E+02	6.1664E+04	9.6279E+00
5.8723E+04	1.9721E+02	6.1785E+04	8.6119E+00
5.8734E+04	1.9682E+02	6.1906E+04	7.3179E+00
5.8744E+04	1.9638E+02	6.2027E+04	6.2299E+00
5.8754E+04	1.9589E+02	6.2148E+04	5.2035E+00
5.8764E+04	1.9522E+02	6.2269E+04	4.3916E+00
5.8775E+04	1.9448E+02	6.2390E+04	3.6881E+00
5.8785E+04	1.9367E+02	6.2511E+04	3.1169E+00
5.8795E+04	1.9280E+02	6.2632E+04	2.8770E+00
5.8806E+04	1.9183E+02	6.2753E+04	2.6295E+00

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 PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = I-129
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   4.000000E+04
TIME HIGH=   1.400000E+05
NUMBER OF CELLS =              400
DELTA TIME INCREMENT =   2.500000E+02


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.3546E+05        MIN. TIME =  3.9913E+04
TOTAL WEIGHT =  1.1385E+03     TOTAL PARCELS =       6269.0
PEAK WEIGHT =       18.805     PEAK WEIGHT TIME =  5.0625E+04
PEAK PARCELS =      37.000     PEAK PARCELS TIME =  5.0625E+04
WT. LOW =  5.0848E-01          NO. PARCELS LOW =          1.0
WT. HI =  0.0000E-01           NO. PARCELS HI =          0.0
 SMOOTHING WINDOW (CELLS)=     20


TOTAL INVENTORY (CURIES) =    1.139027E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   1.140982E+03
PERCENT OF TOTAL INVENTORY = 100.172

TIME OF MAXIMUM CONCENTRATION (YEARS) =   5.037500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   1.993926E-07
MAXIMUM RATE (CURIES/YEAR) =   5.173722E-02
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06


 CONTAMINANT = I-129

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.0375E+04	2.6875E-03	9.3536E+04	6.2621E-03
4.0970E+04	3.6035E-03	9.5595E+04	6.2495E-03
4.1564E+04	6.2962E-03	9.7653E+04	6.2320E-03
4.2159E+04	1.1951E-02	9.9712E+04	6.2092E-03
4.2754E+04	1.9234E-02	1.0177E+05	6.1729E-03
4.3348E+04	2.7100E-02	1.0383E+05	6.1828E-03
4.3943E+04	3.3650E-02	1.0589E+05	6.1874E-03
4.4538E+04	3.8922E-02	1.0795E+05	6.2121E-03
4.5133E+04	4.2726E-02	1.1001E+05	6.2162E-03
4.5727E+04	4.4814E-02	1.1207E+05	6.2202E-03

4.6322E+04	4.5922E-02	1.1412E+05	6.2155E-03
4.6917E+04	4.3743E-02	1.1618E+05	6.2335E-03
4.7511E+04	4.1393E-02	1.1824E+05	6.2421E-03
4.8106E+04	3.8997E-02	1.2030E+05	6.2289E-03
4.8701E+04	4.0861E-02	1.2236E+05	6.2309E-03
4.9295E+04	4.5555E-02	1.2442E+05	6.1879E-03
4.9890E+04	5.0126E-02	1.2648E+05	6.1441E-03
5.0485E+04	5.1737E-02	1.2854E+05	6.1117E-03
5.1080E+04	4.8918E-02	1.3059E+05	6.1626E-03
5.1674E+04	4.6799E-02	1.3076E+05	6.0729E-03
5.2269E+04	4.5442E-02	1.3092E+05	5.9692E-03
5.2864E+04	4.5581E-02	1.3108E+05	5.8539E-03
5.3458E+04	4.4558E-02	1.3125E+05	5.7379E-03
5.4053E+04	4.3534E-02	1.3141E+05	5.6068E-03
5.4648E+04	4.3039E-02	1.3157E+05	5.4192E-03
5.5242E+04	4.3450E-02	1.3173E+05	5.1997E-03
5.5837E+04	4.3699E-02	1.3190E+05	4.9574E-03
5.6432E+04	4.1975E-02	1.3206E+05	4.6693E-03
5.7026E+04	3.6474E-02	1.3222E+05	4.4048E-03
5.7621E+04	2.8422E-02	1.3239E+05	4.1566E-03
5.8216E+04	1.9912E-02	1.3255E+05	3.9208E-03
5.8811E+04	1.3717E-02	1.3271E+05	3.6752E-03
5.9405E+04	9.6440E-03	1.3287E+05	3.4212E-03
6.0000E+04	7.9542E-03	1.3304E+05	3.0902E-03
6.0595E+04	7.4549E-03	1.3320E+05	2.7654E-03
6.2653E+04	6.8773E-03	1.3336E+05	2.4481E-03
6.4712E+04	6.5118E-03	1.3353E+05	2.1622E-03
6.6771E+04	6.3747E-03	1.3369E+05	1.8902E-03
6.8830E+04	6.3398E-03	1.3385E+05	1.6359E-03
7.0889E+04	6.3318E-03	1.3401E+05	1.3982E-03
7.2948E+04	6.3064E-03	1.3418E+05	1.1664E-03
7.5006E+04	6.2699E-03	1.3434E+05	9.4096E-04
7.7065E+04	6.2837E-03	1.3450E+05	7.5628E-04
7.9124E+04	6.2337E-03	1.3467E+05	6.1453E-04
8.1183E+04	6.1644E-03	1.3463E+05	5.5150E-04
8.3242E+04	6.1624E-03	1.3499E+05	4.7253E-04
8.5300E+04	6.1678E-03	1.3516E+05	3.8861E-04
8.7359E+04	6.1527E-03	1.3532E+05	3.1020E-04
8.9418E+04	6.1932E-03	1.3548E+05	2.3178E-04
9.1477E+04	6.2646E-03	1.3564E+05	1.5337E-04

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = I-129
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+04
TIME HIGH= 6.000000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 1.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.3546E+05 MIN. TIME = 3.9913E+04
TOTAL WEIGHT = 6.8244E+02 TOTAL PARCELS = 1459.0
PEAK WEIGHT = 8.642 PEAK WEIGHT TIME = 4.6450E+04
PEAK PARCELS = 17.000 PEAK PARCELS TIME = 4.6450E+04
WT. LOW = 5.0848E-01 NO. PARCELS LOW = 1.0
WT. HI = 4.5608E+02 NO. PARCELS HI = 4810.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 1.139030E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 6.828842E+02
PERCENT OF TOTAL INVENTORY = 59.953

TIME OF MAXIMUM CONCENTRATION (YEARS) = 5.095000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.760500E-07
MAXIMUM RATE (CURIES/YEAR) = 4.568041E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = I-129

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.0350E+04	2.7466E-03	5.0500E+04	4.5648E-02
4.0491E+04	2.7203E-03	5.0824E+04	4.5676E-02
4.0632E+04	2.6336E-03	5.1147E+04	4.5679E-02
4.0773E+04	2.6108E-03	5.1471E+04	4.5653E-02
4.0914E+04	2.5852E-03	5.1794E+04	4.5599E-02
4.1055E+04	2.6590E-03	5.2118E+04	4.5519E-02
4.1195E+04	2.8846E-03	5.2441E+04	4.5417E-02
4.1336E+04	3.2909E-03	5.2765E+04	4.5290E-02
4.1477E+04	3.9392E-03	5.3088E+04	4.5142E-02
4.1618E+04	4.8446E-03	5.3412E+04	4.4979E-02
4.1759E+04	6.0158E-03	5.3735E+04	4.4809E-02

4.1900E+04	7.4803E-03	5.4059E+04	4.4650E-02
4.2041E+04	9.1678E-03	5.4382E+04	4.4502E-02
4.2182E+04	1.1060E-02	5.4706E+04	4.4315E-02
4.2323E+04	1.3069E-02	5.5030E+04	4.4136E-02
4.2464E+04	1.5139E-02	5.5353E+04	4.3972E-02
4.2605E+04	1.7233E-02	5.5677E+04	4.3855E-02
4.2745E+04	1.9337E-02	5.6000E+04	4.3909E-02
4.2886E+04	2.1447E-02	5.6120E+04	4.3995E-02
4.3027E+04	2.3550E-02	5.6239E+04	4.4049E-02
4.3168E+04	2.5598E-02	5.6359E+04	4.4009E-02
4.3309E+04	2.7507E-02	5.6479E+04	4.3793E-02
4.3450E+04	2.9226E-02	5.6599E+04	4.3344E-02
4.3591E+04	3.0679E-02	5.6718E+04	4.2607E-02
4.3732E+04	3.1954E-02	5.6838E+04	4.1540E-02
4.3873E+04	3.3147E-02	5.6958E+04	4.0097E-02
4.4014E+04	3.4410E-02	5.7077E+04	3.8275E-02
4.4155E+04	3.5842E-02	5.7197E+04	3.6147E-02
4.4295E+04	3.7500E-02	5.7317E+04	3.3778E-02
4.4436E+04	3.9273E-02	5.7436E+04	3.1252E-02
4.4577E+04	4.1008E-02	5.7556E+04	2.8679E-02
4.4718E+04	4.2507E-02	5.7676E+04	2.6196E-02
4.4859E+04	4.3633E-02	5.7796E+04	2.3901E-02
4.5000E+04	4.4216E-02	5.7915E+04	2.1865E-02
4.5324E+04	4.4455E-02	5.8035E+04	2.0127E-02
4.5647E+04	4.4523E-02	5.8155E+04	1.8696E-02
4.5971E+04	4.4582E-02	5.8274E+04	1.7538E-02
4.6294E+04	4.4629E-02	5.8394E+04	1.6545E-02
4.6618E+04	4.4690E-02	5.8514E+04	1.5632E-02
4.6941E+04	4.4838E-02	5.8633E+04	1.4725E-02
4.7265E+04	4.4882E-02	5.8753E+04	1.3771E-02
4.7588E+04	4.4935E-02	5.8873E+04	1.2742E-02
4.7912E+04	4.5005E-02	5.8992E+04	1.1660E-02
4.8235E+04	4.5088E-02	5.9112E+04	1.0569E-02
4.8559E+04	4.5181E-02	5.9232E+04	9.5210E-03
4.8882E+04	4.5274E-02	5.9352E+04	8.5620E-03
4.9206E+04	4.5363E-02	5.9471E+04	7.7709E-03
4.9529E+04	4.5451E-02	5.9591E+04	7.1193E-03
4.9853E+04	4.5531E-02	5.9711E+04	6.7076E-03
5.0177E+04	4.5599E-02	5.9830E+04	6.3766E-03

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = CS-135
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+04
TIME HIGH= 6.000000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 1.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9981E+06 MIN. TIME = 4.2923E+04
TOTAL WEIGHT = 7.7351E+03 TOTAL PARCELS = 1999.0
PEAK WEIGHT = 104.731 PEAK WEIGHT TIME = 4.6050E+04
PEAK PARCELS = 27.000 PEAK PARCELS TIME = 4.6050E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 1.6204E+02 NO. PARCELS HI = 61.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 7.897135E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 7.712751E+03
PERCENT OF TOTAL INVENTORY = 97.665

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.495000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.540210E-06
MAXIMUM RATE (CURIES/YEAR) = 6.591187E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = CS-135

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.2950E+04	1.3594E-01	5.0500E+04	5.6923E-01
4.3006E+04	1.3594E-01	5.0835E+04	5.6763E-01
4.3062E+04	1.4089E-01	5.1171E+04	5.6594E-01
4.3118E+04	1.6376E-01	5.1506E+04	5.6381E-01
4.3174E+04	1.8177E-01	5.1841E+04	5.6099E-01
4.3230E+04	1.9342E-01	5.2177E+04	5.5725E-01
4.3286E+04	2.0630E-01	5.2512E+04	5.5272E-01
4.3342E+04	2.1984E-01	5.2847E+04	5.4725E-01
4.3399E+04	2.2637E-01	5.3182E+04	5.4091E-01
4.3455E+04	2.3278E-01	5.3518E+04	5.3366E-01
4.3511E+04	2.3042E-01	5.3853E+04	5.2539E-01

4.3567E+04	2.6843E-01	5.4188E+04	5.1612E-01
4.3623E+04	2.8735E-01	5.4524E+04	5.0516E-01
4.3679E+04	3.0690E-01	5.4859E+04	4.9512E-01
4.3735E+04	3.2706E-01	5.5194E+04	4.8385E-01
4.3791E+04	3.4802E-01	5.5529E+04	4.7171E-01
4.3847E+04	3.6927E-01	5.5865E+04	4.5815E-01
4.3903E+04	3.9243E-01	5.6200E+04	4.4061E-01
4.3959E+04	4.1570E-01	5.6256E+04	4.3597E-01
4.4015E+04	4.3892E-01	5.6312E+04	4.3019E-01
4.4071E+04	4.6187E-01	5.6368E+04	4.2387E-01
4.4127E+04	4.8437E-01	5.6424E+04	4.1644E-01
4.4183E+04	5.0617E-01	5.6480E+04	4.0820E-01
4.4239E+04	5.2750E-01	5.6536E+04	3.9927E-01
4.4296E+04	5.4730E-01	5.6592E+04	3.8910E-01
4.4352E+04	5.6667E-01	5.6649E+04	3.7855E-01
4.4408E+04	5.8339E-01	5.6705E+04	3.6688E-01
4.4464E+04	5.9947E-01	5.6761E+04	3.5501E-01
4.4520E+04	6.1360E-01	5.6817E+04	3.4237E-01
4.4576E+04	6.2636E-01	5.6873E+04	3.2950E-01
4.4632E+04	6.3752E-01	5.6929E+04	3.1627E-01
4.4688E+04	6.4673E-01	5.6985E+04	3.0274E-01
4.4744E+04	6.5501E-01	5.7041E+04	2.8903E-01
4.4800E+04	6.5719E-01	5.7097E+04	2.7503E-01
4.5135E+04	6.5732E-01	5.7153E+04	2.6101E-01
4.5471E+04	6.5050E-01	5.7209E+04	2.4745E-01
4.5806E+04	6.4264E-01	5.7265E+04	2.3438E-01
4.6141E+04	6.3401E-01	5.7321E+04	2.2266E-01
4.6477E+04	6.2836E-01	5.7377E+04	2.1142E-01
4.6812E+04	6.2210E-01	5.7433E+04	2.0068E-01
4.7147E+04	6.1332E-01	5.7489E+04	1.9060E-01
4.7482E+04	6.0507E-01	5.7546E+04	1.8079E-01
4.7818E+04	5.9778E-01	5.7602E+04	1.7158E-01
4.8153E+04	5.9164E-01	5.7658E+04	1.6328E-01
4.8488E+04	5.8648E-01	5.7714E+04	1.6041E-01
4.8824E+04	5.8183E-01	5.7770E+04	1.5614E-01
4.9159E+04	5.7804E-01	5.7826E+04	1.4931E-01
4.9494E+04	5.7499E-01	5.7882E+04	1.4327E-01
4.9829E+04	5.7264E-01	5.7938E+04	1.3783E-01
5.0165E+04	5.7082E-01	5.7994E+04	1.3328E-01

PLTCVT PROGRAM DATA SUMMARY
PIR2.(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 1
CONTAMINANT = U-236
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.900000E+05
TIME HIGH= 5.500000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 4.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 5.7068E+05 MIN. TIME = 3.9071E+05
TOTAL WEIGHT = 1.4364E+04 TOTAL PARCELS = 6846.0
PEAK WEIGHT = 168.684 PEAK WEIGHT TIME = 4.4300E+05
PEAK PARCELS = 67.000 PEAK PARCELS TIME = 4.4300E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 7.0924E+00 NO. PARCELS HI = 30.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 1.437144E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.435503E+04
PERCENT OF TOTAL INVENTORY = 99.886

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.398000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 9.646501E-07
MAXIMUM RATE (CURIES/YEAR) = 2.503017E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = U-236

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.9060E+05	3.9101E-04	4.7020E+05	1.0911E-01
3.9219E+05	7.8740E-04	4.7179E+05	1.0334E-01
3.9378E+05	1.5106E-03	4.7338E+05	9.7931E-02
3.9538E+05	2.4175E-03	4.7498E+05	9.3205E-02
3.9697E+05	3.6362E-03	4.7657E+05	8.9405E-02
3.9856E+05	5.2788E-03	4.7816E+05	8.6592E-02
4.0015E+05	7.4367E-03	4.7975E+05	8.4648E-02
4.0174E+05	1.0206E-02	4.8134E+05	8.3400E-02
4.0334E+05	1.3726E-02	4.8294E+05	8.2690E-02
4.0493E+05	1.8181E-02	4.8453E+05	8.2370E-02
4.0652E+05	2.3746E-02	4.8612E+05	8.2260E-02

4.0811E+05	3.0510E-02	4.8771E+05	8.2120E-02
4.0970E+05	3.8465E-02	4.8930E+05	8.1717E-02
4.1130E+05	4.7536E-02	4.9090E+05	8.0961E-02
4.1289E+05	5.7646E-02	4.9249E+05	7.9898E-02
4.1448E+05	6.8721E-02	4.9408E+05	7.8682E-02
4.1607E+05	8.0663E-02	4.9567E+05	7.7461E-02
4.1766E+05	9.3327E-02	4.9726E+05	7.6245E-02
4.1926E+05	1.0656E-01	4.9886E+05	7.4960E-02
4.2085E+05	1.2022E-01	5.0045E+05	7.3489E-02
4.2244E+05	1.3423E-01	5.0204E+05	7.1814E-02
4.2403E+05	1.4848E-01	5.0363E+05	7.0013E-02
4.2562E+05	1.6285E-01	5.0522E+05	6.8217E-02
4.2722E+05	1.7714E-01	5.0682E+05	6.6440E-02
4.2881E+05	1.9108E-01	5.0841E+05	6.4494E-02
4.3040E+05	2.0441E-01	5.1000E+05	6.2039E-02
4.3199E+05	2.1681E-01	5.1159E+05	5.8775E-02
4.3358E+05	2.2791E-01	5.1318E+05	5.4666E-02
4.3518E+05	2.3728E-01	5.1478E+05	5.0011E-02
4.3677E+05	2.4442E-01	5.1637E+05	4.5313E-02
4.3836E+05	2.4887E-01	5.1796E+05	4.1030E-02
4.3995E+05	2.5028E-01	5.1955E+05	3.7358E-02
4.4154E+05	2.4854E-01	5.2114E+05	3.4193E-02
4.4314E+05	2.4388E-01	5.2274E+05	3.1235E-02
4.4473E+05	2.3684E-01	5.2433E+05	2.8229E-02
4.4632E+05	2.2813E-01	5.2592E+05	2.5090E-02
4.4791E+05	2.1846E-01	5.2751E+05	2.1967E-02
4.4950E+05	2.0835E-01	5.2910E+05	1.9096E-02
4.5110E+05	1.9803E-01	5.3070E+05	1.6675E-02
4.5269E+05	1.8760E-01	5.3229E+05	1.4700E-02
4.5428E+05	1.7725E-01	5.3388E+05	1.3006E-02
4.5587E+05	1.6736E-01	5.3547E+05	1.1372E-02
4.5746E+05	1.5840E-01	5.3706E+05	9.6622E-03
4.5906E+05	1.5065E-01	5.3866E+05	7.8723E-03
4.6065E+05	1.4400E-01	5.4025E+05	6.1034E-03
4.6224E+05	1.3807E-01	5.4184E+05	4.5016E-03
4.6383E+05	1.3239E-01	5.4343E+05	3.1592E-03
4.6542E+05	1.2669E-01	5.4502E+05	2.0976E-03
4.6702E+05	1.2089E-01	5.4662E+05	1.2963E-03
4.6861E+05	1.1500E-01	5.4821E+05	6.9466E-04

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 1
CONTAMINANT = TH-232
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+05
TIME HIGH= 2.000000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 8.000000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9992E+06 MIN. TIME = 4.2119E+05
TOTAL WEIGHT = 4.7333E-02 TOTAL PARCELS = 2663.0
PEAK WEIGHT = 0.001 PEAK WEIGHT TIME = 1.8920E+06
PEAK PARCELS = 23.000 PEAK PARCELS TIME = 8.4400E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 4.733297E-02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.714636E-02
PERCENT OF TOTAL INVENTORY = 99.606

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.996000E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.232157E-13
MAXIMUM RATE (CURIES/YEAR) = 3.197128E-08
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = TH-232

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.2000E+05	1.1470E-08	9.3487E+05	3.0715E-08
4.2545E+05	1.1470E-08	9.5545E+05	3.0770E-08
4.3091E+05	1.3169E-08	9.7604E+05	3.0824E-08
4.3636E+05	1.6185E-08	9.9663E+05	3.0869E-08
4.4182E+05	1.6803E-08	1.0172E+06	3.0901E-08
4.4727E+05	1.7423E-08	1.0378E+06	3.0928E-08
4.5273E+05	1.8043E-08	1.0584E+06	3.0955E-08
4.5818E+05	1.8665E-08	1.0790E+06	3.0984E-08
4.6364E+05	1.8794E-08	1.0996E+06	3.1010E-08
4.6909E+05	1.8894E-08	1.1202E+06	3.1024E-08
4.7455E+05	1.9862E-08	1.1407E+06	3.1021E-08

4.8000E+05	2.0634E-08	1.1613E+06	3.1001E-08
4.8545E+05	2.1334E-08	1.1819E+06	3.0970E-08
4.9091E+05	2.2031E-08	1.2025E+06	3.0929E-08
4.9636E+05	2.2715E-08	1.2231E+06	3.0880E-08
5.0182E+05	2.3386E-08	1.2437E+06	3.0831E-08
5.0727E+05	2.4035E-08	1.2643E+06	3.0783E-08
5.1273E+05	2.4703E-08	1.2849E+06	3.0736E-08
5.1818E+05	2.5333E-08	1.3055E+06	3.0689E-08
5.2364E+05	2.5902E-08	1.3265E+06	3.0647E-08
5.2909E+05	2.6421E-08	1.3476E+06	3.0609E-08
5.3455E+05	2.6908E-08	1.3687E+06	3.0569E-08
5.4000E+05	2.7362E-08	1.3898E+06	3.0522E-08
5.4545E+05	2.7760E-08	1.4109E+06	3.0464E-08
5.5091E+05	2.8121E-08	1.4320E+06	3.0406E-08
5.5636E+05	2.8445E-08	1.4531E+06	3.0359E-08
5.6182E+05	2.8711E-08	1.4742E+06	3.0331E-08
5.6727E+05	2.8936E-08	1.4953E+06	3.0324E-08
5.7273E+05	2.9127E-08	1.5164E+06	3.0325E-08
5.7818E+05	2.9265E-08	1.5375E+06	3.0330E-08
5.8364E+05	2.9375E-08	1.5585E+06	3.0337E-08
5.8909E+05	2.9465E-08	1.5796E+06	3.0341E-08
5.9455E+05	2.9531E-08	1.6007E+06	3.0343E-08
6.0000E+05	2.9579E-08	1.6218E+06	3.0349E-08
6.0545E+05	2.9621E-08	1.6429E+06	3.0366E-08
6.2604E+05	2.9759E-08	1.6640E+06	3.0401E-08
6.4663E+05	2.9851E-08	1.6851E+06	3.0442E-08
6.6722E+05	2.9914E-08	1.7062E+06	3.0481E-08
6.8781E+05	2.9978E-08	1.7273E+06	3.0547E-08
7.0840E+05	3.0050E-08	1.7484E+06	3.0637E-08
7.2898E+05	3.0136E-08	1.7695E+06	3.0741E-08
7.4957E+05	3.0210E-08	1.7905E+06	3.0857E-08
7.7016E+05	3.0267E-08	1.8116E+06	3.0986E-08
7.9075E+05	3.0326E-08	1.8327E+06	3.1138E-08
8.1134E+05	3.0385E-08	1.8538E+06	3.0995E-08
8.3193E+05	3.0437E-08	1.8749E+06	3.1097E-08
8.5251E+05	3.0487E-08	1.8960E+06	3.1218E-08
8.7310E+05	3.0535E-08	1.9171E+06	3.1354E-08
8.9369E+05	3.0593E-08	1.9382E+06	3.1499E-08
9.1428E+05	3.0654E-08	1.9593E+06	3.1647E-08

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 0,5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4,000000E+04
TIME HIGH= 6,000000E+04
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 2,000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX, TIME = 1,9894E+06 MIN, TIME = 4,2768E+04
TOTAL WEIGHT = 2,4058E+04 TOTAL PARCELS = 5598,0
PEAK WEIGHT = 511,864 PEAK WEIGHT TIME = 4,5700E+04
PEAK PARCELS = 333,000 PEAK PARCELS TIME = 4,4700E+04
WT, LOW = 0,0000E-01 NO, PARCELS LOW = 0,0
WT, HI = 1,1255E+04 NO, PARCELS HI = 1248,0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 3,531257E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2,398276E+04
PERCENT OF TOTAL INVENTORY = 67,916

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4,490000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7,907540E-06
MAXIMUM RATE (CURIES/YEAR) = 2,051802E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 3,853949E-06

CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4,2700E+04	2,2338E-01	5,0246E+04	1,7514E+00
4,2770E+04	2,2338E-01	5,0570E+04	1,7396E+00
4,2839E+04	2,2338E-01	5,0893E+04	1,7277E+00
4,2909E+04	2,3461E-01	5,1217E+04	1,7175E+00
4,2979E+04	3,2074E-01	5,1540E+04	1,7055E+00
4,3048E+04	4,0688E-01	5,1864E+04	1,6920E+00
4,3118E+04	4,8475E-01	5,2187E+04	1,6691E+00
4,3188E+04	5,3919E-01	5,2511E+04	1,6500E+00
4,3258E+04	5,9364E-01	5,2834E+04	1,6363E+00
4,3327E+04	6,6378E-01	5,3158E+04	1,6247E+00
4,3397E+04	7,5836E-01	5,3481E+04	1,6137E+00

4.3467E+04	8.5293E-01	5.3805E+04	1.6009E+00
4.3536E+04	9.4333E-01	5.4129E+04	1.5845E+00
4.3606E+04	1.0299E+00	5.4452E+04	1.5664E+00
4.3676E+04	1.1165E+00	5.4776E+04	1.5466E+00
4.3745E+04	1.2005E+00	5.5099E+04	1.5245E+00
4.3815E+04	1.2831E+00	5.5423E+04	1.4923E+00
4.3885E+04	1.3658E+00	5.5746E+04	1.4403E+00
4.3955E+04	1.4419E+00	5.6070E+04	1.3233E+00
4.4024E+04	1.5162E+00	5.6121E+04	1.3036E+00
4.4094E+04	1.5906E+00	5.6173E+04	1.2862E+00
4.4164E+04	1.6459E+00	5.6224E+04	1.2687E+00
4.4233E+04	1.6994E+00	5.6276E+04	1.2513E+00
4.4303E+04	1.7525E+00	5.6327E+04	1.2380E+00
4.4373E+04	1.7963E+00	5.6379E+04	1.2282E+00
4.4442E+04	1.8401E+00	5.6430E+04	1.2185E+00
4.4512E+04	1.8831E+00	5.6482E+04	1.2087E+00
4.4582E+04	1.9225E+00	5.6533E+04	1.2021E+00
4.4651E+04	1.9618E+00	5.6585E+04	1.1973E+00
4.4721E+04	1.9958E+00	5.6636E+04	1.1924E+00
4.4791E+04	2.0176E+00	5.6688E+04	1.1875E+00
4.4861E+04	2.0394E+00	5.6739E+04	1.1827E+00
4.4930E+04	2.0496E+00	5.6791E+04	1.1779E+00
4.5000E+04	2.0446E+00	5.6842E+04	1.1731E+00
4.5070E+04	2.0395E+00	5.6894E+04	1.1683E+00
4.5393E+04	2.0075E+00	5.6945E+04	1.1545E+00
4.5717E+04	1.9759E+00	5.6997E+04	1.1394E+00
4.6040E+04	1.9541E+00	5.7049E+04	1.1243E+00
4.6364E+04	1.9345E+00	5.7100E+04	1.1092E+00
4.6687E+04	1.9179E+00	5.7152E+04	1.0736E+00
4.7011E+04	1.9003E+00	5.7203E+04	1.0381E+00
4.7334E+04	1.8815E+00	5.7255E+04	1.0025E+00
4.7658E+04	1.8654E+00	5.7306E+04	9.6916E-01
4.7981E+04	1.8520E+00	5.7358E+04	9.5272E-01
4.8305E+04	1.8402E+00	5.7409E+04	9.3628E-01
4.8628E+04	1.8285E+00	5.7461E+04	9.1985E-01
4.8952E+04	1.8152E+00	5.7512E+04	8.9709E-01
4.9276E+04	1.7962E+00	5.7564E+04	8.5382E-01
4.9599E+04	1.7791E+00	5.7615E+04	8.1055E-01
4.9923E+04	1.7647E+00	5.7667E+04	7.6728E-01

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 PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = NP-237
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =    1.650000E+06
TIME HIGH=   1.950000E+06
NUMBER OF CELLS =            100
DELTA TIME INCREMENT =   3.000000E+03


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.9894E+06       MIN. TIME =  4.2768E+04
TOTAL WEIGHT =  1.0156E+04    TOTAL PARCELS =        1151.0
PEAK WEIGHT =      269.027    PEAK WEIGHT TIME =  1.8075E+06
PEAK PARCELS =      30.000    PEAK PARCELS TIME =  1.8075E+06
WT. LOW =  2.5064E+04         NO. PARCELS LOW =       5684.0
WT. HI =  9.3109E+01          NO. PARCELS HI =          11.0
 SMOOTHING WINDOW (CELLS)=      5


TOTAL INVENTORY (CURIES) =   3.531258E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =    9.991452E+03
PERCENT OF TOTAL INVENTORY =  28.294

TIME OF MAXIMUM CONCENTRATION (YEARS) =   1.792500E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   2.538891E-07
MAXIMUM RATE (CURIES/YEAR) =   6.587765E-02
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06


 CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.6515E+06	2.7964E-03	1.8000E+06	6.5441E-02
1.6545E+06	2.7964E-03	1.8030E+06	6.4939E-02
1.6574E+06	3.3938E-03	1.8059E+06	6.4259E-02
1.6604E+06	4.3021E-03	1.8089E+06	6.3414E-02
1.6634E+06	5.3188E-03	1.8119E+06	6.2420E-02
1.6664E+06	6.6486E-03	1.8149E+06	6.1294E-02
1.6693E+06	7.8952E-03	1.8178E+06	6.0051E-02
1.6723E+06	9.0272E-03	1.8208E+06	5.8710E-02
1.6753E+06	1.0201E-02	1.8238E+06	5.7289E-02
1.6782E+06	1.1422E-02	1.8267E+06	5.5806E-02
1.6812E+06	1.2685E-02	1.8297E+06	5.4276E-02

1.6842E+06	1.3983E-02	1.8327E+06	5.2715E-02
1.6871E+06	1.5307E-02	1.8356E+06	5.1135E-02
1.6901E+06	1.6669E-02	1.8386E+06	4.9543E-02
1.6931E+06	1.8063E-02	1.8416E+06	4.7946E-02
1.6961E+06	1.9485E-02	1.8446E+06	4.6346E-02
1.6990E+06	2.0930E-02	1.8475E+06	4.4746E-02
1.7020E+06	2.2393E-02	1.8505E+06	4.3145E-02
1.7050E+06	2.3869E-02	1.8535E+06	4.1543E-02
1.7079E+06	2.5356E-02	1.8564E+06	3.9938E-02
1.7109E+06	2.6851E-02	1.8594E+06	3.8328E-02
1.7139E+06	2.8351E-02	1.8624E+06	3.6711E-02
1.7168E+06	2.9857E-02	1.8653E+06	3.5086E-02
1.7198E+06	3.1368E-02	1.8683E+06	3.3455E-02
1.7228E+06	3.2890E-02	1.8713E+06	3.1823E-02
1.7258E+06	3.4429E-02	1.8743E+06	3.0193E-02
1.7287E+06	3.5991E-02	1.8772E+06	2.8573E-02
1.7317E+06	3.7582E-02	1.8802E+06	2.6972E-02
1.7347E+06	3.9208E-02	1.8832E+06	2.5397E-02
1.7376E+06	4.0872E-02	1.8861E+06	2.3855E-02
1.7406E+06	4.2575E-02	1.8891E+06	2.2355E-02
1.7436E+06	4.4316E-02	1.8921E+06	2.0903E-02
1.7465E+06	4.6091E-02	1.8950E+06	1.9507E-02
1.7495E+06	4.7891E-02	1.8980E+06	1.8170E-02
1.7525E+06	4.9705E-02	1.9010E+06	1.6897E-02
1.7555E+06	5.1517E-02	1.9040E+06	1.5687E-02
1.7584E+06	5.3307E-02	1.9069E+06	1.4538E-02
1.7614E+06	5.5056E-02	1.9099E+06	1.3447E-02
1.7644E+06	5.6741E-02	1.9129E+06	1.2409E-02
1.7673E+06	5.8339E-02	1.9158E+06	1.1421E-02
1.7703E+06	5.9831E-02	1.9188E+06	1.0475E-02
1.7733E+06	6.1194E-02	1.9218E+06	9.5558E-03
1.7762E+06	6.2410E-02	1.9247E+06	8.6634E-03
1.7792E+06	6.3460E-02	1.9277E+06	7.7977E-03
1.7822E+06	6.4332E-02	1.9307E+06	6.9600E-03
1.7852E+06	6.5015E-02	1.9337E+06	6.1425E-03
1.7881E+06	6.5502E-02	1.9366E+06	5.2101E-03
1.7911E+06	6.5787E-02	1.9396E+06	4.3569E-03
1.7941E+06	6.5871E-02	1.9426E+06	3.5797E-03
1.7970E+06	6.5754E-02	1.9455E+06	2.8777E-03

PLTCVT PROGRAM DATA SUMMARY
PIR 2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = U-233
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+04
TIME HIGH= 2.000000E+06
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 4.900000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9892E+06 MIN. TIME = 4.6214E+04
TOTAL WEIGHT = 4.9037E+04 TOTAL PARCELS = 33303.0
PEAK WEIGHT = 369.769 PEAK WEIGHT TIME = 1.4831E+06
PEAK PARCELS = 1000.000 PEAK PARCELS TIME = 4.1975E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 4.903742E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.909436E+04
PERCENT OF TOTAL INVENTORY = 100.116

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.644750E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.951557E-07
MAXIMUM RATE (CURIES/YEAR) = 5.063786E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = U-233

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.7350E+04	8.5603E-03	1.1000E+06	3.1753E-02
6.4097E+04	9.8347E-03	1.1294E+06	3.2753E-02
8.0844E+04	1.0244E-02	1.1588E+06	3.3671E-02
9.7591E+04	1.0081E-02	1.1882E+06	3.4475E-02
1.1434E+05	9.5302E-03	1.2176E+06	3.5480E-02
1.3108E+05	8.7626E-03	1.2471E+06	3.6349E-02
1.4783E+05	8.8215E-03	1.2765E+06	3.7271E-02
1.6458E+05	8.1169E-03	1.3059E+06	3.8268E-02
1.8133E+05	7.3903E-03	1.3353E+06	3.9134E-02
1.9807E+05	7.2435E-03	1.3647E+06	4.0133E-02

2.1482E+05	6.4239E-03	1.3941E+06	4.1309E-02
2.3157E+05	6.2746E-03	1.4235E+06	4.2473E-02
2.4831E+05	6.1431E-03	1.4529E+06	4.3723E-02
2.6506E+05	5.7063E-03	1.4824E+06	4.4936E-02
2.8181E+05	5.7441E-03	1.5118E+06	4.6168E-02
2.9855E+05	5.4158E-03	1.5412E+06	4.7422E-02
3.1530E+05	4.9961E-03	1.5706E+06	4.8676E-02
3.3205E+05	4.8328E-03	1.6000E+06	4.9771E-02
3.4880E+05	4.8758E-03	1.6294E+06	5.0462E-02
3.6554E+05	4.5710E-03	1.6412E+06	5.0626E-02
3.8229E+05	4.6557E-03	1.6529E+06	5.0608E-02
3.9904E+05	4.7888E-03	1.6647E+06	5.0509E-02
4.1578E+05	5.6055E-03	1.6764E+06	5.0176E-02
4.3253E+05	7.7093E-03	1.6882E+06	4.9483E-02
4.4928E+05	1.0938E-02	1.6999E+06	4.8495E-02
4.6602E+05	1.4077E-02	1.7117E+06	4.7176E-02
4.8277E+05	1.7933E-02	1.7234E+06	4.5506E-02
4.9952E+05	2.1981E-02	1.7352E+06	4.3402E-02
5.1627E+05	2.1558E-02	1.7469E+06	4.0893E-02
5.3301E+05	2.1700E-02	1.7587E+06	3.8202E-02
5.4976E+05	1.9433E-02	1.7704E+06	3.5058E-02
5.6651E+05	1.8575E-02	1.7822E+06	3.1681E-02
5.8325E+05	1.9054E-02	1.7939E+06	2.8285E-02
6.0000E+05	2.0729E-02	1.8057E+06	2.4767E-02
6.2941E+05	2.1019E-02	1.8174E+06	2.1421E-02
6.5882E+05	2.1614E-02	1.8292E+06	1.8208E-02
6.8824E+05	2.2170E-02	1.8409E+06	1.5227E-02
7.1765E+05	2.2662E-02	1.8527E+06	1.2504E-02
7.4706E+05	2.3278E-02	1.8644E+06	1.0022E-02
7.7647E+05	2.3893E-02	1.8762E+06	7.9496E-03
8.0588E+05	2.4435E-02	1.8879E+06	6.2073E-03
8.3529E+05	2.5086E-02	1.8997E+06	4.7299E-03
8.6471E+05	2.5815E-02	1.9114E+06	3.5882E-03
8.9412E+05	2.6403E-02	1.9232E+06	2.6249E-03
9.2353E+05	2.7097E-02	1.9349E+06	1.8841E-03
9.5294E+05	2.7770E-02	1.9467E+06	1.5503E-03
9.8235E+05	2.8582E-02	1.9584E+06	1.0750E-03
1.0118E+06	2.9308E-02	1.9702E+06	7.2823E-04
1.0412E+06	3.0073E-02	1.9819E+06	4.4383E-04
1.0706E+06	3.0921E-02	1.9937E+06	1.7827E-04

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 PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = TH-229
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =    4.000000E+04
TIME HIGH=   2.000000E+06
NUMBER OF CELLS =              25
DELTA TIME INCREMENT =   7.840000E+04

 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.9996E+06       MIN. TIME =  4.8462E+04
TOTAL WEIGHT =  2.0782E+03   TOTAL PARCELS =        1302.0
PEAK WEIGHT =      241.450    PEAK WEIGHT TIME =  1.7256E+06
PEAK PARCELS =      181.000   PEAK PARCELS TIME =  1.5760E+05
WT. LOW =  0.0000E-01         NO. PARCELS LOW =          0.0
WT. HI =  0.0000E-01          NO. PARCELS HI =          0.0
 SMOOTHING WINDOW (CELLS)=     10

TOTAL INVENTORY (CURIES) =   2.078176E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   1.683538E+03
PERCENT OF TOTAL INVENTORY =  81.010

TIME OF MAXIMUM CONCENTRATION (YEARS) =   1.020000E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   4.676529E-09
MAXIMUM RATE (CURIES/YEAR) =   1.213438E-03
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06


 CONTAMINANT = TH-229

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
7.9200E+04	4.1865E-04	1.0200E+06	1.2134E-03
9.8016E+04	4.1865E-04	1.0388E+06	1.2131E-03
1.1683E+05	4.1865E-04	1.0576E+06	1.2127E-03
1.3565E+05	4.1865E-04	1.0764E+06	1.2124E-03
1.5446E+05	4.1865E-04	1.0953E+06	1.2120E-03
1.7328E+05	4.2134E-04	1.1141E+06	1.2109E-03
1.9210E+05	4.2458E-04	1.1329E+06	1.2096E-03
2.1091E+05	4.2781E-04	1.1517E+06	1.2083E-03
2.2973E+05	4.3104E-04	1.1705E+06	1.2069E-03
2.4854E+05	4.3439E-04	1.1893E+06	1.2040E-03
2.6736E+05	4.3773E-04	1.2082E+06	1.2002E-03

2.8618E+05	4.4118E-04	1.2270E+06	1.1965E-03
3.0499E+05	4.4458E-04	1.2458E+06	1.1927E-03
3.2381E+05	4.4890E-04	1.2646E+06	1.1905E-03
3.4262E+05	4.5413E-04	1.2834E+06	1.1896E-03
3.6144E+05	4.5937E-04	1.3022E+06	1.1888E-03
3.8026E+05	4.6460E-04	1.3211E+06	1.1880E-03
3.9907E+05	4.7862E-04	1.3399E+06	1.1805E-03
4.1789E+05	5.1020E-04	1.3587E+06	1.1594E-03
4.3670E+05	5.4179E-04	1.3775E+06	1.1384E-03
4.5552E+05	5.7337E-04	1.3963E+06	1.1173E-03
4.7434E+05	6.0162E-04	1.4151E+06	1.0990E-03
4.9315E+05	6.1320E-04	1.4340E+06	1.0945E-03
5.1197E+05	6.2478E-04	1.4528E+06	1.0899E-03
5.3078E+05	6.3636E-04	1.4716E+06	1.0854E-03
5.4960E+05	6.4794E-04	1.4904E+06	1.0808E-03
5.6842E+05	6.6604E-04	1.5092E+06	1.0545E-03
5.8723E+05	6.8414E-04	1.5280E+06	1.0283E-03
6.0605E+05	7.0224E-04	1.5468E+06	1.0020E-03
6.2486E+05	7.2034E-04	1.5657E+06	9.7572E-04
6.4368E+05	7.4624E-04	1.5845E+06	9.6166E-04
6.6250E+05	7.7370E-04	1.6033E+06	9.5005E-04
6.8131E+05	8.0117E-04	1.6221E+06	9.3843E-04
7.0013E+05	8.2863E-04	1.6409E+06	9.2681E-04
7.1894E+05	8.5090E-04	1.6597E+06	9.1468E-04
7.3776E+05	8.7057E-04	1.6786E+06	9.0229E-04
7.5658E+05	8.9024E-04	1.6974E+06	8.8991E-04
7.7539E+05	9.0992E-04	1.7162E+06	8.7752E-04
7.9421E+05	9.3033E-04	1.7350E+06	8.6611E-04
8.1302E+05	9.5148E-04	1.7538E+06	8.5568E-04
8.3184E+05	9.7263E-04	1.7726E+06	8.4525E-04
8.5066E+05	9.9377E-04	1.7915E+06	8.3482E-04
8.6947E+05	1.0196E-03	1.8103E+06	8.2678E-04
8.8829E+05	1.0548E-03	1.8291E+06	8.2355E-04
9.0710E+05	1.0900E-03	1.8479E+06	8.2032E-04
9.2592E+05	1.1252E-03	1.8667E+06	8.1709E-04
9.4474E+05	1.1569E-03	1.8855E+06	8.1382E-04
9.6355E+05	1.1710E-03	1.9044E+06	8.1043E-04
9.8237E+05	1.1852E-03	1.9232E+06	8.0703E-04
1.0012E+06	1.1993E-03	1.9420E+06	8.0363E-04

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-238
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.500000E+05
TIME HIGH= 6.000000E+05
NUMBER OF CELLS = 300
DELTA TIME INCREMENT = 8.333333E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9986E+06 MIN. TIME = 3.9262E+05
TOTAL WEIGHT = 1.2231E+04 TOTAL PARCELS = 3725.0
PEAK WEIGHT = 216.371 PEAK WEIGHT TIME = 4.3958E+05
PEAK PARCELS = 50.000 PEAK PARCELS TIME = 4.3958E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 3.6988E+00 NO. PARCELS HI = 3622.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 1.223426E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.220793E+04
PERCENT OF TOTAL INVENTORY = 99.785

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.379167E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7.976323E-07
MAXIMUM RATE (CURIES/YEAR) = 2.069649E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = U-238

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.9292E+05	2.3915E-03	4.9625E+05	6.3844E-02
3.9498E+05	3.5911E-03	4.9832E+05	6.3700E-02
3.9705E+05	6.2666E-03	5.0038E+05	6.3148E-02
3.9912E+05	9.7591E-03	5.0245E+05	6.1998E-02
4.0118E+05	1.3972E-02	5.0452E+05	6.0269E-02
4.0325E+05	1.9174E-02	5.0658E+05	5.7974E-02
4.0532E+05	2.5451E-02	5.0865E+05	5.5224E-02
4.0738E+05	3.2968E-02	5.1072E+05	5.2091E-02
4.0945E+05	4.1773E-02	5.1278E+05	4.8609E-02
4.1152E+05	5.2000E-02	5.1485E+05	4.4753E-02
4.1358E+05	6.3637E-02	5.1692E+05	4.0545E-02

4.1565E+05	7.6757E-02	5.1898E+05	3.6046E-02
4.1772E+05	9.1178E-02	5.2105E+05	3.1386E-02
4.1978E+05	1.0670E-01	5.2312E+05	2.6774E-02
4.2185E+05	1.2296E-01	5.2518E+05	2.2412E-02
4.2392E+05	1.3942E-01	5.2725E+05	1.8472E-02
4.2598E+05	1.5543E-01	5.2932E+05	1.5066E-02
4.2805E+05	1.7032E-01	5.3138E+05	1.2230E-02
4.3012E+05	1.8333E-01	5.3345E+05	9.9558E-03
4.3218E+05	1.9388E-01	5.3552E+05	8.1553E-03
4.3425E+05	2.0143E-01	5.3758E+05	6.7568E-03
4.3632E+05	2.0583E-01	5.3965E+05	5.6437E-03
4.3838E+05	2.0687E-01	5.4172E+05	4.7074E-03
4.4045E+05	2.0495E-01	5.4378E+05	3.8766E-03
4.4252E+05	2.0028E-01	5.4585E+05	3.1039E-03
4.4458E+05	1.9351E-01	5.4792E+05	2.3789E-03
4.4665E+05	1.8508E-01	5.4998E+05	1.7324E-03
4.4872E+05	1.7560E-01	5.5205E+05	1.1863E-03
4.5078E+05	1.6538E-01	5.5412E+05	7.6342E-04
4.5285E+05	1.5479E-01	5.5618E+05	4.5798E-04
4.5492E+05	1.4404E-01	5.5825E+05	2.5924E-04
4.5698E+05	1.3329E-01	5.6032E+05	1.3632E-04
4.5905E+05	1.2280E-01	5.6238E+05	6.9405E-05
4.6112E+05	1.1275E-01	5.6445E+05	3.2966E-05
4.6318E+05	1.0334E-01	5.6652E+05	1.6426E-05
4.6525E+05	9.4776E-02	5.6858E+05	9.0628E-06
4.6732E+05	8.7231E-02	5.7065E+05	6.6077E-06
4.6938E+05	8.0818E-02	5.7272E+05	6.8345E-06
4.7145E+05	7.5651E-02	5.7478E+05	7.3253E-06
4.7352E+05	7.1751E-02	5.7685E+05	6.6077E-06
4.7558E+05	6.9005E-02	5.7892E+05	6.6077E-06
4.7765E+05	6.7240E-02	5.8098E+05	7.2121E-06
4.7972E+05	6.6167E-02	5.8305E+05	9.7798E-06
4.8178E+05	6.5486E-02	5.8512E+05	7.8916E-06
4.8385E+05	6.4964E-02	5.8718E+05	8.2691E-06
4.8592E+05	6.4588E-02	5.8925E+05	7.3629E-06
4.8798E+05	6.4182E-02	5.9132E+05	7.4761E-06
4.9005E+05	6.3820E-02	5.9338E+05	6.1924E-06
4.9212E+05	6.3728E-02	5.9545E+05	3.8137E-06
4.9418E+05	6.3783E-02	5.9752E+05	2.3789E-06

PLTCVT PROGRAM DATA SUMMARY
PIR 2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-234
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.500000E+05
TIME HIGH= 6.000000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 6.250000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9968E+06 MIN. TIME = 3.7646E+05
TOTAL WEIGHT = 2.8387E+04 TOTAL PARCELS = 12685.0
PEAK WEIGHT = 397.751 PEAK WEIGHT TIME = 4.3719E+05
PEAK PARCELS = 120.000 PEAK PARCELS TIME = 4.3719E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 2.5911E+00 NO. PARCELS HI = 7667.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 2.838995E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.838758E+04
PERCENT OF TOTAL INVENTORY = 99.992

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.378125E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.978333E-06
MAXIMUM RATE (CURIES/YEAR) = 5.133262E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = U-234

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.7656E+05	4.1322E-05	4.8813E+05	1.4311E-01
3.7879E+05	1.0423E-04	4.9036E+05	1.3963E-01
3.8103E+05	2.9031E-04	4.9259E+05	1.3625E-01
3.8326E+05	6.6095E-04	4.9482E+05	1.3331E-01
3.8549E+05	1.2849E-03	4.9705E+05	1.3130E-01
3.8772E+05	2.1776E-03	4.9928E+05	1.3021E-01
3.8995E+05	3.3207E-03	5.0151E+05	1.2921E-01
3.9218E+05	4.7531E-03	5.0374E+05	1.2693E-01
3.9441E+05	6.8127E-03	5.0598E+05	1.2246E-01
3.9664E+05	1.0157E-02	5.0821E+05	1.1550E-01

3.9888E+05	1.5766E-02	5.1044E+05	1.0670E-01
4.0111E+05	2.4456E-02	5.1267E+05	9.6976E-02
4.0334E+05	3.6656E-02	5.1490E+05	8.7198E-02
4.0557E+05	5.2344E-02	5.1713E+05	7.7861E-02
4.0780E+05	7.1240E-02	5.1936E+05	6.9127E-02
4.1003E+05	9.3607E-02	5.2159E+05	6.0886E-02
4.1226E+05	1.2021E-01	5.2383E+05	5.2906E-02
4.1449E+05	1.5268E-01	5.2606E+05	4.4988E-02
4.1673E+05	1.9214E-01	5.2829E+05	3.7173E-02
4.1896E+05	2.3806E-01	5.3052E+05	2.9856E-02
4.2119E+05	2.8727E-01	5.3275E+05	2.3532E-02
4.2342E+05	3.3507E-01	5.3498E+05	1.8571E-02
4.2565E+05	3.7769E-01	5.3721E+05	1.4893E-02
4.2788E+05	4.1457E-01	5.3944E+05	1.2204E-02
4.3011E+05	4.4720E-01	5.4168E+05	1.0065E-02
4.3234E+05	4.7629E-01	5.4391E+05	8.1643E-03
4.3458E+05	4.9946E-01	5.4614E+05	6.3763E-03
4.3681E+05	5.1200E-01	5.4837E+05	4.7122E-03
4.3904E+05	5.1084E-01	5.5060E+05	3.2954E-03
4.4127E+05	4.9646E-01	5.5283E+05	2.1824E-03
4.4350E+05	4.7381E-01	5.5506E+05	1.3918E-03
4.4573E+05	4.4832E-01	5.5729E+05	8.4413E-04
4.4796E+05	4.2319E-01	5.5953E+05	4.7568E-04
4.5019E+05	3.9830E-01	5.6176E+05	2.4532E-04
4.5243E+05	3.7167E-01	5.6399E+05	1.1690E-04
4.5466E+05	3.4239E-01	5.6622E+05	5.7015E-05
4.5689E+05	3.1148E-01	5.6845E+05	3.0131E-05
4.5912E+05	2.8140E-01	5.7068E+05	2.0427E-05
4.6135E+05	2.5427E-01	5.7291E+05	1.1328E-05
4.6358E+05	2.3111E-01	5.7514E+05	8.5712E-06
4.6581E+05	2.1225E-01	5.7738E+05	6.4189E-06
4.6804E+05	1.9760E-01	5.7961E+05	3.7758E-06
4.7028E+05	1.8653E-01	5.8184E+05	5.8903E-06
4.7251E+05	1.7812E-01	5.8407E+05	3.7758E-06
4.7474E+05	1.7131E-01	5.8630E+05	3.7758E-06
4.7697E+05	1.6545E-01	5.8853E+05	6.9853E-06
4.7920E+05	1.6019E-01	5.9076E+05	4.8331E-06
4.8143E+05	1.5533E-01	5.9299E+05	3.7758E-06
4.8366E+05	1.5084E-01	5.9523E+05	7.0231E-06
4.8589E+05	1.4677E-01	5.9746E+05	2.1522E-06

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = TH-230
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 1.010000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 5.000000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9965E+06 MIN. TIME = 3.9392E+05
TOTAL WEIGHT = 1.2353E+03 TOTAL PARCELS = 1193.0
PEAK WEIGHT = 73.177 PEAK WEIGHT TIME = 5.0250E+05
PEAK PARCELS = 24.000 PEAK PARCELS TIME = 9.8250E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 7.5739E+00 NO. PARCELS HI = 1546.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 1.242910E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.189764E+03
PERCENT OF TOTAL INVENTORY = 95.724

TIME OF MAXIMUM CONCENTRATION (YEARS) = 5.125000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.081921E-08
MAXIMUM RATE (CURIES/YEAR) = 5.402048E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = TH-230

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.9250E+05	1.6134E-04	6.1500E+05	3.0762E-03
3.9364E+05	1.6134E-04	6.2588E+05	2.7702E-03
3.9477E+05	1.6134E-04	6.3677E+05	2.4690E-03
3.9591E+05	1.6134E-04	6.4765E+05	2.2140E-03
3.9705E+05	1.6134E-04	6.5853E+05	1.9751E-03
3.9818E+05	2.8907E-04	6.6941E+05	1.7494E-03
3.9932E+05	5.0194E-04	6.8029E+05	1.5462E-03
4.0045E+05	7.1480E-04	6.9118E+05	1.3882E-03
4.0159E+05	9.2766E-04	7.0206E+05	1.2426E-03
4.0273E+05	1.1195E-03	7.1294E+05	1.1014E-03
4.0386E+05	1.2272E-03	7.2382E+05	9.7047E-04

4.0500E+05	1.3350E-03	7.3471E+05	8.7500E-04
4.0614E+05	1.4427E-03	7.4559E+05	7.9628E-04
4.0727E+05	1.5504E-03	7.5647E+05	7.1741E-04
4.0841E+05	1.6370E-03	7.6735E+05	6.4705E-04
4.0955E+05	1.7184E-03	7.7824E+05	5.8410E-04
4.1068E+05	1.7998E-03	7.8912E+05	5.2503E-04
4.1182E+05	1.8811E-03	8.0000E+05	4.7329E-04
4.1295E+05	1.9302E-03	8.0629E+05	4.4979E-04
4.1409E+05	1.9310E-03	8.1258E+05	4.2813E-04
4.1523E+05	1.9317E-03	8.1886E+05	4.0804E-04
4.1636E+05	1.9324E-03	8.2515E+05	3.9030E-04
4.1750E+05	1.9331E-03	8.3144E+05	3.7248E-04
4.1864E+05	2.0261E-03	8.3773E+05	3.5208E-04
4.1977E+05	2.1191E-03	8.4402E+05	3.3337E-04
4.2091E+05	2.2121E-03	8.5030E+05	3.1710E-04
4.2205E+05	2.3051E-03	8.5659E+05	3.0189E-04
4.2318E+05	2.3907E-03	8.6288E+05	2.8666E-04
4.2432E+05	2.4714E-03	8.6917E+05	2.7177E-04
4.2545E+05	2.5521E-03	8.7546E+05	2.5826E-04
4.2659E+05	2.6329E-03	8.8174E+05	2.4514E-04
4.2773E+05	2.7102E-03	8.8803E+05	2.3138E-04
4.2886E+05	2.7743E-03	8.9432E+05	2.1816E-04
4.3000E+05	2.8383E-03	9.0061E+05	2.0513E-04
4.4088E+05	3.4609E-03	9.0689E+05	1.9217E-04
4.5177E+05	3.9618E-03	9.1318E+05	1.7994E-04
4.6265E+05	4.3641E-03	9.1947E+05	1.6875E-04
4.7353E+05	4.7443E-03	9.2576E+05	1.5785E-04
4.8441E+05	5.0226E-03	9.3205E+05	1.4755E-04
4.9529E+05	5.2546E-03	9.3833E+05	1.3786E-04
5.0618E+05	5.3888E-03	9.4462E+05	1.2911E-04
5.1706E+05	5.3941E-03	9.5091E+05	1.2018E-04
5.2794E+05	5.3091E-03	9.5720E+05	1.1170E-04
5.3882E+05	5.1325E-03	9.6349E+05	1.1234E-04
5.4971E+05	4.9059E-03	9.6977E+05	1.0526E-04
5.6059E+05	4.6763E-03	9.7606E+05	9.9109E-05
5.7147E+05	4.4149E-03	9.8235E+05	9.3425E-05
5.8235E+05	4.0971E-03	9.8864E+05	8.8160E-05
5.9324E+05	3.7325E-03	9.9493E+05	8.2874E-05
6.0412E+05	3.3791E-03	1.0012E+06	7.7412E-05

PLTCVT PROGRAM DATA SUMMARY
PIR 2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = RA-226
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 1.010000E+06
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 1.000000E+04

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9942E+06 MIN. TIME = 3.8646E+05
TOTAL WEIGHT = 2.5497E+03 TOTAL PARCELS = 1885.0
PEAK WEIGHT = 187.724 PEAK WEIGHT TIME = 5.0500E+05
PEAK PARCELS = 69.000 PEAK PARCELS TIME = 5.9500E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 2.8499E+00 NO. PARCELS HI = 184.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 2.552591E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.687442E+03
PERCENT OF TOTAL INVENTORY = 105.283

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.950000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 6.224496E-08
MAXIMUM RATE (CURIES/YEAR) = 1.615096E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = RA-226

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.8500E+05	1.9333E-04	6.2113E+05	6.5357E-03
3.8848E+05	1.9333E-04	6.2848E+05	6.1898E-03
3.9197E+05	1.9333E-04	6.3584E+05	5.8633E-03
3.9545E+05	2.3302E-04	6.4319E+05	5.4829E-03
3.9894E+05	5.3733E-04	6.5054E+05	5.0645E-03
4.0242E+05	8.4165E-04	6.5790E+05	4.6569E-03
4.0591E+05	1.1266E-03	6.6525E+05	4.2821E-03
4.0939E+05	1.3568E-03	6.7260E+05	3.8226E-03
4.1288E+05	1.5870E-03	6.7996E+05	3.5516E-03
4.1636E+05	1.9540E-03	6.8731E+05	3.3412E-03
4.1985E+05	2.5339E-03	6.9466E+05	3.0637E-03

4.2333E+05	3.1137E-03	7.0201E+05	2.7720E-03
4.2682E+05	3.6741E-03	7.0937E+05	2.5182E-03
4.3030E+05	4.2166E-03	7.1672E+05	2.3036E-03
4.3379E+05	4.7591E-03	7.2407E+05	2.1314E-03
4.3727E+05	5.3480E-03	7.3143E+05	1.9249E-03
4.4076E+05	5.9615E-03	7.3878E+05	1.7593E-03
4.4424E+05	6.5750E-03	7.4613E+05	1.6358E-03
4.4773E+05	7.4169E-03	7.5348E+05	1.5057E-03
4.5121E+05	8.3221E-03	7.6121E+05	1.3625E-03
4.5470E+05	9.2274E-03	7.6894E+05	1.2011E-03
4.5818E+05	9.9470E-03	7.7667E+05	1.0274E-03
4.6167E+05	1.0649E-02	7.8439E+05	8.6735E-04
4.6515E+05	1.1352E-02	7.9212E+05	7.3846E-04
4.6864E+05	1.2076E-02	7.9985E+05	6.4371E-04
4.7212E+05	1.2799E-02	8.0758E+05	5.6344E-04
4.7561E+05	1.3528E-02	8.1530E+05	4.7571E-04
4.7909E+05	1.4280E-02	8.2303E+05	4.1266E-04
4.8258E+05	1.5032E-02	8.3076E+05	3.3538E-04
4.8606E+05	1.5619E-02	8.3848E+05	2.7491E-04
4.8955E+05	1.5826E-02	8.4621E+05	2.4408E-04
4.9303E+05	1.6034E-02	8.5394E+05	2.3059E-04
4.9652E+05	1.5914E-02	8.6167E+05	2.0506E-04
5.0000E+05	1.5370E-02	8.6939E+05	1.7730E-04
5.0348E+05	1.4826E-02	8.7712E+05	1.5311E-04
5.1084E+05	1.4283E-02	8.8485E+05	1.3898E-04
5.1819E+05	1.3807E-02	8.9258E+05	1.1768E-04
5.2554E+05	1.3219E-02	9.0030E+05	7.9475E-05
5.3290E+05	1.2719E-02	9.0803E+05	5.2719E-05
5.4025E+05	1.2098E-02	9.1576E+05	5.5174E-05
5.4760E+05	1.1456E-02	9.2348E+05	5.3784E-05
5.5496E+05	1.0866E-02	9.3121E+05	5.1532E-05
5.6231E+05	1.0334E-02	9.3894E+05	4.7862E-05
5.6966E+05	9.8949E-03	9.4667E+05	4.2715E-05
5.7701E+05	9.4913E-03	9.5439E+05	3.6424E-05
5.8437E+05	9.0386E-03	9.6212E+05	3.0090E-05
5.9172E+05	8.6187E-03	9.6985E+05	2.5756E-05
5.9907E+05	8.1162E-03	9.7757E+05	2.3028E-05
6.0643E+05	7.5397E-03	9.8530E+05	2.1104E-05
6.1378E+05	6.9430E-03	9.9303E+05	1.8415E-05

PLTCVT PROGRAM DATA SUMMARY
PIR 2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = AM-243
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+04
TIME HIGH= 6.000000E+04
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 2.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 5.7841E+04	MIN. TIME = 4.2874E+04
TOTAL WEIGHT = 3.0758E+03	TOTAL PARCELS = 3350.0
PEAK WEIGHT = 97.717	PEAK WEIGHT TIME = 4.5100E+04
PEAK PARCELS = 71.000	PEAK PARCELS TIME = 4.5100E+04
WT. LOW = 0.0000E-01	NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01	NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 10	

TOTAL INVENTORY (CURIES) = 3.075834E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.161992E+03
PERCENT OF TOTAL INVENTORY = 102.801

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.490000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.614601E-06
MAXIMUM RATE (CURIES/YEAR) = 4.189473E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = AM-243

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.2900E+04	1.1215E-01	5.0000E+04	2.1132E-01
4.2964E+04	1.1215E-01	5.0294E+04	2.0562E-01
4.3027E+04	1.1215E-01	5.0588E+04	2.0045E-01
4.3091E+04	1.1215E-01	5.0882E+04	1.9529E-01
4.3155E+04	1.2074E-01	5.1176E+04	1.9043E-01
4.3218E+04	1.3077E-01	5.1471E+04	1.8560E-01
4.3282E+04	1.4080E-01	5.1765E+04	1.8114E-01
4.3345E+04	1.4939E-01	5.2059E+04	1.7669E-01
4.3409E+04	1.5741E-01	5.2353E+04	1.7248E-01
4.3473E+04	1.6543E-01	5.2647E+04	1.6811E-01
4.3536E+04	1.7733E-01	5.2941E+04	1.6343E-01

4.3600E+04	1.9214E-01	5.3235E+04	1.5877E-01
4.3664E+04	2.0694E-01	5.3529E+04	1.5357E-01
4.3727E+04	2.2229E-01	5.3824E+04	1.4814E-01
4.3791E+04	2.3836E-01	5.4118E+04	1.4332E-01
4.3855E+04	2.5443E-01	5.4412E+04	1.3795E-01
4.3918E+04	2.7069E-01	5.4706E+04	1.3249E-01
4.3982E+04	2.8740E-01	5.5000E+04	1.2640E-01
4.4045E+04	3.0411E-01	5.5294E+04	1.1833E-01
4.4109E+04	3.2042E-01	5.5382E+04	1.1567E-01
4.4173E+04	3.3426E-01	5.5470E+04	1.1301E-01
4.4236E+04	3.4810E-01	5.5558E+04	1.1015E-01
4.4300E+04	3.6194E-01	5.5646E+04	1.0718E-01
4.4364E+04	3.7275E-01	5.5734E+04	1.0412E-01
4.4427E+04	3.8357E-01	5.5821E+04	1.0090E-01
4.4491E+04	3.9438E-01	5.5909E+04	9.7705E-02
4.4555E+04	4.0063E-01	5.5997E+04	9.4711E-02
4.4618E+04	4.0612E-01	5.6085E+04	9.1717E-02
4.4682E+04	4.1161E-01	5.6173E+04	8.8669E-02
4.4745E+04	4.1449E-01	5.6261E+04	8.5611E-02
4.4809E+04	4.1633E-01	5.6349E+04	8.2572E-02
4.4873E+04	4.1816E-01	5.6437E+04	7.9550E-02
4.4936E+04	4.1690E-01	5.6524E+04	7.6532E-02
4.5000E+04	4.1332E-01	5.6612E+04	7.3524E-02
4.5294E+04	3.9771E-01	5.6700E+04	7.0517E-02
4.5588E+04	3.8071E-01	5.6788E+04	6.7387E-02
4.5882E+04	3.6503E-01	5.6876E+04	6.4257E-02
4.6176E+04	3.5044E-01	5.6964E+04	6.3295E-02
4.6471E+04	3.3655E-01	5.7052E+04	6.3150E-02
4.6765E+04	3.2383E-01	5.7140E+04	6.1907E-02
4.7059E+04	3.0956E-01	5.7227E+04	5.9326E-02
4.7353E+04	2.9614E-01	5.7315E+04	5.6766E-02
4.7647E+04	2.8358E-01	5.7403E+04	5.4311E-02
4.7941E+04	2.7186E-01	5.7491E+04	5.1855E-02
4.8235E+04	2.6079E-01	5.7579E+04	4.9569E-02
4.8529E+04	2.5108E-01	5.7667E+04	4.7302E-02
4.8824E+04	2.4230E-01	5.7755E+04	4.5229E-02
4.9118E+04	2.3367E-01	5.7843E+04	4.3273E-02
4.9412E+04	2.2590E-01	5.7930E+04	4.1316E-02
4.9706E+04	2.1858E-01	5.8018E+04	3.9360E-02

PLTCVT PROGRAM DATA SUMMARY
PIR2(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 4
CONTAMINANT = PU-239
TONS OF HEAVY METAL FACTOR = 0,5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1,000000E+04
TIME HIGH= 2,000000E+05
NUMBER OF CELLS = 10
DELTA TIME INCREMENT = 1,900000E+04

RAW DATA AND BLOCKED DATA FACTORS:
MAX, TIME = 1,7637E+05 MIN, TIME = 6,2560E+04
TOTAL WEIGHT = 8,3640E+00 TOTAL PARCELS = 10,0
PEAK WEIGHT = 2,541 PEAK WEIGHT TIME = 7,6500E+04
PEAK PARCELS = 2,000 PEAK PARCELS TIME = 7,6500E+04
WT, LOW = 0,0000E-01 NO, PARCELS LOW = 0,0
WT, HI = 0,0000E-01 NO, PARCELS HI = 0,0
SMOOTHING WINDOW (CELLS)= 0

TOTAL INVENTORY (CURIES) = 8,364018E+00
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 8,882326E+00
PERCENT OF TOTAL INVENTORY = 106,197

TIME OF MAXIMUM CONCENTRATION (YEARS) = 5,750000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 5,153578E-10
MAXIMUM RATE (CURIES/YEAR) = 1,337220E-04
CONVERSION FACTOR RATE TO CONCENTRATION = 3,853949E-06

CONTAMINANT = PU-239

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
5,7500E+04	1,3372E-04	1,1450E+05	3,7346E-05
5,8640E+04	1,3372E-04	1,1564E+05	3,5886E-05
5,9780E+04	1,3372E-04	1,1678E+05	3,4426E-05
6,0920E+04	1,3372E-04	1,1792E+05	3,2967E-05
6,2060E+04	1,3372E-04	1,1906E+05	3,1507E-05
6,3200E+04	1,3372E-04	1,2020E+05	3,0047E-05
6,4340E+04	1,3372E-04	1,2134E+05	2,8587E-05
6,5480E+04	1,3372E-04	1,2248E+05	2,7128E-05
6,6620E+04	1,3372E-04	1,2362E+05	2,5668E-05
6,7760E+04	1,3372E-04	1,2476E+05	2,4208E-05
6,8900E+04	1,3372E-04	1,2590E+05	2,2748E-05

7.0040E+04	1.3372E-04	1.2704E+05	2.1289E-05
7.1180E+04	1.3372E-04	1.2818E+05	1.9829E-05
7.2320E+04	1.3372E-04	1.2932E+05	1.8369E-05
7.3460E+04	1.3372E-04	1.3046E+05	1.6909E-05
7.4600E+04	1.3372E-04	1.3160E+05	1.5450E-05
7.5740E+04	1.3372E-04	1.3274E+05	1.3990E-05
7.6880E+04	1.3333E-04	1.3388E+05	1.3174E-05
7.8020E+04	1.3217E-04	1.3502E+05	1.3647E-05
7.9160E+04	1.3101E-04	1.3616E+05	1.4120E-05
8.0300E+04	1.2985E-04	1.3730E+05	1.4593E-05
8.1440E+04	1.2868E-04	1.3844E+05	1.5066E-05
8.2580E+04	1.2752E-04	1.3958E+05	1.5538E-05
8.3720E+04	1.2636E-04	1.4072E+05	1.6011E-05
8.4860E+04	1.2520E-04	1.4186E+05	1.6484E-05
8.6000E+04	1.2403E-04	1.4300E+05	1.6957E-05
8.7140E+04	1.2287E-04	1.4414E+05	1.7430E-05
8.8280E+04	1.2171E-04	1.4528E+05	1.7902E-05
8.9420E+04	1.2055E-04	1.4642E+05	1.8375E-05
9.0560E+04	1.1938E-04	1.4756E+05	1.8848E-05
9.1700E+04	1.1822E-04	1.4870E+05	1.9321E-05
9.2840E+04	1.1706E-04	1.4984E+05	1.9794E-05
9.3980E+04	1.1589E-04	1.5098E+05	2.0267E-05
9.5120E+04	1.1473E-04	1.5212E+05	2.0739E-05
9.6260E+04	1.1126E-04	1.5326E+05	2.0639E-05
9.7400E+04	1.0664E-04	1.5440E+05	2.0252E-05
9.8540E+04	1.0202E-04	1.5554E+05	1.9864E-05
9.9680E+04	9.7405E-05	1.5668E+05	1.9477E-05
1.0082E+05	9.2785E-05	1.5782E+05	1.9090E-05
1.0196E+05	8.8165E-05	1.5896E+05	1.8703E-05
1.0310E+05	8.3545E-05	1.6010E+05	1.8315E-05
1.0424E+05	7.8925E-05	1.6124E+05	1.7928E-05
1.0538E+05	7.4305E-05	1.6238E+05	1.7541E-05
1.0652E+05	6.9685E-05	1.6352E+05	1.7154E-05
1.0766E+05	6.5065E-05	1.6466E+05	1.6766E-05
1.0880E+05	6.0445E-05	1.6580E+05	1.6379E-05
1.0994E+05	5.5826E-05	1.6694E+05	1.5992E-05
1.1108E+05	5.1206E-05	1.6808E+05	1.5605E-05
1.1222E+05	4.6586E-05	1.6922E+05	1.5217E-05
1.1336E+05	4.1966E-05	1.7036E+05	1.4830E-05

PLTCVT PROGRAM DATA SUMMARY
PIR'2(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 4
CONTAMINANT = U-235
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.500000E+05
TIME HIGH= 6.500000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 7.500000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 8.5035E+05 MIN. TIME = 4.7828E+04
TOTAL WEIGHT = 4.1315E+02 TOTAL PARCELS = 18277.0
PEAK WEIGHT = 16.671 PEAK WEIGHT TIME = 4.5613E+05
PEAK PARCELS = 191.000 PEAK PARCELS TIME = 4.3138E+05
WT. LOW = 5.3964E-01 NO. PARCELS LOW = 6188.0
WT. HI = 9.6947E-01 NO. PARCELS HI = 2032.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 4.146562E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.120681E+02
PERCENT OF TOTAL INVENTORY = 99.376

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.673750E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.899718E-08
MAXIMUM RATE (CURIES/YEAR) = 4.929278E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = U-235

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.5038E+05	5.9553E-06	4.9448E+05	3.4778E-03
3.5309E+05	6.0281E-06	4.9772E+05	3.3042E-03
3.5581E+05	6.1193E-06	5.0095E+05	3.1250E-03
3.5852E+05	6.2542E-06	5.0419E+05	2.9309E-03
3.6124E+05	6.4008E-06	5.0742E+05	2.7231E-03
3.6395E+05	6.5756E-06	5.1066E+05	2.5053E-03
3.6667E+05	6.8056E-06	5.1389E+05	2.2809E-03
3.6939E+05	7.0818E-06	5.1713E+05	2.0511E-03
3.7210E+05	7.3583E-06	5.2036E+05	1.8177E-03
3.7482E+05	7.6148E-06	5.2360E+05	1.5840E-03
3.7753E+05	7.8928E-06	5.2683E+05	1.3590E-03

3.8025E+05	8.2779E-06	5.3007E+05	1.1533E-03
3.8297E+05	8.8501E-06	5.3330E+05	9.7538E-04
3.8568E+05	9.6542E-06	5.3654E+05	8.2868E-04
3.8840E+05	1.0946E-05	5.3977E+05	7.0890E-04
3.9111E+05	1.5118E-05	5.4301E+05	6.0879E-04
3.9383E+05	2.6957E-05	5.4625E+05	5.1112E-04
3.9655E+05	5.1922E-05	5.4948E+05	4.1996E-04
3.9926E+05	8.8378E-05	5.5272E+05	3.1305E-04
4.0198E+05	1.2907E-04	5.5573E+05	2.3933E-04
4.0469E+05	1.7069E-04	5.5875E+05	2.4073E-04
4.0741E+05	2.2468E-04	5.6177E+05	2.9084E-04
4.1012E+05	3.2112E-04	5.6479E+05	3.2007E-04
4.1284E+05	4.8945E-04	5.6781E+05	2.8665E-04
4.1556E+05	7.4581E-04	5.7083E+05	2.2645E-04
4.1827E+05	1.0886E-03	5.7385E+05	2.0498E-04
4.2099E+05	1.4994E-03	5.7687E+05	2.4816E-04
4.2370E+05	1.9620E-03	5.7989E+05	3.1083E-04
4.2642E+05	2.4433E-03	5.8291E+05	3.2353E-04
4.2914E+05	2.8818E-03	5.8592E+05	2.6148E-04
4.3185E+05	3.1903E-03	5.8894E+05	1.6952E-04
4.3457E+05	3.3141E-03	5.9196E+05	1.0166E-04
4.3728E+05	3.3237E-03	5.9498E+05	7.1320E-05
4.4000E+05	3.3702E-03	5.9800E+05	5.5385E-05
4.4272E+05	3.5644E-03	6.0102E+05	3.3165E-05
4.4595E+05	3.8004E-03	6.0404E+05	1.4987E-05
4.4919E+05	4.0720E-03	6.0706E+05	1.1345E-05
4.5242E+05	4.3360E-03	6.1008E+05	2.5156E-05
4.5566E+05	4.5650E-03	6.1309E+05	5.0190E-05
4.5889E+05	4.7281E-03	6.1611E+05	7.1042E-05
4.6213E+05	4.8431E-03	6.1913E+05	7.4198E-05
4.6536E+05	4.9141E-03	6.2215E+05	5.9914E-05
4.6860E+05	4.9255E-03	6.2517E+05	4.1441E-05
4.7183E+05	4.8782E-03	6.2819E+05	3.1631E-05
4.7507E+05	4.7715E-03	6.3121E+05	3.0751E-05
4.7830E+05	4.5917E-03	6.3423E+05	3.1134E-05
4.8154E+05	4.3587E-03	6.3725E+05	2.5882E-05
4.8477E+05	4.1115E-03	6.4026E+05	1.6263E-05
4.8801E+05	3.8758E-03	6.4328E+05	6.9948E-06
4.9125E+05	3.6634E-03	6.4630E+05	2.0908E-06

PLTCVT PROGRAM DATA SUMMARY
PIR 2(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = PA-231
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+05
TIME HIGH= 7.000000E+05
NUMBER OF CELLS = 20
DELTA TIME INCREMENT = 1.500000E+04

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.8223E+06 MIN. TIME = 5.5841E+04
TOTAL WEIGHT = 7.8014E+00 TOTAL PARCELS = 300.0
PEAK WEIGHT = 2.628 PEAK WEIGHT TIME = 4.6750E+05
PEAK PARCELS = 21.000 PEAK PARCELS TIME = 5.7250E+05
WT. LOW = 2.7587E-02 NO. PARCELS LOW = 238.0
WT. HI = 4.6006E-02 NO. PARCELS HI = 272.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 7.875027E+00
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 8.460175E+00
PERCENT OF TOTAL INVENTORY = 107.430

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.525000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 3.481995E-10
MAXIMUM RATE (CURIES/YEAR) = 9.034875E-05
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = PA-231

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.0750E+05	3.1762E-08	4.9835E+05	5.2595E-05
4.0879E+05	3.1762E-08	5.0129E+05	5.1080E-05
4.1008E+05	3.1762E-08	5.0423E+05	4.9566E-05
4.1136E+05	3.1762E-08	5.0717E+05	4.8051E-05
4.1265E+05	3.1762E-08	5.1011E+05	4.6537E-05
4.1394E+05	3.1762E-08	5.1305E+05	4.5069E-05
4.1523E+05	3.1762E-08	5.1599E+05	4.3802E-05
4.1652E+05	3.1762E-08	5.1894E+05	4.2535E-05
4.1780E+05	3.1762E-08	5.2188E+05	4.1268E-05
4.1909E+05	3.1762E-08	5.2482E+05	4.0001E-05
4.2038E+05	3.1762E-08	5.2776E+05	3.8816E-05

4.2167E+05	3.1762E-08	5.3070E+05	3.8473E-05
4.2295E+05	2.2345E-06	5.3364E+05	3.8131E-05
4.2424E+05	8.4762E-06	5.3658E+05	3.7789E-05
4.2553E+05	1.4718E-05	5.3952E+05	3.7446E-05
4.2682E+05	2.0960E-05	5.4246E+05	3.7104E-05
4.2811E+05	2.7201E-05	5.4541E+05	3.4015E-05
4.2939E+05	3.3443E-05	5.4835E+05	3.0892E-05
4.3068E+05	3.9685E-05	5.5129E+05	2.7770E-05
4.3197E+05	4.5927E-05	5.5561E+05	2.3185E-05
4.3326E+05	5.2168E-05	5.5992E+05	2.1084E-05
4.3455E+05	5.8410E-05	5.6424E+05	2.0924E-05
4.3583E+05	6.4652E-05	5.6856E+05	2.0763E-05
4.3712E+05	7.0894E-05	5.7288E+05	2.0453E-05
4.3841E+05	7.3798E-05	5.7720E+05	1.8590E-05
4.3970E+05	7.5310E-05	5.8152E+05	1.6727E-05
4.4098E+05	7.6823E-05	5.8583E+05	1.4863E-05
4.4227E+05	7.8336E-05	5.9015E+05	1.3479E-05
4.4356E+05	7.9848E-05	5.9447E+05	1.2395E-05
4.4485E+05	8.1361E-05	5.9879E+05	1.1311E-05
4.4614E+05	8.2874E-05	6.0311E+05	1.0313E-05
4.4742E+05	8.4387E-05	6.0742E+05	9.8438E-06
4.4871E+05	8.5899E-05	6.1174E+05	9.3748E-06
4.5000E+05	8.7412E-05	6.1606E+05	8.9057E-06
4.5129E+05	8.8925E-05	6.2038E+05	7.9894E-06
4.5423E+05	8.8191E-05	6.2470E+05	6.8494E-06
4.5717E+05	8.4520E-05	6.2902E+05	5.7095E-06
4.6011E+05	8.0848E-05	6.3333E+05	4.7627E-06
4.6305E+05	7.7177E-05	6.3765E+05	4.6228E-06
4.6599E+05	7.3506E-05	6.4197E+05	4.4828E-06
4.6893E+05	7.0561E-05	6.4629E+05	4.3429E-06
4.7188E+05	6.8379E-05	6.5061E+05	4.1109E-06
4.7482E+05	6.6196E-05	6.5492E+05	3.8430E-06
4.7776E+05	6.4014E-05	6.5924E+05	3.5751E-06
4.8070E+05	6.1832E-05	6.6356E+05	3.3728E-06
4.8364E+05	5.9928E-05	6.6788E+05	3.3721E-06
4.8658E+05	5.8464E-05	6.7220E+05	3.3713E-06
4.8952E+05	5.7001E-05	6.7652E+05	3.3705E-06
4.9246E+05	5.5537E-05	6.8083E+05	3.4135E-06
4.9541E+05	5.4073E-05	6.8515E+05	3.4693E-06

PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = C-14
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 2.000000E+04
TIME HIGH= 7.000000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 2.500000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 7.7475E+04 MIN. TIME = 3.4197E+04
TOTAL WEIGHT = 1.5179E+02 TOTAL PARCELS = 1777.0
PEAK WEIGHT = 4.835 PEAK WEIGHT TIME = 4.0875E+04
PEAK PARCELS = 25.000 PEAK PARCELS TIME = 6.6125E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 3.2468E-01 NO. PARCELS HI = 410.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 1.521160E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.502798E+02
PERCENT OF TOTAL INVENTORY = 98.793

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.137500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 5.013158E-08
MAXIMUM RATE (CURIES/YEAR) = 1.293252E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = C-14

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.4125E+04	8.5859E-04	5.2000E+04	3.2844E-03
3.4483E+04	9.7862E-04	5.2358E+04	2.9480E-03
3.4840E+04	1.4134E-03	5.2715E+04	2.6318E-03
3.5198E+04	1.9463E-03	5.3073E+04	2.3413E-03
3.5555E+04	2.5844E-03	5.3430E+04	2.0770E-03
3.5913E+04	3.2504E-03	5.3788E+04	1.8307E-03
3.6270E+04	3.9564E-03	5.4145E+04	1.6014E-03
3.6628E+04	4.7109E-03	5.4503E+04	1.3937E-03
3.6985E+04	5.4948E-03	5.4860E+04	1.2038E-03
3.7343E+04	6.2955E-03	5.5218E+04	1.0381E-03
3.7700E+04	7.1235E-03	5.5575E+04	8.9145E-04

3.8058E+04	7.9541E-03	5.5933E+04	7.6409E-04
3.8415E+04	8.7646E-03	5.6290E+04	6.5552E-04
3.8773E+04	9.5595E-03	5.6648E+04	5.6410E-04
3.9130E+04	1.0321E-02	5.7005E+04	4.9084E-04
3.9488E+04	1.1013E-02	5.7363E+04	4.3026E-04
3.9845E+04	1.1640E-02	5.7720E+04	3.8329E-04
4.0203E+04	1.2148E-02	5.8078E+04	3.4487E-04
4.0560E+04	1.2533E-02	5.8435E+04	3.1406E-04
4.0918E+04	1.2798E-02	5.8793E+04	2.8857E-04
4.1275E+04	1.2918E-02	5.9150E+04	2.6731E-04
4.1633E+04	1.2896E-02	5.9508E+04	2.4983E-04
4.1990E+04	1.2752E-02	5.9865E+04	2.3451E-04
4.2348E+04	1.2507E-02	6.0223E+04	2.2204E-04
4.2705E+04	1.2186E-02	6.0580E+04	2.1106E-04
4.3063E+04	1.1832E-02	6.0937E+04	2.0182E-04
4.3420E+04	1.1442E-02	6.1295E+04	1.9404E-04
4.3778E+04	1.1027E-02	6.1653E+04	1.8703E-04
4.4135E+04	1.0629E-02	6.2010E+04	1.8057E-04
4.4493E+04	1.0244E-02	6.2368E+04	1.7388E-04
4.4850E+04	9.8636E-03	6.2725E+04	1.6684E-04
4.5208E+04	9.5042E-03	6.3083E+04	1.5923E-04
4.5565E+04	9.1484E-03	6.3440E+04	1.5179E-04
4.5923E+04	8.7999E-03	6.3798E+04	1.4425E-04
4.6280E+04	8.4772E-03	6.4155E+04	1.3676E-04
4.6638E+04	8.1790E-03	6.4513E+04	1.2940E-04
4.6995E+04	7.8888E-03	6.4870E+04	1.2239E-04
4.7353E+04	7.6132E-03	6.5228E+04	1.1587E-04
4.7710E+04	7.3557E-03	6.5585E+04	1.1008E-04
4.8068E+04	7.0971E-03	6.5943E+04	1.0464E-04
4.8425E+04	6.8310E-03	6.6300E+04	9.9563E-05
4.8783E+04	6.5506E-03	6.6658E+04	9.4662E-05
4.9140E+04	6.2429E-03	6.7015E+04	9.0016E-05
4.9498E+04	5.9084E-03	6.7373E+04	8.5377E-05
4.9855E+04	5.5579E-03	6.7730E+04	7.9915E-05
5.0213E+04	5.1833E-03	6.8088E+04	7.3912E-05
5.0570E+04	4.7872E-03	6.8445E+04	6.7098E-05
5.0928E+04	4.3921E-03	6.8803E+04	5.7968E-05
5.1285E+04	4.0080E-03	6.9160E+04	4.7197E-05
5.1643E+04	3.6354E-03	6.9518E+04	3.6997E-05

PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = TC-99
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 5.000000E+04
TIME HIGH= 1.300000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 4.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.3331E+05 MIN. TIME = 3.7040E+04
TOTAL WEIGHT = 3.8617E+05 TOTAL PARCELS = 4938.0
PEAK WEIGHT = 67872.617 PEAK WEIGHT TIME = 5.4600E+04
PEAK PARCELS = 286.000 PEAK PARCELS TIME = 5.4600E+04
WT. LOW = 6.5724E+02 NO. PARCELS LOW = 3.0
WT. HI = 7.6703E+02 NO. PARCELS HI = 27.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 3.877973E+05
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.259603E+05
PERCENT OF TOTAL INVENTORY = 109.841

TIME OF MAXIMUM CONCENTRATION (YEARS) = 5.380000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 3.782511E-04
MAXIMUM RATE (CURIES/YEAR) = 9.757799E+01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = TC-99

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
5.3800E+04	9.7578E+01	9.0000E+04	1.9938E+00
5.3988E+04	9.7578E+01	9.1765E+04	1.9677E+00
5.4176E+04	9.7578E+01	9.3529E+04	1.9482E+00
5.4364E+04	9.6099E+01	9.5294E+04	1.9366E+00
5.4552E+04	9.4402E+01	9.7059E+04	1.9214E+00
5.4739E+04	9.1423E+01	9.8823E+04	1.9238E+00
5.4927E+04	8.7998E+01	1.0059E+05	1.9233E+00
5.5115E+04	8.3979E+01	1.0235E+05	1.9206E+00
5.5303E+04	7.9584E+01	1.0412E+05	1.9166E+00
5.5491E+04	7.4178E+01	1.0588E+05	1.9205E+00
5.5679E+04	6.7693E+01	1.0765E+05	1.9140E+00
5.5867E+04	6.1560E+01	1.0941E+05	1.8983E+00

5.6055E+04	5.6065E+01	1.1118E+05	1.8724E+00
5.6242E+04	5.0404E+01	1.1294E+05	1.8366E+00
5.6430E+04	4.4169E+01	1.1471E+05	1.7934E+00
5.6618E+04	3.8145E+01	1.1647E+05	1.7634E+00
5.6806E+04	3.4100E+01	1.1824E+05	1.7425E+00
5.6994E+04	3.0054E+01	1.2000E+05	1.7295E+00
5.7182E+04	2.7034E+01	1.2176E+05	1.7428E+00
5.7370E+04	2.4047E+01	1.2206E+05	1.7390E+00
5.7558E+04	2.1363E+01	1.2236E+05	1.7335E+00
5.7745E+04	1.8738E+01	1.2266E+05	1.7261E+00
5.7933E+04	1.6429E+01	1.2295E+05	1.7137E+00
5.8121E+04	1.4250E+01	1.2325E+05	1.6964E+00
5.8309E+04	1.2402E+01	1.2355E+05	1.6829E+00
5.8497E+04	1.0794E+01	1.2384E+05	1.6740E+00
5.8685E+04	9.3456E+00	1.2414E+05	1.6640E+00
5.8873E+04	8.0921E+00	1.2444E+05	1.6458E+00
5.9061E+04	6.9679E+00	1.2473E+05	1.6235E+00
5.9248E+04	6.1151E+00	1.2503E+05	1.5969E+00
5.9436E+04	5.3266E+00	1.2533E+05	1.5546E+00
5.9624E+04	4.8063E+00	1.2563E+05	1.5088E+00
5.9812E+04	4.3072E+00	1.2592E+05	1.4605E+00
6.0000E+04	4.1134E+00	1.2622E+05	1.4105E+00
6.1765E+04	3.1801E+00	1.2652E+05	1.3660E+00
6.3529E+04	2.6344E+00	1.2681E+05	1.3210E+00
6.5294E+04	2.3303E+00	1.2711E+05	1.2745E+00
6.7059E+04	2.2080E+00	1.2741E+05	1.2255E+00
6.8824E+04	2.1218E+00	1.2770E+05	1.1698E+00
7.0588E+04	2.1115E+00	1.2800E+05	1.1509E+00
7.2353E+04	2.1060E+00	1.2830E+05	1.1320E+00
7.4118E+04	2.0905E+00	1.2859E+05	1.0775E+00
7.5882E+04	2.0751E+00	1.2889E+05	1.0280E+00
7.7647E+04	2.0868E+00	1.2919E+05	9.8468E-01
7.9412E+04	2.0641E+00	1.2949E+05	9.4685E-01
8.1176E+04	2.0517E+00	1.2978E+05	9.1380E-01
8.2941E+04	2.0424E+00	1.3008E+05	8.8076E-01
8.4706E+04	2.0401E+00	1.3038E+05	8.4772E-01
8.6471E+04	2.0188E+00	1.3067E+05	8.1467E-01
8.8235E+04	2.0129E+00	1.3097E+05	7.8163E-01

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PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = TC-99
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =    2
TIME LOW =   5.200000E+04
TIME HIGH=   6.000000E+04
NUMBER OF CELLS =              200
DELTA TIME INCREMENT =   4.000000E+01


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.3331E+05        MIN. TIME =  3.7040E+04
TOTAL WEIGHT =  2.5119E+05     TOTAL PARCELS =       1228.0
PEAK WEIGHT =   19356.023      PEAK WEIGHT TIME =  5.4660E+04
PEAK PARCELS =       84.000    PEAK PARCELS TIME =  5.4660E+04
WT. LOW =  8.5724E+02          NO. PARCELS LOW =          3.0
WT. HI =  1.3575E+05           NO. PARCELS HI =      3737.0
 SMOOTHING WINDOW (CELLS)=       5


TOTAL INVENTORY (CURIES) =   3.877972E+05
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   2.453661E+05
PERCENT OF TOTAL INVENTORY =  63.272

TIME OF MAXIMUM CONCENTRATION (YEARS) =   5.474000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   6.384575E-04
MAXIMUM RATE (CURIES/YEAR) =   1.647038E+02
CONVERSION FACTOR RATE TO CONCENTRATION =   3.876398E-06


 CONTAMINANT = TC-99

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
5.3740E+04	1.2849E+01	5.4750E+04	1.6383E+02
5.3763E+04	1.2849E+01	5.4765E+04	1.6255E+02
5.3786E+04	1.3018E+01	5.4779E+04	1.6127E+02
5.3809E+04	1.3661E+01	5.4794E+04	1.5950E+02
5.3832E+04	1.4372E+01	5.4809E+04	1.5772E+02
5.3855E+04	1.5145E+01	5.4824E+04	1.5583E+02
5.3878E+04	1.5777E+01	5.4838E+04	1.5363E+02
5.3901E+04	1.6419E+01	5.4853E+04	1.5144E+02
5.3924E+04	1.7896E+01	5.4868E+04	1.4898E+02
5.3947E+04	1.9587E+01	5.4882E+04	1.4628E+02
5.3970E+04	2.1743E+01	5.4897E+04	1.4359E+02
5.3993E+04	2.4142E+01	5.4912E+04	1.4060E+02

5.4016E+04	2.6718E+01	5.4927E+04	1.3754E+02
5.4039E+04	2.9690E+01	5.4941E+04	1.3446E+02
5.4062E+04	3.2743E+01	5.4956E+04	1.3116E+02
5.4085E+04	3.5847E+01	5.4971E+04	1.2786E+02
5.4109E+04	3.9033E+01	5.4985E+04	1.2445E+02
5.4132E+04	4.2359E+01	5.5000E+04	1.2088E+02
5.4155E+04	4.5684E+01	5.5151E+04	8.7775E+01
5.4178E+04	4.9008E+01	5.5302E+04	7.1171E+01
5.4201E+04	5.2133E+01	5.5453E+04	6.2270E+01
5.4224E+04	5.5160E+01	5.5604E+04	5.6459E+01
5.4247E+04	5.7796E+01	5.5755E+04	5.2112E+01
5.4270E+04	6.0272E+01	5.5906E+04	4.9493E+01
5.4293E+04	6.2527E+01	5.6056E+04	4.8690E+01
5.4316E+04	6.4266E+01	5.6207E+04	4.7176E+01
5.4339E+04	6.5769E+01	5.6358E+04	4.3090E+01
5.4362E+04	6.8456E+01	5.6509E+04	3.6909E+01
5.4385E+04	7.2305E+01	5.6660E+04	3.2457E+01
5.4408E+04	8.0240E+01	5.6811E+04	2.9808E+01
5.4431E+04	8.8086E+01	5.6962E+04	2.8636E+01
5.4454E+04	9.5833E+01	5.7113E+04	2.6747E+01
5.4477E+04	1.0385E+02	5.7264E+04	2.4661E+01
5.4500E+04	1.1197E+02	5.7415E+04	2.2671E+01
5.4515E+04	1.1705E+02	5.7566E+04	2.1215E+01
5.4529E+04	1.2213E+02	5.7716E+04	1.8448E+01
5.4544E+04	1.2679E+02	5.7867E+04	1.4955E+01
5.4559E+04	1.3041E+02	5.8018E+04	1.2148E+01
5.4574E+04	1.3402E+02	5.8169E+04	1.1297E+01
5.4588E+04	1.3774E+02	5.8320E+04	1.0491E+01
5.4603E+04	1.4155E+02	5.8471E+04	9.0938E+00
5.4618E+04	1.4535E+02	5.8622E+04	7.2237E+00
5.4632E+04	1.4891E+02	5.8773E+04	6.2557E+00
5.4647E+04	1.5242E+02	5.8924E+04	5.5189E+00
5.4662E+04	1.5579E+02	5.9075E+04	4.8782E+00
5.4677E+04	1.5816E+02	5.9226E+04	3.9799E+00
5.4691E+04	1.6053E+02	5.9376E+04	3.3232E+00
5.4706E+04	1.6235E+02	5.9527E+04	2.9553E+00
5.4721E+04	1.6337E+02	5.9678E+04	3.0262E+00
5.4735E+04	1.6438E+02	5.9829E+04	3.2366E+00

PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = I-129
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+04
TIME HIGH= 1.000000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 5.500000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.3706E+05 MIN. TIME = 3.3626E+04
TOTAL WEIGHT = 1.1393E+03 TOTAL PARCELS = 4968.0
PEAK WEIGHT = 35.578 PEAK WEIGHT TIME = 4.3475E+04
PEAK PARCELS = 48.000 PEAK PARCELS TIME = 1.2488E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 1.139251E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.133633E+03
PERCENT OF TOTAL INVENTORY = 99.507

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.457500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.877773E-07
MAXIMUM RATE (CURIES/YEAR) = 4.844120E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = I-129

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.3575E+04	1.3903E-03	9.3000E+04	6.2195E-03
3.4315E+04	1.9093E-03	9.5059E+04	6.2251E-03
3.5055E+04	4.2412E-03	9.7118E+04	6.2305E-03
3.5795E+04	6.2058E-03	9.9176E+04	6.2321E-03
3.6536E+04	9.6566E-03	1.0124E+05	6.2334E-03
3.7276E+04	1.4040E-02	1.0329E+05	6.2306E-03
3.8016E+04	1.8437E-02	1.0535E+05	6.2264E-03
3.8756E+04	2.2884E-02	1.0741E+05	6.1948E-03
3.9496E+04	2.7323E-02	1.0947E+05	6.1560E-03
4.0236E+04	3.2106E-02	1.1153E+05	6.1060E-03
4.0977E+04	3.6440E-02	1.1359E+05	6.0305E-03

4.1717E+04	4.0493E-02	1.1565E+05	5.9213E-03
4.2457E+04	4.4221E-02	1.1771E+05	5.6806E-03
4.3197E+04	4.6801E-02	1.1976E+05	5.4620E-03
4.3937E+04	4.8077E-02	1.2182E+05	5.2842E-03
4.4677E+04	4.8366E-02	1.2388E+05	4.9973E-03
4.5417E+04	4.7832E-02	1.2594E+05	4.5847E-03
4.6158E+04	4.6651E-02	1.2800E+05	3.5640E-03
4.6898E+04	4.5468E-02	1.3006E+05	1.7562E-03
4.7638E+04	4.4379E-02	1.3033E+05	1.5453E-03
4.8378E+04	4.3233E-02	1.3060E+05	1.3471E-03
4.9118E+04	4.1787E-02	1.3087E+05	1.1514E-03
4.9858E+04	4.0574E-02	1.3115E+05	9.8281E-04
5.0599E+04	3.8840E-02	1.3142E+05	8.2038E-04
5.1339E+04	3.6225E-02	1.3169E+05	6.8600E-04
5.2079E+04	3.2875E-02	1.3196E+05	5.5896E-04
5.2819E+04	2.9276E-02	1.3223E+05	4.5962E-04
5.3559E+04	2.4676E-02	1.3251E+05	3.6855E-04
5.4299E+04	2.0148E-02	1.3278E+05	2.9995E-04
5.5039E+04	1.5979E-02	1.3305E+05	2.3893E-04
5.5780E+04	1.2648E-02	1.3332E+05	1.9205E-04
5.6520E+04	1.0016E-02	1.3359E+05	1.5051E-04
5.7260E+04	8.2341E-03	1.3387E+05	1.2057E-04
5.8000E+04	7.3071E-03	1.3414E+05	9.5505E-05
6.0059E+04	6.8224E-03	1.3441E+05	7.7953E-05
6.2118E+04	6.6343E-03	1.3468E+05	6.3914E-05
6.4177E+04	6.5406E-03	1.3495E+05	5.5609E-05
6.6235E+04	6.5023E-03	1.3523E+05	5.0272E-05
6.8294E+04	6.3204E-03	1.3550E+05	4.6338E-05
7.0353E+04	6.2658E-03	1.3577E+05	4.3206E-05
7.2412E+04	6.2620E-03	1.3604E+05	3.9432E-05
7.4471E+04	6.2464E-03	1.3631E+05	3.5255E-05
7.6529E+04	6.2374E-03	1.3659E+05	3.1422E-05
7.8588E+04	6.2366E-03	1.3686E+05	2.7826E-05
8.0647E+04	6.2362E-03	1.3713E+05	2.4229E-05
8.2706E+04	6.2285E-03	1.3740E+05	2.0632E-05
8.4765E+04	6.2284E-03	1.3767E+05	1.7036E-05
8.6824E+04	6.2094E-03	1.3795E+05	1.3439E-05
8.8882E+04	6.2003E-03	1.3822E+05	9.8426E-06
9.0941E+04	6.2068E-03	1.3849E+05	6.2460E-06

PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = CS-135
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+04
TIME HIGH= 6.000000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 1.500000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9572E+06 MIN. TIME = 3.8579E+04
TOTAL WEIGHT = 7.3290E+03 TOTAL PARCELS = 790.0
PEAK WEIGHT = 156.826 PEAK WEIGHT TIME = 4.9275E+04
PEAK PARCELS = 17.000 PEAK PARCELS TIME = 4.9275E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 3.8519E+02 NO. PARCELS HI = 59.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 7.714209E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 7.301982E+03
PERCENT OF TOTAL INVENTORY = 94.656

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.357500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.294437E-06
MAXIMUM RATE (CURIES/YEAR) = 5.918992E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = CS-135

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.8625E+04	2.2710E-01	4.5000E+04	5.8273E-01
3.8667E+04	2.2710E-01	4.5294E+04	5.8254E-01
3.8708E+04	2.2710E-01	4.5588E+04	5.8090E-01
3.8750E+04	2.2710E-01	4.5882E+04	5.7430E-01
3.8792E+04	2.3296E-01	4.6177E+04	5.6616E-01
3.8833E+04	2.4759E-01	4.6471E+04	5.6321E-01
3.8875E+04	2.6223E-01	4.6765E+04	5.6161E-01
3.8917E+04	2.7687E-01	4.7059E+04	5.6334E-01
3.8958E+04	2.8476E-01	4.7353E+04	5.6693E-01
3.9000E+04	2.9097E-01	4.7647E+04	5.7161E-01
3.9042E+04	2.9718E-01	4.7941E+04	5.7453E-01

3.9063E+04	3.0537E-01	4.8235E+04	5.7797E-01
3.9125E+04	3.2146E-01	4.8529E+04	5.7462E-01
3.9167E+04	3.3755E-01	4.8824E+04	5.7217E-01
3.9208E+04	3.5364E-01	4.9118E+04	5.7980E-01
3.9250E+04	3.6711E-01	4.9412E+04	5.8241E-01
3.9292E+04	3.7883E-01	4.9706E+04	5.7543E-01
3.9333E+04	3.9056E-01	5.0000E+04	5.5269E-01
3.9375E+04	4.0228E-01	5.0110E+04	5.3636E-01
3.9417E+04	4.1400E-01	5.0220E+04	5.1511E-01
3.9458E+04	4.2572E-01	5.0330E+04	4.8957E-01
3.9500E+04	4.3744E-01	5.0439E+04	4.6788E-01
3.9542E+04	4.5055E-01	5.0549E+04	4.4877E-01
3.9583E+04	4.6571E-01	5.0659E+04	4.2948E-01
3.9625E+04	4.8088E-01	5.0769E+04	4.0707E-01
3.9667E+04	4.9605E-01	5.0879E+04	3.8067E-01
3.9708E+04	5.0585E-01	5.0989E+04	3.5934E-01
3.9750E+04	5.1432E-01	5.1099E+04	3.4345E-01
3.9792E+04	5.2279E-01	5.1208E+04	3.3337E-01
3.9833E+04	5.3045E-01	5.1318E+04	3.2242E-01
3.9875E+04	5.3489E-01	5.1428E+04	3.0995E-01
3.9917E+04	5.3932E-01	5.1538E+04	2.9616E-01
3.9958E+04	5.4376E-01	5.1648E+04	2.6351E-01
4.0000E+04	5.4728E-01	5.1758E+04	2.6955E-01
4.0294E+04	5.6358E-01	5.1867E+04	2.5651E-01
4.0588E+04	5.7000E-01	5.1977E+04	2.4541E-01
4.0882E+04	5.7362E-01	5.2087E+04	2.2527E-01
4.1177E+04	5.7764E-01	5.2197E+04	2.0634E-01
4.1471E+04	5.8507E-01	5.2307E+04	1.8864E-01
4.1765E+04	5.8343E-01	5.2417E+04	1.7240E-01
4.2059E+04	5.8433E-01	5.2527E+04	1.5897E-01
4.2353E+04	5.8423E-01	5.2636E+04	1.4602E-01
4.2647E+04	5.8637E-01	5.2746E+04	1.3387E-01
4.2941E+04	5.9110E-01	5.2856E+04	1.2420E-01
4.3235E+04	5.9080E-01	5.2966E+04	1.1131E-01
4.3529E+04	5.9165E-01	5.3076E+04	9.9596E-02
4.3824E+04	5.9047E-01	5.3186E+04	9.0760E-02
4.4118E+04	5.8701E-01	5.3295E+04	8.8656E-02
4.4412E+04	5.8499E-01	5.3405E+04	8.2017E-02
4.4706E+04	5.8402E-01	5.3515E+04	7.2709E-02

PLTCVT PROGRAM DATA SUMMARY
PIR3(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 1
CONTAMINANT = U-236
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+05
TIME HIGH= 5.500000E+05
NUMBER OF CELLS = 150
DELTA TIME INCREMENT = 1.666667E+03

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 5.4949E+05	MIN. TIME = 3.2052E+05
TOTAL WEIGHT = 1.4390E+04	TOTAL PARCELS = 6956.0
PEAK WEIGHT = 354.052	PEAK WEIGHT TIME = 4.0750E+05
PEAK PARCELS = 159.000	PEAK PARCELS TIME = 3.9917E+05
WT. LOW = 0.0000E-01	NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01	NO. PARCELS HI = 0.0

SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 1.439013E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.437596E+04
PERCENT OF TOTAL INVENTORY = 99.901

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.991667E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 6.622095E-07
MAXIMUM RATE (CURIES/YEAR) = 1.708311E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = U-236

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.2083E+05	1.0336E-03	4.3500E+05	1.0563E-01
3.2312E+05	1.1664E-03	4.3728E+05	1.0067E-01
3.2540E+05	1.7162E-03	4.3957E+05	9.5920E-02
3.2768E+05	2.4313E-03	4.4185E+05	9.1380E-02
3.2997E+05	3.3699E-03	4.4413E+05	8.7047E-02
3.3225E+05	4.4819E-03	4.4642E+05	8.2961E-02
3.3453E+05	5.8450E-03	4.4870E+05	7.9073E-02
3.3682E+05	7.5320E-03	4.5098E+05	7.5373E-02
3.3910E+05	9.5667E-03	4.5327E+05	7.1844E-02
3.4138E+05	1.2082E-02	4.5555E+05	6.8429E-02
3.4367E+05	1.5077E-02	4.5783E+05	6.5105E-02

3.4595E+05	1.8615E-02	4.6012E+05	6.1632E-02
3.4823E+05	2.2825E-02	4.6240E+05	5.8576E-02
3.5052E+05	2.7650E-02	4.6468E+05	5.5318E-02
3.5280E+05	3.3181E-02	4.6697E+05	5.2044E-02
3.5508E+05	3.9435E-02	4.6925E+05	4.8755E-02
3.5737E+05	4.6332E-02	4.7153E+05	4.5458E-02
3.5965E+05	5.3943E-02	4.7382E+05	4.2173E-02
3.6193E+05	6.2132E-02	4.7610E+05	3.8919E-02
3.6422E+05	7.0806E-02	4.7838E+05	3.5733E-02
3.6650E+05	7.9919E-02	4.8067E+05	3.2632E-02
3.6878E+05	8.9273E-02	4.8295E+05	2.9657E-02
3.7107E+05	9.8742E-02	4.8523E+05	2.6822E-02
3.7335E+05	1.0816E-01	4.8752E+05	2.4138E-02
3.7563E+05	1.1738E-01	4.8980E+05	2.1648E-02
3.7792E+05	1.2621E-01	4.9208E+05	1.9327E-02
3.8020E+05	1.3452E-01	4.9437E+05	1.7189E-02
3.8248E+05	1.4224E-01	4.9665E+05	1.5241E-02
3.8477E+05	1.4910E-01	4.9893E+05	1.3455E-02
3.8705E+05	1.5516E-01	5.0122E+05	1.1840E-02
3.8933E+05	1.6030E-01	5.0350E+05	1.0376E-02
3.9162E+05	1.6439E-01	5.0578E+05	9.0442E-03
3.9390E+05	1.6754E-01	5.0807E+05	7.8534E-03
3.9618E+05	1.6962E-01	5.1035E+05	6.7736E-03
3.9847E+05	1.7065E-01	5.1263E+05	5.8002E-03
4.0075E+05	1.7074E-01	5.1492E+05	4.9341E-03
4.0303E+05	1.6976E-01	5.1720E+05	4.1572E-03
4.0532E+05	1.6792E-01	5.1948E+05	3.4730E-03
4.0760E+05	1.6529E-01	5.2177E+05	2.8741E-03
4.0988E+05	1.6186E-01	5.2405E+05	2.3503E-03
4.1217E+05	1.5786E-01	5.2633E+05	1.9075E-03
4.1445E+05	1.5334E-01	5.2862E+05	1.5303E-03
4.1673E+05	1.4842E-01	5.3090E+05	1.2140E-03
4.1902E+05	1.4323E-01	5.3318E+05	9.5698E-04
4.2130E+05	1.3786E-01	5.3547E+05	7.4477E-04
4.2358E+05	1.3238E-01	5.3775E+05	5.7384E-04
4.2587E+05	1.2689E-01	5.4003E+05	4.3925E-04
4.2815E+05	1.2142E-01	5.4232E+05	3.2501E-04
4.3043E+05	1.1603E-01	5.4460E+05	2.3359E-04
4.3272E+05	1.1075E-01	5.4688E+05	1.6375E-04

PLTCVT PROGRAM DATA SUMMARY
PIR 3(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 1
CONTAMINANT = TH-232
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+05
TIME HIGH= 2.000000E+06
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 1.700000E+04

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9991E+06 MIN. TIME = 3.2990E+05
TOTAL WEIGHT = 4.8362E-02 TOTAL PARCELS = 3497.0
PEAK WEIGHT = 0.001 PEAK WEIGHT TIME = 1.0905E+06
PEAK PARCELS = 55.000 PEAK PARCELS TIME = 1.9915E+06
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 4.836214E-02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.817145E-02
PERCENT OF TOTAL INVENTORY = 99.606

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.090500E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.245488E-13
MAXIMUM RATE (CURIES/YEAR) = 3.213004E-08
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = TH-232

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.2550E+05	1.0945E-09	1.0700E+06	3.1702E-08
3.3079E+05	1.0945E-09	1.1053E+06	3.1696E-08
3.3608E+05	1.0945E-09	1.1406E+06	3.1401E-08
3.4136E+05	1.0945E-09	1.1759E+06	3.1501E-08
3.4665E+05	1.6208E-09	1.2112E+06	3.1452E-08
3.5194E+05	2.2912E-09	1.2465E+06	3.1305E-08
3.5723E+05	2.9616E-09	1.2818E+06	3.1119E-08
3.6252E+05	3.8547E-09	1.3171E+06	3.0928E-08
3.6780E+05	4.9137E-09	1.3523E+06	3.1039E-08
3.7309E+05	5.9768E-09	1.3876E+06	3.1133E-08
3.7838E+05	7.2139E-09	1.4229E+06	3.1173E-08
3.8367E+05	8.7708E-09	1.4582E+06	3.0561E-08

3.8895E+05	1.0328E-08	1.4935E+06	3.0221E-08
3.9424E+05	1.1798E-08	1.5288E+06	3.0336E-08
3.9953E+05	1.2741E-08	1.5641E+06	3.0096E-08
4.0482E+05	1.3685E-08	1.5994E+06	2.9950E-08
4.1011E+05	1.4628E-08	1.6347E+06	3.0479E-08
4.1539E+05	1.5832E-08	1.6700E+06	3.0427E-08
4.2068E+05	1.7057E-08	1.7053E+06	3.0004E-08
4.2597E+05	1.8281E-08	1.7141E+06	2.9868E-08
4.3126E+05	1.9904E-08	1.7230E+06	2.9789E-08
4.3655E+05	2.1689E-08	1.7318E+06	2.9799E-08
4.4183E+05	2.3474E-08	1.7406E+06	2.9744E-08
4.4712E+05	2.4727E-08	1.7495E+06	2.9614E-08
4.5241E+05	2.5436E-08	1.7583E+06	2.9625E-08
4.5770E+05	2.6146E-08	1.7671E+06	2.9753E-08
4.6298E+05	2.6634E-08	1.7760E+06	2.9855E-08
4.6827E+05	2.6554E-08	1.7848E+06	2.9940E-08
4.7356E+05	2.6473E-08	1.7936E+06	2.9901E-08
4.7885E+05	2.6400E-08	1.8025E+06	2.9808E-08
4.8414E+05	2.6419E-08	1.8113E+06	2.9779E-08
4.8942E+05	2.6439E-08	1.8201E+06	2.9769E-08
4.9471E+05	2.6459E-08	1.8290E+06	2.9718E-08
5.0000E+05	2.6939E-08	1.8378E+06	2.9660E-08
5.0529E+05	2.7501E-08	1.8466E+06	2.9571E-08
5.4058E+05	2.9348E-08	1.8555E+06	2.9479E-08
5.7588E+05	2.9129E-08	1.8643E+06	2.9443E-08
6.1117E+05	2.8993E-08	1.8731E+06	2.9409E-08
6.4646E+05	2.9407E-08	1.8820E+06	2.9386E-08
6.8176E+05	3.0340E-08	1.8908E+06	2.9380E-08
7.1705E+05	3.0305E-08	1.8996E+06	2.9464E-08
7.5235E+05	3.0171E-08	1.9085E+06	2.9517E-08
7.8764E+05	3.0868E-08	1.9173E+06	2.9460E-08
8.2293E+05	3.1057E-08	1.9261E+06	2.9362E-08
8.5823E+05	3.0760E-08	1.9350E+06	2.9167E-08
8.9352E+05	3.1303E-08	1.9438E+06	2.9003E-08
9.2882E+05	3.0859E-08	1.9526E+06	2.8893E-08
9.6411E+05	3.0699E-08	1.9615E+06	2.8823E-08
9.9941E+05	3.0848E-08	1.9703E+06	2.8803E-08
1.0347E+06	3.1317E-08	1.9791E+06	2.8594E-08

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 PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = NP-237
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   1.000000E+04
TIME HIGH=   1.900000E+06
NUMBER OF CELLS =             400
DELTA TIME INCREMENT =   4.725000E+03


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.9182E+06       MIN. TIME =  3.8315E+04
TOTAL WEIGHT =  3.5699E+04    TOTAL PARCELS =       9613.0
PEAK WEIGHT =    8045.227     PEAK WEIGHT TIME =  4.5438E+04
PEAK PARCELS =    4042.000    PEAK PARCELS TIME =  4.0713E+04
WT. LOW =  0.0000E-01         NO. PARCELS LOW =          0.0
WT. HI =  1.5796E+01          NO. PARCELS HI =          4.0
 SMOOTHING WINDOW (CELLS)=      1


TOTAL INVENTORY (CURIES) =   3.571469E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   3.837943E+04
PERCENT OF TOTAL INVENTORY = 107.461

TIME OF MAXIMUM CONCENTRATION (YEARS) =   4.543750E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   6.229741E-06
MAXIMUM RATE (CURIES/YEAR) =   1.607095E+00
CONVERSION FACTOR RATE TO CONCENTRATION =   3.876398E-06


 CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.5988E+04	1.0981E+00	9.6651E+05	5.3166E-04
5.4604E+04	5.7090E-01	9.8543E+05	5.6588E-04
7.3221E+04	1.4914E-03	1.0040E+06	5.6268E-04
9.1837E+04	7.4815E-04	1.0227E+06	8.9232E-04
1.1045E+05	2.5047E-04	1.0413E+06	9.9340E-04
1.2907E+05	3.7258E-04	1.0599E+06	1.2937E-03
1.4769E+05	5.0453E-04	1.0785E+06	1.0110E-03
1.6637E+05	1.8142E-03	1.0971E+06	1.1407E-03
1.8492E+05	5.9275E-04	1.1157E+06	3.9060E-04
2.0354E+05	1.4500E-04	1.1344E+06	1.4452E-03
2.2215E+05	1.8967E-04	1.1530E+06	1.7920E-03
2.4077E+05	9.0950E-04	1.1716E+06	7.7584E-04

2.5939E+05	6.1203E-04	1.1902E+06	1.0600E-03
2.7800E+05	4.7159E-04	1.2088E+06	1.4055E-03
2.9662E+05	5.9713E-04	1.2274E+06	2.7395E-03
3.1524E+05	4.6668E-04	1.2461E+06	1.6666E-03
3.3385E+05	6.2654E-04	1.2647E+06	2.4286E-03
3.5247E+05	1.2320E-03	1.2833E+06	2.4076E-03
3.7108E+05	7.0634E-04	1.3019E+06	1.3356E-03
3.8970E+05	1.1456E-03	1.3205E+06	1.4752E-03
4.0832E+05	4.6962E-04	1.3391E+06	2.0894E-03
4.2693E+05	3.2300E-04	1.3578E+06	2.5147E-03
4.4555E+05	4.7923E-04	1.3764E+06	2.9989E-03
4.6417E+05	1.3410E-03	1.3950E+06	3.9896E-03
4.8278E+05	9.8677E-04	1.4136E+06	4.7731E-03
5.0140E+05	2.1961E-04	1.4322E+06	7.8526E-03
5.2002E+05	4.2976E-04	1.4508E+06	1.0620E-02
5.3863E+05	2.0466E-03	1.4695E+06	1.4129E-02
5.5725E+05	5.2546E-04	1.4881E+06	2.2593E-02
5.7587E+05	1.1416E-03	1.5067E+06	2.4450E-02
5.9448E+05	5.3119E-04	1.5253E+06	2.6318E-02
6.1310E+05	7.0296E-04	1.5439E+06	3.7346E-02
6.3172E+05	1.2480E-03	1.5625E+06	4.2362E-02
6.5033E+05	3.7209E-04	1.5812E+06	4.6834E-02
6.6895E+05	2.7686E-04	1.5998E+06	5.0999E-02
6.8757E+05	2.7686E-04	1.6184E+06	5.4255E-02
7.0618E+05	6.1926E-04	1.6370E+06	4.4206E-02
7.2480E+05	1.2321E-03	1.6556E+06	3.9626E-02
7.4341E+05	2.0098E-03	1.6742E+06	3.9921E-02
7.6203E+05	1.1478E-03	1.6929E+06	3.6119E-02
7.8065E+05	4.9524E-04	1.7115E+06	2.6196E-02
7.9926E+05	3.9835E-04	1.7301E+06	1.9941E-02
8.1788E+05	5.2565E-04	1.7487E+06	1.6986E-02
8.3650E+05	1.3916E-03	1.7673E+06	9.5011E-03
8.5511E+05	7.4980E-04	1.7859E+06	8.6248E-03
8.7373E+05	8.3540E-04	1.8046E+06	6.4020E-03
8.9235E+05	3.8867E-04	1.8232E+06	2.4500E-03
9.1096E+05	1.6863E-03	1.8418E+06	2.5724E-03
9.2958E+05	1.1306E-03	1.8604E+06	1.3864E-03
9.4820E+05	3.3612E-04	1.8790E+06	6.4675E-04

PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.500000E+04
TIME HIGH= 6.000000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 1.250000E+02

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 1.9182E+06	MIN. TIME = 3.8313E+04
TOTAL WEIGHT = 2.3173E+04	TOTAL PARCELS = 6768.0
PEAK WEIGHT = 326.393	PEAK WEIGHT TIME = 5.0563E+04
PEAK PARCELS = 171.000	PEAK PARCELS TIME = 4.0313E+04
WT. LOW = 0.0000E-01	NO. PARCELS LOW = 0.0
WT. HI = 1.2542E+04	NO. PARCELS HI = 2849.0

SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 3.571471E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.321170E+04
PERCENT OF TOTAL INVENTORY = 64.992

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.068750E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7.312789E-06
MAXIMUM RATE (CURIES/YEAR) = 1.886491E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.8313E+04	3.1614E-01	4.5000E+04	1.7517E+00
3.8364E+04	3.1614E-01	4.5294E+04	1.7444E+00
3.8415E+04	3.1614E-01	4.5588E+04	1.7393E+00
3.8466E+04	3.4760E-01	4.5882E+04	1.7343E+00
3.8517E+04	4.0422E-01	4.6176E+04	1.7295E+00
3.8568E+04	4.5671E-01	4.6471E+04	1.7254E+00
3.8619E+04	4.7614E-01	4.6765E+04	1.7213E+00
3.8670E+04	4.9557E-01	4.7059E+04	1.7170E+00
3.8722E+04	5.3068E-01	4.7353E+04	1.7124E+00
3.8773E+04	5.7363E-01	4.7647E+04	1.7084E+00
3.8824E+04	6.1330E-01	4.7941E+04	1.7062E+00

3.8875E+04	6.4155E-01	4.8235E+04	1.7061E+00
3.8926E+04	6.6980E-01	4.8529E+04	1.7043E+00
3.8977E+04	6.9649E-01	4.8824E+04	1.7007E+00
3.9028E+04	7.2272E-01	4.9118E+04	1.7005E+00
3.9080E+04	7.5326E-01	4.9412E+04	1.6976E+00
3.9131E+04	7.9238E-01	4.9706E+04	1.6944E+00
3.9182E+04	8.3150E-01	5.0000E+04	1.6849E+00
3.9233E+04	8.7707E-01	5.0294E+04	1.6630E+00
3.9284E+04	9.2345E-01	5.0406E+04	1.6512E+00
3.9335E+04	9.7594E-01	5.0518E+04	1.6357E+00
3.9386E+04	1.0361E+00	5.0629E+04	1.6147E+00
3.9438E+04	1.0962E+00	5.0741E+04	1.5901E+00
3.9489E+04	1.1710E+00	5.0853E+04	1.5625E+00
3.9540E+04	1.2457E+00	5.0965E+04	1.5293E+00
3.9591E+04	1.3267E+00	5.1076E+04	1.4884E+00
3.9642E+04	1.4127E+00	5.1188E+04	1.4429E+00
3.9693E+04	1.4977E+00	5.1300E+04	1.3864E+00
3.9744E+04	1.5743E+00	5.1412E+04	1.3237E+00
3.9795E+04	1.6509E+00	5.1523E+04	1.2626E+00
3.9847E+04	1.7134E+00	5.1635E+04	1.2066E+00
3.9898E+04	1.7689E+00	5.1747E+04	1.1496E+00
3.9949E+04	1.8156E+00	5.1859E+04	1.0903E+00
4.0000E+04	1.8317E+00	5.1970E+04	1.0314E+00
4.0294E+04	1.8666E+00	5.2082E+04	9.6948E-01
4.0588E+04	1.8859E+00	5.2194E+04	9.0052E-01
4.0882E+04	1.8840E+00	5.2305E+04	8.3216E-01
4.1176E+04	1.8766E+00	5.2417E+04	7.6480E-01
4.1471E+04	1.8647E+00	5.2529E+04	7.0193E-01
4.1765E+04	1.8543E+00	5.2641E+04	6.4555E-01
4.2059E+04	1.8463E+00	5.2752E+04	5.9367E-01
4.2353E+04	1.8484E+00	5.2864E+04	5.3976E-01
4.2647E+04	1.8399E+00	5.2976E+04	4.8044E-01
4.2941E+04	1.8252E+00	5.3088E+04	4.3043E-01
4.3235E+04	1.8134E+00	5.3199E+04	4.1621E-01
4.3529E+04	1.8028E+00	5.3311E+04	3.6578E-01
4.3824E+04	1.7906E+00	5.3423E+04	3.2520E-01
4.4118E+04	1.7794E+00	5.3535E+04	2.9067E-01
4.4412E+04	1.7700E+00	5.3646E+04	2.5815E-01
4.4706E+04	1.7604E+00	5.3758E+04	2.2600E-01

PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.300000E+06
TIME HIGH= 1.900000E+06
NUMBER OF CELLS = 150
DELTA TIME INCREMENT = 4.000000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9182E+06 MIN. TIME = 3.8315E+04
TOTAL WEIGHT = 1.1361E+04 TOTAL PARCELS = 2641.0
PEAK WEIGHT = 258.395 PEAK WEIGHT TIME = 1.6300E+06
PEAK PARCELS = 61.000 PEAK PARCELS TIME = 1.6300E+06
WT. LOW = 2.4338E+04 NO. PARCELS LOW = 6972.0
WT. HI = 1.5796E+01 NO. PARCELS HI = 4.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 3.571473E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.131240E+04
PERCENT OF TOTAL INVENTORY = 31.674

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.610000E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.874323E-07
MAXIMUM RATE (CURIES/YEAR) = 4.835219E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.3020E+06	5.8395E-04	1.6000E+06	4.7762E-02
1.3080E+06	6.6053E-04	1.6060E+06	4.8222E-02
1.3139E+06	9.0725E-04	1.6119E+06	4.8348E-02
1.3199E+06	1.1873E-03	1.6179E+06	4.8208E-02
1.3258E+06	1.4928E-03	1.6238E+06	4.7765E-02
1.3318E+06	1.7384E-03	1.6298E+06	4.7102E-02
1.3378E+06	1.9756E-03	1.6358E+06	4.6218E-02
1.3437E+06	2.2019E-03	1.6417E+06	4.5188E-02
1.3497E+06	2.4168E-03	1.6477E+06	4.4028E-02
1.3556E+06	2.6291E-03	1.6536E+06	4.2788E-02
1.3616E+06	2.8466E-03	1.6596E+06	4.1482E-02

1.3676E+06	3.0787E-03	1.6656E+06	4.0130E-02
1.3735E+06	3.3320E-03	1.6715E+06	5.8723E-02
1.3795E+06	3.6181E-03	1.6775E+06	3.7264E-02
1.3854E+06	3.9408E-03	1.6834E+06	3.5737E-02
1.3914E+06	4.3127E-03	1.6894E+06	3.4145E-02
1.3974E+06	4.7363E-03	1.6954E+06	3.2479E-02
1.4033E+06	5.2227E-03	1.7013E+06	3.0748E-02
1.4093E+06	5.7716E-03	1.7073E+06	2.8959E-02
1.4152E+06	6.3908E-03	1.7132E+06	2.7131E-02
1.4212E+06	7.0796E-03	1.7192E+06	2.5288E-02
1.4272E+06	7.8452E-03	1.7252E+06	2.3452E-02
1.4331E+06	8.6877E-03	1.7311E+06	2.1647E-02
1.4391E+06	9.6120E-03	1.7371E+06	1.9891E-02
1.4450E+06	1.0617E-02	1.7430E+06	1.8201E-02
1.4510E+06	1.1705E-02	1.7490E+06	1.6590E-02
1.4570E+06	1.2874E-02	1.7550E+06	1.5070E-02
1.4629E+06	1.4120E-02	1.7609E+06	1.3647E-02
1.4689E+06	1.5438E-02	1.7669E+06	1.2319E-02
1.4748E+06	1.6814E-02	1.7728E+06	1.1090E-02
1.4808E+06	1.8236E-02	1.7788E+06	9.9568E-03
1.4868E+06	1.9692E-02	1.7848E+06	8.9211E-03
1.4927E+06	2.1171E-02	1.7907E+06	7.9722E-03
1.4987E+06	2.2662E-02	1.7967E+06	7.1093E-03
1.5046E+06	2.4159E-02	1.8026E+06	6.3193E-03
1.5106E+06	2.5660E-02	1.8086E+06	5.6033E-03
1.5166E+06	2.7171E-02	1.8146E+06	4.9506E-03
1.5225E+06	2.8699E-02	1.8205E+06	4.3608E-03
1.5285E+06	3.0255E-02	1.8265E+06	3.8235E-03
1.5344E+06	3.1842E-02	1.8324E+06	3.3390E-03
1.5404E+06	3.3468E-02	1.8384E+06	2.8996E-03
1.5464E+06	3.5130E-02	1.8444E+06	2.5075E-03
1.5523E+06	3.6823E-02	1.8503E+06	2.1532E-03
1.5583E+06	3.8528E-02	1.8563E+06	1.8386E-03
1.5642E+06	4.0216E-02	1.8622E+06	1.5515E-03
1.5702E+06	4.1858E-02	1.8682E+06	1.2938E-03
1.5762E+06	4.3400E-02	1.8742E+06	1.0597E-03
1.5821E+06	4.4818E-02	1.8801E+06	8.4170E-04
1.5881E+06	4.6033E-02	1.8861E+06	6.3130E-04
1.5940E+06	4.7044E-02	1.8920E+06	4.5821E-04

PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = U-233
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+04
TIME HIGH= 2.000000E+06
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 4.925000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9934E+06 MIN. TIME = 4.2293E+04
TOTAL WEIGHT = 5.1210E+04 TOTAL PARCELS = 44197.0
PEAK WEIGHT = 413.956 PEAK WEIGHT TIME = 1.3819E+06
PEAK PARCELS = 1065.000 PEAK PARCELS TIME = 3.7229E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 5.120995E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 5.094494E+04
PERCENT OF TOTAL INVENTORY = 99.483

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.445938E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.026791E-07
MAXIMUM RATE (CURIES/YEAR) = 5.228542E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = U-233

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.2313E+04	9.5930E-03	9.1615E+05	3.5431E-02
5.3758E+04	1.0234E-02	9.4645E+05	3.6338E-02
6.5203E+04	1.0472E-02	9.7674E+05	3.7408E-02
7.6648E+04	9.6855E-03	1.0070E+06	3.8631E-02
8.8093E+04	9.2364E-03	1.0373E+06	3.9747E-02
9.9538E+04	9.2760E-03	1.0676E+06	4.0641E-02
1.1098E+05	9.2684E-03	1.0979E+06	4.1739E-02
1.2243E+05	9.1420E-03	1.1282E+06	4.2939E-02
1.3387E+05	8.8392E-03	1.1585E+06	4.4063E-02
1.4532E+05	8.3394E-03	1.1888E+06	4.5075E-02
1.5676E+05	7.9609E-03	1.2191E+06	4.6060E-02

1.6821E+05	7.8026E-03	1.2494E+06	4.7149E-02
1.7965E+05	7.7133E-03	1.2797E+06	4.8168E-02
1.9110E+05	7.5131E-03	1.3100E+06	4.9018E-02
2.0254E+05	7.2156E-03	1.3403E+06	5.0028E-02
2.1399E+05	6.9301E-03	1.3706E+06	5.0862E-02
2.2543E+05	6.7316E-03	1.4009E+06	5.1326E-02
2.3688E+05	6.7327E-03	1.4312E+06	5.1943E-02
2.4832E+05	6.7581E-03	1.4614E+06	5.1993E-02
2.5977E+05	6.5568E-03	1.4779E+06	5.1219E-02
2.7121E+05	6.3986E-03	1.4943E+06	4.9904E-02
2.8266E+05	6.3690E-03	1.5108E+06	4.8137E-02
2.9410E+05	6.3062E-03	1.5272E+06	4.6445E-02
3.0555E+05	6.2205E-03	1.5437E+06	4.4144E-02
3.1699E+05	6.2270E-03	1.5601E+06	4.1299E-02
3.2844E+05	6.2179E-03	1.5765E+06	3.8146E-02
3.3988E+05	6.3852E-03	1.5930E+06	3.4798E-02
3.5133E+05	6.8866E-03	1.6094E+06	3.1271E-02
3.6277E+05	7.7191E-03	1.6259E+06	2.7257E-02
3.7422E+05	8.7840E-03	1.6423E+06	2.3412E-02
3.8566E+05	1.0301E-02	1.6588E+06	1.9842E-02
3.9711E+05	1.2269E-02	1.6752E+06	1.6374E-02
4.0855E+05	1.4379E-02	1.6916E+06	1.3197E-02
4.2000E+05	1.7290E-02	1.7081E+06	1.0333E-02
4.3144E+05	1.9850E-02	1.7245E+06	8.0666E-03
4.6174E+05	2.2686E-02	1.7410E+06	6.1330E-03
4.9203E+05	2.4229E-02	1.7574E+06	4.5110E-03
5.2233E+05	2.5753E-02	1.7739E+06	3.2867E-03
5.5262E+05	2.6849E-02	1.7903E+06	2.3392E-03
5.8292E+05	2.7561E-02	1.6067E+06	1.6478E-03
6.1321E+05	2.8274E-02	1.8232E+06	1.1481E-03
6.4350E+05	2.8869E-02	1.8396E+06	7.8291E-04
6.7380E+05	2.9426E-02	1.8561E+06	5.2760E-04
7.0409E+05	3.0022E-02	1.8725E+06	3.4829E-04
7.3439E+05	3.0684E-02	1.8890E+06	2.2298E-04
7.6468E+05	3.1324E-02	1.9054E+06	1.4281E-04
7.9497E+05	3.1906E-02	1.9218E+06	9.0259E-05
8.2527E+05	3.2593E-02	1.9383E+06	5.7510E-05
8.5556E+05	3.3483E-02	1.9547E+06	4.1077E-05
8.8586E+05	3.4492E-02	1.9712E+06	2.6667E-05

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PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = TH-229
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =    2
TIME LOW =   3.000000E+04
TIME HIGH=   2.000000E+06
NUMBER OF CELLS =              100
DELTA TIME INCREMENT =   1.970000E+04

 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.9998E+06        MIN. TIME =  5.1598E+04
TOTAL WEIGHT =  1.9528E+03     TOTAL PARCELS =        3049.0
PEAK WEIGHT =     164.076      PEAK WEIGHT TIME =  1.5371E+06
PEAK PARCELS =     110.000     PEAK PARCELS TIME =  1.7775E+05
WT. LOW =  0.0000E-01          NO. PARCELS LOW =           0.0
WT. HI =  0.0000E-01           NO. PARCELS HI =           0.0
 SMOOTHING WINDOW (CELLS)=      20

TOTAL INVENTORY (CURIES) =   1.952768E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   1.786265E+03
PERCENT OF TOTAL INVENTORY =  91.473

TIME OF MAXIMUM CONCENTRATION (YEARS) =   1.280950E+06
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   5.506379E-09
MAXIMUM RATE (CURIES/YEAR) =   1.420489E-03
CONVERSION FACTOR RATE TO CONCENTRATION =   3.876398E-06


 CONTAMINANT = TH-229

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
5.9550E+04	2.2441E-04	1.0249E+06	1.3053E-03
7.8856E+04	2.2441E-04	1.0442E+06	1.3209E-03
9.8162E+04	2.3909E-04	1.0635E+06	1.3355E-03
1.1747E+05	2.5405E-04	1.0828E+06	1.3498E-03
1.3677E+05	2.6955E-04	1.1021E+06	1.3630E-03
1.5608E+05	2.8642E-04	1.1214E+06	1.3754E-03
1.7539E+05	3.0387E-04	1.1407E+06	1.3860E-03
1.9469E+05	3.2164E-04	1.1600E+06	1.3943E-03
2.1400E+05	3.4072E-04	1.1793E+06	1.4009E-03
2.3330E+05	3.6023E-04	1.1986E+06	1.4071E-03
2.5261E+05	3.8019E-04	1.2179E+06	1.4129E-03

2.7192E+05	4.0021E-04	1.2372E+06	1.4179E-03
2.9122E+05	4.2062E-04	1.2565E+06	1.4198E-03
3.1053E+05	4.4131E-04	1.2758E+06	1.4204E-03
3.2983E+05	4.6268E-04	1.2951E+06	1.4200E-03
3.4914E+05	4.8512E-04	1.3144E+06	1.4184E-03
3.6845E+05	5.0831E-04	1.3337E+06	1.4155E-03
3.8775E+05	5.3172E-04	1.3531E+06	1.4107E-03
4.0706E+05	5.5512E-04	1.3724E+06	1.4055E-03
4.2636E+05	5.7867E-04	1.3917E+06	1.4000E-03
4.4567E+05	6.0348E-04	1.4110E+06	1.3919E-03
4.6498E+05	6.2906E-04	1.4303E+06	1.3818E-03
4.8428E+05	6.5149E-04	1.4496E+06	1.3712E-03
5.0359E+05	6.7149E-04	1.4689E+06	1.3588E-03
5.2289E+05	6.9181E-04	1.4882E+06	1.3421E-03
5.4220E+05	7.1266E-04	1.5075E+06	1.3207E-03
5.6151E+05	7.3231E-04	1.5268E+06	1.2971E-03
5.8081E+05	7.5052E-04	1.5461E+06	1.2686E-03
6.0012E+05	7.6956E-04	1.5654E+06	1.2345E-03
6.1942E+05	7.8952E-04	1.5847E+06	1.1979E-03
6.3873E+05	8.0885E-04	1.6040E+06	1.1578E-03
6.5804E+05	8.2775E-04	1.6233E+06	1.1159E-03
6.7734E+05	8.4844E-04	1.6426E+06	1.0737E-03
6.9665E+05	8.7144E-04	1.6619E+06	1.0312E-03
7.1595E+05	8.9545E-04	1.6813E+06	9.8878E-04
7.3526E+05	9.2051E-04	1.7006E+06	9.4689E-04
7.5457E+05	9.4841E-04	1.7199E+06	9.0565E-04
7.7387E+05	9.7642E-04	1.7392E+06	8.6460E-04
7.9318E+05	1.0057E-03	1.7585E+06	8.2436E-04
8.1248E+05	1.0345E-03	1.7778E+06	7.8555E-04
8.3179E+05	1.0635E-03	1.7971E+06	7.4747E-04
8.5110E+05	1.0925E-03	1.8164E+06	7.1014E-04
8.7040E+05	1.1213E-03	1.8357E+06	6.7436E-04
8.8971E+05	1.1491E-03	1.8550E+06	6.3924E-04
9.0901E+05	1.1753E-03	1.8743E+06	6.0470E-04
9.2832E+05	1.2015E-03	1.8936E+06	5.7043E-04
9.4763E+05	1.2263E-03	1.9129E+06	5.3686E-04
9.6693E+05	1.2482E-03	1.9322E+06	5.0383E-04
9.8624E+05	1.2689E-03	1.9515E+06	4.7184E-04
1.0055E+06	1.2887E-03	1.9708E+06	4.4117E-04

PLTCVT PROGRAM DATA SUMMARY
PIR3(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-238
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.300000E+05
TIME HIGH= 5.300000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 5.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9998E+06 MIN. TIME = 3.2093E+05
TOTAL WEIGHT = 1.2219E+04 TOTAL PARCELS = 7542.0
PEAK WEIGHT = 115.912 PEAK WEIGHT TIME = 4.0175E+05
PEAK PARCELS = 62.000 PEAK PARCELS TIME = 4.0175E+05
WT. LOW = 8.1069E+00 NO. PARCELS LOW = 4.0
WT. HI = 8.2843E+00 NO. PARCELS HI = 9139.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 1.223504E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.220578E+04
PERCENT OF TOTAL INVENTORY = 99.761

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.967500E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 5.895563E-07
MAXIMUM RATE (CURIES/YEAR) = 1.520887E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = U-238

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.3125E+05	9.2209E-04	4.3050E+05	8.9952E-02
3.3324E+05	1.4318E-03	4.3249E+05	8.6769E-02
3.3522E+05	2.3516E-03	4.3447E+05	8.3834E-02
3.3721E+05	3.5683E-03	4.3646E+05	8.1136E-02
3.3919E+05	5.0023E-03	4.3844E+05	7.8654E-02
3.4118E+05	6.7773E-03	4.4043E+05	7.6338E-02
3.4316E+05	8.9388E-03	4.4241E+05	7.4118E-02
3.4515E+05	1.1552E-02	4.4440E+05	7.1918E-02
3.4713E+05	1.4675E-02	4.4638E+05	6.9683E-02
3.4912E+05	1.8358E-02	4.4837E+05	6.7377E-02
3.5110E+05	2.2634E-02	4.5035E+05	6.4994E-02

3.5309E+05	2.7508E-02	4.5234E+05	6.2560E-02
3.5507E+05	3.2964E-02	4.5432E+05	6.0109E-02
3.5706E+05	3.8962E-02	4.5631E+05	5.7679E-02
3.5904E+05	4.5439E-02	4.5829E+05	5.5282E-02
3.6103E+05	5.2317E-02	4.6028E+05	5.2932E-02
3.6301E+05	5.9513E-02	4.6226E+05	5.0639E-02
3.6500E+05	6.6942E-02	4.6425E+05	4.8394E-02
3.6698E+05	7.4507E-02	4.6623E+05	4.6196E-02
3.6897E+05	8.2113E-02	4.6822E+05	4.4038E-02
3.7095E+05	8.9669E-02	4.7020E+05	4.1905E-02
3.7294E+05	9.7094E-02	4.7219E+05	3.9774E-02
3.7492E+05	1.0432E-01	4.7417E+05	3.7597E-02
3.7691E+05	1.1128E-01	4.7616E+05	3.5339E-02
3.7889E+05	1.1793E-01	4.7814E+05	3.2979E-02
3.8088E+05	1.2425E-01	4.8013E+05	3.0506E-02
3.8286E+05	1.3015E-01	4.8211E+05	2.7949E-02
3.8485E+05	1.3557E-01	4.8410E+05	2.5359E-02
3.8683E+05	1.4040E-01	4.8608E+05	2.2795E-02
3.8882E+05	1.4451E-01	4.8807E+05	2.0326E-02
3.9080E+05	1.4780E-01	4.9005E+05	1.7992E-02
3.9279E+05	1.5017E-01	4.9204E+05	1.5826E-02
3.9477E+05	1.5159E-01	4.9402E+05	1.3840E-02
3.9676E+05	1.5209E-01	4.9601E+05	1.2034E-02
3.9874E+05	1.5173E-01	4.9799E+05	1.0397E-02
4.0073E+05	1.5060E-01	4.9998E+05	8.9286E-03
4.0271E+05	1.4877E-01	5.0196E+05	7.6253E-03
4.0470E+05	1.4633E-01	5.0395E+05	6.4805E-03
4.0668E+05	1.4329E-01	5.0593E+05	5.4834E-03
4.0867E+05	1.3966E-01	5.0792E+05	4.6281E-03
4.1065E+05	1.3548E-01	5.0990E+05	3.8996E-03
4.1264E+05	1.3083E-01	5.1189E+05	3.2819E-03
4.1462E+05	1.2581E-01	5.1387E+05	2.7599E-03
4.1661E+05	1.2060E-01	5.1586E+05	2.3141E-03
4.1859E+05	1.1539E-01	5.1784E+05	1.9328E-03
4.2058E+05	1.1035E-01	5.1983E+05	1.5957E-03
4.2256E+05	1.0560E-01	5.2181E+05	1.2962E-03
4.2455E+05	1.0119E-01	5.2380E+05	1.0210E-03
4.2653E+05	9.7137E-02	5.2578E+05	7.4851E-04
4.2852E+05	9.3401E-02	5.2777E+05	4.9588E-04

PLTCVT PROGRAM DATA SUMMARY
PIR3(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-234
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.100000E+05
TIME HIGH= 6.000000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 7.250000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9964E+06 MIN. TIME = 3.0934E+05
TOTAL WEIGHT = 3.0556E+04 TOTAL PARCELS = 15837.0
PEAK WEIGHT = 350.336 PEAK WEIGHT TIME = 3.9664E+05
PEAK PARCELS = 112.000 PEAK PARCELS TIME = 3.8576E+05
WT. LOW = 8.5390E-03 NO. PARCELS LOW = 1.0
WT. HI = 2.2978E+00 NO. PARCELS HI = 7322.0
SMOOTHING WINDOW (CELLS)= 7

TOTAL INVENTORY (CURIES) = 3.055844E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.055127E+04
PERCENT OF TOTAL INVENTORY = 99.977

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.973625E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.501328E-06
MAXIMUM RATE (CURIES/YEAR) = 3.872999E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = U-234

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.1326E+05	1.7371E-04	4.5645E+05	1.3718E-01
3.1613E+05	3.6449E-04	4.5931E+05	1.2955E-01
3.1899E+05	8.3225E-04	4.6218E+05	1.2146E-01
3.2185E+05	1.6081E-03	4.6504E+05	1.1314E-01
3.2472E+05	2.7680E-03	4.6791E+05	1.0477E-01
3.2758E+05	4.3436E-03	4.7077E+05	9.6398E-02
3.3045E+05	6.3616E-03	4.7363E+05	8.7871E-02
3.3331E+05	8.9401E-03	4.7650E+05	7.9009E-02
3.3617E+05	1.2377E-02	4.7936E+05	6.9752E-02
3.3904E+05	1.7132E-02	4.8222E+05	6.0305E-02
3.4190E+05	2.3758E-02	4.8509E+05	5.1062E-02

3.4476E+05	3.2729E-02	4.8795E+05	4.2464E-02
3.4763E+05	4.4368E-02	4.9082E+05	3.4871E-02
3.5049E+05	5.8872E-02	4.9368E+05	2.8437E-02
3.5336E+05	7.6367E-02	4.9654E+05	2.3161E-02
3.5622E+05	9.6992E-02	4.9941E+05	1.8861E-02
3.5908E+05	1.2079E-01	5.0227E+05	1.5358E-02
3.6195E+05	1.4755E-01	5.0513E+05	1.2456E-02
3.6481E+05	1.7664E-01	5.0800E+05	9.9863E-03
3.6767E+05	2.0691E-01	5.1086E+05	7.8453E-03
3.7054E+05	2.3695E-01	5.1373E+05	5.9782E-03
3.7340E+05	2.6537E-01	5.1659E+05	4.3897E-03
3.7627E+05	2.9119E-01	5.1945E+05	3.0925E-03
3.7913E+05	3.1402E-01	5.2232E+05	2.0975E-03
3.8199E+05	3.3390E-01	5.2518E+05	1.3939E-03
3.8486E+05	3.5096E-01	5.2804E+05	9.1972E-04
3.8772E+05	3.6520E-01	5.3091E+05	6.2316E-04
3.9058E+05	3.7629E-01	5.3377E+05	4.2495E-04
3.9345E+05	3.8375E-01	5.3664E+05	2.8718E-04
3.9631E+05	3.8712E-01	5.3950E+05	1.9408E-04
3.9918E+05	3.8607E-01	5.4236E+05	1.2388E-04
4.0204E+05	3.8049E-01	5.4523E+05	7.5830E-05
4.0490E+05	3.7059E-01	5.4809E+05	4.9553E-05
4.0777E+05	3.5685E-01	5.5095E+05	3.4349E-05
4.1063E+05	3.4020E-01	5.5382E+05	2.1022E-05
4.1349E+05	3.2178E-01	5.5668E+05	1.8770E-05
4.1636E+05	3.0267E-01	5.5955E+05	1.3890E-05
4.1922E+05	2.8381E-01	5.6241E+05	6.3818E-06
4.2209E+05	2.6564E-01	5.6527E+05	1.1262E-05
4.2495E+05	2.4829E-01	5.6814E+05	5.4433E-06
4.2781E+05	2.3180E-01	5.7100E+05	7.5080E-06
4.3068E+05	2.1623E-01	5.7386E+05	5.8187E-06
4.3354E+05	2.0197E-01	5.7673E+05	7.5080E-06
4.3640E+05	1.8944E-01	5.7959E+05	7.5080E-06
4.3927E+05	1.7892E-01	5.8246E+05	2.6278E-06
4.4213E+05	1.7032E-01	5.8532E+05	3.7540E-06
4.4500E+05	1.6316E-01	5.8818E+05	3.7540E-06
4.4786E+05	1.5682E-01	5.9105E+05	6.9449E-06
4.5072E+05	1.5065E-01	5.9391E+05	7.1326E-06
4.5359E+05	1.4418E-01	5.9677E+05	1.8770E-07

PLOT PROGRAM DATA SUMMARY
PIR3(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = TH-230
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.300000E+05
TIME HIGH= 1.000000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 3.350000E+03

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 1.9973E+06	MIN. TIME = 3.2312E+05
TOTAL WEIGHT = 1.3679E+03	TOTAL PARCELS = 1999.0
PEAK WEIGHT = 43.594	PEAK WEIGHT TIME = 4.5563E+05
PEAK PARCELS = 26.000	PEAK PARCELS TIME = 9.8493E+05
WT. LOW = 9.6160E-02	NO. PARCELS LOW = 2.0
WT. HI = 5.4396E+00	NO. PARCELS HI = 2050.0

SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 1.373437E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.369095E+03
PERCENT OF TOTAL INVENTORY = 99.684

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.623250E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.495375E-08
MAXIMUM RATE (CURIES/YEAR) = 6.437355E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = TH-230

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.3168E+05	1.6671E-04	6.0000E+05	2.1705E-03
3.3375E+05	1.6671E-04	6.1177E+05	1.8843E-03
3.3582E+05	1.7820E-04	6.2353E+05	1.6423E-03
3.3789E+05	2.0828E-04	6.3529E+05	1.4366E-03
3.3996E+05	2.2709E-04	6.4706E+05	1.2617E-03
3.4203E+05	2.4449E-04	6.5882E+05	1.1244E-03
3.4410E+05	2.7708E-04	6.7059E+05	1.0191E-03
3.4617E+05	3.1384E-04	6.8235E+05	9.3389E-04
3.4824E+05	3.5468E-04	6.9412E+05	8.6507E-04
3.5031E+05	4.0672E-04	7.0588E+05	8.0408E-04
3.5238E+05	4.6474E-04	7.1765E+05	7.4581E-04
3.5445E+05	5.3457E-04	7.2941E+05	6.8655E-04

3.5652E+05	6.2193E-04	7.4118E+05	6.2431E-04
3.5859E+05	7.1989E-04	7.5294E+05	5.6099E-04
3.6066E+05	8.5348E-04	7.6471E+05	4.9756E-04
3.6273E+05	9.9707E-04	7.7647E+05	4.3926E-04
3.6480E+05	1.1535E-03	7.8824E+05	3.8876E-04
3.6687E+05	1.3407E-03	8.0000E+05	3.4555E-04
3.6894E+05	1.5460E-03	8.0601E+05	3.2623E-04
3.7101E+05	1.7958E-03	8.1202E+05	3.0836E-04
3.7308E+05	2.0841E-03	8.1803E+05	2.9181E-04
3.7515E+05	2.3998E-03	8.2404E+05	2.7671E-04
3.7723E+05	2.7354E-03	8.3005E+05	2.6307E-04
3.7930E+05	3.0900E-03	8.3606E+05	2.5014E-04
3.8137E+05	3.4791E-03	8.4207E+05	2.3769E-04
3.8344E+05	3.8813E-03	8.4808E+05	2.2556E-04
3.8551E+05	4.2814E-03	8.5409E+05	2.1359E-04
3.8758E+05	4.6250E-03	8.6010E+05	2.0192E-04
3.8965E+05	4.9084E-03	8.6611E+05	1.9044E-04
3.9172E+05	5.1300E-03	8.7212E+05	1.7946E-04
3.9379E+05	5.2939E-03	8.7813E+05	1.6883E-04
3.9586E+05	5.4269E-03	8.8414E+05	1.5889E-04
3.9793E+05	5.4946E-03	8.9015E+05	1.4944E-04
4.0000E+05	5.5304E-03	8.9616E+05	1.4029E-04
4.1177E+05	5.7335E-03	9.0217E+05	1.3155E-04
4.2353E+05	5.9739E-03	9.0818E+05	1.2346E-04
4.3529E+05	6.1657E-03	9.1419E+05	1.1596E-04
4.4706E+05	6.3423E-03	9.2020E+05	1.0919E-04
4.5882E+05	6.4327E-03	9.2621E+05	1.0309E-04
4.7059E+05	6.4106E-03	9.3222E+05	9.7632E-05
4.8235E+05	6.2812E-03	9.3823E+05	9.2752E-05
4.9412E+05	6.0159E-03	9.4424E+05	8.8242E-05
5.0588E+05	5.6494E-03	9.5025E+05	8.4028E-05
5.1765E+05	5.2112E-03	9.5626E+05	8.0112E-05
5.2941E+05	4.7405E-03	9.6227E+05	7.6585E-05
5.4118E+05	4.2448E-03	9.6828E+05	7.6118E-05
5.5294E+05	3.7518E-03	9.7429E+05	7.3377E-05
5.6471E+05	3.2977E-03	9.8030E+05	7.1008E-05
5.7647E+05	2.8676E-03	9.8631E+05	6.8823E-05
5.8824E+05	2.5110E-03	9.9232E+05	6.6708E-05

PLTCVT PROGRAM DATA SUMMARY
PIR3 (TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = RA-226
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.300000E+05
TIME HIGH= 8.000000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 2.350000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9924E+06 MIN. TIME = 3.2354E+05
TOTAL WEIGHT = 3.1244E+03 TOTAL PARCELS = 2339.0
PEAK WEIGHT = 108.076 PEAK WEIGHT TIME = 4.3458E+05
PEAK PARCELS = 39.000 PEAK PARCELS TIME = 4.3458E+05
WT. LOW = 8.0015E-02 NO. PARCELS LOW = 6.0
WT. HI = 6.2234E+01 NO. PARCELS HI = 333.0
SMOOTHING WINDOW (CELLS)= 7

TOTAL INVENTORY (CURIES) = 3.186702E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.120973E+03
PERCENT OF TOTAL INVENTORY = 97.937

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.510250E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7.412791E-08
MAXIMUM RATE (CURIES/YEAR) = 1.912289E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = RA-226

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.3118E+05	2.1863E-04	5.6500E+05	6.9734E-03
3.3585E+05	2.9282E-04	5.6968E+05	6.5176E-03
3.4053E+05	4.9288E-04	5.7435E+05	6.1504E-03
3.4520E+05	7.7750E-04	5.7903E+05	5.8505E-03
3.4988E+05	1.1581E-03	5.8371E+05	5.6064E-03
3.5456E+05	1.6325E-03	5.8838E+05	5.3849E-03
3.5923E+05	2.2279E-03	5.9306E+05	5.1460E-03
3.6391E+05	2.9383E-03	5.9774E+05	4.9030E-03
3.6859E+05	3.7317E-03	6.0241E+05	4.6445E-03
3.7326E+05	4.5841E-03	6.0709E+05	4.3335E-03
3.7794E+05	5.4850E-03	6.1177E+05	3.9838E-03

3.8262E+05	6.4134E-03	6.1644E+05	3.6128E-03
3.8729E+05	7.4037E-03	6.2112E+05	3.2409E-03
3.9197E+05	8.4283E-03	6.2579E+05	2.8900E-03
3.9665E+05	9.4812E-03	6.3047E+05	2.5801E-03
4.0132E+05	1.0566E-02	6.3515E+05	2.3108E-03
4.0600E+05	1.1704E-02	6.3982E+05	2.1009E-03
4.1068E+05	1.2856E-02	6.4450E+05	1.9529E-03
4.1535E+05	1.4054E-02	6.4918E+05	1.8514E-03
4.2003E+05	1.5228E-02	6.5385E+05	1.7835E-03
4.2471E+05	1.6268E-02	6.5853E+05	1.7380E-03
4.2938E+05	1.7170E-02	6.6321E+05	1.7002E-03
4.3406E+05	1.7896E-02	6.6788E+05	1.6562E-03
4.3873E+05	1.8456E-02	6.7256E+05	1.6046E-03
4.4341E+05	1.8857E-02	6.7724E+05	1.5317E-03
4.4809E+05	1.9085E-02	6.8191E+05	1.4472E-03
4.5276E+05	1.9108E-02	6.8659E+05	1.3496E-03
4.5744E+05	1.9028E-02	6.9127E+05	1.2453E-03
4.6212E+05	1.8898E-02	6.9594E+05	1.1387E-03
4.6679E+05	1.8691E-02	7.0062E+05	1.0403E-03
4.7147E+05	1.8393E-02	7.0530E+05	9.5058E-04
4.7615E+05	1.7999E-02	7.0997E+05	8.6857E-04
4.8082E+05	1.7518E-02	7.1465E+05	7.9057E-04
4.8550E+05	1.6985E-02	7.1932E+05	7.1783E-04
4.9018E+05	1.6403E-02	7.2400E+05	6.5064E-04
4.9485E+05	1.5752E-02	7.2868E+05	5.8455E-04
4.9953E+05	1.5059E-02	7.3335E+05	5.2025E-04
5.0421E+05	1.4385E-02	7.3803E+05	4.5526E-04
5.0888E+05	1.3755E-02	7.4271E+05	3.9364E-04
5.1356E+05	1.3157E-02	7.4738E+05	3.3761E-04
5.1824E+05	1.2569E-02	7.5206E+05	2.9283E-04
5.2291E+05	1.1995E-02	7.5674E+05	2.5612E-04
5.2759E+05	1.1446E-02	7.6141E+05	2.2812E-04
5.3226E+05	1.0928E-02	7.6609E+05	2.0835E-04
5.3694E+05	1.0382E-02	7.7077E+05	1.9255E-04
5.4162E+05	9.8039E-03	7.7544E+05	1.7857E-04
5.4629E+05	9.1942E-03	7.8012E+05	1.6512E-04
5.5097E+05	8.5861E-03	7.8480E+05	1.4496E-04
5.5565E+05	8.0199E-03	7.8947E+05	1.1964E-04
5.6032E+05	7.4857E-03	7.9415E+05	9.4781E-05

PLTCVT PROGRAM DATA SUMMARY
PIR3(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 4
CONTAMINANT = AM-243
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+04
TIME HIGH= 6.000000E+04
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 3.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 5.4016E+04 MIN. TIME = 3.8421E+04
TOTAL WEIGHT = 4.5463E+03 TOTAL PARCELS = 3162.0
PEAK WEIGHT = 195.675 PEAK WEIGHT TIME = 4.0350E+04
PEAK PARCELS = 90.000 PEAK PARCELS TIME = 4.9050E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 4.546324E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.726858E+03
PERCENT OF TOTAL INVENTORY = 103.971

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.035000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.316288E-06
MAXIMUM RATE (CURIES/YEAR) = 5.975363E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = AM-243

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.8550E+04	2.3201E-01	4.5310E+04	3.4190E-01
3.8624E+04	2.3201E-01	4.5574E+04	3.3254E-01
3.8698E+04	2.3201E-01	4.5839E+04	3.2334E-01
3.8773E+04	2.3201E-01	4.6104E+04	3.1430E-01
3.8847E+04	2.3201E-01	4.6368E+04	3.0585E-01
3.8921E+04	2.5144E-01	4.6633E+04	2.9775E-01
3.8995E+04	2.7169E-01	4.6898E+04	2.8983E-01
3.9070E+04	2.9195E-01	4.7162E+04	2.8204E-01
3.9144E+04	3.1220E-01	4.7427E+04	2.7405E-01
3.9218E+04	3.3668E-01	4.7692E+04	2.6616E-01
3.9292E+04	3.6152E-01	4.7957E+04	2.5875E-01

3.9367E+04	3.8637E-01	4.6221E+04	2.5183E-01
3.9441E+04	4.1122E-01	4.6486E+04	2.4516E-01
3.9515E+04	4.3580E-01	4.6751E+04	2.3847E-01
3.9589E+04	4.6034E-01	4.9015E+04	2.3129E-01
3.9664E+04	4.8488E-01	4.9280E+04	2.2470E-01
3.9738E+04	5.0943E-01	4.9545E+04	2.1862E-01
3.9812E+04	5.2385E-01	4.9810E+04	2.1358E-01
3.9886E+04	5.3629E-01	5.0074E+04	2.0608E-01
3.9961E+04	5.4873E-01	5.0200E+04	2.0089E-01
4.0035E+04	5.6118E-01	5.0326E+04	1.9485E-01
4.0109E+04	5.7038E-01	5.0452E+04	1.8825E-01
4.0183E+04	5.7875E-01	5.0577E+04	1.8150E-01
4.0258E+04	5.8712E-01	5.0703E+04	1.7419E-01
4.0332E+04	5.9549E-01	5.0829E+04	1.6688E-01
4.0406E+04	5.9663E-01	5.0955E+04	1.5935E-01
4.0480E+04	5.9543E-01	5.1080E+04	1.5178E-01
4.0555E+04	5.9422E-01	5.1206E+04	1.4445E-01
4.0629E+04	5.9302E-01	5.1332E+04	1.3741E-01
4.0703E+04	5.8974E-01	5.1458E+04	1.3039E-01
4.0777E+04	5.8564E-01	5.1583E+04	1.2349E-01
4.0852E+04	5.8153E-01	5.1709E+04	1.1658E-01
4.0926E+04	5.7742E-01	5.1835E+04	1.0941E-01
4.1000E+04	5.7105E-01	5.1961E+04	1.0212E-01
4.1074E+04	5.6359E-01	5.2086E+04	9.4843E-02
4.1339E+04	5.3859E-01	5.2212E+04	8.7606E-02
4.1604E+04	5.1775E-01	5.2338E+04	8.0368E-02
4.1868E+04	5.0096E-01	5.2464E+04	7.2942E-02
4.2133E+04	4.8645E-01	5.2589E+04	6.5497E-02
4.2398E+04	4.7257E-01	5.2715E+04	5.8319E-02
4.2662E+04	4.5881E-01	5.2841E+04	5.1390E-02
4.2927E+04	4.4557E-01	5.2967E+04	4.4609E-02
4.3192E+04	4.3311E-01	5.3092E+04	3.8799E-02
4.3457E+04	4.2152E-01	5.3218E+04	3.2989E-02
4.3721E+04	4.0991E-01	5.3344E+04	2.8192E-02
4.3986E+04	3.9670E-01	5.3470E+04	2.3739E-02
4.4251E+04	3.8425E-01	5.3595E+04	2.0001E-02
4.4515E+04	3.7254E-01	5.3721E+04	1.7525E-02
4.4780E+04	3.6178E-01	5.3847E+04	1.5049E-02
4.5045E+04	3.5160E-01	5.3973E+04	1.2731E-02

PLTCVT PROGRAM DATA SUMMARY
PIR3(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = PU-239
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 2.000000E+04
TIME HIGH= 2.000000E+05
NUMBER OF CELLS = 10
DELTA TIME INCREMENT = 1.800000E+04

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.5187E+05 MIN. TIME = 4.9050E+04
TOTAL WEIGHT = 6.8111E+00 TOTAL PARCELS = 15.0
PEAK WEIGHT = 3.616 PEAK WEIGHT TIME = 6.5000E+04
PEAK PARCELS = 5.000 PEAK PARCELS TIME = 6.5000E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 0

TOTAL INVENTORY (CURIES) = 6.811129E+00
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 9.463253E+00
PERCENT OF TOTAL INVENTORY = 138.938

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.700000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7.788292E-10
MAXIMUM RATE (CURIES/YEAR) = 2.009157E-04
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = PU-239

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.7000E+04	2.0092E-04	1.0100E+05	2.6412E-05
4.8080E+04	2.0092E-04	1.0208E+05	2.5174E-05
4.9160E+04	2.0092E-04	1.0316E+05	2.3936E-05
5.0240E+04	2.0092E-04	1.0424E+05	2.2698E-05
5.1320E+04	2.0092E-04	1.0532E+05	2.1460E-05
5.2400E+04	2.0092E-04	1.0640E+05	2.0221E-05
5.3480E+04	2.0092E-04	1.0748E+05	1.8983E-05
5.4560E+04	2.0092E-04	1.0856E+05	1.7745E-05
5.5640E+04	2.0092E-04	1.0964E+05	1.6507E-05
5.6720E+04	2.0092E-04	1.1072E+05	1.5269E-05
5.7800E+04	2.0092E-04	1.1180E+05	1.4031E-05

5,8880E+04	2,0092E-04	1,1288E+05	1,2793E-05
5,9960E+04	2,0092E-04	1,1396E+05	1,1555E-05
6,1040E+04	2,0092E-04	1,1504E+05	1,0316E-05
6,2120E+04	2,0092E-04	1,1612E+05	9,0783E-06
6,3200E+04	2,0092E-04	1,1720E+05	7,8402E-06
6,4280E+04	2,0092E-04	1,1828E+05	6,6020E-06
6,5360E+04	1,9785E-04	1,1936E+05	5,8957E-06
6,6440E+04	1,8864E-04	1,2044E+05	6,2531E-06
6,7520E+04	1,7943E-04	1,2152E+05	6,6104E-06
6,8600E+04	1,7022E-04	1,2260E+05	6,9677E-06
6,9680E+04	1,6101E-04	1,2368E+05	7,3251E-06
7,0760E+04	1,5180E-04	1,2476E+05	7,6824E-06
7,1840E+04	1,4260E-04	1,2584E+05	8,0397E-06
7,2920E+04	1,3339E-04	1,2692E+05	8,3971E-06
7,4000E+04	1,2418E-04	1,2800E+05	8,7544E-06
7,5080E+04	1,1497E-04	1,2908E+05	9,1117E-06
7,6160E+04	1,0576E-04	1,3016E+05	9,4691E-06
7,7240E+04	9,6552E-05	1,3124E+05	9,6264E-06
7,8320E+04	8,7344E-05	1,3232E+05	1,0184E-05
7,9400E+04	7,8135E-05	1,3340E+05	1,0541E-05
8,0480E+04	6,8927E-05	1,3448E+05	1,0898E-05
8,1560E+04	5,9718E-05	1,3556E+05	1,1256E-05
8,2640E+04	5,0510E-05	1,3664E+05	1,1613E-05
8,3720E+04	4,6599E-05	1,3772E+05	1,2565E-05
8,4800E+04	4,5337E-05	1,3880E+05	1,3813E-05
8,5880E+04	4,4076E-05	1,3988E+05	1,5062E-05
8,6960E+04	4,2814E-05	1,4096E+05	1,6311E-05
8,8040E+04	4,1552E-05	1,4204E+05	1,7559E-05
8,9120E+04	4,0291E-05	1,4312E+05	1,8808E-05
9,0200E+04	3,9029E-05	1,4420E+05	2,0057E-05
9,1280E+04	3,7767E-05	1,4528E+05	2,1305E-05
9,2360E+04	3,6506E-05	1,4636E+05	2,2554E-05
9,3440E+04	3,5244E-05	1,4744E+05	2,3803E-05
9,4520E+04	3,3982E-05	1,4852E+05	2,5051E-05
9,5600E+04	3,2721E-05	1,4960E+05	2,6300E-05
9,6680E+04	3,1459E-05	1,5068E+05	2,7549E-05
9,7760E+04	3,0197E-05	1,5176E+05	2,8798E-05
9,8840E+04	2,8935E-05	1,5284E+05	3,0046E-05
9,9920E+04	2,7674E-05	1,5392E+05	3,1295E-05

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PLTCVT PROGRAM DATA SUMMARY
PIR 3(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = U-235
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   3.000000E+05
TIME HIGH=   7.000000E+05
NUMBER OF CELLS =            400
DELTA TIME INCREMENT =   1.000000E+03

 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  8.3036E+05       MIN. TIME =  4.1726E+04
TOTAL WEIGHT =  4.1413E+02    TOTAL PARCELS =      21369.0
PEAK WEIGHT =       12.590    PEAK WEIGHT TIME =  4.5050E+05
PEAK PARCELS =     215.000    PEAK PARCELS TIME =  3.8350E+05
WT. LOW =  4.7584E-01         NO. PARCELS LOW =      6145.0
WT. HI =  5.0361E-02          NO. PARCELS HI =      1715.0
 SMOOTHING WINDOW (CELLS)=      10

TOTAL INVENTORY (CURIES) =    4.146564E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =    4.140642E+02
PERCENT OF TOTAL INVENTORY =  99.857

TIME OF MAXIMUM CONCENTRATION (YEARS) =    4.335000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) =    1.722498E-08
MAXIMUM RATE (CURIES/YEAR) =    4.443553E-03
CONVERSION FACTOR RATE TO CONCENTRATION =    3.876398E-06


 CONTAMINANT = U-235

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE    100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.0050E+05	2.0181E-06	5.0000E+05	7.2955E-04
3.0449E+05	2.9922E-06	5.0399E+05	6.1756E-04
3.0848E+05	4.6483E-06	5.0798E+05	5.2675E-04
3.1247E+05	6.7881E-06	5.1197E+05	4.5093E-04
3.1646E+05	9.4470E-06	5.1596E+05	3.8531E-04
3.2045E+05	1.3555E-05	5.1995E+05	3.2743E-04
3.2444E+05	2.0316E-05	5.2394E+05	2.7734E-04
3.2843E+05	3.1548E-05	5.2793E+05	2.3570E-04
3.3242E+05	4.9635E-05	5.3192E+05	2.0287E-04
3.3641E+05	7.7508E-05	5.3591E+05	1.7861E-04
3.4040E+05	1.1835E-04	5.3990E+05	1.6166E-04

3.4439E+05	1.7549E-04	5.4389E+05	1.4942E-04
3.4838E+05	2.5238E-04	5.4788E+05	1.3926E-04
3.5237E+05	3.5235E-04	5.5187E+05	1.2944E-04
3.5636E+05	4.7838E-04	5.5586E+05	1.1871E-04
3.6035E+05	6.3306E-04	5.5985E+05	1.0664E-04
3.6434E+05	8.1733E-04	5.6384E+05	9.3936E-05
3.6833E+05	1.0297E-03	5.6783E+05	8.1376E-05
3.7232E+05	1.2660E-03	5.7182E+05	6.9419E-05
3.7631E+05	1.5190E-03	5.7581E+05	5.8402E-05
3.8030E+05	1.7785E-03	5.7980E+05	4.8623E-05
3.8429E+05	2.0353E-03	5.8379E+05	3.9944E-05
3.8828E+05	2.2832E-03	5.8778E+05	3.2451E-05
3.9227E+05	2.5201E-03	5.9177E+05	2.6281E-05
3.9626E+05	2.7488E-03	5.9576E+05	2.1561E-05
4.0025E+05	2.9771E-03	5.9975E+05	1.8293E-05
4.0424E+05	3.2116E-03	6.0374E+05	1.6178E-05
4.0823E+05	3.4523E-03	6.0773E+05	1.4978E-05
4.1222E+05	3.6942E-03	6.1172E+05	1.4172E-05
4.1621E+05	3.9257E-03	6.1571E+05	1.3482E-05
4.2020E+05	4.1284E-03	6.1970E+05	1.2552E-05
4.2419E+05	4.2861E-03	6.2369E+05	1.1446E-05
4.2818E+05	4.3907E-03	6.2768E+05	1.0225E-05
4.3217E+05	4.4394E-03	6.3167E+05	8.9245E-06
4.3616E+05	4.4333E-03	6.3566E+05	7.7590E-06
4.4015E+05	4.3801E-03	6.3965E+05	6.7938E-06
4.4414E+05	4.2863E-03	6.4364E+05	6.0210E-06
4.4813E+05	4.1511E-03	6.4763E+05	5.5201E-06
4.5212E+05	3.9724E-03	6.5162E+05	5.1113E-06
4.5611E+05	3.7500E-03	6.5561E+05	4.7772E-06
4.6010E+05	3.4840E-03	6.5960E+05	4.5898E-06
4.6409E+05	3.1774E-03	6.6359E+05	4.2819E-06
4.6808E+05	2.8425E-03	6.6758E+05	4.0379E-06
4.7207E+05	2.4947E-03	6.7157E+05	3.6933E-06
4.7606E+05	2.1492E-03	6.7556E+05	3.3416E-06
4.8005E+05	1.8209E-03	6.7955E+05	2.9871E-06
4.8404E+05	1.5236E-03	6.8354E+05	2.5750E-06
4.8803E+05	1.2648E-03	6.8753E+05	2.1081E-06
4.9202E+05	1.0472E-03	6.9152E+05	1.5509E-06
4.9601E+05	8.7028E-04	6.9551E+05	1.0546E-06

PLTCVT PROGRAM DATA SUMMARY
PIR 3(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = PA-231
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+05
TIME HIGH= 5.000000E+05
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 2.000000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.6413E+06 MIN. TIME = 4.0800E+04
TOTAL WEIGHT = 4.6076E+00 TOTAL PARCELS = 1786.0
PEAK WEIGHT = 0.407 PEAK WEIGHT TIME = 4.0900E+05
PEAK PARCELS = 32.000 PEAK PARCELS TIME = 4.1300E+05
WT. LOW = 1.4309E-02 NO. PARCELS LOW = 1345.0
WT. HI = 8.0174E+00 NO. PARCELS HI = 2384.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 1.263927E+01
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.479630E+00
PERCENT OF TOTAL INVENTORY = 35.442

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.110000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.406968E-10
MAXIMUM RATE (CURIES/YEAR) = 6.209291E-05
CONVERSION FACTOR RATE TO CONCENTRATION = 3.876398E-06

CONTAMINANT = PA-231

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.0100E+05	6.2025E-08	4.0030E+05	5.3258E-05
3.0298E+05	6.2025E-08	4.0198E+05	5.5819E-05
3.0496E+05	7.8059E-08	4.0396E+05	5.8003E-05
3.0694E+05	9.5654E-08	4.0594E+05	5.9757E-05
3.0892E+05	1.1468E-07	4.0792E+05	6.1037E-05
3.1090E+05	1.3529E-07	4.0990E+05	6.1816E-05
3.1288E+05	1.5781E-07	4.1188E+05	6.2088E-05
3.1486E+05	1.7702E-07	4.1386E+05	6.1866E-05
3.1684E+05	1.9752E-07	4.1584E+05	6.1182E-05
3.1882E+05	2.2048E-07	4.1782E+05	6.0079E-05
3.2080E+05	2.4711E-07	4.1980E+05	5.8612E-05

3.2278E+05	2.7903E-07	4.2178E+05	5.6846E-05
3.2476E+05	3.1832E-07	4.2376E+05	5.4857E-05
3.2674E+05	3.6807E-07	4.2574E+05	5.2717E-05
3.2872E+05	4.3147E-07	4.2772E+05	5.0494E-05
3.3070E+05	5.1202E-07	4.2970E+05	4.8257E-05
3.3268E+05	6.1314E-07	4.3168E+05	4.6062E-05
3.3466E+05	7.3828E-07	4.3366E+05	4.3955E-05
3.3664E+05	8.9099E-07	4.3564E+05	4.1968E-05
3.3862E+05	1.0751E-06	4.3762E+05	4.0121E-05
3.4060E+05	1.2947E-06	4.3960E+05	3.8424E-05
3.4258E+05	1.5536E-06	4.4158E+05	3.6875E-05
3.4456E+05	1.8556E-06	4.4356E+05	3.5463E-05
3.4654E+05	2.2036E-06	4.4554E+05	3.4167E-05
3.4852E+05	2.6000E-06	4.4752E+05	3.2966E-05
3.5050E+05	3.0475E-06	4.4950E+05	3.1837E-05
3.5248E+05	3.5498E-06	4.5148E+05	3.0756E-05
3.5446E+05	4.1121E-06	4.5346E+05	2.9705E-05
3.5644E+05	4.7411E-06	4.5544E+05	2.8667E-05
3.5842E+05	5.4453E-06	4.5742E+05	2.7629E-05
3.6040E+05	6.2346E-06	4.5940E+05	2.6583E-05
3.6238E+05	7.1194E-06	4.6138E+05	2.5526E-05
3.6436E+05	8.1117E-06	4.6336E+05	2.4460E-05
3.6634E+05	9.2265E-06	4.6534E+05	2.3389E-05
3.6832E+05	1.0482E-05	4.6732E+05	2.2320E-05
3.7030E+05	1.1898E-05	4.6930E+05	2.1261E-05
3.7228E+05	1.3497E-05	4.7128E+05	2.0213E-05
3.7426E+05	1.5296E-05	4.7326E+05	1.9179E-05
3.7624E+05	1.7308E-05	4.7524E+05	1.8159E-05
3.7822E+05	1.9543E-05	4.7722E+05	1.7150E-05
3.8020E+05	2.2004E-05	4.7920E+05	1.6147E-05
3.8218E+05	2.4685E-05	4.8118E+05	1.5115E-05
3.8416E+05	2.7575E-05	4.8316E+05	1.4059E-05
3.8614E+05	3.0653E-05	4.8514E+05	1.2979E-05
3.8812E+05	3.3887E-05	4.8712E+05	1.1879E-05
3.9010E+05	3.7229E-05	4.8910E+05	1.0745E-05
3.9208E+05	4.0619E-05	4.9108E+05	9.2888E-06
3.9406E+05	4.3990E-05	4.9306E+05	7.9157E-06
3.9604E+05	4.7269E-05	4.9504E+05	6.6277E-06
3.9802E+05	5.0384E-05	4.9702E+05	5.4266E-06

APPENDIX H.3: WELL PUMPING CASE

Simulation Run 4.

```
PLTCVT PROGRAM DATA SUMMARY
PIR 4 Fission   PIR 4
CONTAMINANT = C-14
  TONS OF HEAVY METAL FACTOR =    1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =    2
TIME LOW =    1.000000E+03
TIME HIGH=    2.500000E+04
NUMBER OF CELLS =              500
DELTA TIME INCREMENT =    4.800000E+01


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  9.1321E+04        MIN. TIME =  1.0206E+03
TOTAL WEIGHT =  2.7430E+04     TOTAL PARCELS =        8937.0
PEAK WEIGHT =       258.987    PEAK WEIGHT TIME =  2.2240E+03
PEAK PARCELS =        31.000   PEAK PARCELS TIME =  3.8560E+03
WT. LOW =  0.0000E-01          NO. PARCELS LOW =          0.0
WT. HI =  2.5045E+02           NO. PARCELS HI =      24863.0
 SMOOTHING WINDOW (CELLS)=      20


TOTAL INVENTORY (CURIES) =    2.768001E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =    2.757593E+04
PERCENT OF TOTAL INVENTORY =  99.624

TIME OF MAXIMUM CONCENTRATION (YEARS) =   1.744000E+03
MAXIMUM CONCENTRATION (MICROCURIES/ML) =    4.426165E-06
MAXIMUM RATE (CURIES/YEAR) =   3.694952E+00
CONVERSION FACTOR RATE TO CONCENTRATION =    1.197895E-06


TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE    100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.0240E+03	8.8980E-01	8.3176E+03	1.6706E+00
1.0475E+03	8.8980E-01	8.7235E+03	1.5934E+00
1.0710E+03	8.8980E-01	9.1294E+03	1.5139E+00
1.0945E+03	1.0644E+00	9.5353E+03	1.4404E+00
1.1181E+03	1.2465E+00	9.9412E+03	1.3716E+00
1.1416E+03	1.3547E+00	1.0347E+04	1.3075E+00
1.1651E+03	1.4564E+00	1.0755E+04	1.2466E+00
1.1886E+03	1.6618E+00	1.1159E+04	1.1655E+00
1.2121E+03	1.8818E+00	1.1565E+04	1.1320E+00
1.2356E+03	2.0470E+00	1.1971E+04	1.0731E+00
1.2592E+03	2.2014E+00	1.2376E+04	1.0224E+00

1.2827E+03	2.3427E+00	1.2782E+04	9.7347E-01
1.3062E+03	2.4807E+00	1.3188E+04	9.2726E-01
1.3297E+03	2.6324E+00	1.3594E+04	8.8037E-01
1.3532E+03	2.7886E+00	1.4000E+04	8.4106E-01
1.3767E+03	2.9139E+00	1.4406E+04	7.9949E-01
1.4002E+03	3.0266E+00	1.4812E+04	7.5917E-01
1.4238E+03	3.1139E+00	1.5218E+04	7.2210E-01
1.4473E+03	3.1886E+00	1.5624E+04	6.7085E-01
1.4708E+03	3.2782E+00	1.5908E+04	4.2891E-01
1.4943E+03	3.3766E+00	1.6192E+04	1.5496E-01
1.5178E+03	3.4629E+00	1.6476E+04	8.9181E-02
1.5413E+03	3.5406E+00	1.6760E+04	8.4646E-02
1.5648E+03	3.5774E+00	1.7044E+04	7.6335E-02
1.5884E+03	3.5802E+00	1.7328E+04	7.7909E-02
1.6119E+03	3.5869E+00	1.7612E+04	7.5670E-02
1.6354E+03	3.5972E+00	1.7896E+04	6.9892E-02
1.6589E+03	3.6186E+00	1.8181E+04	6.7750E-02
1.6824E+03	3.6530E+00	1.8465E+04	6.3243E-02
1.7059E+03	3.6774E+00	1.8749E+04	6.5991E-02
1.7295E+03	3.6882E+00	1.9033E+04	6.5198E-02
1.7530E+03	3.6926E+00	1.9317E+04	6.0740E-02
1.7765E+03	3.6863E+00	1.9601E+04	5.9227E-02
1.8000E+03	3.6787E+00	1.9885E+04	5.6598E-02
1.8235E+03	3.6688E+00	2.0169E+04	5.2287E-02
2.2294E+03	3.4848E+00	2.0454E+04	5.0913E-02
2.6353E+03	3.3222E+00	2.0738E+04	5.1127E-02
3.0412E+03	3.1703E+00	2.1022E+04	5.0032E-02
3.4470E+03	3.0281E+00	2.1306E+04	4.7333E-02
3.8529E+03	2.8979E+00	2.1590E+04	4.5905E-02
4.2588E+03	2.7639E+00	2.1874E+04	4.4113E-02
4.6647E+03	2.6367E+00	2.2158E+04	4.2741E-02
5.0706E+03	2.4961E+00	2.2442E+04	4.1759E-02
5.4765E+03	2.3678E+00	2.2727E+04	3.9240E-02
5.8823E+03	2.2411E+00	2.3011E+04	3.8179E-02
6.2882E+03	2.1316E+00	2.3295E+04	3.5531E-02
6.6941E+03	2.0204E+00	2.3579E+04	3.6676E-02
7.1000E+03	1.9309E+00	2.3863E+04	3.4834E-02
7.5059E+03	1.8389E+00	2.4147E+04	3.2517E-02
7.9117E+03	1.7560E+00	2.4431E+04	3.2571E-02

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Fission PIR 4
CONTAMINANT = TC-99
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.400000E+04
TIME HIGH= 1.700000E+04
NUMBER OF CELLS = 300
DELTA TIME INCREMENT = 1.000000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 9.1182E+04 MIN. TIME = 1.0677E+03
TOTAL WEIGHT = 4.3244E+05 TOTAL PARCELS = 4747.0
PEAK WEIGHT = 29853.873 PEAK WEIGHT TIME = 1.6015E+04
PEAK PARCELS = 307.000 PEAK PARCELS TIME = 1.6015E+04
WT. LOW = 1.1763E+05 NO. PARCELS LOW = 1183.0
WT. HI = 3.3131E+05 NO. PARCELS HI = 27870.0
SMOOTHING WINDOW (CELLS)= 15

TOTAL INVENTORY (CURIES) = 8.813796E+05
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.606703E+05
PERCENT OF TOTAL INVENTORY = 52.267

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.602500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 3.275067E-03
MAXIMUM RATE (CURIES/YEAR) = 2.734017E+03
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.4005E+04	4.0036E+01	1.5900E+04	2.8629E+02
1.4061E+04	3.9112E+01	1.5903E+04	2.9290E+02
1.4117E+04	3.8584E+01	1.5906E+04	3.0074E+02
1.4173E+04	3.8822E+01	1.5909E+04	3.1144E+02
1.4229E+04	3.8415E+01	1.5912E+04	3.2214E+02
1.4285E+04	3.8521E+01	1.5915E+04	3.3285E+02
1.4340E+04	3.8977E+01	1.5918E+04	3.4723E+02
1.4396E+04	3.9009E+01	1.5921E+04	3.6202E+02
1.4452E+04	3.8566E+01	1.5924E+04	3.7680E+02
1.4508E+04	3.7771E+01	1.5926E+04	3.9518E+02
1.4564E+04	3.7770E+01	1.5929E+04	4.1711E+02

1.4620E+04	3.7126E+01	1.5932E+04	4.3909E+02
1.4676E+04	3.6644E+01	1.5935E+04	4.6253E+02
1.4732E+04	3.7333E+01	1.5938E+04	4.9941E+02
1.4788E+04	3.7923E+01	1.5941E+04	5.3629E+02
1.4844E+04	3.8236E+01	1.5944E+04	5.7317E+02
1.4900E+04	3.7561E+01	1.5947E+04	6.1155E+02
1.4955E+04	3.7835E+01	1.5950E+04	6.5057E+02
1.5011E+04	3.7854E+01	1.5982E+04	1.1632E+03
1.5067E+04	3.7958E+01	1.6013E+04	2.6769E+03
1.5123E+04	3.8526E+01	1.6045E+04	2.3219E+03
1.5179E+04	3.9480E+01	1.6077E+04	1.6868E+03
1.5235E+04	4.0251E+01	1.6108E+04	1.0667E+03
1.5291E+04	4.0140E+01	1.6140E+04	6.0681E+02
1.5347E+04	4.0596E+01	1.6172E+04	3.7238E+02
1.5403E+04	4.0378E+01	1.6203E+04	2.2196E+02
1.5459E+04	4.0731E+01	1.6235E+04	1.2026E+02
1.5515E+04	4.0417E+01	1.6267E+04	8.3292E+01
1.5570E+04	4.0898E+01	1.6298E+04	3.0989E+01
1.5626E+04	4.1457E+01	1.6330E+04	2.2537E+01
1.5682E+04	5.4852E+01	1.6362E+04	1.3802E+01
1.5738E+04	7.3781E+01	1.6393E+04	5.8707E+00
1.5794E+04	1.2497E+02	1.6425E+04	7.1837E+00
1.5850E+04	1.9412E+02	1.6457E+04	5.7895E+00
1.5853E+04	1.9815E+02	1.6488E+04	4.6110E+00
1.5856E+04	2.0248E+02	1.6520E+04	6.2159E+00
1.5859E+04	2.0748E+02	1.6552E+04	4.5294E+00
1.5862E+04	2.1248E+02	1.6583E+04	3.6758E+00
1.5865E+04	2.1748E+02	1.6615E+04	5.4527E+00
1.5868E+04	2.2313E+02	1.6647E+04	6.0821E+00
1.5871E+04	2.2884E+02	1.6678E+04	4.7221E+00
1.5874E+04	2.3456E+02	1.6710E+04	5.3641E+00
1.5876E+04	2.4033E+02	1.6742E+04	5.0187E+00
1.5879E+04	2.4614E+02	1.6773E+04	5.8588E+00
1.5882E+04	2.5195E+02	1.6805E+04	4.0240E+00
1.5885E+04	2.5771E+02	1.6837E+04	3.9488E+00
1.5888E+04	2.6297E+02	1.6868E+04	3.7748E+00
1.5891E+04	2.6823E+02	1.6900E+04	5.8077E+00
1.5894E+04	2.7349E+02	1.6932E+04	6.5535E+00
1.5897E+04	2.7969E+02	1.6963E+04	5.2592E+00

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Fission PIR 4
CONTAMINANT = I-129
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 9.000000E+02
TIME HIGH= 1.000000E+05
NUMBER OF CELLS = 500
DELTA TIME INCREMENT = 1.982000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 9.1189E+04 MIN. TIME = 9.9794E+02
TOTAL WEIGHT = 2.2821E+03 TOTAL PARCELS = 33800.0
PEAK WEIGHT = 22.118 PEAK WEIGHT TIME = 1.2891E+04
PEAK PARCELS = 92.000 PEAK PARCELS TIME = 8.0279E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 15

TOTAL INVENTORY (CURIES) = 2.282146E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.245961E+03
PERCENT OF TOTAL INVENTORY = 98.414

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.377500E+03
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.103832E-07
MAXIMUM RATE (CURIES/YEAR) = 9.214763E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
9.9910E+02	6.3092E-02	1.2760E+04	8.5166E-02
1.2537E+03	6.7992E-02	1.2955E+04	8.3939E-02
1.5082E+03	8.1972E-02	1.3149E+04	8.2431E-02
1.7628E+03	8.5059E-02	1.3343E+04	8.0544E-02
2.0174E+03	8.4599E-02	1.3537E+04	7.8767E-02
2.2720E+03	8.9234E-02	1.3731E+04	7.7918E-02
2.5265E+03	9.0484E-02	1.3925E+04	7.6933E-02
2.7811E+03	9.0981E-02	1.4119E+04	7.5777E-02
3.0357E+03	9.1964E-02	1.4313E+04	7.4429E-02
3.2903E+03	9.2115E-02	1.4508E+04	7.2827E-02
3.5448E+03	9.2083E-02	1.4702E+04	7.0927E-02

3.7994E+03	9.1561E-02	1.4896E+04	6.8819E-02
4.0540E+03	9.0960E-02	1.5090E+04	6.6748E-02
4.3085E+03	9.0879E-02	1.5284E+04	6.4355E-02
4.5631E+03	9.0870E-02	1.5478E+04	6.1342E-02
4.8177E+03	9.0747E-02	1.5672E+04	5.7421E-02
5.0723E+03	9.0565E-02	1.5866E+04	5.2116E-02
5.3268E+03	9.0704E-02	1.6060E+04	4.4116E-02
5.5814E+03	9.1011E-02	1.8339E+04	1.2490E-02
5.8360E+03	9.1332E-02	2.0617E+04	1.2528E-02
6.0906E+03	9.1530E-02	2.2695E+04	1.2422E-02
6.3451E+03	9.1694E-02	2.5173E+04	1.2486E-02
6.5997E+03	9.1852E-02	2.7451E+04	1.2492E-02
6.8543E+03	9.2059E-02	2.9730E+04	1.2571E-02
7.1088E+03	9.1972E-02	3.2008E+04	1.2460E-02
7.3634E+03	9.1995E-02	3.4286E+04	1.2544E-02
7.6180E+03	9.2073E-02	3.6564E+04	1.2411E-02
7.8726E+03	9.1844E-02	3.8842E+04	1.2529E-02
8.1271E+03	9.1849E-02	4.1120E+04	1.2362E-02
8.3817E+03	9.1741E-02	4.3399E+04	1.2442E-02
8.6363E+03	9.1607E-02	4.5677E+04	1.2614E-02
8.8909E+03	9.1567E-02	4.7955E+04	1.2392E-02
9.1454E+03	9.1396E-02	5.0233E+04	1.2536E-02
9.4000E+03	9.1217E-02	5.2511E+04	1.2595E-02
9.6546E+03	9.1185E-02	5.4790E+04	1.2438E-02
9.8487E+03	9.1224E-02	5.7068E+04	1.2568E-02
1.0043E+04	9.1251E-02	5.9346E+04	1.2438E-02
1.0237E+04	9.1273E-02	6.1624E+04	1.2462E-02
1.0431E+04	9.1268E-02	6.3902E+04	1.2429E-02
1.0625E+04	9.1243E-02	6.6180E+04	1.2509E-02
1.0819E+04	9.1058E-02	6.8459E+04	1.2423E-02
1.1013E+04	9.0614E-02	7.0737E+04	1.2493E-02
1.1208E+04	9.0050E-02	7.3015E+04	1.2431E-02
1.1402E+04	8.9465E-02	7.5293E+04	1.2358E-02
1.1596E+04	8.8963E-02	7.7571E+04	1.2550E-02
1.1790E+04	8.8560E-02	7.9850E+04	1.2428E-02
1.1984E+04	8.8100E-02	8.2128E+04	1.2440E-02
1.2178E+04	8.7540E-02	8.4406E+04	1.2509E-02
1.2372E+04	8.6891E-02	8.6684E+04	1.2456E-02
1.2566E+04	8.6125E-02	8.8962E+04	1.2425E-02

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Fission PIR 4
CONTAMINANT = CS-135
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+03
TIME HIGH= 2.000000E+04
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 4.750000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.0626E+05 MIN. TIME = 1.2157E+03
TOTAL WEIGHT = 1.6579E+04 TOTAL PARCELS = 5505.0
PEAK WEIGHT = 84.401 PEAK WEIGHT TIME = 7.9588E+03
PEAK PARCELS = 28.000 PEAK PARCELS TIME = 7.9588E+03
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 3.3059E+03 NO. PARCELS HI = 8030.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 1.988446E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.660350E+04
PERCENT OF TOTAL INVENTORY = 83.500

TIME OF MAXIMUM CONCENTRATION (YEARS) = 2.353750E+03
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.368702E-06
MAXIMUM RATE (CURIES/YEAR) = 1.142589E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.2138E+03	8.6335E-01	8.1160E+03	1.1321E+00
1.2209E+03	8.6335E-01	8.5322E+03	1.1327E+00
1.2281E+03	8.6335E-01	8.9483E+03	1.1325E+00
1.2352E+03	8.6335E-01	9.3645E+03	1.1300E+00
1.2424E+03	8.6335E-01	9.7807E+03	1.1304E+00
1.2495E+03	8.6335E-01	1.0197E+04	1.1310E+00
1.2567E+03	8.6335E-01	1.0613E+04	1.1299E+00
1.2639E+03	8.6937E-01	1.1029E+04	1.1296E+00
1.2710E+03	8.8584E-01	1.1445E+04	1.1335E+00
1.2782E+03	9.0231E-01	1.1862E+04	1.1337E+00
1.2853E+03	9.1878E-01	1.2278E+04	1.1329E+00

1,2925E+03	9,3525E-01	1,2694E+04	1,1335E+00
1,2997E+03	9,5172E-01	1,3110E+04	1,1317E+00
1,3068E+03	9,6820E-01	1,3526E+04	1,1283E+00
1,3140E+03	9,7733E-01	1,3942E+04	1,1299E+00
1,3211E+03	9,8375E-01	1,4359E+04	1,1284E+00
1,3283E+03	9,9017E-01	1,4775E+04	1,1304E+00
1,3355E+03	9,9659E-01	1,5191E+04	1,1300E+00
1,3426E+03	1,0030E+00	1,5607E+04	1,1171E+00
1,3498E+03	1,0094E+00	1,5658E+04	1,0721E+00
1,3569E+03	1,0166E+00	1,5708E+04	1,0207E+00
1,3641E+03	1,0304E+00	1,5759E+04	9,3753E-01
1,3712E+03	1,0442E+00	1,5809E+04	8,1567E-01
1,3784E+03	1,0581E+00	1,5860E+04	6,4945E-01
1,3856E+03	1,0719E+00	1,5911E+04	4,7916E-01
1,3927E+03	1,0858E+00	1,5961E+04	3,0682E-01
1,3999E+03	1,0996E+00	1,6012E+04	1,6603E-01
1,4070E+03	1,1079E+00	1,6062E+04	7,6372E-02
1,4142E+03	1,1098E+00	1,6113E+04	2,8092E-02
1,4214E+03	1,1116E+00	1,6163E+04	7,3213E-03
1,4285E+03	1,1135E+00	1,6214E+04	2,1811E-03
1,4357E+03	1,1154E+00	1,6265E+04	1,6555E-03
1,4428E+03	1,1172E+00	1,6315E+04	1,6746E-03
1,4500E+03	1,1191E+00	1,6366E+04	1,6764E-03
1,4572E+03	1,1206E+00	1,6416E+04	1,6738E-03
1,8733E+03	1,1413E+00	1,6467E+04	1,6335E-03
2,2895E+03	1,1388E+00	1,6517E+04	1,6764E-03
2,7057E+03	1,1367E+00	1,6568E+04	1,6704E-03
3,1219E+03	1,1348E+00	1,6619E+04	1,6597E-03
3,5380E+03	1,1300E+00	1,6669E+04	1,6582E-03
3,9542E+03	1,1329E+00	1,6720E+04	1,6706E-03
4,3704E+03	1,1361E+00	1,6770E+04	1,6759E-03
4,7866E+03	1,1346E+00	1,6821E+04	1,6555E-03
5,2027E+03	1,1376E+00	1,6871E+04	1,6764E-03
5,6189E+03	1,1395E+00	1,6922E+04	1,6594E-03
6,0351E+03	1,1343E+00	1,6973E+04	1,6707E-03
6,4513E+03	1,1336E+00	1,7023E+04	1,6362E-03
6,8675E+03	1,1342E+00	1,7074E+04	1,7146E-03
7,2836E+03	1,1306E+00	1,7124E+04	1,6320E-03
7,6998E+03	1,1306E+00	1,7175E+04	1,6754E-03

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 1 PIR 4 Chain 1
CONTAMINANT = U-236
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 8.000000E+03
TIME HIGH= 1.100000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 2.550000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4988E+05 MIN. TIME = 8.3545E+03
TOTAL WEIGHT = 2.9102E+04 TOTAL PARCELS = 11880.0
PEAK WEIGHT = 382.689 PEAK WEIGHT TIME = 2.2918E+04
PEAK PARCELS = 74.000 PEAK PARCELS TIME = 2.2918E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 2.3395E-01 NO. PARCELS HI = 152.0
SMOOTHING WINDOW (CELLS)= 25

TOTAL INVENTORY (CURIES) = 2.910240E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.916672E+04
PERCENT OF TOTAL INVENTORY = 100.221

TIME OF MAXIMUM CONCENTRATION (YEARS) = 2.164250E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.408673E-06
MAXIMUM RATE (CURIES/YEAR) = 1.175956E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
8.3825E+03	5.0306E-02	6.2500E+04	1.6307E-01
9.0376E+03	1.9601E-01	6.4412E+04	1.6209E-01
9.6927E+03	2.8737E-01	6.6324E+04	1.6117E-01
1.0348E+04	3.7476E-01	6.8235E+04	1.6099E-01
1.1003E+04	4.9759E-01	7.0147E+04	1.6045E-01
1.1658E+04	6.2610E-01	7.2059E+04	1.6010E-01
1.2313E+04	7.4469E-01	7.3971E+04	1.5965E-01
1.2968E+04	8.4089E-01	7.5882E+04	1.5914E-01
1.3623E+04	9.1638E-01	7.7794E+04	1.5916E-01
1.4278E+04	9.7672E-01	7.9706E+04	1.5931E-01
1.4933E+04	1.0151E+00	8.1618E+04	1.5908E-01

1,5588E+04	1,0419E+00	8,3529E+04	1,5885E-01
1,6243E+04	1,0637E+00	8,5441E+04	1,5911E-01
1,6898E+04	1,0883E+00	8,7353E+04	1,5934E-01
1,7554E+04	1,1001E+00	8,9265E+04	1,5874E-01
1,8209E+04	1,1247E+00	9,1177E+04	1,5824E-01
1,8864E+04	1,1358E+00	9,3088E+04	1,5773E-01
1,9519E+04	1,1476E+00	9,5000E+04	1,5360E-01
2,0174E+04	1,1647E+00	9,5451E+04	1,5450E-01
2,0829E+04	1,1684E+00	9,5901E+04	1,5792E-01
2,1484E+04	1,1755E+00	9,6352E+04	1,5973E-01
2,2139E+04	1,1626E+00	9,6803E+04	1,6273E-01
2,2794E+04	1,1333E+00	9,7253E+04	1,6384E-01
2,3449E+04	1,0785E+00	9,7704E+04	1,5995E-01
2,4104E+04	9,8811E-01	9,8155E+04	1,5537E-01
2,4759E+04	8,6566E-01	9,8605E+04	1,4468E-01
2,5414E+04	7,2626E-01	9,9056E+04	1,3132E-01
2,6070E+04	5,8540E-01	9,9507E+04	1,1588E-01
2,6725E+04	4,5620E-01	9,9958E+04	9,6326E-02
2,7380E+04	3,6656E-01	1,0041E+05	7,6562E-02
2,8035E+04	3,0276E-01	1,0086E+05	5,6596E-02
2,8690E+04	2,6404E-01	1,0131E+05	4,0482E-02
2,9345E+04	2,4998E-01	1,0176E+05	2,8082E-02
3,0000E+04	2,4200E-01	1,0221E+05	1,8587E-02
3,1912E+04	2,2975E-01	1,0266E+05	1,1786E-02
3,3824E+04	2,2029E-01	1,0311E+05	6,5510E-03
3,5735E+04	2,1098E-01	1,0356E+05	2,9681E-03
3,7647E+04	2,0315E-01	1,0401E+05	1,0701E-03
3,9559E+04	1,9617E-01	1,0446E+05	3,8880E-04
4,1471E+04	1,9062E-01	1,0491E+05	5,5380E-05
4,3382E+04	1,8579E-01	1,0537E+05	4,8592E-05
4,5294E+04	1,8132E-01	1,0582E+05	3,6444E-05
4,7206E+04	1,7770E-01	1,0627E+05	3,6444E-05
4,9118E+04	1,7481E-01	1,0672E+05	2,1179E-05
5,1029E+04	1,7214E-01	1,0717E+05	2,6831E-05
5,2941E+04	1,7009E-01	1,0762E+05	2,4296E-05
5,4853E+04	1,6781E-01	1,0807E+05	2,4296E-05
5,6765E+04	1,6630E-01	1,0852E+05	2,7967E-05
5,8676E+04	1,6502E-01	1,0897E+05	2,9946E-05
6,0588E+04	1,6399E-01	1,0942E+05	4,2093E-05

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Fission PIR 4 PIR 4 Chain 1
CONTAMINANT = TH-232
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 9.000000E+03
TIME HIGH= 1.500000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 7.050000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.5000E+05 MIN. TIME = 9.5542E+03
TOTAL WEIGHT = 7.0575E-03 TOTAL PARCELS = 4186.0
PEAK WEIGHT = 0.000 PEAK WEIGHT TIME = 9.7478E+04
PEAK PARCELS = 45.000 PEAK PARCELS TIME = 1.3837E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 7.057547E-03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 7.021453E-03
PERCENT OF TOTAL INVENTORY = 99.489

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.122825E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7.373095E-14
MAXIMUM RATE (CURIES/YEAR) = 6.155042E-08
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

CONTAMINANT = TH-232

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
9.3525E+03	3.9800E-09	5.4155E+04	4.7393E-08
9.9782E+03	3.9800E-09	5.5626E+04	4.7911E-08
1.0604E+04	5.0668E-09	5.7096E+04	4.8445E-08
1.1230E+04	5.9734E-09	5.8567E+04	4.8989E-08
1.1855E+04	6.5327E-09	6.0037E+04	4.9541E-08
1.2481E+04	7.3069E-09	6.1508E+04	5.0096E-08
1.3107E+04	8.4654E-09	6.2979E+04	5.0648E-08
1.3732E+04	9.6810E-09	6.4449E+04	5.1189E-08
1.4358E+04	1.1009E-08	6.5920E+04	5.1713E-08
1.4984E+04	1.2496E-08	6.7390E+04	5.2215E-08
1.5609E+04	1.4051E-08	6.8861E+04	5.2688E-08

1,6235E+04	1,5639E-08	7,0332E+04	5,3131E-08
1,6861E+04	1,7303E-08	7,1802E+04	5,3545E-08
1,7486E+04	1,8954E-08	7,3273E+04	5,3932E-08
1,8112E+04	2,0601E-08	7,4743E+04	5,4298E-08
1,8738E+04	2,2209E-08	7,6214E+04	5,4648E-08
1,9363E+04	2,3767E-08	7,7685E+04	5,4989E-08
1,9989E+04	2,5255E-08	7,9155E+04	5,5326E-08
2,0615E+04	2,6691E-08	8,0626E+04	5,5667E-08
2,1240E+04	2,8030E-08	8,2736E+04	5,6169E-08
2,1866E+04	2,9290E-08	8,4847E+04	5,6694E-08
2,2492E+04	3,0479E-08	8,6957E+04	5,7237E-08
2,3117E+04	3,1609E-08	8,9068E+04	5,7783E-08
2,3743E+04	3,2692E-08	9,1178E+04	5,8316E-08
2,4369E+04	3,3737E-08	9,3289E+04	5,8824E-08
2,4995E+04	3,4746E-08	9,5399E+04	5,9300E-08
2,5620E+04	3,5722E-08	9,7510E+04	5,9737E-08
2,6246E+04	3,6659E-08	9,9620E+04	6,0136E-08
2,6872E+04	3,7543E-08	1,0173E+05	6,0497E-08
2,7497E+04	3,8362E-08	1,0384E+05	6,0822E-08
2,8123E+04	3,9084E-08	1,0595E+05	6,1106E-08
2,8749E+04	3,9700E-08	1,0806E+05	6,1336E-08
2,9374E+04	4,0211E-08	1,1017E+05	6,1492E-08
3,0000E+04	4,0583E-08	1,1228E+05	6,1550E-08
3,0626E+04	4,0792E-08	1,1439E+05	6,1493E-08
3,2096E+04	4,1209E-08	1,1650E+05	6,1316E-08
3,3567E+04	4,1585E-08	1,1862E+05	6,1026E-08
3,5037E+04	4,1973E-08	1,2073E+05	6,0639E-08
3,6508E+04	4,2403E-08	1,2284E+05	6,0189E-08
3,7979E+04	4,2753E-08	1,2495E+05	5,9716E-08
3,9449E+04	4,3102E-08	1,2706E+05	5,9262E-08
4,0920E+04	4,3465E-08	1,2917E+05	5,8862E-08
4,2390E+04	4,3844E-08	1,3128E+05	5,8538E-08
4,3861E+04	4,4229E-08	1,3339E+05	5,8297E-08
4,5332E+04	4,4630E-08	1,3550E+05	5,8137E-08
4,6802E+04	4,5049E-08	1,3761E+05	5,8049E-08
4,8273E+04	4,5485E-08	1,3972E+05	5,8014E-08
4,9743E+04	4,5937E-08	1,4183E+05	5,8010E-08
5,1214E+04	4,6405E-08	1,4394E+05	5,8009E-08
5,2685E+04	4,6890E-08	1,4605E+05	5,8032E-08

1.2783E+03	5.0013E+02	1.6438E+03	1.1210E+03
1.2839E+03	5.4436E+02	1.6526E+03	1.1052E+03
1.2894E+03	5.8860E+02	1.6614E+03	1.0945E+03
1.2949E+03	6.3881E+02	1.6702E+03	1.0827E+03
1.3005E+03	6.9669E+02	1.6791E+03	1.0689E+03
1.3060E+03	7.5457E+02	1.6879E+03	1.0532E+03
1.3115E+03	8.1730E+02	1.6967E+03	1.0363E+03
1.3170E+03	8.8186E+02	1.7055E+03	1.0188E+03
1.3226E+03	9.4642E+02	1.7750E+03	8.9127E+02
1.3281E+03	1.0114E+03	1.8445E+03	7.8064E+02
1.3336E+03	1.0763E+03	1.9139E+03	6.8567E+02
1.3392E+03	1.1399E+03	1.9834E+03	6.0079E+02
1.3447E+03	1.2003E+03	2.0529E+03	5.2374E+02
1.3502E+03	1.2606E+03	2.1223E+03	4.6065E+02
1.3558E+03	1.3153E+03	2.1918E+03	4.0924E+02
1.3613E+03	1.3660E+03	2.2613E+03	3.6446E+02
1.3668E+03	1.4167E+03	2.3308E+03	3.2763E+02
1.3723E+03	1.4548E+03	2.4002E+03	2.9536E+02
1.3779E+03	1.4912E+03	2.4697E+03	2.6660E+02
1.3834E+03	1.5263E+03	2.5392E+03	2.3962E+02
1.3889E+03	1.5553E+03	2.6086E+03	2.1658E+02
1.3945E+03	1.5642E+03	2.6781E+03	1.9676E+02
1.4000E+03	1.5964E+03	2.7476E+03	1.7784E+02
1.4055E+03	1.5881E+03	2.8170E+03	1.5969E+02
1.4144E+03	1.5744E+03	2.8865E+03	1.4324E+02
1.4232E+03	1.5591E+03	2.9560E+03	1.2770E+02
1.4320E+03	1.5431E+03	3.0255E+03	1.1335E+02
1.4408E+03	1.5265E+03	3.0949E+03	1.0037E+02
1.4496E+03	1.5074E+03	3.1644E+03	8.9283E+01
1.4585E+03	1.4879E+03	3.2339E+03	7.9031E+01
1.4673E+03	1.4685E+03	3.3033E+03	7.0016E+01
1.4761E+03	1.4493E+03	3.3728E+03	6.2452E+01
1.4849E+03	1.4302E+03	3.4423E+03	5.5942E+01
1.4938E+03	1.4115E+03	3.5117E+03	5.0185E+01
1.5026E+03	1.3928E+03	3.5812E+03	4.5474E+01
1.5114E+03	1.3753E+03	3.6507E+03	4.1355E+01
1.5202E+03	1.3581E+03	3.7201E+03	4.0264E+01
1.5291E+03	1.3416E+03	3.7896E+03	3.7393E+01
1.5379E+03	1.3244E+03	3.8591E+03	3.4873E+01

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 2 PIR 4 Chain 2
CONTAMINANT = AM-241
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 1.000000E+03
TIME HIGH= 4.000000E+03
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 1.500000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 5.9932E+03 MIN. TIME = 1.2132E+03
TOTAL WEIGHT = 1.0707E+06 TOTAL PARCELS = 1072.0
PEAK WEIGHT = 44005.074 PEAK WEIGHT TIME = 1.4275E+03
PEAK PARCELS = 14.000 PEAK PARCELS TIME = 1.6225E+03
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 1.3054E+04 NO. PARCELS HI = 797.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 1.083800E+06
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.126187E+06
PERCENT OF TOTAL INVENTORY = 103.911

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.397500E+03
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.916738E-03
MAXIMUM RATE (CURIES/YEAR) = 1.600088E+03
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.2175E+03	2.3292E+02	1.5467E+03	1.3066E+03
1.2230E+03	2.3292E+02	1.5555E+03	1.2890E+03
1.2286E+03	2.3292E+02	1.5644E+03	1.2714E+03
1.2341E+03	2.4268E+02	1.5732E+03	1.2536E+03
1.2396E+03	2.7662E+02	1.5820E+03	1.2357E+03
1.2452E+03	3.1056E+02	1.5908E+03	1.2179E+03
1.2507E+03	3.4662E+02	1.5996E+03	1.2009E+03
1.2562E+03	3.8424E+02	1.6085E+03	1.1841E+03
1.2617E+03	4.2187E+02	1.6173E+03	1.1680E+03
1.2673E+03	4.4816E+02	1.6261E+03	1.1521E+03
1.2728E+03	4.7246E+02	1.6349E+03	1.1366E+03

PLTCVT PROGRAM DATA SUMMARY
PIR4(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 1.000000E+03
TIME HIGH= 1.700000E+04
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 4.000000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4560E+05 MIN. TIME = 1.2044E+03
TOTAL WEIGHT = 5.1448E+04 TOTAL PARCELS = 11361.0
PEAK WEIGHT = 251.471 PEAK WEIGHT TIME = 1.0700E+04
PEAK PARCELS = 154.000 PEAK PARCELS TIME = 1.4200E+03
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 3.5474E+04 NO. PARCELS HI = 4160.0
SMOOTHING WINDOW (CELLS)= 25

TOTAL INVENTORY (CURIES) = 8.692206E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 5.140218E+04
PERCENT OF TOTAL INVENTORY = 59.136

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.434000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 4.260102E-06
MAXIMUM RATE (CURIES/YEAR) = 3.556323E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.2200E+03	2.5014E+00	8.4000E+03	3.5260E+00
1.2255E+03	2.5014E+00	8.8118E+03	3.5272E+00
1.2309E+03	2.5014E+00	9.2235E+03	3.5256E+00
1.2364E+03	2.5014E+00	9.6353E+03	3.5242E+00
1.2418E+03	2.5014E+00	1.0047E+04	3.5256E+00
1.2473E+03	2.5014E+00	1.0459E+04	3.5236E+00
1.2527E+03	2.5014E+00	1.0871E+04	3.5230E+00
1.2582E+03	2.5014E+00	1.1282E+04	3.5231E+00
1.2636E+03	2.5289E+00	1.1694E+04	3.5219E+00
1.2691E+03	2.5701E+00	1.2106E+04	3.5206E+00
1.2745E+03	2.6113E+00	1.2518E+04	3.5229E+00

1,2800E+03	2,6526E+00	1,2929E+04	3,5274E+00
1,2855E+03	2,6938E+00	1,3341E+04	3,5360E+00
1,2909E+03	2,7350E+00	1,3753E+04	3,5463E+00
1,2964E+03	2,7763E+00	1,4165E+04	3,5551E+00
1,3018E+03	2,8083E+00	1,4576E+04	3,5403E+00
1,3073E+03	2,8221E+00	1,4988E+04	3,5261E+00
1,3127E+03	2,8359E+00	1,5400E+04	3,3738E+00
1,3182E+03	2,8497E+00	1,5422E+04	3,3254E+00
1,3236E+03	2,8635E+00	1,5445E+04	3,2691E+00
1,3291E+03	2,8773E+00	1,5467E+04	3,2125E+00
1,3345E+03	2,8911E+00	1,5490E+04	3,1548E+00
1,3400E+03	2,9048E+00	1,5512E+04	3,0974E+00
1,3455E+03	2,9408E+00	1,5535E+04	3,0403E+00
1,3509E+03	2,9768E+00	1,5557E+04	2,9875E+00
1,3564E+03	3,0128E+00	1,5579E+04	2,9360E+00
1,3618E+03	3,0488E+00	1,5602E+04	2,8918E+00
1,3673E+03	3,0847E+00	1,5624E+04	2,8486E+00
1,3727E+03	3,1207E+00	1,5647E+04	2,8096E+00
1,3782E+03	3,1567E+00	1,5669E+04	2,7701E+00
1,3836E+03	3,1749E+00	1,5692E+04	2,7296E+00
1,3891E+03	3,1842E+00	1,5714E+04	2,6830E+00
1,3945E+03	3,1935E+00	1,5736E+04	2,6326E+00
1,4000E+03	3,2027E+00	1,5759E+04	2,5641E+00
1,8118E+03	3,3827E+00	1,5781E+04	2,4906E+00
2,2235E+03	3,4232E+00	1,5804E+04	2,3918E+00
2,6353E+03	3,4686E+00	1,5826E+04	2,2876E+00
3,0471E+03	3,4879E+00	1,5848E+04	2,1692E+00
3,4588E+03	3,5037E+00	1,5871E+04	2,0427E+00
3,8706E+03	3,5154E+00	1,5893E+04	1,9079E+00
4,2824E+03	3,5251E+00	1,5916E+04	1,7707E+00
4,6941E+03	3,5289E+00	1,5938E+04	1,6326E+00
5,1059E+03	3,5280E+00	1,5961E+04	1,4902E+00
5,5176E+03	3,5252E+00	1,5983E+04	1,3482E+00
5,9294E+03	3,5240E+00	1,6005E+04	1,2112E+00
6,3412E+03	3,5210E+00	1,6028E+04	1,1018E+00
6,7529E+03	3,5194E+00	1,6050E+04	1,0435E+00
7,1647E+03	3,5208E+00	1,6073E+04	9,6080E-01
7,5765E+03	3,5236E+00	1,6095E+04	8,5941E-01
7,9882E+03	3,5232E+00	1,6118E+04	7,6933E-01

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 2   PIR 4 Chain 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 1.000000E+03
TIME HIGH= 1.700000E+04
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 4.000000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4560E+05   MIN. TIME = 1.2044E+03
TOTAL WEIGHT = 5.1446E+04   TOTAL PARCELS = 11361.0
PEAK WEIGHT = 251.471   PEAK WEIGHT TIME = 1.0700E+04
PEAK PARCELS = 154.000   PEAK PARCELS TIME = 1.4200E+03
WT. LOW = 0.0000E-01   NO. PARCELS LOW = 0.0
WT. HI = 3.5474E+04   NO. PARCELS HI = 4160.0
SMOOTHING WINDOW (CELLS)= 25

TOTAL INVENTORY (CURIES) = 8.692206E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 5.129139E+04
PERCENT OF TOTAL INVENTORY = 59.008

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.362000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 4.235771E-06
MAXIMUM RATE (CURIES/YEAR) = 3.536011E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197695E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.2200E+03	2.0882E+00	8.5500E+03	3.5250E+00
1.2255E+03	2.0882E+00	8.9706E+03	3.5263E+00
1.2309E+03	2.0882E+00	9.3912E+03	3.5290E+00
1.2364E+03	2.0882E+00	9.8118E+03	3.5262E+00
1.2418E+03	2.0882E+00	1.0232E+04	3.5167E+00
1.2473E+03	2.0882E+00	1.0653E+04	3.5306E+00
1.2527E+03	2.0882E+00	1.1074E+04	3.5236E+00
1.2582E+03	2.0882E+00	1.1494E+04	3.5237E+00
1.2636E+03	2.1521E+00	1.1915E+04	3.5194E+00
1.2691E+03	2.2479E+00	1.2335E+04	3.5178E+00
1.2745E+03	2.3436E+00	1.2756E+04	3.5172E+00

1,2800E+03	2,4394E+00	1,3176E+04	3,5303E+00
1,2855E+03	2,5352E+00	1,3597E+04	3,5356E+00
1,2909E+03	2,6310E+00	1,4018E+04	3,5306E+00
1,2964E+03	2,7268E+00	1,4438E+04	3,5025E+00
1,3018E+03	2,7975E+00	1,4859E+04	3,3990E+00
1,3073E+03	2,8181E+00	1,5279E+04	3,2807E+00
1,3127E+03	2,8387E+00	1,5700E+04	2,8671E+00
1,3182E+03	2,8594E+00	1,6121E+04	4,4566E-01
1,3236E+03	2,8800E+00	1,6134E+04	4,1524E-01
1,3291E+03	2,9006E+00	1,6147E+04	3,8483E-01
1,3345E+03	2,9212E+00	1,6161E+04	3,5441E-01
1,3400E+03	2,9418E+00	1,6174E+04	3,2399E-01
1,3455E+03	2,9950E+00	1,6187E+04	2,9357E-01
1,3509E+03	3,0482E+00	1,6201E+04	2,6316E-01
1,3564E+03	3,1014E+00	1,6214E+04	2,3274E-01
1,3618E+03	3,1546E+00	1,6227E+04	2,0232E-01
1,3673E+03	3,2078E+00	1,6241E+04	1,7190E-01
1,3727E+03	3,2610E+00	1,6254E+04	1,4149E-01
1,3782E+03	3,3141E+00	1,6267E+04	1,1107E-01
1,3836E+03	3,3355E+00	1,6281E+04	8,0651E-02
1,3891E+03	3,3409E+00	1,6294E+04	5,0233E-02
1,3945E+03	3,3463E+00	1,6307E+04	1,9815E-02
1,4000E+03	3,3518E+00	1,6321E+04	-1,0602E-02
1,8206E+03	3,4274E+00	1,6334E+04	-4,1020E-02
2,2412E+03	3,4492E+00	1,6347E+04	-7,1437E-02
2,6618E+03	3,4690E+00	1,6361E+04	-1,0185E-01
3,0824E+03	3,4843E+00	1,6374E+04	-1,3227E-01
3,5029E+03	3,5123E+00	1,6387E+04	-1,6269E-01
3,9235E+03	3,5267E+00	1,6401E+04	-1,9311E-01
4,3441E+03	3,5300E+00	1,6414E+04	-2,2353E-01
4,7647E+03	3,5279E+00	1,6427E+04	-2,5395E-01
5,1853E+03	3,5308E+00	1,6441E+04	-2,8437E-01
5,6059E+03	3,5270E+00	1,6454E+04	-3,1479E-01
6,0265E+03	3,5181E+00	1,6467E+04	-3,4521E-01
6,4471E+03	3,5158E+00	1,6481E+04	-3,7563E-01
6,8676E+03	3,5257E+00	1,6494E+04	-4,0605E-01
7,2882E+03	3,5179E+00	1,6507E+04	-4,3647E-01
7,7088E+03	3,5206E+00	1,6521E+04	-4,6689E-01
8,1294E+03	3,5311E+00	1,6534E+04	-4,9731E-01

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 2 PIR 4 Chain 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 5.000000E+04
TIME HIGH= 1.400000E+05
NUMBER OF CELLS = 300
DELTA TIME INCREMENT = 3.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4560E+05 MIN. TIME = 1.2044E+03
TOTAL WEIGHT = 3.5237E+04 TOTAL PARCELS = 4129.0
PEAK WEIGHT = 252.102 PEAK WEIGHT TIME = 7.8350E+04
PEAK PARCELS = 29.000 PEAK PARCELS TIME = 7.5350E+04
WT. LOW = 5.1538E+04 NO. PARCELS LOW = 11373.0
WT. HI = 1.4725E+02 NO. PARCELS HI = 19.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 8.692206E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.429582E+04
PERCENT OF TOTAL INVENTORY = 39.456

TIME OF MAXIMUM CONCENTRATION (YEARS) = 7.835000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 5.854890E-07
MAXIMUM RATE (CURIES/YEAR) = 4.887648E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
5.0150E+04	4.4512E-02	9.5000E+04	4.6417E-01
5.1047E+04	5.8179E-02	9.5897E+04	4.6564E-01
5.1944E+04	8.1817E-02	9.6794E+04	4.6703E-01
5.2841E+04	1.0914E-01	9.7691E+04	4.6823E-01
5.3738E+04	1.3795E-01	9.8588E+04	4.6915E-01
5.4635E+04	1.6381E-01	9.9485E+04	4.6972E-01
5.5532E+04	1.8943E-01	1.0038E+05	4.6990E-01
5.6429E+04	2.1410E-01	1.0128E+05	4.6966E-01
5.7326E+04	2.3739E-01	1.0218E+05	4.6901E-01
5.8223E+04	2.5952E-01	1.0307E+05	4.6801E-01
5.9120E+04	2.8032E-01	1.0397E+05	4.6671E-01

6.0017E+04	2.9976E-01	1.0487E+05	4.6521E-01
6.0914E+04	3.1786E-01	1.0576E+05	4.6360E-01
6.1811E+04	3.3465E-01	1.0666E+05	4.6200E-01
6.2708E+04	3.5021E-01	1.0756E+05	4.6050E-01
6.3605E+04	3.6464E-01	1.0846E+05	4.5919E-01
6.4502E+04	3.7805E-01	1.0935E+05	4.5814E-01
6.5399E+04	3.9055E-01	1.1025E+05	4.5739E-01
6.6296E+04	4.0227E-01	1.1115E+05	4.5695E-01
6.7193E+04	4.1329E-01	1.1204E+05	4.5678E-01
6.8090E+04	4.2369E-01	1.1294E+05	4.5682E-01
6.8987E+04	4.3351E-01	1.1384E+05	4.5697E-01
6.9884E+04	4.4276E-01	1.1473E+05	4.5706E-01
7.0781E+04	4.5140E-01	1.1563E+05	4.5696E-01
7.1678E+04	4.5937E-01	1.1653E+05	4.5644E-01
7.2575E+04	4.6659E-01	1.1743E+05	4.5529E-01
7.3472E+04	4.7293E-01	1.1832E+05	4.5332E-01
7.4369E+04	4.7832E-01	1.1922E+05	4.5029E-01
7.5266E+04	4.8264E-01	1.2012E+05	4.4601E-01
7.6163E+04	4.8582E-01	1.2101E+05	4.4029E-01
7.7060E+04	4.8785E-01	1.2191E+05	4.3302E-01
7.7957E+04	4.8872E-01	1.2281E+05	4.2405E-01
7.8854E+04	4.8850E-01	1.2370E+05	4.1337E-01
7.9751E+04	4.8730E-01	1.2460E+05	4.0092E-01
8.0648E+04	4.8527E-01	1.2550E+05	3.8671E-01
8.1545E+04	4.8259E-01	1.2640E+05	3.7084E-01
8.2442E+04	4.7946E-01	1.2729E+05	3.5337E-01
8.3339E+04	4.7610E-01	1.2819E+05	3.3442E-01
8.4236E+04	4.7272E-01	1.2909E+05	3.1416E-01
8.5133E+04	4.6949E-01	1.2998E+05	2.9273E-01
8.6030E+04	4.6656E-01	1.3088E+05	2.7033E-01
8.6927E+04	4.6407E-01	1.3178E+05	2.4716E-01
8.7824E+04	4.6209E-01	1.3267E+05	2.2339E-01
8.8721E+04	4.6068E-01	1.3357E+05	1.9924E-01
8.9618E+04	4.5984E-01	1.3447E+05	1.7481E-01
9.0515E+04	4.5955E-01	1.3537E+05	1.5017E-01
9.1412E+04	4.5978E-01	1.3626E+05	1.2596E-01
9.2309E+04	4.6044E-01	1.3716E+05	1.0116E-01
9.3206E+04	4.6146E-01	1.3806E+05	7.6211E-02
9.4103E+04	4.6274E-01	1.3895E+05	5.4808E-02

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 2   PIR 4 Chain 2
CONTAMINANT = U-233
TONS OF HEAVY METAL FACTOR =   1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW =   2.000000E+03
TIME HIGH=   1.300000E+05
NUMBER OF CELLS =   500
DELTA TIME INCREMENT =   2.560000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.3705E+05   MIN. TIME = 1.8632E+03
TOTAL WEIGHT = 1.5191E+04   TOTAL PARCELS =   12695.0
PEAK WEIGHT =   101.149   PEAK WEIGHT TIME = 9.4800E+04
PEAK PARCELS =   153.000   PEAK PARCELS TIME = 1.6208E+04
WT. LOW = 4.6720E-01   NO. PARCELS LOW =   4.0
WT. HI = 1.5057E+01   NO. PARCELS HI =   9.0
SMOOTHING WINDOW (CELLS)=   20

TOTAL INVENTORY (CURIES) =   1.520654E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   1.515843E+04
PERCENT OF TOTAL INVENTORY = 99.684

TIME OF MAXIMUM CONCENTRATION (YEARS) =   9.454400E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   2.702254E-07
MAXIMUM RATE (CURIES/YEAR) =   2.255835E-01
CONVERSION FACTOR RATE TO CONCENTRATION =   1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.1280E+03	2.1505E-03	6.1433E+04	1.7337E-01
2.9726E+03	2.8911E-03	6.3345E+04	1.7707E-01
3.8172E+03	4.3933E-03	6.5256E+04	1.8238E-01
4.6618E+03	5.9231E-03	6.7168E+04	1.8718E-01
5.5064E+03	6.9368E-03	6.9080E+04	1.9129E-01
6.3510E+03	8.2874E-03	7.0992E+04	1.9485E-01
7.1956E+03	1.0112E-02	7.2903E+04	1.9827E-01
8.0402E+03	1.1800E-02	7.4815E+04	2.0071E-01
8.8848E+03	1.3708E-02	7.6727E+04	2.0239E-01
9.7295E+03	1.7478E-02	7.8639E+04	2.0388E-01
1.0574E+04	2.2656E-02	8.0551E+04	2.0598E-01

1,1419E+04	2,8494E-02	8,2462E+04	2,0853E-01
1,2263E+04	3,7145E-02	8,4374E+04	2,1009E-01
1,3108E+04	4,8042E-02	8,6286E+04	2,1336E-01
1,3952E+04	5,9299E-02	8,8198E+04	2,1742E-01
1,4797E+04	7,2352E-02	9,0109E+04	2,1997E-01
1,5642E+04	8,8877E-02	9,2021E+04	2,2240E-01
1,6486E+04	1,0333E-01	9,3933E+04	2,2468E-01
1,7331E+04	1,1246E-01	9,5845E+04	2,1640E-01
1,8176E+04	1,2034E-01	9,6870E+04	2,0935E-01
1,9020E+04	1,2803E-01	9,7896E+04	1,9748E-01
1,9865E+04	1,3226E-01	9,8922E+04	1,8278E-01
2,0709E+04	1,3918E-01	9,9947E+04	1,6340E-01
2,1554E+04	1,5463E-01	1,0097E+05	1,4335E-01
2,2399E+04	1,7183E-01	1,0200E+05	1,2459E-01
2,3243E+04	1,7516E-01	1,0302E+05	1,0944E-01
2,4088E+04	1,5716E-01	1,0405E+05	9,7863E-02
2,4932E+04	1,2455E-01	1,0508E+05	8,6806E-02
2,5777E+04	8,9249E-02	1,0610E+05	7,8002E-02
2,6622E+04	6,1148E-02	1,0713E+05	7,3097E-02
2,7466E+04	4,7729E-02	1,0815E+05	6,9813E-02
2,8311E+04	4,7223E-02	1,0918E+05	6,6005E-02
2,9155E+04	4,9613E-02	1,1020E+05	6,3876E-02
3,0000E+04	5,3305E-02	1,1123E+05	6,1533E-02
3,0845E+04	5,7022E-02	1,1226E+05	6,0094E-02
3,2756E+04	6,4495E-02	1,1328E+05	5,8646E-02
3,4668E+04	7,2412E-02	1,1431E+05	5,5249E-02
3,6580E+04	8,0629E-02	1,1533E+05	5,0802E-02
3,8492E+04	8,8705E-02	1,1636E+05	4,6386E-02
4,0403E+04	9,7579E-02	1,1738E+05	4,1538E-02
4,2315E+04	1,0584E-01	1,1841E+05	3,8001E-02
4,4227E+04	1,1489E-01	1,1944E+05	3,4901E-02
4,6139E+04	1,2330E-01	1,2046E+05	3,2392E-02
4,8050E+04	1,3164E-01	1,2149E+05	3,1365E-02
4,9962E+04	1,3923E-01	1,2251E+05	3,0493E-02
5,1874E+04	1,4708E-01	1,2354E+05	2,9036E-02
5,3786E+04	1,5412E-01	1,2456E+05	2,6134E-02
5,5698E+04	1,5924E-01	1,2559E+05	2,3089E-02
5,7609E+04	1,6443E-01	1,2662E+05	2,1845E-02
5,9521E+04	1,6910E-01	1,2764E+05	1,7022E-02

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 2 PIR 4 Chain 2
CONTAMINANT = TH-229
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 1.000000E+04
TIME HIGH= 1.500000E+05
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 1.400000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4974E+05 MIN. TIME = 1.9676E+03
TOTAL WEIGHT = 7.4882E+02 TOTAL PARCELS = 974.0
PEAK WEIGHT = 57.434 PEAK WEIGHT TIME = 1.1850E+05
PEAK PARCELS = 25.000 PEAK PARCELS TIME = 6.5300E+04
WT. LOW = 1.1732E+00 NO. PARCELS LOW = 26.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 7.499958E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 7.038610E+02
PERCENT OF TOTAL INVENTORY = 93.849

TIME OF MAXIMUM CONCENTRATION (YEARS) = 8.070000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 9.861395E-09
MAXIMUM RATE (CURIES/YEAR) = 8.232269E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.0700E+04	9.3460E-04	8.0000E+04	8.2289E-03
1.2086E+04	9.3460E-04	8.1386E+04	8.2301E-03
1.3472E+04	1.0728E-03	8.2772E+04	8.2204E-03
1.4858E+04	1.2214E-03	8.4158E+04	8.1995E-03
1.6244E+04	1.3792E-03	8.5544E+04	8.1672E-03
1.7630E+04	1.5462E-03	8.6930E+04	8.1236E-03
1.9016E+04	1.7225E-03	8.8316E+04	8.0685E-03
2.0402E+04	1.9082E-03	8.9702E+04	8.0022E-03
2.1788E+04	2.1034E-03	9.1088E+04	7.9246E-03
2.3174E+04	2.3080E-03	9.2474E+04	7.8361E-03
2.4560E+04	2.5221E-03	9.3860E+04	7.7370E-03

2,5946E+04	2,7454E-03	9,5246E+04	7,6275E-03
2,7332E+04	2,9386E-03	9,6632E+04	7,5080E-03
2,8718E+04	3,1301E-03	9,8018E+04	7,3789E-03
3,0104E+04	3,3238E-03	9,9404E+04	7,2408E-03
3,1490E+04	3,5190E-03	1,0079E+05	7,0940E-03
3,2876E+04	3,7152E-03	1,0218E+05	6,9390E-03
3,4262E+04	3,9118E-03	1,0356E+05	6,7764E-03
3,5648E+04	4,1083E-03	1,0495E+05	6,6066E-03
3,7034E+04	4,3040E-03	1,0633E+05	6,4300E-03
3,8420E+04	4,4983E-03	1,0772E+05	6,2473E-03
3,9806E+04	4,6906E-03	1,0911E+05	6,0594E-03
4,1192E+04	4,8800E-03	1,1049E+05	5,8667E-03
4,2578E+04	5,0678E-03	1,1188E+05	5,6701E-03
4,3964E+04	5,2537E-03	1,1326E+05	5,4705E-03
4,5350E+04	5,4374E-03	1,1465E+05	5,2684E-03
4,6736E+04	5,6185E-03	1,1604E+05	5,0647E-03
4,8122E+04	5,7964E-03	1,1742E+05	4,8601E-03
4,9508E+04	5,9709E-03	1,1881E+05	4,6550E-03
5,0894E+04	6,1414E-03	1,2019E+05	4,4503E-03
5,2280E+04	6,3078E-03	1,2158E+05	4,2460E-03
5,3666E+04	6,4695E-03	1,2297E+05	4,0417E-03
5,5052E+04	6,6263E-03	1,2435E+05	3,8382E-03
5,6438E+04	6,7780E-03	1,2574E+05	3,6360E-03
5,7824E+04	6,9243E-03	1,2712E+05	3,4358E-03
5,9210E+04	7,0647E-03	1,2851E+05	3,2381E-03
6,0596E+04	7,1989E-03	1,2990E+05	3,0435E-03
6,1982E+04	7,3265E-03	1,3128E+05	2,8525E-03
6,3368E+04	7,4472E-03	1,3267E+05	2,6657E-03
6,4754E+04	7,5606E-03	1,3405E+05	2,4834E-03
6,6140E+04	7,6663E-03	1,3544E+05	2,3033E-03
6,7526E+04	7,7639E-03	1,3683E+05	2,1034E-03
6,8912E+04	7,8531E-03	1,3821E+05	1,9137E-03
7,0298E+04	7,9335E-03	1,3960E+05	1,7340E-03
7,1684E+04	8,0048E-03	1,4098E+05	1,5642E-03
7,3070E+04	8,0668E-03	1,4237E+05	1,4040E-03
7,4456E+04	8,1193E-03	1,4376E+05	1,2533E-03
7,5842E+04	8,1619E-03	1,4514E+05	1,1118E-03
7,7228E+04	8,1945E-03	1,4653E+05	9,7930E-04
7,8614E+04	8,2170E-03	1,4791E+05	8,5564E-04

PLTCVT PROGRAM DATA SUMMARY
PIR4(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-238
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 7.000000E+03
TIME HIGH= 1.100000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 5.150000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4971E+05 MIN. TIME = 8.3672E+03
TOTAL WEIGHT = 2.4461E+04 TOTAL PARCELS = 5816.0
PEAK WEIGHT = 636.759 PEAK WEIGHT TIME = 1.7043E+04
PEAK PARCELS = 129.000 PEAK PARCELS TIME = 1.6528E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 7.0768E-01 NO. PARCELS HI = 136.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 2.446161E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.452136E+04
PERCENT OF TOTAL INVENTORY = 100.244

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.961750E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.208078E-06
MAXIMUM RATE (CURIES/YEAR) = 1.008501E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

CONTAMINANT = U-238

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
8.2875E+03	1.7848E-01	6.2366E+04	1.3440E-01
9.0061E+03	2.6606E-01	6.4219E+04	1.3446E-01
9.7246E+03	4.5116E-01	6.6072E+04	1.3452E-01
1.0443E+04	5.2904E-01	6.7924E+04	1.3429E-01
1.1162E+04	5.8251E-01	6.9777E+04	1.3403E-01
1.1880E+04	6.8142E-01	7.1630E+04	1.3401E-01
1.2599E+04	7.5948E-01	7.3483E+04	1.3417E-01
1.3317E+04	8.2980E-01	7.5336E+04	1.3422E-01
1.4036E+04	8.9171E-01	7.7189E+04	1.3398E-01
1.4755E+04	9.3141E-01	7.9042E+04	1.3386E-01

1,5473E+04	9,5723E-01	8,0895E+04	1,3379E-01
1,6192E+04	9,7825E-01	8,2748E+04	1,3363E-01
1,6910E+04	9,9514E-01	8,4601E+04	1,3289E-01
1,7629E+04	9,9815E-01	8,6454E+04	1,3175E-01
1,8347E+04	1,0016E+00	8,8307E+04	1,3132E-01
1,9066E+04	1,0057E+00	9,0160E+04	1,3012E-01
1,9784E+04	1,0084E+00	9,2013E+04	1,2897E-01
2,0503E+04	1,0010E+00	9,3866E+04	1,2536E-01
2,1222E+04	9,7907E-01	9,5719E+04	1,2324E-01
2,1940E+04	9,4233E-01	9,6165E+04	1,2330E-01
2,2659E+04	8,9124E-01	9,6612E+04	1,2320E-01
2,3377E+04	8,1848E-01	9,7059E+04	1,2249E-01
2,4096E+04	7,2576E-01	9,7505E+04	1,2083E-01
2,4814E+04	6,2121E-01	9,7952E+04	1,1881E-01
2,5533E+04	5,1401E-01	9,8399E+04	1,1510E-01
2,6252E+04	4,1345E-01	9,8846E+04	1,0797E-01
2,6970E+04	3,2674E-01	9,9292E+04	9,7862E-02
2,7689E+04	2,5542E-01	9,9739E+04	8,6595E-02
2,8407E+04	2,0144E-01	1,0019E+05	7,5084E-02
2,9126E+04	1,6946E-01	1,0063E+05	6,3771E-02
2,9844E+04	1,5123E-01	1,0108E+05	5,2595E-02
3,0563E+04	1,4370E-01	1,0153E+05	4,0720E-02
3,1281E+04	1,4051E-01	1,0197E+05	2,9473E-02
3,2000E+04	1,4012E-01	1,0242E+05	2,0702E-02
3,2719E+04	1,4020E-01	1,0287E+05	1,4433E-02
3,4572E+04	1,3867E-01	1,0331E+05	9,6574E-03
3,6424E+04	1,3781E-01	1,0376E+05	5,8676E-03
3,8277E+04	1,3717E-01	1,0421E+05	2,9281E-03
4,0130E+04	1,3626E-01	1,0465E+05	8,0025E-04
4,1983E+04	1,3605E-01	1,0510E+05	3,0988E-05
4,3836E+04	1,3522E-01	1,0555E+05	2,0813E-05
4,5689E+04	1,3455E-01	1,0599E+05	1,6882E-05
4,7542E+04	1,3439E-01	1,0644E+05	1,6971E-05
4,9395E+04	1,3443E-01	1,0689E+05	1,6839E-05
5,1248E+04	1,3452E-01	1,0733E+05	1,4204E-05
5,3101E+04	1,3422E-01	1,0778E+05	1,2726E-05
5,4954E+04	1,3401E-01	1,0823E+05	1,5185E-05
5,6807E+04	1,3403E-01	1,0867E+05	1,5185E-05
5,8660E+04	1,3438E-01	1,0912E+05	1,2777E-05
6,0513E+04	1,3456E-01	1,0957E+05	1,2148E-05

PLTCVT PROGRAM DATA SUMMARY
PIR4(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-234
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 6.000000E+03
TIME HIGH= 1.100000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 5.200000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4879E+05 MIN. TIME = 7.8283E+03
TOTAL WEIGHT = 1.30622E+05 TOTAL PARCELS = 5809.0
PEAK WEIGHT = 3541.084 PEAK WEIGHT TIME = 1.8220E+04
PEAK PARCELS = 146.000 PEAK PARCELS TIME = 1.1460E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 1.5189E-02 NO. PARCELS HI = 40.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 1.306189E+05
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.310632E+05
PERCENT OF TOTAL INVENTORY = 100.340

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.978000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 6.661860E-06
MAXIMUM RATE (CURIES/YEAR) = 5.561304E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

CONTAMINANT = U-234

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
7.8200E+03	5.9107E-01	6.2202E+04	6.7621E-01
8.4921E+03	7.6736E-01	6.4172E+04	6.7271E-01
9.1642E+03	1.4584E+00	6.6143E+04	6.6986E-01
9.8364E+03	1.8506E+00	6.8113E+04	6.6711E-01
1.0508E+04	2.5526E+00	7.0084E+04	6.6284E-01
1.1181E+04	3.2932E+00	7.2054E+04	6.5949E-01
1.1853E+04	4.0110E+00	7.4025E+04	6.5456E-01
1.2525E+04	4.5991E+00	7.5996E+04	6.5024E-01
1.3197E+04	5.0293E+00	7.7966E+04	6.4776E-01
1.3869E+04	5.2792E+00	7.9937E+04	6.4359E-01
1.4541E+04	5.4031E+00	8.1907E+04	6.3989E-01

1.5213E+04	5.4258E+00	8.3878E+04	6.3682E-01
1.5885E+04	5.4207E+00	8.5849E+04	6.3302E-01
1.6558E+04	5.4016E+00	8.7819E+04	6.3154E-01
1.7230E+04	5.4083E+00	8.9790E+04	6.2797E-01
1.7902E+04	5.4757E+00	9.1760E+04	6.2597E-01
1.8574E+04	5.5186E+00	9.3731E+04	6.2252E-01
1.9246E+04	5.5426E+00	9.5702E+04	6.2255E-01
1.9918E+04	5.5612E+00	9.7672E+04	5.8877E-01
2.0590E+04	5.5371E+00	9.8058E+04	5.6523E-01
2.1262E+04	5.4345E+00	9.8444E+04	5.3457E-01
2.1935E+04	5.2425E+00	9.8830E+04	4.9489E-01
2.2607E+04	4.9740E+00	9.9216E+04	4.5427E-01
2.3279E+04	4.6244E+00	9.9602E+04	4.0943E-01
2.3951E+04	4.1733E+00	9.9988E+04	3.6207E-01
2.4623E+04	3.6347E+00	1.0037E+05	3.1362E-01
2.5295E+04	3.0523E+00	1.0076E+05	2.6773E-01
2.5967E+04	2.4977E+00	1.0115E+05	2.2480E-01
2.6639E+04	1.9744E+00	1.0153E+05	1.8400E-01
2.7312E+04	1.5291E+00	1.0192E+05	1.4433E-01
2.7984E+04	1.1822E+00	1.0230E+05	1.1000E-01
2.8656E+04	9.6122E-01	1.0269E+05	8.0031E-02
2.9328E+04	8.2242E-01	1.0308E+05	5.5009E-02
3.0000E+04	7.6448E-01	1.0346E+05	3.6647E-02
3.0672E+04	7.5185E-01	1.0385E+05	2.4662E-02
3.2643E+04	7.3737E-01	1.0424E+05	1.6147E-02
3.4613E+04	7.2815E-01	1.0462E+05	1.0087E-02
3.6584E+04	7.2279E-01	1.0501E+05	4.9100E-03
3.8554E+04	7.1862E-01	1.0539E+05	2.3809E-03
4.0525E+04	7.0732E-01	1.0578E+05	8.3880E-04
4.2496E+04	7.0540E-01	1.0617E+05	0.0000E-01
4.4466E+04	7.0254E-01	1.0655E+05	0.0000E-01
4.6437E+04	6.9843E-01	1.0694E+05	0.0000E-01
4.8407E+04	6.9645E-01	1.0732E+05	0.0000E-01
5.0378E+04	6.9430E-01	1.0771E+05	0.0000E-01
5.2349E+04	6.9192E-01	1.0810E+05	0.0000E-01
5.4319E+04	6.9055E-01	1.0848E+05	0.0000E-01
5.6290E+04	6.8629E-01	1.0887E+05	0.0000E-01
5.8260E+04	6.8264E-01	1.0925E+05	0.0000E-01
6.0231E+04	6.7907E-01	1.0964E+05	0.0000E-01

PLTCVT PROGRAM DATA SUMMARY
PIR4(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = TH-230
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 8.000000E+03
TIME HIGH= 1.500000E+05
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 7.100000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4985E+05 MIN. TIME = 8.6008E+03
TOTAL WEIGHT = 3.5873E+03 TOTAL PARCELS = 1188.0
PEAK WEIGHT = 61.072 PEAK WEIGHT TIME = 2.6105E+04
PEAK PARCELS = 19.000 PEAK PARCELS TIME = 1.2622E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 15

TOTAL INVENTORY (CURIES) = 3.587342E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.492420E+03
PERCENT OF TOTAL INVENTORY = 97.354

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.811500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 3.734272E-08
MAXIMUM RATE (CURIES/YEAR) = 3.117361E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

CONTAMINANT = TH-230

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
8.3550E+03	1.4611E-03	6.8000E+04	2.9271E-02
8.5867E+03	1.4611E-03	7.1059E+04	2.8764E-02
8.8183E+03	1.4611E-03	7.4118E+04	2.8326E-02
9.0500E+03	1.4611E-03	7.7176E+04	2.7946E-02
9.2817E+03	1.8462E-03	8.0235E+04	2.7692E-02
9.5133E+03	2.2579E-03	8.3294E+04	2.7576E-02
9.7450E+03	2.6696E-03	8.6353E+04	2.7593E-02
9.9767E+03	2.9141E-03	8.9412E+04	2.7623E-02
1.0208E+04	3.1336E-03	9.2471E+04	2.7528E-02
1.0440E+04	3.3531E-03	9.5529E+04	2.7302E-02
1.0672E+04	3.7184E-03	9.8588E+04	2.6992E-02

1.0903E+04	4.1188E-03	1.0165E+05	2.6496E-02
1.1135E+04	4.5192E-03	1.0471E+05	2.5830E-02
1.1367E+04	4.9014E-03	1.0776E+05	2.5054E-02
1.1598E+04	5.2773E-03	1.1082E+05	2.4254E-02
1.1830E+04	5.6532E-03	1.1388E+05	2.3496E-02
1.2062E+04	6.0429E-03	1.1694E+05	2.2832E-02
1.2293E+04	6.4390E-03	1.2000E+05	2.2206E-02
1.2525E+04	6.8352E-03	1.2306E+05	2.1677E-02
1.2757E+04	7.2036E-03	1.2396E+05	2.1543E-02
1.2988E+04	7.5544E-03	1.2486E+05	2.1420E-02
1.3220E+04	7.9052E-03	1.2575E+05	2.1306E-02
1.3452E+04	8.2325E-03	1.2665E+05	2.1202E-02
1.3683E+04	8.5403E-03	1.2755E+05	2.1104E-02
1.3915E+04	8.8481E-03	1.2845E+05	2.1014E-02
1.4147E+04	9.1491E-03	1.2935E+05	2.0929E-02
1.4378E+04	9.4427E-03	1.3025E+05	2.0849E-02
1.4610E+04	9.7362E-03	1.3114E+05	2.0772E-02
1.4842E+04	1.0028E-02	1.3204E+05	2.0702E-02
1.5073E+04	1.0316E-02	1.3294E+05	2.0638E-02
1.5305E+04	1.0604E-02	1.3384E+05	2.0575E-02
1.5537E+04	1.0952E-02	1.3474E+05	2.0512E-02
1.5768E+04	1.1411E-02	1.3564E+05	2.0449E-02
1.6000E+04	1.1871E-02	1.3653E+05	2.0387E-02
1.9059E+04	1.7079E-02	1.3743E+05	2.0328E-02
2.2118E+04	2.0657E-02	1.3833E+05	2.0275E-02
2.5176E+04	2.3266E-02	1.3923E+05	2.0252E-02
2.8235E+04	2.6014E-02	1.4013E+05	2.0256E-02
3.1294E+04	2.7907E-02	1.4103E+05	2.0214E-02
3.4353E+04	2.9185E-02	1.4192E+05	2.0175E-02
3.7412E+04	3.0015E-02	1.4282E+05	2.0138E-02
4.0471E+04	3.0536E-02	1.4372E+05	2.0105E-02
4.3529E+04	3.0906E-02	1.4462E+05	2.0073E-02
4.6588E+04	3.1137E-02	1.4552E+05	2.0042E-02
4.9647E+04	3.1168E-02	1.4642E+05	2.0010E-02
5.2706E+04	3.1114E-02	1.4731E+05	1.9979E-02
5.5765E+04	3.0986E-02	1.4821E+05	1.9948E-02
5.8824E+04	3.0803E-02	1.4911E+05	1.9916E-02
6.1882E+04	3.0469E-02	1.5001E+05	1.9883E-02
6.4941E+04	2.9899E-02	1.5091E+05	1.9850E-02

PLTCVT PROGRAM DATA SUMMARY
PIR4(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = RA-226
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 8.000000E+03
TIME HIGH= 1.500000E+05
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 1.420000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4985E+05 MIN. TIME = 8.3876E+03
TOTAL WEIGHT = 8.3023E+03 TOTAL PARCELS = 1581.0
PEAK WEIGHT = 264.938 PEAK WEIGHT TIME = 1.0527E+05
PEAK PARCELS = 36.000 PEAK PARCELS TIME = 3.9950E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 8.302277E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 7.880475E+03
PERCENT OF TOTAL INVENTORY = 94.919

TIME OF MAXIMUM CONCENTRATION (YEARS) = 5.841000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 9.829432E-08
MAXIMUM RATE (CURIES/YEAR) = 8.205585E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

CONTAMINANT = RA-226

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
8.7100E+03	1.4427E-02	7.9000E+04	7.3430E-02
1.0116E+04	1.4427E-02	8.0406E+04	7.2509E-02
1.1522E+04	1.6612E-02	8.1812E+04	7.1546E-02
1.2927E+04	1.8971E-02	8.3217E+04	7.0564E-02
1.4333E+04	2.1490E-02	8.4623E+04	6.9567E-02
1.5739E+04	2.4157E-02	8.6029E+04	6.8568E-02
1.7145E+04	2.6957E-02	8.7435E+04	6.7578E-02
1.8551E+04	2.9896E-02	8.8841E+04	6.6598E-02
1.9956E+04	3.2966E-02	9.0246E+04	6.5639E-02
2.1362E+04	3.6143E-02	9.1652E+04	6.4694E-02
2.2768E+04	3.9429E-02	9.3058E+04	6.3756E-02

2,4174E+04	4,2813E-02	9,4464E+04	6,2833E-02
2,5580E+04	4,5709E-02	9,5870E+04	6,1933E-02
2,6985E+04	4,8521E-02	9,7275E+04	6,1066E-02
2,8391E+04	5,1292E-02	9,8681E+04	6,0238E-02
2,9797E+04	5,4011E-02	1,0009E+05	5,9443E-02
3,1203E+04	5,6662E-02	1,0149E+05	5,8659E-02
3,2609E+04	5,9245E-02	1,0290E+05	5,7869E-02
3,4014E+04	6,1756E-02	1,0430E+05	5,7064E-02
3,5420E+04	6,4174E-02	1,0571E+05	5,6267E-02
3,6826E+04	6,6463E-02	1,0712E+05	5,5508E-02
3,8232E+04	6,8601E-02	1,0852E+05	5,4787E-02
3,9638E+04	7,0587E-02	1,0993E+05	5,4096E-02
4,1043E+04	7,2410E-02	1,1133E+05	5,3446E-02
4,2449E+04	7,4065E-02	1,1274E+05	5,2818E-02
4,3855E+04	7,5534E-02	1,1414E+05	5,2178E-02
4,5261E+04	7,6825E-02	1,1555E+05	5,1510E-02
4,6667E+04	7,7962E-02	1,1696E+05	5,0807E-02
4,8072E+04	7,8938E-02	1,1836E+05	5,0070E-02
4,9478E+04	7,9763E-02	1,1977E+05	4,9291E-02
5,0884E+04	8,0468E-02	1,2117E+05	4,8443E-02
5,2290E+04	8,1036E-02	1,2258E+05	4,7516E-02
5,3696E+04	8,1473E-02	1,2399E+05	4,6502E-02
5,5101E+04	8,1788E-02	1,2539E+05	4,5400E-02
5,6507E+04	8,1975E-02	1,2680E+05	4,4199E-02
5,7913E+04	8,2045E-02	1,2820E+05	4,2895E-02
5,9319E+04	8,2001E-02	1,2961E+05	4,1492E-02
6,0725E+04	8,1847E-02	1,3101E+05	4,0025E-02
6,2130E+04	8,1588E-02	1,3242E+05	3,8505E-02
6,3536E+04	8,1223E-02	1,3383E+05	3,6935E-02
6,4942E+04	8,0759E-02	1,3523E+05	3,5241E-02
6,6348E+04	8,0216E-02	1,3664E+05	3,2922E-02
6,7754E+04	7,9607E-02	1,3804E+05	3,0617E-02
6,9159E+04	7,8931E-02	1,3945E+05	2,8348E-02
7,0565E+04	7,8205E-02	1,4086E+05	2,6105E-02
7,1971E+04	7,7446E-02	1,4226E+05	2,3888E-02
7,3377E+04	7,6680E-02	1,4367E+05	2,1724E-02
7,4783E+04	7,5914E-02	1,4507E+05	1,9629E-02
7,6188E+04	7,5124E-02	1,4648E+05	1,7602E-02
7,7594E+04	7,4296E-02	1,4788E+05	1,5642E-02

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 4   PIR 4 Chain 4
CONTAMINANT = AM-243
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 8.000000E+02
TIME HIGH= 1.700000E+04
NUMBER OF CELLS = 300
DELTA TIME INCREMENT = 5.400000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.6135E+04   MIN. TIME = 1.2291E+03
TOTAL WEIGHT = 3.2877E+05   TOTAL PARCELS = 5755.0
PEAK WEIGHT = 3941.435   PEAK WEIGHT TIME = 1.4210E+03
PEAK PARCELS = 38.000   PEAK PARCELS TIME = 1.4210E+03
WT. LOW = 0.0000E-01   NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01   NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 3.287672E+05
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.309197E+05
PERCENT OF TOTAL INVENTORY = 100.655

TIME OF MAXIMUM CONCENTRATION (YEARS) = 1.475000E+03
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 4.991681E-05
MAXIMUM RATE (CURIES/YEAR) = 4.167043E+01
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
1.2050E+03	2.6952E+01	8.6000E+03	2.0750E+01
1.2170E+03	2.6952E+01	9.0118E+03	1.9912E+01
1.2289E+03	2.6952E+01	9.4235E+03	1.9158E+01
1.2409E+03	2.6952E+01	9.8353E+03	1.8436E+01
1.2529E+03	2.6952E+01	1.0247E+04	1.7729E+01
1.2648E+03	2.7825E+01	1.0659E+04	1.7114E+01
1.2768E+03	2.9613E+01	1.1071E+04	1.6500E+01
1.2888E+03	3.1401E+01	1.1482E+04	1.5860E+01
1.3008E+03	3.3189E+01	1.1894E+04	1.5212E+01
1.3127E+03	3.4977E+01	1.2306E+04	1.4646E+01
1.3247E+03	3.5326E+01	1.2718E+04	1.4104E+01

1.3367E+03	3.5641E+01	1.3129E+04	1.3569E+01
1.3486E+03	3.5955E+01	1.3541E+04	1.3047E+01
1.3606E+03	3.6270E+01	1.3953E+04	1.2557E+01
1.3726E+03	3.6926E+01	1.4365E+04	1.1982E+01
1.3845E+03	3.7974E+01	1.4776E+04	1.1176E+01
1.3965E+03	3.9022E+01	1.5188E+04	1.0431E+01
1.4085E+03	4.0069E+01	1.5600E+04	9.1313E+00
1.4205E+03	4.1117E+01	1.5615E+04	9.0307E+00
1.4324E+03	4.1271E+01	1.5631E+04	8.9222E+00
1.4444E+03	4.1384E+01	1.5646E+04	8.8061E+00
1.4564E+03	4.1496E+01	1.5662E+04	8.6899E+00
1.4683E+03	4.1608E+01	1.5677E+04	8.5736E+00
1.4803E+03	4.1652E+01	1.5693E+04	8.4309E+00
1.4923E+03	4.1609E+01	1.5708E+04	8.2882E+00
1.5042E+03	4.1566E+01	1.5723E+04	8.1455E+00
1.5162E+03	4.1524E+01	1.5739E+04	7.9865E+00
1.5282E+03	4.1481E+01	1.5754E+04	7.8115E+00
1.5402E+03	4.1325E+01	1.5770E+04	7.6365E+00
1.5521E+03	4.1159E+01	1.5785E+04	7.4614E+00
1.5641E+03	4.0994E+01	1.5801E+04	7.2612E+00
1.5761E+03	4.0829E+01	1.5816E+04	7.0610E+00
1.5880E+03	4.0708E+01	1.5831E+04	6.8608E+00
1.6000E+03	4.0646E+01	1.5847E+04	6.7756E+00
2.0118E+03	3.8653E+01	1.5862E+04	6.8034E+00
2.4235E+03	3.7160E+01	1.5878E+04	6.8311E+00
2.8353E+03	3.5640E+01	1.5893E+04	6.8582E+00
3.2471E+03	3.4308E+01	1.5908E+04	6.6839E+00
3.6588E+03	3.3033E+01	1.5924E+04	6.5096E+00
4.0706E+03	3.1824E+01	1.5939E+04	6.3352E+00
4.4824E+03	3.0660E+01	1.5955E+04	6.1559E+00
4.8941E+03	2.9585E+01	1.5970E+04	5.9716E+00
5.3059E+03	2.8488E+01	1.5986E+04	5.7873E+00
5.7176E+03	2.7434E+01	1.6001E+04	5.6030E+00
6.1294E+03	2.6425E+01	1.6016E+04	5.4295E+00
6.5412E+03	2.5396E+01	1.6032E+04	5.2561E+00
6.9529E+03	2.4439E+01	1.6047E+04	5.0827E+00
7.3647E+03	2.3479E+01	1.6063E+04	4.9066E+00
7.7765E+03	2.2571E+01	1.6078E+04	4.7278E+00
8.1882E+03	2.1666E+01	1.6094E+04	4.5491E+00

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 4 PIR 4 Chain 4
CONTAMINANT = PU-239
TONS OF HEAVY METAL FACTOR = 1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =2
TIME LOW = 2.000000E+03
TIME HIGH= 5.000000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 2.400000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 4.6662E+04 MIN. TIME = 2.2850E+03
TOTAL WEIGHT = 3.8941E+02 TOTAL PARCELS = 1024.0
PEAK WEIGHT = 9.403 PEAK WEIGHT TIME = 2.3720E+04
PEAK PARCELS = 23.000 PEAK PARCELS TIME = 2.3720E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 3.894141E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.778806E+02
PERCENT OF TOTAL INVENTORY = 97.038

TIME OF MAXIMUM CONCENTRATION (YEARS) = 2.228000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.699334E-08
MAXIMUM RATE (CURIES/YEAR) = 1.418600E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.3600E+03	1.2097E-03	2.4560E+04	1.3769E-02
2.8040E+03	1.3610E-03	2.5004E+04	1.3617E-02
3.2480E+03	1.7154E-03	2.5448E+04	1.3455E-02
3.6920E+03	2.1045E-03	2.5892E+04	1.3264E-02
4.1360E+03	2.5251E-03	2.6336E+04	1.3039E-02
4.5800E+03	2.9795E-03	2.6780E+04	1.2803E-02
5.0240E+03	3.4631E-03	2.7224E+04	1.2561E-02
5.4680E+03	3.8659E-03	2.7668E+04	1.2317E-02
5.9120E+03	4.2645E-03	2.8112E+04	1.2075E-02
6.3560E+03	4.6527E-03	2.8556E+04	1.1838E-02
6.8000E+03	5.0258E-03	2.9000E+04	1.1612E-02

7.2440E+03	5.3774E-03	2.9444E+04	1.1398E-02
7.6880E+03	5.6971E-03	2.9888E+04	1.1187E-02
8.1320E+03	5.9880E-03	3.0332E+04	1.0978E-02
8.5760E+03	6.2440E-03	3.0776E+04	1.0782E-02
9.0200E+03	6.4695E-03	3.1220E+04	1.0604E-02
9.4640E+03	6.6602E-03	3.1664E+04	1.0430E-02
9.9080E+03	6.8106E-03	3.2108E+04	1.0250E-02
1.0352E+04	6.9243E-03	3.2552E+04	1.0067E-02
1.0796E+04	7.0133E-03	3.2996E+04	9.8751E-03
1.1240E+04	7.0851E-03	3.3440E+04	9.6729E-03
1.1684E+04	7.1466E-03	3.3884E+04	9.4650E-03
1.2128E+04	7.2051E-03	3.4328E+04	9.2542E-03
1.2572E+04	7.2751E-03	3.4772E+04	9.0502E-03
1.3016E+04	7.3711E-03	3.5216E+04	8.8497E-03
1.3460E+04	7.5086E-03	3.5660E+04	8.6453E-03
1.3904E+04	7.6995E-03	3.6104E+04	8.4298E-03
1.4348E+04	7.9485E-03	3.6548E+04	8.2118E-03
1.4792E+04	8.2660E-03	3.6992E+04	7.9982E-03
1.5236E+04	8.6522E-03	3.7436E+04	7.7885E-03
1.5680E+04	9.0902E-03	3.7880E+04	7.5812E-03
1.6124E+04	9.5665E-03	3.8324E+04	7.3784E-03
1.6568E+04	1.0075E-02	3.8768E+04	7.1795E-03
1.7012E+04	1.0608E-02	3.9212E+04	6.9779E-03
1.7456E+04	1.1152E-02	3.9656E+04	6.7746E-03
1.7900E+04	1.1688E-02	4.0100E+04	6.5662E-03
1.8344E+04	1.2191E-02	4.0544E+04	6.3550E-03
1.8788E+04	1.2645E-02	4.0988E+04	6.1480E-03
1.9232E+04	1.3044E-02	4.1432E+04	5.9446E-03
1.9676E+04	1.3382E-02	4.1876E+04	5.7393E-03
2.0120E+04	1.3650E-02	4.2320E+04	5.5170E-03
2.0564E+04	1.3847E-02	4.2764E+04	5.2701E-03
2.1008E+04	1.4001E-02	4.3208E+04	4.9999E-03
2.1452E+04	1.4112E-02	4.3652E+04	4.7032E-03
2.1896E+04	1.4170E-02	4.4096E+04	4.3836E-03
2.2340E+04	1.4184E-02	4.4540E+04	3.9774E-03
2.2784E+04	1.4154E-02	4.4984E+04	3.4837E-03
2.3228E+04	1.4094E-02	4.5428E+04	3.0098E-03
2.3672E+04	1.4013E-02	4.5872E+04	2.5548E-03
2.4116E+04	1.3905E-02	4.6316E+04	2.1175E-03

PLTCVT PROGRAM DATA SUMMARY
PIR 4 Chain 4   PIR 4 Chain 4
CONTAMINANT = U-235
TONS OF HEAVY METAL FACTOR =   1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   2.000000E+03
TIME HIGH=   1.100000E+05
NUMBER OF CELLS =   500
DELTA TIME INCREMENT =   2.160000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.4992E+05   MIN. TIME = 2.6171E+03
TOTAL WEIGHT = 7.8186E+02   TOTAL PARCELS =   10486.0
PEAK WEIGHT =   28.233   PEAK WEIGHT TIME = 3.0620E+04
PEAK PARCELS =   109.000   PEAK PARCELS TIME = 1.4420E+04
WT. LOW = 0.0000E-01   NO. PARCELS LOW =   0.0
WT. HI = 2.6866E+01   NO. PARCELS HI =   12.0
SMOOTHING WINDOW (CELLS)=   20

TOTAL INVENTORY (CURIES) =   8.087227E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   7.891524E+02
PERCENT OF TOTAL INVENTORY = 97.580

TIME OF MAXIMUM CONCENTRATION (YEARS) =   2.198000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   1.668911E-08
MAXIMUM RATE (CURIES/YEAR) =   1.393203E-02
CONVERSION FACTOR RATE TO CONCENTRATION =   1.197895E-06

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.5400E+03	9.6030E-08	5.8500E+04	8.0477E-03
3.1297E+03	2.1837E-06	6.0647E+04	7.8902E-03
3.7194E+03	2.4274E-05	6.2794E+04	7.7617E-03
4.3091E+03	4.6369E-05	6.4941E+04	7.6690E-03
4.8988E+03	6.8803E-05	6.7088E+04	7.5982E-03
5.4885E+03	1.1309E-04	6.9235E+04	7.5229E-03
6.0782E+03	1.7973E-04	7.1382E+04	7.4253E-03
6.6679E+03	2.7448E-04	7.3529E+04	7.2949E-03
7.2576E+03	4.0557E-04	7.5676E+04	7.1350E-03
7.8473E+03	5.8141E-04	7.7824E+04	6.9616E-03
8.4370E+03	8.0879E-04	7.9971E+04	6.7890E-03

9.0267E+03	1.0948E-03	8.2118E+04	6.6347E-03
9.6164E+03	1.4476E-03	8.4265E+04	6.5165E-03
1.0206E+04	1.8693E-03	8.6412E+04	6.4495E-03
1.0796E+04	2.3610E-03	8.8559E+04	6.4568E-03
1.1385E+04	2.9223E-03	9.0706E+04	6.5489E-03
1.1975E+04	3.5511E-03	9.2853E+04	6.7316E-03
1.2565E+04	4.2394E-03	9.5000E+04	7.0366E-03
1.3155E+04	4.9791E-03	9.5445E+04	7.1655E-03
1.3744E+04	5.7610E-03	9.5890E+04	7.2923E-03
1.4334E+04	6.5732E-03	9.6334E+04	7.3888E-03
1.4924E+04	7.4031E-03	9.6779E+04	7.4135E-03
1.5513E+04	8.2386E-03	9.7224E+04	7.3323E-03
1.6103E+04	9.0665E-03	9.7668E+04	7.1150E-03
1.6693E+04	9.8729E-03	9.8113E+04	6.7486E-03
1.7282E+04	1.0644E-02	9.8558E+04	6.2391E-03
1.7872E+04	1.1365E-02	9.9003E+04	5.6140E-03
1.8462E+04	1.2018E-02	9.9447E+04	4.9115E-03
1.9052E+04	1.2591E-02	9.9892E+04	4.1802E-03
1.9641E+04	1.3073E-02	1.0034E+05	3.4685E-03
2.0231E+04	1.3450E-02	1.0078E+05	2.8186E-03
2.0821E+04	1.3711E-02	1.0123E+05	2.2576E-03
2.1410E+04	1.3868E-02	1.0167E+05	1.8009E-03
2.2000E+04	1.3929E-02	1.0212E+05	1.4523E-03
2.4147E+04	1.3484E-02	1.0256E+05	1.2120E-03
2.6294E+04	1.3038E-02	1.0301E+05	1.0706E-03
2.8441E+04	1.2454E-02	1.0345E+05	1.0221E-03
3.0588E+04	1.1873E-02	1.0389E+05	1.0637E-03
3.2735E+04	1.1304E-02	1.0434E+05	1.1891E-03
3.4882E+04	1.0739E-02	1.0478E+05	1.3829E-03
3.7029E+04	1.0182E-02	1.0523E+05	1.6275E-03
3.9176E+04	9.6660E-03	1.0567E+05	1.8942E-03
4.1324E+04	9.2330E-03	1.0612E+05	2.1470E-03
4.3471E+04	8.9197E-03	1.0656E+05	2.3517E-03
4.5618E+04	8.7279E-03	1.0701E+05	2.4876E-03
4.7765E+04	8.6249E-03	1.0745E+05	2.5423E-03
4.9912E+04	8.5600E-03	1.0790E+05	2.5325E-03
5.2059E+04	8.4829E-03	1.0834E+05	2.4655E-03
5.4206E+04	8.3701E-03	1.0879E+05	2.4163E-03
5.6353E+04	8.2183E-03	1.0923E+05	2.3283E-03

```
PLTCVT PROGRAM DATA SUMMARY
 PIR 4 Chain 4   PIR 4  Chain 4
CONTAMINANT = PA-231
  TONS OF HEAVY METAL FACTOR =    1.000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =    2.000000E+03
TIME HIGH=   1.600020E+05
NUMBER OF CELLS =              200
DELTA TIME INCREMENT =    7.900000E+02


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.5000E+05       MIN. TIME =  2.6648E+03
TOTAL WEIGHT =  2.9597E+01    TOTAL PARCELS =       2553.0
PEAK WEIGHT =          0.504  PEAK WEIGHT TIME =  4.5055E+04
PEAK PARCELS =        33.000  PEAK PARCELS TIME =  9.0085E+04
WT. LOW =  0.0000E-01         NO. PARCELS LOW =          0.0
WT. HI =  0.0000E-01          NO. PARCELS HI =          0.0
 SMOOTHING WINDOW (CELLS)=     10


TOTAL INVENTORY (CURIES) =    2.959672E+01
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =    2.871982E+01
PERCENT OF TOTAL INVENTORY =  97.037

TIME OF MAXIMUM CONCENTRATION (YEARS) =    8.376500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =    3.488800E-10
MAXIMUM RATE (CURIES/YEAR) =    2.912442E-04
CONVERSION FACTOR RATE TO CONCENTRATION =    1.197895E-06


TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE    100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.3950E+03	1.2340E-05	7.6260E+04	2.8519E-04
3.8723E+03	1.4259E-05	7.7737E+04	2.8719E-04
5.3496E+03	1.8971E-05	7.9215E+04	2.8886E-04
6.8269E+03	2.4566E-05	8.0692E+04	2.9012E-04
8.3042E+03	3.1119E-05	8.2169E+04	2.9093E-04
9.7815E+03	3.8661E-05	8.3646E+04	2.9123E-04
1.1259E+04	4.7196E-05	8.5124E+04	2.9101E-04
1.2736E+04	5.5915E-05	8.6601E+04	2.9025E-04
1.4213E+04	6.5384E-05	8.8078E+04	2.8893E-04
1.5691E+04	7.5526E-05	8.9556E+04	2.8706E-04
1.7168E+04	8.6210E-05	9.1033E+04	2.8463E-04

1,8645E+04	9,7307E-05	9,2510E+04	2,8167E-04
2,0123E+04	1,0868E-04	9,3988E+04	2,7817E-04
2,1600E+04	1,2022E-04	9,5465E+04	2,7417E-04
2,3077E+04	1,3178E-04	9,6942E+04	2,6972E-04
2,4555E+04	1,4325E-04	9,8419E+04	2,6485E-04
2,6032E+04	1,5447E-04	9,9897E+04	2,5959E-04
2,7509E+04	1,6534E-04	1,0137E+05	2,5402E-04
2,8986E+04	1,7575E-04	1,0285E+05	2,4816E-04
3,0464E+04	1,8560E-04	1,0433E+05	2,4209E-04
3,1941E+04	1,9484E-04	1,0581E+05	2,3587E-04
3,3418E+04	2,0342E-04	1,0728E+05	2,2956E-04
3,4896E+04	2,1130E-04	1,0876E+05	2,2324E-04
3,6373E+04	2,1849E-04	1,1024E+05	2,1695E-04
3,7850E+04	2,2495E-04	1,1172E+05	2,1077E-04
3,9328E+04	2,3072E-04	1,1319E+05	2,0474E-04
4,0805E+04	2,3579E-04	1,1467E+05	1,9891E-04
4,2282E+04	2,4021E-04	1,1615E+05	1,9332E-04
4,3759E+04	2,4400E-04	1,1762E+05	1,8798E-04
4,5237E+04	2,4720E-04	1,1910E+05	1,8289E-04
4,6714E+04	2,4988E-04	1,2058E+05	1,7805E-04
4,8191E+04	2,5209E-04	1,2206E+05	1,7341E-04
4,9669E+04	2,5390E-04	1,2353E+05	1,6896E-04
5,1146E+04	2,5538E-04	1,2501E+05	1,6463E-04
5,2623E+04	2,5661E-04	1,2649E+05	1,6037E-04
5,4101E+04	2,5764E-04	1,2797E+05	1,5609E-04
5,5578E+04	2,5858E-04	1,2944E+05	1,5167E-04
5,7055E+04	2,5951E-04	1,3092E+05	1,4703E-04
5,8532E+04	2,6049E-04	1,3240E+05	1,4206E-04
6,0010E+04	2,6162E-04	1,3387E+05	1,3669E-04
6,1487E+04	2,6293E-04	1,3535E+05	1,3073E-04
6,2964E+04	2,6447E-04	1,3683E+05	1,2401E-04
6,4442E+04	2,6624E-04	1,3831E+05	1,1659E-04
6,5919E+04	2,6824E-04	1,3978E+05	1,0851E-04
6,7396E+04	2,7045E-04	1,4126E+05	9,9861E-05
6,8874E+04	2,7283E-04	1,4274E+05	8,9692E-05
7,0351E+04	2,7535E-04	1,4422E+05	7,7665E-05
7,1828E+04	2,7791E-04	1,4569E+05	6,6179E-05
7,3305E+04	2,8047E-04	1,4717E+05	5,5296E-05
7,4783E+04	2,8292E-04	1,4865E+05	4,5083E-05

APPENDIX H.4: SABINE RIVER DISCHARGE SITE
Lower bound Ke values used.
Simulation Run 5.

```
 PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = C-14
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =    2
TIME LOW =    3.000000E+04
TIME HIGH=   7.000000E+04
NUMBER OF CELLS =             200
DELTA TIME INCREMENT =   2.000000E+02


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.3648E+05      MIN. TIME =  4.0561E+04
TOTAL WEIGHT =  8.8817E+01   TOTAL PARCELS =       2108.0
PEAK WEIGHT =        2.663   PEAK WEIGHT TIME =  4.4900E+04
PEAK PARCELS =      27.000   PEAK PARCELS TIME =  4.6700E+04
WT. LOW =  0.0000E-01        NO. PARCELS LOW =        0.0
WT. HI =  5.4829E-01         NO. PARCELS HI =      4162.0
 SMOOTHING WINDOW (CELLS)=      5


TOTAL INVENTORY (CURIES) =    8.936533E+01
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   8.778386E+01
PERCENT OF TOTAL INVENTORY =  98.230

TIME OF MAXIMUM CONCENTRATION (YEARS) =   4.510000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   3.312263E-08
MAXIMUM RATE (CURIES/YEAR) =   8.594465E-03
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06


 CONTAMINANT = C-14

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.0500E+04	9.1765E-04	5.5200E+04	2.8538E-03
4.0794E+04	1.0536E-03	5.5494E+04	2.6768E-03
4.1088E+04	1.5245E-03	5.5788E+04	2.4862E-03
4.1382E+04	2.1036E-03	5.6082E+04	2.2847E-03
4.1676E+04	2.7699E-03	5.6376E+04	2.0751E-03
4.1970E+04	3.4316E-03	5.6670E+04	1.8671E-03
4.2264E+04	4.1427E-03	5.6964E+04	1.6651E-03
4.2558E+04	4.8847E-03	5.7258E+04	1.4712E-03
4.2852E+04	5.6189E-03	5.7552E+04	1.2850E-03
4.3146E+04	6.3048E-03	5.7846E+04	1.1094E-03
4.3440E+04	6.9242E-03	5.8140E+04	9.5005E-04

4.3734E+04	7.4629E-03	5.8434E+04	8.1165E-04
4.4028E+04	7.9537E-03	5.8728E+04	6.9084E-04
4.4322E+04	8.3007E-03	5.9022E+04	5.8752E-04
4.4616E+04	8.5008E-03	5.9316E+04	4.9808E-04
4.4910E+04	8.5895E-03	5.9610E+04	4.2421E-04
4.5204E+04	8.5810E-03	5.9904E+04	3.6370E-04
4.5498E+04	8.5139E-03	6.0198E+04	3.1705E-04
4.5792E+04	8.3695E-03	6.0492E+04	2.7787E-04
4.6086E+04	8.1589E-03	6.0786E+04	2.4610E-04
4.6380E+04	7.9181E-03	6.1080E+04	2.1983E-04
4.6674E+04	7.6830E-03	6.1374E+04	1.9996E-04
4.6968E+04	7.4480E-03	6.1668E+04	1.8527E-04
4.7262E+04	7.2068E-03	6.1962E+04	1.7435E-04
4.7556E+04	6.9522E-03	6.2256E+04	1.6556E-04
4.7850E+04	6.6937E-03	6.2550E+04	1.5867E-04
4.8144E+04	6.4603E-03	6.2844E+04	1.5370E-04
4.8438E+04	6.2559E-03	6.3138E+04	1.5013E-04
4.8732E+04	6.0576E-03	6.3432E+04	1.4738E-04
4.9026E+04	5.8734E-03	6.3726E+04	1.4441E-04
4.9320E+04	5.7101E-03	6.4020E+04	1.4123E-04
4.9614E+04	5.5776E-03	6.4314E+04	1.3807E-04
4.9908E+04	5.4687E-03	6.4608E+04	1.3462E-04
5.0202E+04	5.3676E-03	6.4902E+04	1.3086E-04
5.0496E+04	5.2458E-03	6.5196E+04	1.2655E-04
5.0790E+04	5.1117E-03	6.5490E+04	1.2179E-04
5.1084E+04	4.9680E-03	6.5784E+04	1.1695E-04
5.1378E+04	4.8061E-03	6.6078E+04	1.1205E-04
5.1672E+04	4.6333E-03	6.6372E+04	1.0691E-04
5.1966E+04	4.4437E-03	6.6666E+04	1.0190E-04
5.2260E+04	4.2513E-03	6.6960E+04	9.7022E-05
5.2554E+04	4.0762E-03	6.7254E+04	9.2206E-05
5.2848E+04	3.9238E-03	6.7548E+04	8.7312E-05
5.3142E+04	3.7820E-03	6.7842E+04	8.2459E-05
5.3436E+04	3.6544E-03	6.8136E+04	7.6927E-05
5.3730E+04	3.5357E-03	6.8430E+04	7.0703E-05
5.4024E+04	3.4207E-03	6.8724E+04	6.3865E-05
5.4318E+04	3.3038E-03	6.9018E+04	5.4936E-05
5.4612E+04	3.1718E-03	6.9312E+04	4.4219E-05
5.4906E+04	3.0209E-03	6.9606E+04	3.4303E-05

```
 PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = TC-99
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   5.800000E+04
TIME HIGH=   6.300000E+04
NUMBER OF CELLS =           200
DELTA TIME INCREMENT =   2.500000E+01

 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.3630E+05        MIN. TIME =  3.9436E+04
TOTAL WEIGHT =  2.4643E+05    TOTAL PARCELS =        1655.0
PEAK WEIGHT =     7729.911    PEAK WEIGHT TIME =  5.8638E+04
PEAK PARCELS =       44.000   PEAK PARCELS TIME =  5.8638E+04
WT. LOW =  5.6780E+02         NO. PARCELS LOW =          3.0
WT. HI =  1.3566E+05          NO. PARCELS HI =        4612.0
 SMOOTHING WINDOW (CELLS)=     10

TOTAL INVENTORY (CURIES) =   3.826520E+05
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   2.568296E+05
PERCENT OF TOTAL INVENTORY =  67.118

TIME OF MAXIMUM CONCENTRATION (YEARS) =   5.858750E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   9.596348E-04
MAXIMUM RATE (CURIES/YEAR) =   2.490004E+02
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06

 CONTAMINANT = TC-99

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
5.8588E+04	2.4900E+02	5.9350E+04	1.2639E+02
5.8591E+04	2.4900E+02	5.9388E+04	1.2096E+02
5.8594E+04	2.4900E+02	5.9426E+04	1.1542E+02
5.8598E+04	2.4900E+02	5.9465E+04	1.0990E+02
5.8601E+04	2.4900E+02	5.9503E+04	1.0461E+02
5.8605E+04	2.4900E+02	5.9541E+04	9.9534E+01
5.8608E+04	2.4900E+02	5.9579E+04	9.4836E+01
5.8611E+04	2.4900E+02	5.9618E+04	9.0215E+01
5.8615E+04	2.4871E+02	5.9656E+04	8.5856E+01
5.8618E+04	2.4827E+02	5.9694E+04	8.1790E+01
5.8622E+04	2.4783E+02	5.9732E+04	7.7894E+01
5.8625E+04	2.4739E+02	5.9771E+04	7.4399E+01

5.8628E+04	2.4695E+02	5.9809E+04	7.1053E+01
5.8632E+04	2.4651E+02	5.9847E+04	6.7771E+01
5.8635E+04	2.4607E+02	5.9885E+04	6.4796E+01
5.8639E+04	2.4580E+02	5.9924E+04	6.2037E+01
5.8642E+04	2.4584E+02	5.9962E+04	5.9674E+01
5.8645E+04	2.4589E+02	6.0000E+04	5.7650E+01
5.8649E+04	2.4593E+02	6.0091E+04	5.3310E+01
5.8652E+04	2.4598E+02	6.0181E+04	4.9071E+01
5.8656E+04	2.4602E+02	6.0272E+04	4.5170E+01
5.8659E+04	2.4607E+02	6.0362E+04	4.1738E+01
5.8663E+04	2.4611E+02	6.0453E+04	3.8653E+01
5.8666E+04	2.4613E+02	6.0543E+04	3.5390E+01
5.8669E+04	2.4615E+02	6.0634E+04	3.2230E+01
5.8673E+04	2.4617E+02	6.0724E+04	2.9353E+01
5.8676E+04	2.4619E+02	6.0815E+04	2.6274E+01
5.8680E+04	2.4621E+02	6.0905E+04	2.2745E+01
5.8683E+04	2.4624E+02	6.0996E+04	1.9309E+01
5.8686E+04	2.4626E+02	6.1086E+04	1.6203E+01
5.8690E+04	2.4600E+02	6.1177E+04	1.3446E+01
5.8693E+04	2.4562E+02	6.1267E+04	1.1355E+01
5.8697E+04	2.4524E+02	6.1358E+04	9.8407E+00
5.8700E+04	2.4486E+02	6.1449E+04	8.8530E+00
5.8738E+04	2.3944E+02	6.1539E+04	7.9862E+00
5.8777E+04	2.3193E+02	6.1630E+04	7.3364E+00
5.8815E+04	2.2383E+02	6.1720E+04	6.7413E+00
5.8853E+04	2.1597E+02	6.1811E+04	6.1526E+00
5.8891E+04	2.0808E+02	6.1901E+04	5.4675E+00
5.8929E+04	2.0128E+02	6.1992E+04	4.8728E+00
5.8968E+04	1.9425E+02	6.2082E+04	4.5054E+00
5.9006E+04	1.8658E+02	6.2173E+04	4.2112E+00
5.9044E+04	1.7888E+02	6.2263E+04	3.8869E+00
5.9082E+04	1.7143E+02	6.2354E+04	3.6225E+00
5.9121E+04	1.6412E+02	6.2444E+04	3.4565E+00
5.9159E+04	1.5705E+02	6.2535E+04	3.1999E+00
5.9197E+04	1.5052E+02	6.2625E+04	2.9273E+00
5.9235E+04	1.4424E+02	6.2716E+04	2.6732E+00
5.9274E+04	1.3793E+02	6.2806E+04	2.5648E+00
5.9312E+04	1.3190E+02	6.2897E+04	2.3240E+00

PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE 1FISSION PRODUCTS
CONTAMINANT = I-129
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+04
TIME HIGH= 1.400000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 2.500000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.3623E+05 MIN. TIME = 4.0567E+04
TOTAL WEIGHT = 1.1390E+03 TOTAL PARCELS = 6270.0
PEAK WEIGHT = 16.267 PEAK WEIGHT TIME = 4.6125E+04
PEAK PARCELS = 32.000 PEAK PARCELS TIME = 4.6125E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 1.139028E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.140647E+03
PERCENT OF TOTAL INVENTORY = 100.142

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.962500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.894850E-07
MAXIMUM RATE (CURIES/YEAR) = 4.916646E-02
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = I-129

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.0625E+04	4.6390E-03	9.3528E+04	6.1756E-03
4.1212E+04	6.0260E-03	9.5587E+04	6.2003E-03
4.1799E+04	8.9483E-03	9.7646E+04	6.1983E-03
4.2386E+04	1.4075E-02	9.9705E+04	6.2036E-03
4.2973E+04	2.1395E-02	1.0176E+05	6.2434E-03
4.3561E+04	2.8029E-02	1.0382E+05	6.2637E-03
4.4148E+04	3.3521E-02	1.0588E+05	6.2384E-03
4.4735E+04	3.6477E-02	1.0794E+05	6.2545E-03
4.5322E+04	3.9397E-02	1.1000E+05	6.2427E-03
4.5909E+04	4.2090E-02	1.1206E+05	6.2377E-03
4.6496E+04	4.4866E-02	1.1412E+05	6.2587E-03
4.7083E+04	4.6302E-02	1.1618E+05	6.2734E-03

4.7670E+04	4.6987E-02	1.1823E+05	6.2602E-03
4.8258E+04	4.7522E-02	1.2029E+05	6.2961E-03
4.8845E+04	4.8027E-02	1.2235E+05	6.2603E-03
4.9432E+04	4.8718E-02	1.2441E+05	6.1811E-03
5.0019E+04	4.8553E-02	1.2647E+05	6.0415E-03
5.0606E+04	4.8523E-02	1.2853E+05	5.8113E-03
5.1193E+04	4.7345E-02	1.3059E+05	5.1843E-03
5.1780E+04	4.6180E-02	1.3077E+05	5.1583E-03
5.2367E+04	4.4135E-02	1.3096E+05	5.1217E-03
5.2955E+04	4.3467E-02	1.3114E+05	5.0577E-03
5.3542E+04	4.4457E-02	1.3133E+05	5.0013E-03
5.4129E+04	4.5777E-02	1.3152E+05	4.8687E-03
5.4716E+04	4.5129E-02	1.3170E+05	4.6784E-03
5.5303E+04	4.2134E-02	1.3189E+05	4.4454E-03
5.5890E+04	4.0052E-02	1.3207E+05	4.2947E-03
5.6477E+04	3.8626E-02	1.3226E+05	4.0737E-03
5.7064E+04	3.5780E-02	1.3244E+05	3.8021E-03
5.7652E+04	2.9464E-02	1.3263E+05	3.4915E-03
5.8239E+04	2.1456E-02	1.3281E+05	3.1769E-03
5.8826E+04	1.4665E-02	1.3300E+05	2.8820E-03
5.9413E+04	1.0091E-02	1.3319E+05	2.6138E-03
6.0000E+04	7.9562E-03	1.3337E+05	2.3808E-03
6.0587E+04	7.4009E-03	1.3356E+05	2.1814E-03
6.2646E+04	6.8047E-03	1.3374E+05	1.9446E-03
6.4705E+04	6.4465E-03	1.3393E+05	1.7018E-03
6.6764E+04	6.3268E-03	1.3411E+05	1.4996E-03
6.8822E+04	6.3048E-03	1.3430E+05	1.3205E-03
7.0881E+04	6.3183E-03	1.3448E+05	1.1656E-03
7.2940E+04	6.2774E-03	1.3467E+05	1.0261E-03
7.4999E+04	6.2777E-03	1.3486E+05	8.8520E-04
7.7058E+04	6.2462E-03	1.3504E+05	7.3395E-04
7.9117E+04	6.2268E-03	1.3523E+05	6.0005E-04
8.1175E+04	6.1925E-03	1.3541E+05	4.9791E-04
8.3234E+04	6.2108E-03	1.3560E+05	4.6077E-04
8.5293E+04	6.1942E-03	1.3578E+05	3.9660E-04
8.7352E+04	6.2071E-03	1.3597E+05	3.2738E-04
8.9411E+04	6.2081E-03	1.3616E+05	2.5765E-04
9.1469E+04	6.1951E-03	1.3634E+05	1.8791E-04

PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE :FISSION PRODUCTS
CONTAMINANT = CS-135
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+04
TIME HIGH= 6.000000E+04
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 5.000000E+01

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 1.9998E+06	MIN. TIME = 4.3177E+04
TOTAL WEIGHT = 7.6815E+03	TOTAL PARCELS = 1233.0
PEAK WEIGHT = 87.191	PEAK WEIGHT TIME = 5.3275E+04
PEAK PARCELS = 14.000	PEAK PARCELS TIME = 5.3275E+04
WT. LOW = 0.0000E-01	NO. PARCELS LOW = 0.0
WT. HI = 3.7069E+02	NO. PARCELS HI = 134.0

SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 8.052167E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 7.638863E+03
PERCENT OF TOTAL INVENTORY = 94.867

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.477500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.631266E-06
MAXIMUM RATE (CURIES/YEAR) = 6.827456E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = CS-135

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.3175E+04	2.5384E-01	5.0214E+04	5.6848E-01
4.3224E+04	2.5384E-01	5.0549E+04	5.6862E-01
4.3273E+04	2.6128E-01	5.0885E+04	5.6932E-01
4.3323E+04	2.7008E-01	5.1220E+04	5.7081E-01
4.3372E+04	2.8021E-01	5.1555E+04	5.7298E-01
4.3421E+04	2.8446E-01	5.1890E+04	5.7549E-01
4.3470E+04	2.9685E-01	5.2226E+04	5.7784E-01
4.3520E+04	3.1095E-01	5.2561E+04	5.7929E-01
4.3569E+04	3.2594E-01	5.2896E+04	5.7883E-01
4.3618E+04	3.4159E-01	5.3232E+04	5.7565E-01
4.3667E+04	3.5853E-01	5.3567E+04	5.6916E-01

4.3717E+04	3.7584E-01	5.3902E+04	5.5899E-01
4.3766E+04	3.9325E-01	5.4237E+04	5.4490E-01
4.3815E+04	4.1066E-01	5.4573E+04	5.2643E-01
4.3864E+04	4.2796E-01	5.4908E+04	5.0415E-01
4.3914E+04	4.4500E-01	5.5243E+04	4.7704E-01
4.3963E+04	4.6177E-01	5.5579E+04	4.4632E-01
4.4012E+04	4.7835E-01	5.5914E+04	4.1223E-01
4.4061E+04	4.9485E-01	5.6249E+04	3.6091E-01
4.4111E+04	5.1134E-01	5.6305E+04	3.4794E-01
4.4160E+04	5.2783E-01	5.6360E+04	3.3467E-01
4.4209E+04	5.4434E-01	5.6415E+04	3.2149E-01
4.4258E+04	5.6081E-01	5.6470E+04	3.0911E-01
4.4308E+04	5.7718E-01	5.6526E+04	2.9806E-01
4.4357E+04	5.9328E-01	5.6581E+04	2.8878E-01
4.4406E+04	6.0890E-01	5.6636E+04	2.8124E-01
4.4455E+04	6.2372E-01	5.6692E+04	2.7536E-01
4.4505E+04	6.3747E-01	5.6747E+04	2.7084E-01
4.4554E+04	6.4987E-01	5.6802E+04	2.6731E-01
4.4603E+04	6.6054E-01	5.6858E+04	2.6444E-01
4.4652E+04	6.6924E-01	5.6913E+04	2.6182E-01
4.4702E+04	6.7597E-01	5.6968E+04	2.5899E-01
4.4751E+04	6.8081E-01	5.7023E+04	2.5542E-01
4.4800E+04	6.8257E-01	5.7079E+04	2.5071E-01
4.4849E+04	6.8190E-01	5.7134E+04	2.4454E-01
4.5185E+04	6.6948E-01	5.7189E+04	2.3675E-01
4.5520E+04	6.5379E-01	5.7245E+04	2.2728E-01
4.5855E+04	6.3985E-01	5.7300E+04	2.1607E-01
4.6190E+04	6.2399E-01	5.7355E+04	2.0317E-01
4.6526E+04	6.0945E-01	5.7411E+04	1.8880E-01
4.6861E+04	5.9674E-01	5.7466E+04	1.7341E-01
4.7196E+04	5.8634E-01	5.7521E+04	1.5733E-01
4.7532E+04	5.7852E-01	5.7577E+04	1.4104E-01
4.7867E+04	5.7321E-01	5.7632E+04	1.2516E-01
4.8202E+04	5.7012E-01	5.7687E+04	1.1058E-01
4.8537E+04	5.6869E-01	5.7742E+04	9.7062E-02
4.8873E+04	5.6827E-01	5.7798E+04	8.4895E-02
4.9208E+04	5.6830E-01	5.7853E+04	7.7345E-02
4.9543E+04	5.6844E-01	5.7908E+04	7.0613E-02
4.9879E+04	5.6851E-01	5.7964E+04	6.2980E-02

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 PLTCVT PROGRAM DATA SUMMARY
PIR 5(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 1
CONTAMINANT = U-236
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS;
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   3.000000E+05
TIME HIGH=   4.500000E+05
NUMBER OF CELLS =              200
DELTA TIME INCREMENT =   7.500000E+02


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  4.6966E+05       MIN. TIME =  2.9265E+05
TOTAL WEIGHT =  1.4410E+04    TOTAL PARCELS =        6879.0
PEAK WEIGHT =     294.766     PEAK WEIGHT TIME =  3.3863E+05
PEAK PARCELS =     124.000    PEAK PARCELS TIME =  3.3863E+05
WT. LOW =  5.6301E+00         NO. PARCELS LOW =           4.0
WT. HI =  1.3808E-02          NO. PARCELS HI =          19.0
 SMOOTHING WINDOW (CELLS)=      5


TOTAL INVENTORY (CURIES) =   1.441536E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   1.438215E+04
PERCENT OF TOTAL INVENTORY =  99.770

TIME OF MAXIMUM CONCENTRATION (YEARS) =   3.363750E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   1.090322E-06
MAXIMUM RATE (CURIES/YEAR) =   2.829184E-01
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06


 CONTAMINANT = U-236

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.0113E+05	4.9336E-03	3.7538E+05	8.2469E-02
3.0261E+05	6.4665E-03	3.7686E+05	8.1790E-02
3.0410E+05	1.0376E-02	3.7835E+05	8.1124E-02
3.0558E+05	1.5586E-02	3.7983E+05	8.0422E-02
3.0707E+05	2.1464E-02	3.8132E+05	7.9693E-02
3.0855E+05	2.8619E-02	3.8280E+05	7.9000E-02
3.1004E+05	3.7189E-02	3.8429E+05	7.8437E-02
3.1152E+05	4.7352E-02	3.8577E+05	7.8075E-02
3.1301E+05	5.9213E-02	3.8726E+05	7.7946E-02
3.1449E+05	7.2755E-02	3.8874E+05	7.8003E-02
3.1598E+05	8.7873E-02	3.9023E+05	7.8142E-02

3.1746E+05	1.0437E-01	3.9171E+05	7.8211E-02
3.1895E+05	1.2198E-01	3.9320E+05	7.8061E-02
3.2043E+05	1.4036E-01	3.9468E+05	7.7560E-02
3.2192E+05	1.5916E-01	3.9617E+05	7.6636E-02
3.2340E+05	1.7805E-01	3.9765E+05	7.5303E-02
3.2489E+05	1.9663E-01	3.9914E+05	7.3643E-02
3.2637E+05	2.1448E-01	4.0062E+05	7.1767E-02
3.2786E+05	2.3120E-01	4.0211E+05	6.9761E-02
3.2934E+05	2.4634E-01	4.0359E+05	6.7666E-02
3.3083E+05	2.5940E-01	4.0508E+05	6.5480E-02
3.3231E+05	2.6993E-01	4.0656E+05	6.3123E-02
3.3380E+05	2.7750E-01	4.0805E+05	6.0487E-02
3.3528E+05	2.8183E-01	4.0953E+05	5.7494E-02
3.3677E+05	2.8269E-01	4.1102E+05	5.4122E-02
3.3825E+05	2.8009E-01	4.1250E+05	5.0403E-02
3.3974E+05	2.7428E-01	4.1399E+05	4.6419E-02
3.4122E+05	2.6569E-01	4.1547E+05	4.2304E-02
3.4271E+05	2.5489E-01	4.1696E+05	3.8190E-02
3.4419E+05	2.4261E-01	4.1844E+05	3.4189E-02
3.4568E+05	2.2959E-01	4.1993E+05	3.0366E-02
3.4716E+05	2.1646E-01	4.2141E+05	2.6770E-02
3.4865E+05	2.0372E-01	4.2290E+05	2.3420E-02
3.5013E+05	1.9169E-01	4.2438E+05	2.0313E-02
3.5162E+05	1.8050E-01	4.2587E+05	1.7443E-02
3.5310E+05	1.7008E-01	4.2735E+05	1.4813E-02
3.5459E+05	1.6032E-01	4.2884E+05	1.2417E-02
3.5607E+05	1.5107E-01	4.3032E+05	1.0255E-02
3.5756E+05	1.4218E-01	4.3181E+05	8.3262E-03
3.5904E+05	1.3355E-01	4.3329E+05	6.6321E-03
3.6053E+05	1.2521E-01	4.3478E+05	5.1661E-03
3.6201E+05	1.1726E-01	4.3626E+05	3.9258E-03
3.6350E+05	1.0985E-01	4.3775E+05	2.9041E-03
3.6498E+05	1.0317E-01	4.3923E+05	2.0847E-03
3.6647E+05	9.7389E-02	4.4072E+05	1.4500E-03
3.6795E+05	9.2659E-02	4.4220E+05	9.7813E-04
3.6944E+05	8.9006E-02	4.4369E+05	6.4091E-04
3.7092E+05	8.6344E-02	4.4517E+05	4.0636E-04
3.7241E+05	8.4514E-02	4.4666E+05	2.4679E-04
3.7389E+05	8.3395E-02	4.4814E+05	1.4088E-04

PLTCVT PROGRAM DATA SUMMARY
PIRS(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 1
CONTAMINANT = TH-232
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 3.000000E+05
TIME HIGH= 2.000000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 8.500000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9994E+06 MIN. TIME = 3.1745E+05
TOTAL WEIGHT = 3.8736E-02 TOTAL PARCELS = 1868.0
PEAK WEIGHT = 0.001 PEAK WEIGHT TIME = 8.8575E+05
PEAK PARCELS = 19.000 PEAK PARCELS TIME = 1.0693E+06
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 30

TOTAL INVENTORY (CURIES) = 3.873644E-02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.805251E-02
PERCENT OF TOTAL INVENTORY = 98.234

TIME OF MAXIMUM CONCENTRATION (YEARS) = 8.992500E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 9.355277E-14
MAXIMUM RATE (CURIES/YEAR) = 2.427452E-08
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = TH-232

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
3.2125E+05	1.3705E-08	8.5000E+05	2.4219E-08
3.2364E+05	1.3705E-08	8.7647E+05	2.4263E-08
3.2602E+05	1.3705E-08	9.0294E+05	2.4274E-08
3.2841E+05	1.3705E-08	9.2941E+05	2.4256E-08
3.3080E+05	1.4107E-08	9.5588E+05	2.4213E-08
3.3318E+05	1.5025E-08	9.8235E+05	2.4148E-08
3.3557E+05	1.5942E-08	1.0088E+06	2.4064E-08
3.3795E+05	1.6860E-08	1.0353E+06	2.3967E-08
3.4034E+05	1.7054E-08	1.0618E+06	2.3861E-08
3.4273E+05	1.7146E-08	1.0882E+06	2.3748E-08
3.4511E+05	1.7237E-08	1.1147E+06	2.3633E-08
3.4750E+05	1.7322E-08	1.1412E+06	2.3515E-08
3.4989E+05	1.7393E-08	1.1676E+06	2.3396E-08

3.5227E+05	1.7463E-08	1.1941E+06	2.3280E-08
3.5466E+05	1.7533E-08	1.2206E+06	2.3167E-08
3.5705E+05	1.7589E-08	1.2471E+06	2.3062E-08
3.5943E+05	1.7641E-08	1.2735E+06	2.2963E-08
3.6182E+05	1.7693E-08	1.3000E+06	2.2872E-08
3.6420E+05	1.7719E-08	1.3211E+06	2.2808E-08
3.6659E+05	1.7631E-08	1.3422E+06	2.2750E-08
3.6898E+05	1.7542E-08	1.3633E+06	2.2705E-08
3.7136E+05	1.7454E-08	1.3843E+06	2.2671E-08
3.7375E+05	1.7533E-08	1.4054E+06	2.2650E-08
3.7614E+05	1.7710E-08	1.4265E+06	2.2639E-08
3.7852E+05	1.7887E-08	1.4476E+06	2.2637E-08
3.8091E+05	1.8056E-08	1.4687E+06	2.2642E-08
3.8330E+05	1.8102E-08	1.4898E+06	2.2653E-08
3.8568E+05	1.8148E-08	1.5108E+06	2.2665E-08
3.8807E+05	1.8195E-08	1.5319E+06	2.2682E-08
3.9045E+05	1.8241E-08	1.5530E+06	2.2703E-08
3.9284E+05	1.8286E-08	1.5741E+06	2.2728E-08
3.9523E+05	1.8332E-08	1.5952E+06	2.2756E-08
3.9761E+05	1.8378E-08	1.6163E+06	2.2787E-08
4.0000E+05	1.8435E-08	1.6373E+06	2.2820E-08
4.2647E+05	1.9074E-08	1.6584E+06	2.2854E-08
4.5294E+05	1.9655E-08	1.6795E+06	2.2890E-08
4.7941E+05	2.0196E-08	1.7006E+06	2.2928E-08
5.0588E+05	2.0695E-08	1.7217E+06	2.2968E-08
5.3235E+05	2.1151E-08	1.7428E+06	2.2991E-08
5.5882E+05	2.1564E-08	1.7638E+06	2.2965E-08
5.8529E+05	2.1913E-08	1.7849E+06	2.3005E-08
6.1177E+05	2.2207E-08	1.8060E+06	2.3047E-08
6.3824E+05	2.2564E-08	1.8271E+06	2.3089E-08
6.6471E+05	2.2892E-08	1.8482E+06	2.3128E-08
6.9118E+05	2.3202E-08	1.8693E+06	2.3165E-08
7.1765E+05	2.3466E-08	1.8903E+06	2.3196E-08
7.4412E+05	2.3685E-08	1.9114E+06	2.3224E-08
7.7059E+05	2.3871E-08	1.9325E+06	2.3249E-08
7.9706E+05	2.4023E-08	1.9536E+06	2.3272E-08
8.2353E+05	2.4139E-08	1.9747E+06	2.3298E-08

PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE1 CHAIN 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 2.000000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 9.950000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 7.8534E+05 MIN. TIME = 4.3019E+04
TOTAL WEIGHT = 3.9952E+04 TOTAL PARCELS = 10250.0
PEAK WEIGHT = 12512.462 PEAK WEIGHT TIME = 5.4775E+04
PEAK PARCELS = 5441.000 PEAK PARCELS TIME = 4.4885E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 1

TOTAL INVENTORY (CURIES) = 3.995167E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.846111E+04
PERCENT OF TOTAL INVENTORY = 71.239

TIME OF MAXIMUM CONCENTRATION (YEARS) = 6.472500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.618013E-06
MAXIMUM RATE (CURIES/YEAR) = 4.198325E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.4825E+04	4.1951E-01	4.1298E+05	2.7715E-03
5.2188E+04	4.1951E-01	4.2034E+05	3.3450E-03
5.9551E+04	4.1966E-01	4.2770E+05	3.6258E-03
6.6914E+04	3.2771E-01	4.3506E+05	3.5339E-03
7.4277E+04	1.7839E-02	4.4243E+05	2.9359E-03
8.1640E+04	1.3147E-03	4.4979E+05	2.7626E-03
8.9003E+04	1.3624E-03	4.5715E+05	2.4448E-03
9.6366E+04	1.2606E-03	4.6452E+05	2.1156E-03
1.0373E+05	1.0982E-03	4.7188E+05	2.1086E-03
1.1109E+05	7.9323E-04	4.7924E+05	2.4809E-03
1.1846E+05	7.3015E-04	4.8661E+05	2.8234E-03
1.2582E+05	9.4696E-04	4.9397E+05	3.0212E-03

1.3318E+05	1.4193E-03	5.0133E+05	2.8746E-03
1.4054E+05	1.4945E-03	5.0869E+05	2.8547E-03
1.4791E+05	1.6446E-03	5.1606E+05	2.7259E-03
1.5527E+05	1.8700E-03	5.2342E+05	2.5499E-03
1.6263E+05	1.5520E-03	5.3078E+05	2.9746E-03
1.7000E+05	1.6039E-03	5.3815E+05	2.9504E-03
1.7736E+05	1.5543E-03	5.4551E+05	3.1155E-03
1.8472E+05	1.2878E-03	5.5287E+05	3.6109E-03
1.9209E+05	1.5940E-03	5.6024E+05	3.1894E-03
1.9945E+05	1.6744E-03	5.6760E+05	3.2596E-03
2.0681E+05	1.6713E-03	5.7496E+05	3.4599E-03
2.1417E+05	1.6642E-03	5.8232E+05	3.5864E-03
2.2154E+05	1.5060E-03	5.8969E+05	4.1304E-03
2.2890E+05	1.3494E-03	5.9705E+05	4.0504E-03
2.3626E+05	1.1937E-03	6.0441E+05	5.4409E-03
2.4363E+05	1.0383E-03	6.1178E+05	1.0519E-02
2.5099E+05	7.3404E-04	6.1914E+05	1.9552E-02
2.5835E+05	8.0483E-04	6.2650E+05	3.4618E-02
2.6572E+05	1.1876E-03	6.3387E+05	5.4102E-02
2.7308E+05	1.7898E-03	6.4123E+05	7.5780E-02
2.8044E+05	1.9752E-03	6.4859E+05	9.8020E-02
2.8780E+05	1.9515E-03	6.5595E+05	1.1772E-01
2.9517E+05	1.7316E-03	6.6332E+05	1.3573E-01
3.0253E+05	1.2762E-03	6.7068E+05	1.5472E-01
3.0989E+05	1.3411E-03	6.7804E+05	1.6962E-01
3.1726E+05	1.4871E-03	6.8541E+05	1.7846E-01
3.2462E+05	1.6329E-03	6.9277E+05	1.7972E-01
3.3198E+05	1.7777E-03	7.0013E+05	1.6834E-01
3.3935E+05	1.9212E-03	7.0750E+05	1.4968E-01
3.4671E+05	2.1317E-03	7.1486E+05	1.2882E-01
3.5407E+05	2.4071E-03	7.2222E+05	1.0696E-01
3.6143E+05	2.5643E-03	7.2958E+05	8.1764E-02
3.6880E+05	2.2668E-03	7.3695E+05	5.8771E-02
3.7616E+05	1.8231E-03	7.4431E+05	3.8466E-02
3.8352E+05	1.3786E-03	7.5167E+05	2.1521E-02
3.9089E+05	9.2259E-04	7.5904E+05	1.2603E-02
3.9825E+05	1.1814E-03	7.6640E+05	7.4999E-03
4.0561E+05	1.7504E-03	7.7376E+05	4.5438E-03

PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 2
CONTAMINANT = NP-237
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+04
TIME HIGH= 5.800000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 9.000000E+01

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 7.8534E+05 MIN. TIME = 4.3019E+04
TOTAL WEIGHT = 2.3997E+04 TOTAL PARCELS = 7374.0
PEAK WEIGHT = 276.645 PEAK WEIGHT TIME = 4.4455E+04
PEAK PARCELS = 174.000 PEAK PARCELS TIME = 4.4725E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 1.5954E+04 NO. PARCELS HI = 2884.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 3.995163E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.311015E+04
PERCENT OF TOTAL INVENTORY = 57.845

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.607500E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 7.192517E-06
MAXIMUM RATE (CURIES/YEAR) = 1.866272E+00
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.3015E+04	5.3679E-01	5.0371E+04	1.7364E+00
4.3057E+04	5.3679E-01	5.0742E+04	1.7318E+00
4.3099E+04	5.3679E-01	5.1113E+04	1.7268E+00
4.3141E+04	6.1839E-01	5.1483E+04	1.7205E+00
4.3183E+04	7.1378E-01	5.1854E+04	1.7119E+00
4.3225E+04	7.6491E-01	5.2224E+04	1.7000E+00
4.3267E+04	7.9807E-01	5.2595E+04	1.6839E+00
4.3309E+04	8.3271E-01	5.2966E+04	1.6628E+00
4.3351E+04	8.6847E-01	5.3336E+04	1.6358E+00
4.3393E+04	8.9239E-01	5.3707E+04	1.6013E+00
4.3435E+04	9.0010E-01	5.4077E+04	1.5594E+00
4.3477E+04	9.1965E-01	5.4448E+04	1.5103E+00

4.3519E+04	9.7004E-01	5.4818E+04	1.4526E+00
4.3561E+04	1.0196E+00	5.5189E+04	1.3841E+00
4.3603E+04	1.0643E+00	5.5560E+04	1.2994E+00
4.3645E+04	1.1089E+00	5.5930E+04	1.2249E+00
4.3687E+04	1.1546E+00	5.6301E+04	1.1353E+00
4.3728E+04	1.2003E+00	5.6671E+04	1.0303E+00
4.3770E+04	1.2461E+00	5.7042E+04	8.7880E-01
4.3812E+04	1.2918E+00	5.7071E+04	8.6205E-01
4.3854E+04	1.3395E+30	5.7100E+04	8.4476E-01
4.3896E+04	1.3881E+00	5.7129E+04	8.2747E-01
4.3938E+04	1.4349E+00	5.7158E+04	8.0973E-01
4.3980E+04	1.4803E+00	5.7187E+04	7.9145E-01
4.4022E+04	1.5238E+00	5.7216E+04	7.7316E-01
4.4064E+04	1.5647E+00	5.7245E+04	7.5508E-01
4.4106E+04	1.6043E+00	5.7273E+04	7.3743E-01
4.4148E+04	1.6401E+00	5.7302E+04	7.1979E-01
4.4190E+04	1.6754E+00	5.7331E+04	7.0207E-01
4.4232E+04	1.7059E+00	5.7360E+04	6.8411E-01
4.4274E+04	1.7365E+00	5.7389E+04	6.6616E-01
4.4316E+04	1.7614E+00	5.7418E+04	6.4825E-01
4.4358E+04	1.7861E+00	5.7447E+04	6.3080E-01
4.4400E+04	1.7984E+00	5.7476E+04	6.1335E-01
4.4442E+04	1.8083E+00	5.7505E+04	5.9589E-01
4.4813E+04	1.8497E+00	5.7534E+04	5.7929E-01
4.5183E+04	1.8611E+00	5.7563E+04	5.6270E-01
4.5554E+04	1.8596E+00	5.7592E+04	5.4610E-01
4.5924E+04	1.8619E+00	5.7621E+04	5.4008E-01
4.6295E+04	1.8634E+00	5.7650E+04	5.3538E-01
4.6665E+04	1.8510E+00	5.7679E+04	5.3068E-01
4.7036E+04	1.8361E+00	5.7708E+04	5.1929E-01
4.7407E+04	1.8207E+00	5.7736E+04	5.0600E-01
4.7777E+04	1.8058E+00	5.7765E+04	4.9272E-01
4.8148E+04	1.7905E+00	5.7794E+04	4.8053E-01
4.8518E+04	1.7767E+00	5.7823E+04	4.6888E-01
4.8889E+04	1.7650E+00	5.7852E+04	4.5724E-01
4.9260E+04	1.7553E+00	5.7881E+04	4.4647E-01
4.9630E+04	1.7476E+00	5.7910E+04	4.3640E-01
5.0001E+04	1.7415E+00	5.7939E+04	4.2633E-01

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 PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = NP-237
  TONS OF HEAVY METAL FACTOR =  9.3000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   6.000000E+05
TIME HIGH=   7.500000E+05
NUMBER OF CELLS =            200
DELTA TIME INCREMENT =   7.500000E+02


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  7.8534E+05        MIN. TIME =  4.3019E+04
TOTAL WEIGHT =  1.4596E+04     TOTAL PARCELS =       2646.0
PEAK WEIGHT =      205.230     PEAK WEIGHT TIME =  6.9488E+05
PEAK PARCELS =      37.000     PEAK PARCELS TIME =  6.9488E+05
WT. LOW =  2.5093E+04          NO. PARCELS LOW =      7559.0
WT. HI =  2.6332E+02           NO. PARCELS HI =         53.0
 SMOOTHING WINDOW (CELLS)=     10


TOTAL INVENTORY (CURIES) =   3.995162E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   1.435759E+04
PERCENT OF TOTAL INVENTORY =  35.937

TIME OF MAXIMUM CONCENTRATION (YEARS) =   6.896250E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   6.881710E-07
MAXIMUM RATE (CURIES/YEAR) =   1.785626E-01
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06


 CONTAMINANT = NP-237

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
6.0188E+05	2.2939E-03	6.7575E+05	1.6352E-01
6.0335E+05	2.6687E-03	6.7723E+05	1.6640E-01
6.0483E+05	3.3367E-03	6.7871E+05	1.6904E-01
6.0631E+05	4.5626E-03	6.8018E+05	1.7141E-01
6.0779E+05	5.7629E-03	6.8166E+05	1.7347E-01
6.0926E+05	7.1545E-03	6.8314E+05	1.7521E-01
6.1074E+05	8.6743E-03	6.8462E+05	1.7660E-01
6.1222E+05	1.0263E-02	6.8609E+05	1.7763E-01
6.1370E+05	1.2017E-02	6.8757E+05	1.7828E-01
6.1517E+05	1.3940E-02	6.8905E+05	1.7855E-01
6.1665E+05	1.6034E-02	6.9053E+05	1.7844E-01

6.1813E+05	1.8296E-02	6.9200E+05	1.7793E-01
6.1961E+05	2.0735E-02	6.9348E+05	1.7705E-01
6.2108E+05	2.3358E-02	6.9496E+05	1.7579E-01
6.2256E+05	2.6164E-02	6.9644E+05	1.7418E-01
6.2404E+05	2.9155E-02	6.9791E+05	1.7220E-01
6.2552E+05	3.2331E-02	6.9939E+05	1.6986E-01
6.2699E+05	3.5690E-02	7.0087E+05	1.6721E-01
6.2847E+05	3.9230E-02	7.0235E+05	1.6421E-01
6.2995E+05	4.2946E-02	7.0382E+05	1.6091E-01
6.3143E+05	4.6829E-02	7.0530E+05	1.5734E-01
6.3290E+05	5.0868E-02	7.0678E+05	1.5350E-01
6.3438E+05	5.5051E-02	7.0826E+05	1.4945E-01
6.3586E+05	5.9360E-02	7.0973E+05	1.4519E-01
6.3734E+05	6.3775E-02	7.1121E+05	1.4077E-01
6.3881E+05	6.8272E-02	7.1269E+05	1.3621E-01
6.4029E+05	7.2823E-02	7.1417E+05	1.3156E-01
6.4177E+05	7.7397E-02	7.1564E+05	1.2684E-01
6.4325E+05	8.1966E-02	7.1712E+05	1.2208E-01
6.4472E+05	8.6497E-02	7.1860E+05	1.1730E-01
6.4620E+05	9.0964E-02	7.2008E+05	1.1252E-01
6.4768E+05	9.5344E-02	7.2155E+05	1.0773E-01
6.4916E+05	9.9616E-02	7.2303E+05	1.0295E-01
6.5063E+05	1.0377E-01	7.2451E+05	9.8184E-02
6.5211E+05	1.0779E-01	7.2599E+05	9.3419E-02
6.5359E+05	1.1169E-01	7.2746E+05	8.8650E-02
6.5507E+05	1.1547E-01	7.2894E+05	8.3860E-02
6.5654E+05	1.1914E-01	7.3042E+05	7.9036E-02
6.5802E+05	1.2274E-01	7.3190E+05	7.4163E-02
6.5950E+05	1.2627E-01	7.3337E+05	6.9243E-02
6.6098E+05	1.2975E-01	7.3485E+05	6.4270E-02
6.6245E+05	1.3322E-01	7.3633E+05	5.9186E-02
6.6393E+05	1.3668E-01	7.3781E+05	5.4018E-02
6.6541E+05	1.4014E-01	7.3928E+05	4.8810E-02
6.6689E+05	1.4361E-01	7.4076E+05	4.3619E-02
6.6836E+05	1.4708E-01	7.4224E+05	3.8403E-02
6.6984E+05	1.5052E-01	7.4372E+05	3.2413E-02
6.7132E+05	1.5392E-01	7.4519E+05	2.6899E-02
6.7280E+05	1.5724E-01	7.4667E+05	2.1875E-02
6.7427E+05	1.6045E-01	7.4815E+05	1.7339E-02

PLTCVT PROGRAM DATA SUMMARY
PIR 5(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 2
CONTAMINANT = U-233
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 2.000000E+06
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 4.975000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 7.8623E+05   MIN. TIME = 4.3895E+04
TOTAL WEIGHT = 3.1540E+04   TOTAL PARCELS = 37687.0
PEAK WEIGHT = 678.911   PEAK WEIGHT TIME = 6.2939E+05
PEAK PARCELS = 1581.000   PEAK PARCELS TIME = 3.2591E+05
WT. LOW = 0.0000E-01   NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01   NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 3.154041E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 3.155322E+04
PERCENT OF TOTAL INVENTORY = 100.041

TIME OF MAXIMUM CONCENTRATION (YEARS) = 6.343625E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 4.932845E-07
MAXIMUM RATE (CURIES/YEAR) = 1.279946E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = U-233

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.2338E+04	5.5905E-03	3.1847E+05	1.1044E-02
4.2570E+04	5.5905E-03	3.3523E+05	1.4682E-02
4.2802E+04	5.5905E-03	3.5200E+05	2.0296E-02
4.3034E+04	5.5905E-03	3.6876E+05	2.7990E-02
4.3266E+04	5.5905E-03	3.8553E+05	3.6038E-02
4.3498E+04	5.5905E-03	4.0229E+05	4.3184E-02
4.3731E+04	5.5905E-03	4.1906E+05	4.8155E-02
4.3963E+04	5.5905E-03	4.3582E+05	5.1356E-02
4.4195E+04	5.5905E-03	4.5259E+05	5.4558E-02
4.4427E+04	5.5905E-03	4.6935E+05	5.8227E-02
4.4659E+04	5.5905E-03	4.8611E+05	6.3703E-02
4.4892E+04	5.5905E-03	5.0288E+05	6.9704E-02

4.5124E+04	5.5905E-03	5.1964E+05	7.6080E-02
4.5356E+04	5.5905E-03	5.3641E+05	8.2671E-02
4.5588E+04	5.5905E-03	5.5317E+05	8.9279E-02
4.5820E+04	5.5905E-03	5.6994E+05	9.6579E-02
4.6053E+04	5.5905E-03	5.8670E+05	1.0504E-01
4.6285E+04	5.5905E-03	6.0347E+05	1.1432E-01
4.6517E+04	5.5905E-03	6.2023E+05	1.2403E-01
4.6749E+04	5.5905E-03	6.2534E+05	1.2601E-01
4.6981E+04	5.5905E-03	6.3045E+05	1.2741E-01
4.7214E+04	5.5905E-03	6.3556E+05	1.2782E-01
4.7446E+04	5.6839E-03	6.4067E+05	1.2695E-01
4.7678E+04	5.8464E-03	6.4578E+05	1.2534E-01
4.7910E+04	6.0090E-03	6.5088E+05	1.2215E-01
4.8142E+04	6.1715E-03	6.5599E+05	1.1733E-01
4.8375E+04	6.3341E-03	6.6110E+05	1.1193E-01
4.8607E+04	6.4966E-03	6.6621E+05	1.0663E-01
4.8839E+04	6.6592E-03	6.7132E+05	1.0050E-01
4.9071E+04	6.8217E-03	6.7643E+05	9.4064E-02
4.9303E+04	6.9843E-03	6.8154E+05	8.7573E-02
4.9536E+04	7.1468E-03	6.8665E+05	8.0114E-02
4.9768E+04	7.3094E-03	6.9175E+05	7.1311E-02
5.0000E+04	7.4719E-03	6.9686E+05	6.2259E-02
5.0232E+04	7.6345E-03	7.0197E+05	5.3415E-02
6.6997E+04	1.3149E-02	7.0708E+05	4.4587E-02
8.3762E+04	1.6089E-02	7.1219E+05	3.6458E-02
1.0053E+05	1.5969E-02	7.1730E+05	2.9429E-02
1.1729E+05	1.4805E-02	7.2241E+05	2.3252E-02
1.3406E+05	1.3536E-02	7.2751E+05	1.7704E-02
1.5082E+05	1.2586E-02	7.3262E+05	1.3231E-02
1.6759E+05	1.1567E-02	7.3773E+05	9.5825E-03
1.8435E+05	1.0786E-02	7.4284E+05	6.6690E-03
2.0111E+05	1.0018E-02	7.4795E+05	4.4501E-03
2.1788E+05	9.3940E-03	7.5306E+05	2.9788E-03
2.3464E+05	8.9217E-03	7.5817E+05	1.9641E-03
2.5141E+05	8.5909E-03	7.6328E+05	1.2859E-03
2.6817E+05	8.3239E-03	7.6838E+05	8.4047E-04
2.8494E+05	8.3930E-03	7.7349E+05	5.4705E-04
3.0170E+05	9.1663E-03	7.7860E+05	3.3470E-04

PLTCVT PROGRAM DATA SUMMARY
PIR 5 Chain 2
CONTAMINANT = TH-229
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 1.000000E+04
TIME HIGH= 1.000000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 4.950000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.0945E+06 MIN. TIME = 4.6923E+04
TOTAL WEIGHT = 1.0800E+03 TOTAL PARCELS = 2081.0
PEAK WEIGHT = 105.571 PEAK WEIGHT TIME = 6.1638E+05
PEAK PARCELS = 31.000 PEAK PARCELS TIME = 7.6983E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 1.2640E-10 NO. PARCELS HI = 52.0
SMOOTHING WINDOW (CELLS)= 7

TOTAL INVENTORY (CURIES) = 1.080000E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.068648E+03
PERCENT OF TOTAL INVENTORY = 98.949

TIME OF MAXIMUM CONCENTRATION (YEARS) = 6.213250E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.954749E-08
MAXIMUM RATE (CURIES/YEAR) = 5.072067E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = TH-229

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.7125E+04	2.2557E-04	5.2233E+05	1.6589E-03
5.6629E+04	2.6245E-04	5.3183E+05	1.9387E-03
6.6133E+04	3.4218E-04	5.4133E+05	2.2879E-03
7.5637E+04	4.2441E-04	5.5084E+05	2.6986E-03
8.5141E+04	5.0586E-04	5.6034E+05	3.1674E-03
9.4645E+04	5.5602E-04	5.6985E+05	3.6566E-03
1.0415E+05	5.8805E-04	5.7935E+05	4.1118E-03
1.1365E+05	6.0385E-04	5.8885E+05	4.5001E-03
1.2316E+05	6.0366E-04	5.9836E+05	4.7922E-03
1.3266E+05	5.9172E-04	6.0786E+05	4.9827E-03
1.4217E+05	5.7189E-04	6.1737E+05	5.0661E-03
1.5167E+05	5.4657E-04	6.2687E+05	5.0400E-03

1.6117E+05	5.1886E-04	6.3637E+05	4.8845E-03
1.7068E+05	4.8890E-04	6.4588E+05	4.6267E-03
1.8018E+05	4.5918E-04	6.5538E+05	4.3061E-03
1.8969E+05	4.3296E-04	6.6489E+05	3.9560E-03
1.9919E+05	4.0889E-04	6.7439E+05	3.5846E-03
2.0869E+05	3.8608E-04	6.8389E+05	3.1953E-03
2.1820E+05	3.6558E-04	6.9340E+05	2.7902E-03
2.2770E+05	3.4638E-04	7.0290E+05	2.3803E-03
2.3721E+05	3.2961E-04	7.1241E+05	1.9943E-03
2.4671E+05	3.1577E-04	7.2191E+05	1.6382E-03
2.5621E+05	3.0386E-04	7.3141E+05	1.3114E-03
2.6572E+05	2.9368E-04	7.4092E+05	1.0147E-03
2.7522E+05	2.8747E-04	7.5042E+05	7.5684E-04
2.8473E+05	2.8906E-04	7.5993E+05	5.4163E-04
2.9423E+05	2.9919E-04	7.6943E+05	3.7496E-04
3.0373E+05	3.1812E-04	7.7893E+05	2.5249E-04
3.1324E+05	3.4489E-04	7.8844E+05	1.6414E-04
3.2274E+05	3.8046E-04	7.9794E+05	1.0166E-04
3.3225E+05	4.2547E-04	8.0745E+05	6.0532E-05
3.4175E+05	4.8028E-04	8.1695E+05	3.4179E-05
3.5125E+05	5.4327E-04	8.2645E+05	1.8014E-05
3.6076E+05	6.0440E-04	8.3596E+05	9.1895E-06
3.7026E+05	6.6329E-04	8.4546E+05	4.4986E-06
3.7977E+05	7.2237E-04	8.5497E+05	2.1711E-06
3.8927E+05	7.8243E-04	8.6447E+05	9.6992E-07
3.9877E+05	8.3822E-04	8.7397E+05	4.2124E-07
4.0828E+05	8.8776E-04	8.8348E+05	1.8053E-07
4.1778E+05	9.2831E-04	8.9298E+05	7.7287E-08
4.2729E+05	9.5998E-04	9.0249E+05	2.9499E-08
4.3679E+05	9.9454E-04	9.1199E+05	4.1298E-09
4.4629E+05	1.0286E-03	9.2149E+05	0.0000E-01
4.5580E+05	1.0576E-03	9.3100E+05	0.0000E-01
4.6530E+05	1.0817E-03	9.4050E+05	0.0000E-01
4.7481E+05	1.1085E-03	9.5001E+05	0.0000E-01
4.8431E+05	1.1437E-03	9.5951E+05	1.0030E-08
4.9381E+05	1.2002E-03	9.6901E+05	0.0000E-01
5.0332E+05	1.3008E-03	9.7852E+05	0.0000E-01
5.1282E+05	1.4477E-03	9.8802E+05	0.0000E-01

PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 3
CONTAMINANT = U-238
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 2.900000E+05
TIME HIGH= 4.500000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 4.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9999E+06 MIN. TIME = 2.9769E+05
TOTAL WEIGHT = 1.2231E+04 TOTAL PARCELS = 6690.0
PEAK WEIGHT = 137.292 PEAK WEIGHT TIME = 3.3340E+05
PEAK PARCELS = 68.000 PEAK PARCELS TIME = 3.3340E+05
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 4.2393E+00 NO. PARCELS HI = 7518.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 1.223524E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.220619E+04
PERCENT OF TOTAL INVENTORY = 99.763

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.342000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 9.908181E-07
MAXIMUM RATE (CURIES/YEAR) = 2.570916E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = U-238

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.9780E+05	1.6942E-03	3.8631E+05	6.9038E-02
2.9999E+05	2.2923E-03	3.8719E+05	6.8728E-02
3.0218E+05	3.8835E-03	3.8807E+05	6.8376E-02
3.0436E+05	7.3494E-03	3.8895E+05	6.7985E-02
3.0655E+05	1.3576E-02	3.8983E+05	6.7551E-02
3.0874E+05	2.3260E-02	3.9072E+05	6.7076E-02
3.1093E+05	3.6290E-02	3.9160E+05	6.6563E-02
3.1312E+05	5.2227E-02	3.9248E+05	6.6014E-02
3.1530E+05	7.0537E-02	3.9336E+05	6.5429E-02
3.1749E+05	9.1096E-02	3.9425E+05	6.4814E-02
3.1968E+05	1.1523E-01	3.9513E+05	6.4167E-02
3.2187E+05	1.4475E-01	3.9601E+05	6.3486E-02

3.2405E+05	1.7843E-01	3.9689E+05	6.2766E-02
3.2624E+05	2.1051E-01	3.9778E+05	6.2008E-02
3.2843E+05	2.3481E-01	3.9866E+05	6.1198E-02
3.3062E+05	2.4942E-01	3.9954E+05	6.0332E-02
3.3281E+05	2.5597E-01	4.0042E+05	5.9403E-02
3.3499E+05	2.5682E-01	4.0193E+05	5.7647E-02
3.3718E+05	2.5285E-21	4.0344E+05	5.5660E-02
3.3937E+05	2.4410E-01	4.0495E+05	5.3430E-02
3.4156E+05	2.3044E-01	4.0646E+05	5.0973E-02
3.4375E+05	2.1230E-01	4.0797E+05	4.8317E-02
3.4593E+05	1.9050E-01	4.0948E+05	4.5504E-02
3.4812E+05	1.6694E-01	4.1099E+05	4.2588E-02
3.5031E+05	1.4499E-01	4.1250E+05	3.9614E-02
3.5250E+05	1.2744E-01	4.1400E+05	3.6622E-02
3.5468E+05	1.1391E-01	4.1551E+05	3.3639E-02
3.5687E+05	1.0183E-01	4.1702E+05	3.0695E-02
3.5906E+05	8.9942E-02	4.1853E+05	2.7813E-02
3.6125E+05	7.9534E-02	4.2004E+05	2.5008E-02
3.6344E+05	7.2187E-02	4.2155E+05	2.2298E-02
3.6562E+05	6.8292E-02	4.2306E+05	1.9706E-02
3.6781E+05	6.7316E-02	4.2457E+05	1.7237E-02
3.7000E+05	6.8126E-02	4.2608E+05	1.4919E-02
3.7219E+05	6.9140E-02	4.2759E+05	1.2765E-02
3.7307E+05	6.9498E-02	4.2910E+05	1.0779E-02
3.7395E+05	6.9806E-02	4.3060E+05	8.9757E-03
3.7483E+05	7.0047E-02	4.3211E+05	7.3720E-03
3.7572E+05	7.0232E-02	4.3362E+05	5.9670E-03
3.7660E+05	7.0357E-02	4.3513E+05	4.7624E-03
3.7748E+05	7.0421E-02	4.3664E+05	3.7481E-03
3.7836E+05	7.0434E-02	4.3815E+05	2.9251E-03
3.7925E+05	7.0403E-02	4.3966E+05	2.2710E-03
3.8013E+05	7.0334E-02	4.4117E+05	1.7655E-03
3.8101E+05	7.0235E-02	4.4268E+05	1.3927E-03
3.8189E+05	7.0105E-02	4.4419E+05	1.1144E-03
3.8278E+05	6.9945E-02	4.4570E+05	9.2977E-04
3.8366E+05	6.9766E-02	4.4720E+05	8.3881E-04
3.8454E+05	6.9556E-02	4.4871E+05	7.4549E-04
3.8542E+05	6.9317E-02	4.5022E+05	6.7679E-04

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PLTCVT PROGRAM DATA SUMMARY
PIRS(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 3
CONTAMINANT = U-234
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =   2
TIME LOW =   2.500000E+05
TIME HIGH=   5.000000E+05
NUMBER OF CELLS =            400
DELTA TIME INCREMENT =   6.250000E+02


 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.9990E+06       MIN. TIME =  2.8674E+05
TOTAL WEIGHT =  3.3895E+04   TOTAL PARCELS =       13214.0
PEAK WEIGHT =      596.715   PEAK WEIGHT TIME =  3.3844E+05
PEAK PARCELS =      138.000  PEAK PARCELS TIME =  3.3469E+05
WT. LOW =  0.0000E-01        NO. PARCELS LOW =          0.0
WT. HI =  2.2189E+00         NO. PARCELS HI =       6655.0
 SMOOTHING WINDOW (CELLS)=      5


TOTAL INVENTORY (CURIES) =   3.389698E+04
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   3.389454E+04
PERCENT OF TOTAL INVENTORY =  99.993

TIME OF MAXIMUM CONCENTRATION (YEARS) =   3.353125E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   2.840388E-06
MAXIMUM RATE (CURIES/YEAR) =   7.370073E-01
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06


 CONTAMINANT = U-234

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
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TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.8656E+05	2.7867E-04	3.9313E+05	1.7313E-01
2.8869E+05	5.7557E-04	3.9526E+05	1.6840E-01
2.9083E+05	1.2904E-03	3.9739E+05	1.6224E-01
2.9296E+05	2.4351E-03	3.9952E+05	1.5580E-01
2.9509E+05	4.1779E-03	4.0165E+05	1.4981E-01
2.9722E+05	6.7329E-03	4.0378E+05	1.4403E-01
2.9935E+05	1.0593E-02	4.0591E+05	1.3775E-01
3.0148E+05	1.6617E-02	4.0804E+05	1.3020E-01
3.0361E+05	2.6438E-02	4.1018E+05	1.2100E-01
3.0574E+05	4.2110E-02	4.1231E+05	1.1009E-01
3.0788E+05	6.5864E-02	4.1444E+05	9.7529E-02
3.1001E+05	9.9575E-02	4.1657E+05	8.3805E-02

3,1214E+05	1,4364E-01	4,1870E+05	6,9784E-02
3,1427E+05	1,9751E-01	4,2083E+05	5,6544E-02
3,1640E+05	2,5897E-01	4,2296E+05	4,4943E-02
3,1853E+05	3,2533E-01	4,2509E+05	3,5243E-02
3,2066E+05	3,9390E-01	4,2723E+05	2,7251E-02
3,2279E+05	4,6274E-01	4,2936E+05	2,0682E-02
3,2493E+05	5,3009E-01	4,3149E+05	1,5257E-02
3,2706E+05	5,9402E-01	4,3362E+05	1,0886E-02
3,2919E+05	6,5096E-01	4,3575E+05	7,4452E-03
3,3132E+05	6,9661E-01	4,3788E+05	4,8518E-03
3,3345E+05	7,2665E-01	4,4001E+05	3,0024E-03
3,3558E+05	7,3696E-01	4,4214E+05	1,7510E-03
3,3771E+05	7,2620E-01	4,4428E+05	9,6541E-04
3,3984E+05	6,9430E-01	4,4641E+05	4,8803E-04
3,4198E+05	6,4484E-01	4,4854E+05	2,2867E-04
3,4411E+05	5,8401E-01	4,5067E+05	1,0576E-04
3,4624E+05	5,1933E-01	4,5280E+05	4,5612E-05
3,4837E+05	4,5726E-01	4,5493E+05	2,4958E-05
3,5050E+05	4,0191E-01	4,5706E+05	1,5859E-05
3,5263E+05	3,5434E-01	4,5919E+05	1,4310E-05
3,5476E+05	3,1432E-01	4,6133E+05	6,6455E-06
3,5689E+05	2,8103E-01	4,6346E+05	2,2655E-07
3,5903E+05	2,5325E-01	4,6559E+05	5,8903E-06
3,6116E+05	2,3007E-01	4,6772E+05	6,9853E-06
3,6329E+05	2,1067E-01	4,6985E+05	4,7576E-06
3,6542E+05	1,9526E-01	4,7198E+05	6,3057E-06
3,6755E+05	1,8442E-01	4,7411E+05	4,0779E-06
3,6968E+05	1,7820E-01	4,7624E+05	3,7758E-06
3,7181E+05	1,7580E-01	4,7838E+05	1,1328E-06
3,7394E+05	1,7531E-01	4,8051E+05	2,6053E-06
3,7608E+05	1,7511E-01	4,8264E+05	6,4945E-06
3,7821E+05	1,7442E-01	4,8477E+05	3,7758E-06
3,8034E+05	1,7348E-01	4,8690E+05	5,8148E-06
3,8247E+05	1,7303E-01	4,8903E+05	7,3629E-06
3,8460E+05	1,7349E-01	4,9116E+05	1,3593E-06
3,8673E+05	1,7475E-01	4,9329E+05	0,0000E-01
3,8886E+05	1,7584E-01	4,9543E+05	1,0648E-05
3,9099E+05	1,7562E-01	4,9756E+05	1,5481E-06

PLTCVT PROGRAM DATA SUMMARY
PIR 5(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 3
CONTAMINANT = TH-230
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 2.900000E+05
TIME HIGH= 1.000000E+06
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 3.550000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 1.9992E+06   MIN. TIME = 2.9259E+05
TOTAL WEIGHT = 1.0659E+03   TOTAL PARCELS = 1604.0
PEAK WEIGHT = 47.420   PEAK WEIGHT TIME = 3.3793E+05
PEAK PARCELS = 18.000   PEAK PARCELS TIME = 7.0003E+05
WT. LOW = 0.0000E-01   NO. PARCELS LOW = 0.0
WT. HI = 2.3801E+00   NO. PARCELS HI = 1317.0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 1.068286E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1.087266E+03
PERCENT OF TOTAL INVENTORY = 101.777

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.769750E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.434547E-08
MAXIMUM RATE (CURIES/YEAR) = 6.317019E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = TH-230

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.9178E+05	2.7775E-05	4.5034E+05	3.4967E-03
2.9505E+05	2.7775E-05	4.5328E+05	3.4470E-03
2.9833E+05	8.5651E-05	4.5622E+05	3.3977E-03
3.0161E+05	1.7012E-04	4.5916E+05	3.3480E-03
3.0489E+05	2.6452E-04	4.6210E+05	3.2984E-03
3.0817E+05	4.3362E-04	4.6504E+05	3.2525E-03
3.1145E+05	7.0173E-04	4.6799E+05	3.2088E-03
3.1473E+05	1.0668E-03	4.7093E+05	3.1637E-03
3.1801E+05	1.5141E-03	4.7387E+05	3.1221E-03
3.2129E+05	2.0298E-03	4.7681E+05	3.0777E-03
3.2457E+05	2.6086E-03	4.7975E+05	3.0326E-03
3.2785E+05	3.2211E-03	4.8269E+05	2.9872E-03

3.3113E+05	3.8269E-03	4.8563E+05	2.9415E-03
3.3441E+05	4.3605E-03	4.8857E+05	2.8954E-03
3.3769E+05	4.7497E-03	4.9151E+05	2.8488E-03
3.4097E+05	5.0143E-03	4.9446E+05	2.8013E-03
3.4425E+05	5.1947E-03	4.9740E+05	2.7525E-03
3.4753E+05	5.3039E-03	5.0034E+05	2.7020E-03
3.5081E+05	5.3534E-03	5.1544E+05	2.4229E-03
3.5409E+05	5.3782E-03	5.3053E+05	2.1278E-03
3.5737E+05	5.4172E-03	5.4563E+05	1.8458E-03
3.6065E+05	5.5124E-03	5.6073E+05	1.5832E-03
3.6392E+05	5.6804E-03	5.7583E+05	1.3533E-03
3.6720E+05	5.8901E-03	5.9092E+05	1.1625E-03
3.7048E+05	6.0937E-03	6.0602E+05	1.0083E-03
3.7376E+05	6.2396E-03	6.2112E+05	8.8504E-04
3.7704E+05	6.3165E-03	6.3622E+05	7.9328E-04
3.8032E+05	6.2895E-03	6.5132E+05	7.2372E-04
3.8360E+05	6.1836E-03	6.6641E+05	6.6451E-04
3.8688E+05	5.9869E-03	6.8151E+05	6.0480E-04
3.9016E+05	5.7324E-03	6.9661E+05	5.3709E-04
3.9344E+05	5.4449E-03	7.1171E+05	4.5839E-04
3.9672E+05	5.1618E-03	7.2680E+05	3.7627E-04
4.0000E+05	4.9423E-03	7.4190E+05	2.9946E-04
4.0328E+05	4.7891E-03	7.5700E+05	2.3683E-04
4.0622E+05	4.6722E-03	7.7210E+05	1.9088E-04
4.0916E+05	4.5594E-03	7.8720E+05	1.6008E-04
4.1210E+05	4.4596E-03	8.0229E+05	1.4026E-04
4.1504E+05	4.3709E-03	8.1739E+05	1.2775E-04
4.1799E+05	4.2885E-03	8.3249E+05	1.1769E-04
4.2093E+05	4.2119E-03	8.4759E+05	1.0840E-04
4.2387E+05	4.1303E-03	8.6268E+05	9.9465E-05
4.2681E+05	4.0229E-03	8.7778E+05	9.0433E-05
4.2975E+05	3.9328E-03	8.9288E+05	8.0943E-05
4.3269E+05	3.8521E-03	9.0798E+05	7.1558E-05
4.3563E+05	3.7809E-03	9.2308E+05	6.2699E-05
4.3857E+05	3.7164E-03	9.3817E+05	5.4751E-05
4.4151E+05	3.6560E-03	9.5327E+05	4.8039E-05
4.4446E+05	3.5997E-03	9.6837E+05	4.4354E-05
4.4740E+05	3.5473E-03	9.8347E+05	4.0307E-05

PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE; CHAIN 3
CONTAMINANT = RA-226
TONS OF HEAVY METAL FACTOR = 0,5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 2,000000E+05
TIME HIGH= 1,000000E+06
NUMBER OF CELLS = 100
DELTA TIME INCREMENT = 8,000000E+03

RAW DATA AND BLOCKED DATA FACTORS:
MAX, TIME = 1,9984E+06 MIN, TIME = 2,9492E+05
TOTAL WEIGHT = 1,7290E+03 TOTAL PARCELS = 1872,0
PEAK WEIGHT = 111,036 PEAK WEIGHT TIME = 4,1200E+05
PEAK PARCELS = 68,000 PEAK PARCELS TIME = 4,9200E+05
WT, LOW = 0,0000E-01 NO, PARCELS LOW = 0,0
WT, HI = 7,9568E-01 NO, PARCELS HI = 186,0
SMOOTHING WINDOW (CELLS)= 10

TOTAL INVENTORY (CURIES) = 1,729819E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 1,697821E+03
PERCENT OF TOTAL INVENTORY = 98,150

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3,800000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 3,016919E-08
MAXIMUM RATE (CURIES/YEAR) = 7,828124E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 3,853949E-06

CONTAMINANT = RA-226

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2,9200E+05	2,3162E-04	4,6940E+05	6,2515E-03
2,9376E+05	2,3162E-04	4,7676E+05	6,0227E-03
2,9552E+05	2,3162E-04	4,8411E+05	5,7836E-03
2,9727E+05	2,3162E-04	4,9146E+05	5,5420E-03
2,9903E+05	2,3162E-04	4,9882E+05	5,2895E-03
3,0079E+05	3,0331E-04	5,0617E+05	5,0270E-03
3,0255E+05	4,6323E-04	5,1352E+05	4,7581E-03
3,0430E+05	6,2316E-04	5,2087E+05	4,4890E-03
3,0606E+05	7,8309E-04	5,2823E+05	4,2218E-03
3,0782E+05	9,4301E-04	5,3558E+05	3,9556E-03
3,0958E+05	1,1198E-03	5,4293E+05	3,6919E-03
3,1133E+05	1,2984E-03	5,5029E+05	3,4360E-03

3.1309E+05	1.4771E-03	5.5764E+05	3.1908E-03
3.1485E+05	1.6558E-03	5.6499E+05	2.9493E-03
3.1661E+05	1.8682E-03	5.7235E+05	2.7124E-03
3.1836E+05	2.1440E-03	5.7970E+05	2.4825E-03
3.2012E+05	2.4214E-03	5.8705E+05	2.2775E-03
3.2188E+05	2.6980E-03	5.9440E+05	2.0859E-03
3.2364E+05	2.9746E-03	6.0176E+05	1.9028E-03
3.2539E+05	3.3016E-03	6.1376E+05	1.6127E-03
3.2715E+05	3.6418E-03	6.2576E+05	1.3496E-03
3.2891E+05	3.9820E-03	6.3776E+05	1.1138E-03
3.3067E+05	4.3222E-03	6.4976E+05	9.0107E-04
3.3242E+05	4.6534E-03	6.6176E+05	7.2461E-04
3.3418E+05	4.9562E-03	6.7376E+05	5.8123E-04
3.3594E+05	5.2591E-03	6.8576E+05	4.6166E-04
3.3770E+05	5.5619E-03	6.9776E+05	3.6602E-04
3.3945E+05	5.8648E-03	7.0976E+05	2.8953E-04
3.4121E+05	6.1423E-03	7.2176E+05	2.2454E-04
3.4297E+05	6.4085E-03	7.3376E+05	1.7658E-04
3.4473E+05	6.6747E-03	7.4576E+05	1.3899E-04
3.4648E+05	6.9408E-03	7.5776E+05	1.0582E-04
3.4824E+05	7.1831E-03	7.6976E+05	7.6718E-05
3.5000E+05	7.2756E-03	7.8176E+05	5.4645E-05
3.5176E+05	7.3681E-03	7.9376E+05	4.2820E-05
3.5911E+05	7.6588E-03	8.0576E+05	3.6559E-05
3.6646E+05	7.7780E-03	8.1776E+05	3.2832E-05
3.7382E+05	7.8122E-03	8.2976E+05	2.9608E-05
3.8117E+05	7.8217E-03	8.4176E+05	2.6655E-05
3.8852E+05	7.7784E-03	8.5376E+05	2.3932E-05
3.9587E+05	7.6981E-03	8.6576E+05	2.1219E-05
4.0323E+05	7.5706E-03	8.7776E+05	1.8827E-05
4.1058E+05	7.4260E-03	8.8976E+05	1.7110E-05
4.1793E+05	7.4083E-03	9.0176E+05	1.5625E-05
4.2529E+05	7.3634E-03	9.1376E+05	1.4399E-05
4.3264E+05	7.2426E-03	9.2576E+05	1.5160E-05
4.3999E+05	7.0841E-03	9.3776E+05	1.4657E-05
4.4735E+05	6.9055E-03	9.4976E+05	1.4191E-05
4.5470E+05	6.7003E-03	9.6176E+05	1.3609E-05
4.6205E+05	6.4780E-03	9.7376E+05	1.2728E-05

PLTCVT PROGRAM DATA SUMMARY
PIR 5(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = AM-243
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 4.000000E+04
TIME HIGH= 6.000000E+04
NUMBER OF CELLS = 200
DELTA TIME INCREMENT = 1.000000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 5.7928E+04 MIN. TIME = 4.3119E+04
TOTAL WEIGHT = 3.0762E+03 TOTAL PARCELS = 3174.0
PEAK WEIGHT = 56.982 PEAK WEIGHT TIME = 4.4750E+04
PEAK PARCELS = 38.000 PEAK PARCELS TIME = 4.4750E+04
WT. LOW = 0.0000E-01 NO. PARCELS LOW = 0.0
WT. HI = 0.0000E-01 NO. PARCELS HI = 0.0
SMOOTHING WINDOW (CELLS)= 5

TOTAL INVENTORY (CURIES) = 3.076162E+03
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 2.985438E+03
PERCENT OF TOTAL INVENTORY = 97.051

TIME OF MAXIMUM CONCENTRATION (YEARS) = 4.515000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 1.495393E-06
MAXIMUM RATE (CURIES/YEAR) = 3.880158E-01
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = AM-243

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
4.3150E+04	7.9740E-02	5.0550E+04	1.9657E-01
4.3298E+04	9.0296E-02	5.0698E+04	1.9406E-01
4.3446E+04	1.2494E-01	5.0846E+04	1.9150E-01
4.3594E+04	1.6453E-01	5.0994E+04	1.8896E-01
4.3742E+04	2.0777E-01	5.1142E+04	1.8645E-01
4.3890E+04	2.4328E-01	5.1290E+04	1.8401E-01
4.4038E+04	2.7642E-01	5.1438E+04	1.8167E-01
4.4186E+04	3.0594E-01	5.1586E+04	1.7945E-01
4.4334E+04	3.3104E-01	5.1734E+04	1.7737E-01
4.4482E+04	3.5132E-01	5.1882E+04	1.7542E-01
4.4630E+04	3.6714E-01	5.2030E+04	1.7336E-01
4.4778E+04	3.7822E-01	5.2178E+04	1.7179E-01

4.4926E+04	3.8498E-01	5.2326E+04	1.7008E-01
4.5074E+04	3.8781E-01	5.2474E+04	1.6840E-01
4.5222E+04	3.8719E-01	5.2622E+04	1.6673E-01
4.5370E+04	3.8383E-01	5.2770E+04	1.6506E-01
4.5518E+04	3.7825E-01	5.2918E+04	1.6335E-01
4.5666E+04	3.7121E-01	5.3066E+04	1.6161E-01
4.5814E+04	3.6317E-01	5.3214E+04	1.5983E-01
4.5962E+04	3.5470E-01	5.3362E+04	1.5799E-01
4.6110E+04	3.4609E-01	5.3510E+04	1.5610E-01
4.6258E+04	3.3759E-01	5.3658E+04	1.5415E-01
4.6406E+04	3.2934E-01	5.3806E+04	1.5208E-01
4.6554E+04	3.2135E-01	5.3954E+04	1.4989E-01
4.6702E+04	3.1366E-01	5.4102E+04	1.4753E-01
4.6850E+04	3.0618E-01	5.4250E+04	1.4499E-01
4.6998E+04	2.9893E-01	5.4398E+04	1.4218E-01
4.7146E+04	2.9184E-01	5.4546E+04	1.3913E-01
4.7294E+04	2.8500E-01	5.4694E+04	1.3575E-01
4.7442E+04	2.7840E-01	5.4842E+04	1.3211E-01
4.7590E+04	2.7213E-01	5.4990E+04	1.2819E-01
4.7738E+04	2.6618E-01	5.5138E+04	1.2404E-01
4.7886E+04	2.6060E-01	5.5286E+04	1.1968E-01
4.8034E+04	2.5535E-01	5.5434E+04	1.1517E-01
4.8182E+04	2.5042E-01	5.5582E+04	1.1053E-01
4.8330E+04	2.4575E-01	5.5730E+04	1.0578E-01
4.8478E+04	2.4126E-01	5.5878E+04	1.0091E-01
4.8626E+04	2.3693E-01	5.6026E+04	9.5905E-02
4.8774E+04	2.3273E-01	5.6174E+04	9.0706E-02
4.8922E+04	2.2866E-01	5.6322E+04	8.5268E-02
4.9070E+04	2.2476E-01	5.6470E+04	7.9548E-02
4.9218E+04	2.2107E-01	5.6618E+04	7.3485E-02
4.9366E+04	2.1760E-01	5.6766E+04	6.7098E-02
4.9514E+04	2.1441E-01	5.6914E+04	6.0400E-02
4.9662E+04	2.1147E-01	5.7062E+04	5.3423E-02
4.9810E+04	2.0877E-01	5.7210E+04	4.6231E-02
4.9958E+04	2.0623E-01	5.7358E+04	3.9046E-02
5.0106E+04	2.0380E-01	5.7506E+04	3.1638E-02
5.0254E+04	2.0141E-01	5.7654E+04	2.4121E-02
5.0402E+04	1.9901E-01	5.7802E+04	1.7697E-02

```
 PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = PU-239
  TONS OF HEAVY METAL FACTOR =  0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE =    2
TIME LOW =   1.000000E+04
TIME HIGH=   2.000000E+05
NUMBER OF CELLS =             10
DELTA TIME INCREMENT =   1.900000E+04

 RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME =  1.7387E+05      MIN. TIME =  4.8134E+04
TOTAL WEIGHT =  9.2658E+00   TOTAL PARCELS =          20.0
PEAK WEIGHT =        4.418   PEAK WEIGHT TIME =  5.7500E+04
PEAK PARCELS =       8.000   PEAK PARCELS TIME =  7.6500E+04
WT. LOW =  0.0000E-01        NO. PARCELS LOW =          0.0
WT. HI =  0.0000E-01         NO. PARCELS HI =          0.0
 SMOOTHING WINDOW (CELLS)=      0

TOTAL INVENTORY (CURIES) =   9.265795E+00
INVENTORY UNDER THE CURRENT GRAPH (CURIES) =   8.188638E+00
PERCENT OF TOTAL INVENTORY =  88.375

TIME OF MAXIMUM CONCENTRATION (YEARS) =   5.750000E+04
MAXIMUM CONCENTRATION (MICROCURIES/ML) =   6.775651E-10
MAXIMUM RATE (CURIES/YEAR) =   1.758106E-04
CONVERSION FACTOR RATE TO CONCENTRATION =   3.853949E-06


 CONTAMINANT = PU-239

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE   100 POINTS
```

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
5.7500E+04	1.7581E-04	1.1450E+05	3.4857E-09
5.8640E+04	1.7581E-04	1.1564E+05	2.0065E-06
5.9780E+04	1.7581E-04	1.1678E+05	4.0096E-06
6.0920E+04	1.7581E-04	1.1792E+05	6.0126E-06
6.2060E+04	1.7581E-04	1.1906E+05	8.0157E-06
6.3200E+04	1.7581E-04	1.2020E+05	1.0019E-05
6.4340E+04	1.7581E-04	1.2134E+05	1.2022E-05
6.5480E+04	1.7581E-04	1.2248E+05	1.4025E-05
6.6620E+04	1.7581E-04	1.2362E+05	1.6028E-05
6.7760E+04	1.7581E-04	1.2476E+05	1.8031E-05
6.8900E+04	1.7581E-04	1.2590E+05	2.0034E-05
7.0040E+04	1.7581E-04	1.2704E+05	2.2037E-05

7,1180E+04	1,7581E-04	1,2818E+05	2,4040E-05
7,2320E+04	1,7581E-04	1,2932E+05	2,6043E-05
7,3460E+04	1,7581E-04	1,3046E+05	2,8046E-05
7,4600E+04	1,7581E-04	1,3160E+05	3,0049E-05
7,5740E+04	1,7581E-04	1,3274E+05	3,2052E-05
7,6880E+04	1,7307E-04	1,3388E+05	3,2790E-05
7,8020E+04	1,6486E-04	1,3502E+05	3,0997E-05
7,9160E+04	1,5665E-04	1,3616E+05	2,9204E-05
8,0300E+04	1,4844E-04	1,3730E+05	2,7411E-05
8,1440E+04	1,4023E-04	1,3844E+05	2,5618E-05
8,2580E+04	1,3202E-04	1,3958E+05	2,3825E-05
8,3720E+04	1,2381E-04	1,4072E+05	2,2032E-05
8,4860E+04	1,1560E-04	1,4186E+05	2,0239E-05
8,6000E+04	1,0739E-04	1,4300E+05	1,8446E-05
8,7140E+04	9,9175E-05	1,4414E+05	1,6653E-05
8,8280E+04	9,0964E-05	1,4528E+05	1,4859E-05
8,9420E+04	8,2753E-05	1,4642E+05	1,3066E-05
9,0560E+04	7,4542E-05	1,4756E+05	1,1273E-05
9,1700E+04	6,6331E-05	1,4870E+05	9,4803E-06
9,2840E+04	5,8120E-05	1,4984E+05	7,6873E-06
9,3980E+04	4,9909E-05	1,5098E+05	5,8942E-06
9,5120E+04	4,1698E-05	1,5212E+05	4,1012E-06
9,6260E+04	3,7403E-05	1,5326E+05	3,5035E-06
9,7400E+04	3,5066E-05	1,5440E+05	3,5035E-06
9,8540E+04	3,2728E-05	1,5554E+05	3,5035E-06
9,9680E+04	3,0391E-05	1,5668E+05	3,5035E-06
1,0082E+05	2,8053E-05	1,5782E+05	3,5035E-06
1,0196E+05	2,5716E-05	1,5896E+05	3,5035E-06
1,0310E+05	2,3378E-05	1,6010E+05	3,5035E-06
1,0424E+05	2,1041E-05	1,6124E+05	3,5035E-06
1,0538E+05	1,8703E-05	1,6238E+05	3,5035E-06
1,0652E+05	1,6366E-05	1,6352E+05	3,5035E-06
1,0766E+05	1,4028E-05	1,6466E+05	3,5035E-06
1,0880E+05	1,1691E-05	1,6580E+05	3,5035E-06
1,0994E+05	9,3534E-06	1,6694E+05	3,5035E-06
1,1108E+05	7,0159E-06	1,6808E+05	3,5035E-06
1,1222E+05	4,6785E-06	1,6922E+05	3,5035E-06
1,1336E+05	2,3410E-06	1,7036E+05	3,5035E-06

PLTCVT PROGRAM DATA SUMMARY
PIR5(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = U-235
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 2.500000E+05
TIME HIGH= 6.000000E+05
NUMBER OF CELLS = 400
DELTA TIME INCREMENT = 8.750000E+02

RAW DATA AND BLOCKED DATA FACTORS:
MAX. TIME = 8.5372E+05 MIN. TIME = 4.7994E+04
TOTAL WEIGHT = 4.1419E+02 TOTAL PARCELS = 20888.0
PEAK WEIGHT = 11.131 PEAK WEIGHT TIME = 3.4231E+05
PEAK PARCELS = 272.000 PEAK PARCELS TIME = 3.2744E+05
WT. LOW = 3.5468E-01 NO. PARCELS LOW = 4575.0
WT. HI = 1.5525E-01 NO. PARCELS HI = 1370.0
SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 4.147037E+02
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 4.191252E+02
PERCENT OF TOTAL INVENTORY = 101.066

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.466875E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.156511E-08
MAXIMUM RATE (CURIES/YEAR) = 5.595589E-03
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = U-235

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.5044E+05	5.8135E-06	4.0008E+05	2.9431E-03
2.5345E+05	6.0531E-06	4.0302E+05	2.7901E-03
2.5647E+05	6.3792E-06	4.0596E+05	2.6495E-03
2.5949E+05	6.8414E-06	4.0890E+05	2.5087E-03
2.6251E+05	7.3533E-06	4.1184E+05	2.3622E-03
2.6552E+05	7.7895E-06	4.1478E+05	2.1955E-03
2.6854E+05	8.0070E-06	4.1772E+05	1.9944E-03
2.7156E+05	8.0442E-06	4.2066E+05	1.7924E-03
2.7457E+05	7.9959E-06	4.2361E+05	1.5811E-03
2.7759E+05	8.0017E-06	4.2655E+05	1.3827E-03
2.8061E+05	8.2732E-06	4.2949E+05	1.2096E-03
2.8362E+05	8.6618E-06	4.3243E+05	1.0526E-03

2.8664E+05	9.5707E-06	4.3537E+05	9.2171E-04
2.8966E+05	1.0666E-05	4.3831E+05	8.0015E-04
2.9268E+05	1.2178E-05	4.4125E+05	6.8100E-04
2.9569E+05	1.4740E-05	4.4419E+05	5.2864E-04
2.9871E+05	1.9172E-05	4.4713E+05	4.3289E-04
3.0173E+05	2.9238E-05	4.5008E+05	3.9915E-04
3.0474E+05	6.9879E-05	4.5461E+05	3.5691E-04
3.0776E+05	1.7389E-04	4.5914E+05	3.2280E-04
3.1078E+05	3.5578E-04	4.6367E+05	2.4663E-04
3.1380E+05	5.9876E-04	4.6820E+05	1.9478E-04
3.1681E+05	8.7803E-04	4.7274E+05	1.9230E-04
3.1983E+05	1.2505E-03	4.7727E+05	1.7690E-04
3.2285E+05	1.7398E-03	4.8180E+05	1.5334E-04
3.2586E+05	2.3441E-03	4.8633E+05	1.2131E-04
3.2888E+05	3.0327E-03	4.9087E+05	7.5272E-05
3.3190E+05	3.5683E-03	4.9540E+05	4.7258E-05
3.3491E+05	4.1606E-03	4.9993E+05	4.6381E-05
3.3793E+05	4.4959E-03	5.0446E+05	5.7153E-05
3.4095E+05	5.0159E-03	5.0899E+05	7.7207E-05
3.4397E+05	5.2897E-03	5.1353E+05	7.8419E-05
3.4698E+05	5.5933E-03	5.1806E+05	6.7428E-05
3.5000E+05	5.3584E-03	5.2259E+05	5.2304E-05
3.5302E+05	5.1733E-03	5.2712E+05	2.9967E-05
3.5596E+05	5.0247E-03	5.3166E+05	1.6452E-05
3.5890E+05	4.8438E-03	5.3619E+05	1.0055E-05
3.6184E+05	4.6839E-03	5.4072E+05	7.1314E-06
3.6478E+05	4.5369E-03	5.4525E+05	9.6072E-06
3.6772E+05	4.3939E-03	5.4978E+05	1.3300E-05
3.7066E+05	4.2166E-03	5.5432E+05	1.5546E-05
3.7360E+05	4.0937E-03	5.5885E+05	1.5793E-05
3.7655E+05	3.9492E-03	5.6338E+05	1.3725E-05
3.7949E+05	3.8010E-03	5.6791E+05	1.1162E-05
3.8243E+05	3.6740E-03	5.7244E+05	9.3796E-06
3.8537E+05	3.5580E-03	5.7698E+05	7.7839E-06
3.8831E+05	3.4484E-03	5.8151E+05	7.1062E-06
3.9125E+05	3.3483E-03	5.8604E+05	6.8571E-06
3.9419E+05	3.2326E-03	5.9057E+05	6.6158E-06
3.9713E+05	3.0897E-03	5.9511E+05	6.8189E-06

PLTCVT PROGRAM DATA SUMMARY
PIR 5(TOTAL FUEL ASSEMBLIES) BASE CASE: CHAIN 4
CONTAMINANT = PA-231
TONS OF HEAVY METAL FACTOR = 0.5000000
DATA BLOCKING FACTORS:
ENTRY MODE (1 = T(LOW),DT,NCELLS) (2 = T(LOW),T(HI),NCELLS) MODE = 2
TIME LOW = 2.500000E+05
TIME HIGH= 5.000000E+05
NUMBER OF CELLS = 50
DELTA TIME INCREMENT = 5.000000E+03

RAW DATA AND BLOCKED DATA FACTORS:

MAX. TIME = 1.7273E+06	MIN. TIME = 4.6288E+04
TOTAL WEIGHT = 5.9369E+00	TOTAL PARCELS = 1738.0
PEAK WEIGHT = 0.718	PEAK WEIGHT TIME = 3.4750E+05
PEAK PARCELS = 55.000	PEAK PARCELS TIME = 4.8750E+05
WT. LOW = 6.3969E-03	NO. PARCELS LOW = 724.0
WT. HI = 2.6895E+00	NO. PARCELS HI = 1670.0

SMOOTHING WINDOW (CELLS)= 20

TOTAL INVENTORY (CURIES) = 8.632784E+00
INVENTORY UNDER THE CURRENT GRAPH (CURIES) = 6.093069E+00
PERCENT OF TOTAL INVENTORY = 70.581

TIME OF MAXIMUM CONCENTRATION (YEARS) = 3.525000E+05
MAXIMUM CONCENTRATION (MICROCURIES/ML) = 2.905533E-10
MAXIMUM RATE (CURIES/YEAR) = 7.539126E-05
CONVERSION FACTOR RATE TO CONCENTRATION = 3.853949E-06

CONTAMINANT = PA-231

TIME (YEARS) AND RATE (CURIES/YEAR) FOR THE 100 POINTS

TIME (YR)	RATE (CU/YR)	TIME (YR)	RATE (CU/YR)
2.5250E+05	1.9697E-07	4.0001E+05	4.2876E-05
2.5545E+05	1.9697E-07	4.0295E+05	4.1132E-05
2.5841E+05	1.9435E-07	4.0590E+05	3.9509E-05
2.6136E+05	1.8585E-07	4.0884E+05	3.8143E-05
2.6432E+05	1.8689E-07	4.1178E+05	3.7086E-05
2.6727E+05	1.9390E-07	4.1472E+05	3.5872E-05
2.7023E+05	2.0187E-07	4.1766E+05	3.4678E-05
2.7318E+05	2.0671E-07	4.2060E+05	3.4713E-05
2.7614E+05	2.0082E-07	4.2354E+05	3.3780E-05
2.7909E+05	2.0144E-07	4.2648E+05	3.1086E-05
2.8205E+05	2.0764E-07	4.2943E+05	2.9006E-05

2.8500E+05	2.3908E-07	4.3237E+05	2.7251E-05
2.8795E+05	2.6812E-07	4.3531E+05	2.3809E-05
2.9091E+05	2.5872E-07	4.3825E+05	2.0574E-05
2.9386E+05	2.7739E-07	4.4119E+05	1.8180E-05
2.9682E+05	3.2883E-07	4.4413E+05	1.6319E-05
2.9977E+05	3.8643E-07	4.4707E+05	1.4887E-05
3.0273E+05	4.6416E-07	4.5001E+05	1.4417E-05
3.0568E+05	7.6140E-07	4.5145E+05	1.4267E-05
3.0864E+05	1.0417E-06	4.5289E+05	1.3979E-05
3.1159E+05	1.2951E-06	4.5433E+05	1.3323E-05
3.1455E+05	2.4298E-06	4.5577E+05	1.2667E-05
3.1750E+05	3.9565E-06	4.5721E+05	1.2011E-05
3.2045E+05	6.3374E-06	4.5865E+05	1.1367E-05
3.2341E+05	8.7982E-06	4.6009E+05	1.0726E-05
3.2636E+05	1.1439E-05	4.6153E+05	1.0085E-05
3.2932E+05	1.5492E-05	4.6297E+05	9.5453E-06
3.3227E+05	2.0430E-05	4.6441E+05	9.2143E-06
3.3523E+05	3.6184E-05	4.6585E+05	8.8832E-06
3.3818E+05	5.0244E-05	4.6729E+05	8.5522E-06
3.4114E+05	5.5642E-05	4.6873E+05	8.2163E-06
3.4409E+05	6.3138E-05	4.7017E+05	7.8795E-06
3.4705E+05	7.2433E-05	4.7160E+05	7.5428E-06
3.5000E+05	7.4628E-05	4.7304E+05	7.2252E-06
3.5295E+05	7.5182E-05	4.7448E+05	6.9395E-06
3.5590E+05	7.3829E-05	4.7592E+05	6.6537E-06
3.5884E+05	7.3396E-05	4.7736E+05	6.3679E-06
3.6178E+05	7.4067E-05	4.7880E+05	6.0759E-06
3.6472E+05	7.1432E-05	4.8024E+05	5.7832E-06
3.6766E+05	6.7821E-05	4.8168E+05	5.4905E-06
3.7060E+05	6.5974E-05	4.8312E+05	5.3506E-06
3.7354E+05	6.3740E-05	4.8456E+05	5.4126E-06
3.7648E+05	6.0802E-05	4.8600E+05	5.4747E-06
3.7942E+05	5.7976E-05	4.8744E+05	5.5368E-06
3.8237E+05	5.5209E-05	4.8888E+05	5.3620E-06
3.8531E+05	5.2938E-05	4.9032E+05	5.1766E-06
3.8825E+05	5.0708E-05	4.9176E+05	4.9911E-06
3.9119E+05	4.8531E-05	4.9320E+05	4.7340E-06
3.9413E+05	4.6526E-05	4.9463E+05	4.4000E-06
3.9707E+05	4.4657E-05	4.9607E+05	4.0661E-06

APPENDIX I

NEAR-DOME HYDROLOGIC SIMULATION OUTPUTS

APPENDIX I

NEAR-DOME HYDROLOGIC SIMULATION OUTPUTS

APPENDIX I-1: PROG1-OUTPUT

Hydraulic properties, model coordinates, held boundary conditions, element details, and summary regarding total number of nodes, elements, boundary nodes used for flow through dome breach.

TIME= 14:55:25   DATE= 22-AUG-79

##

SOLUTION MINING - MAINS.OUT FOR DETERMINATION OF FLOW THROUGH BREACH

##

VALUES OF CONVERSION FACTORS SPECIFIED

CONVERSION FACTOR FOR PERMEABILITY DATA	1.0000
CONVERSION FACTOR FOR XY-COORDINATES	1.0000
CONVERSION FACTOR FOR Z-COORDINATES	1.0000
CONVERSION FACTOR FOR HEAD(BOTH INITIAL AND B.C.)	1.00
KTYPE =	0
FLAG FOR CONTROLLING THE LEVEL OF PRINT OUTPUT=	3

PROPERTIES FOR MATERIAL 1 ########

CARRIZZO AQUIFER

K-X=	13.2300	L/T
K-Y=	13.2300	L/T
K-Z=	13.2300	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

PROPERTIES FOR MATERIAL 2 ########

WILCOX AQUIFER

K-X=	2.48000	L/T
K-Y=	2.48000	L/T
K-Z=	2.46000	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

PROPERTIES FOR MATERIAL 3 ########

WILCOX AQUIFER

K-X=	2.48000	L/T
K-Y=	2.48000	L/T
K-Z=	2.48000	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

PROPERTIES FOR MATERIAL 4 ########

WILCOX AQUIFER

K-X=	2.48000	L/T
K-Y=	2.48000	L/T
K-Z=	2.48000	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

PROPERTIES FOR MATERIAL 5 ########

WILCOX AQUIFER

K-X=	2.48000	L/T
K-Y=	2.48000	L/T
K-Z=	2.48000	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

PROPERTIES FOR MATERIAL 6 ########

WILCOX AQUIFER

K-X=	2.48000	L/T
K-Y=	2.48000	L/T
K-Z=	2.48000	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

PROPERTIES FOR MATERIAL 7 ########

WILCOX AQUIFER

K-X=	2.48000	L/T
K-Y=	2.48000	L/T
K-Z=	2.48000	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

PROPERTIES FOR MATERIAL 8 ########

HOLE MATERIAL

K-X=	10000.0	L/T
K-Y=	10000.0	L/T
K-Z=	10000.0	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

COORDINATES AND OTHER DETAILS OF EACH NODE

INTERNAL NODE#	USER NODE#	X-COORD.	Y-COORD.	Z-COORD.	INITIAL HEAD	TEMP C DEG
1	1	0.0	0.0	0.0	100.0	
2	1001	0.0	0.0	-100.0	100.0	
3	2001	0.0	0.0	-2100.0	100.0	
4	2	5000.0	0.0	0.0	95.0	
5	1002	5000.0	0.0	-100.0	95.0	
6	2002	5000.0	0.0	-2100.0	95.0	
7	3	10000.0	0.0	0.0	90.0	
8	1003	10000.0	0.0	-100.0	90.0	
9	2003	10000.0	0.0	-2100.0	90.0	
10	4	15000.0	0.0	0.0	85.0	
11	1004	15000.0	0.0	-100.0	85.0	
12	2004	15000.0	0.0	-2100.0	85.0	

13	6	25000,0	0,0	0,0	75,0
14	1006	25000,0	0,0	=100,0	75,0
15	2006	25000,0	0,0	=900,0	75,0
16	8	35000,0	0,0	0,0	65,0
17	1008	35000,0	0,0	=100,0	65,0
18	2008	35000,0	0,0	=2100,0	65,0
19	9	40000,0	0,0	0,0	60,0
20	1009	40000,0	0,0	=100,0	60,0
21	2009	40000,0	0,0	=2100,0	60,0
22	10	45000,0	0,0	0,0	55,0
23	1010	45000,0	0,0	=100,0	55,0
24	2010	45000,0	0,0	=2100,0	55,0
25	11	50000,0	0,0	0,0	50,0
26	1011	50000,0	0,0	=100,0	50,0
27	2011	50000,0	0,0	=2100,0	50,0
28	12	55000,0	0,0	0,0	45,0
29	1012	55000,0	0,0	=100,0	45,0
30	2012	55000,0	0,0	=2100,0	45,0
31	13	60000,0	0,0	0,0	40,0
32	1013	60000,0	0,0	=100,0	40,0
33	2013	60000,0	0,0	=2100,0	40,0
34	14	65000,0	0,0	0,0	35,0
35	1014	65000,0	0,0	=100,0	35,0
36	2014	65000,0	0,0	=2100,0	35,0
37	15	70000,0	0,0	0,0	30,0
38	1015	70000,0	0,0	=100,0	30,0
39	2015	70000,0	0,0	=2100,0	30,0

40	16	75000.0	0.0	0.0	25.0
41	1016	75000.0	0.0	-100.0	25.0
42	2016	75000.0	0.0	-2100.0	25.0
43	17	80000.0	0.0	0.0	20.0
44	1017	80000.0	0.0	-100.0	20.0
45	2017	80000.0	0.0	-2100.0	20.0
46	18	0.0	5000.0	0.0	100.0
47	1018	0.0	5000.0	-100.0	100.0
48	2018	0.0	5000.0	-2100.0	100.0
49	19	5000.0	5000.0	0.0	95.0
50	1019	5000.0	5000.0	-100.0	95.0
51	2019	5000.0	5000.0	-2100.0	95.0
52	20	10000.0	5000.0	0.0	90.0
53	1020	10000.0	5000.0	-100.0	90.0
54	2020	10000.0	5000.0	-2100.0	90.0
55	21	15000.0	5000.0	0.0	85.0
56	1021	15000.0	5000.0	-100.0	85.0
57	2021	15000.0	5000.0	-2100.0	85.0
58	25	35000.0	5000.0	0.0	65.0
59	1025	35000.0	5000.0	-100.0	65.0
60	2025	35000.0	5000.0	-2100.0	65.0
61	26	40000.0	5000.0	0.0	60.0
62	1026	40000.0	5000.0	-100.0	60.0
63	2026	40000.0	5000.0	-2100.0	60.0
64	27	45000.0	5000.0	0.0	55.0
65	1027	45000.0	5000.0	-100.0	55.0
66	2027	45000.0	5000.0	-2100.0	55.0

67	28	50000,0	5000,0	0,0	50,0
68	1028	50000,0	5000,0	-120,0	50,0
69	2028	50000,0	5000,0	-2100,0	50,0
70	29	55000,0	5000,0	0,0	45,0
71	1029	55000,0	5000,0	-100,0	45,0
72	2029	55000,0	5000,0	-2100,0	45,0
73	30	60000,0	5000,0	0,0	40,0
74	1030	60000,0	5000,0	-100,0	40,0
75	2030	60000,0	5000,0	-2100,0	40,0
76	31	65000,0	5000,0	0,0	35,0
77	1031	65000,0	5000,0	-100,0	35,0
78	2031	65000,0	5000,0	-2100,0	35,0
79	32	70000,0	5000,0	0,0	30,0
80	1032	70000,0	5000,0	-100,0	30,0
81	2032	70000,0	5000,0	-2100,0	30,0
82	33	75000,0	5000,0	0,0	25,0
83	1033	75000,0	5000,0	-100,0	25,0
84	2033	75000,0	5000,0	-2100,0	25,0
85	34	80000,0	5000,0	0,0	20,0
86	1034	80000,0	5000,0	-100,0	20,0
87	2034	80000,0	5000,0	-2100,0	20,0
88	35	0,0	10000,0	0,0	100,0
89	1035	0,0	10000,0	-100,0	100,0
90	2035	0,0	10000,0	-2100,0	100,0
91	36	5000,0	10000,0	0,0	95,0
92	1036	5000,0	10000,0	-100,0	95,0
93	2036	5000,0	10000,0	-2100,0	95,0

94	37	10000.0	10000.0	0.0	90.0
95	1037	10000.0	10000.0	-100.0	90.0
96	2037	10000.0	10000.0	-2100.0	90.0
97	38	15000.0	10000.0	0.0	85.0
98	1038	15000.0	10000.0	-100.0	85.0
99	2038	15000.0	10000.0	-2100.0	85.0
100	39	20000.0	10000.0	0.0	80.0
101	1039	20000.0	10000.0	-100.0	80.0
102	2039	20000.0	10000.0	-2100.0	80.0
103	40	25000.0	10000.0	0.0	75.0
104	1040	25000.0	10000.0	-100.0	75.0
105	2040	25000.0	10000.0	-2100.0	75.0
106	41	30000.0	10000.0	0.0	70.0
107	1041	30000.0	10000.0	-100.0	70.0
108	2041	30000.0	10000.0	-2100.0	70.0
109	42	35000.0	10000.0	0.0	65.0
110	1042	35000.0	10000.0	-100.0	65.0
111	2042	35000.0	10000.0	-2100.0	65.0
112	43	40000.0	10000.0	0.0	60.0
113	1043	40000.0	10000.0	-100.0	60.0
114	2043	40000.0	10000.0	-2100.0	60.0
115	44	45000.0	10000.0	0.0	55.0
116	1044	45000.0	10000.0	-100.0	55.0
117	2044	45000.0	10000.0	-2100.0	55.0
118	45	50000.0	10000.0	0.0	50.0
119	1045	50000.0	10000.0	-100.0	50.0
120	2045	50000.0	10000.0	-2100.0	50.0

121	46	55000,0	10000,0	0,0	45,0
122	1046	55000,0	10000,0	-100,0	45,0
123	2046	55000,0	10000,0	-2100,0	45,0
124	47	60000,0	10000,0	0,0	40,0
125	1047	60000,0	10000,0	-100,0	40,0
126	2047	60000,0	10000,0	-2100,0	40,0
127	48	65000,0	10000,0	0,0	35,0
128	1048	65000,0	10000,0	-100,0	35,0
129	2048	65000,0	10000,0	-2100,0	35,0
130	49	70000,0	10000,0	0,0	30,0
131	1049	70000,0	10000,0	-100,0	30,0
132	2049	70000,0	10000,0	-2100,0	30,0
133	50	75000,0	10000,0	0,0	25,0
134	1050	75000,0	10000,0	-100,0	25,0
135	2050	75000,0	10000,0	-2100,0	25,0
136	51	80000,0	10000,0	0,0	20,0
137	1051	80000,0	10000,0	-100,0	20,0
138	2051	80000,0	10000,0	-2100,0	20,0
139	52	0,0	15000,0	0,0	100,0
140	1052	0,0	15000,0	-100,0	100,0
141	2052	0,0	15000,0	-2100,0	100,0
142	53	5000,0	15000,0	0,0	95,0
143	1053	5000,0	15000,0	-100,0	95,0
144	2053	5000,0	15000,0	-2100,0	95,0
145	54	10000,0	15000,0	0,0	90,0
146	1054	10000,0	15000,0	-100,0	90,0
147	2054	10000,0	15000,0	-2100,0	90,0

148	55	15000.0	15000.0	0.0	85.0
149	1055	15000.0	15000.0	-100.0	85.0
150	2055	15000.0	15000.0	-2100.0	85.0
151	56	20000.0	15000.0	0.0	80.0
152	1056	20000.0	15000.0	-100.0	80.0
153	2056	20000.0	15000.0	-2100.0	80.0
154	57	25000.0	15000.0	0.0	75.0
155	1057	25000.0	15000.0	-100.0	75.0
156	2057	25000.0	15000.0	-2100.0	75.0
157	58	30000.0	15000.0	0.0	70.0
158	1058	30000.0	15000.0	-100.0	70.0
159	2058	30000.0	15000.0	-2100.0	70.0
160	59	35000.0	15000.0	0.0	65.0
161	1059	35000.0	15000.0	-100.0	65.0
162	2059	35000.0	15000.0	-2100.0	65.0
163	60	40000.0	15000.0	0.0	60.0
164	1060	40000.0	15000.0	-100.0	60.0
165	2060	40000.0	15000.0	-2100.0	60.0
166	61	45000.0	15000.0	0.0	55.0
167	1061	45000.0	15000.0	-100.0	55.0
168	2061	45000.0	15000.0	-2100.0	55.0
169	62	50000.0	15000.0	0.0	50.0
170	1062	50000.0	15000.0	-100.0	50.0
171	2062	50000.0	15000.0	-2100.0	50.0
172	63	55000.0	15000.0	0.0	45.0
173	1063	55000.0	15000.0	-100.0	45.0
174	2063	55000.0	15000.0	-2100.0	45.0

175	64	60000,0	15000,0	0,0	40,0
176	1064	60000,0	15000,0	-100,0	40,0
177	2064	60000,0	15000,0	-2100,0	40,0
178	65	65000,0	15000,0	0,0	35,0
179	1063	65000,0	15000,0	-100,0	35,0
180	2065	65000,0	15000,0	-2100,0	35,0
181	66	70000,0	15000,0	0,0	30,0
182	1066	70000,0	15000,0	-100,0	30,0
183	2066	70000,0	15000,0	-2100,0	30,0
184	67	75000,0	15000,0	0,0	25,0
185	1067	75000,0	15000,0	-100,0	25,0
186	2067	75000,0	15000,0	-2100,0	25,0
187	68	80000,0	15000,0	0,0	20,0
188	1068	80000,0	15000,0	-100,0	20,0
189	2068	80000,0	15000,0	-2100,0	20,0
190	69	0,0	20000,0	0,0	100,0
191	1069	0,0	20000,0	-100,0	100,0
192	2069	0,0	20000,0	-2100,0	100,0
193	70	5000,0	20000,0	0,0	95,0
194	1070	5000,0	20000,0	-100,0	95,0
195	2070	5000,0	20000,0	-2100,0	95,0
196	71	10000,0	20000,0	0,0	90,0
197	1071	10000,0	20000,0	-100,0	90,0
198	2071	10000,0	20000,0	-2100,0	90,0
199	72	15000,0	20000,0	0,0	85,0
200	1072	15000,0	20000,0	-100,0	85,0
201	2072	15000,0	20000,0	-2100,0	85,0

202	73	20000.0	20000.0	0.0	80.0
203	1073	20000.0	20000.0	-100.0	80.0
204	2073	20000.0	20000.0	-2100.0	80.0
205	74	25000.0	20000.0	0.0	75.0
206	1074	25000.0	20000.0	-100.0	75.0
207	2074	25000.0	20000.0	-2100.0	75.0
208	75	30000.0	20000.0	0.0	70.0
209	1075	30000.0	20000.0	-100.0	70.0
210	2075	30000.0	20000.0	-2100.0	70.0
211	76	35000.0	20000.0	0.0	65.0
212	1076	35000.0	20000.0	-100.0	65.0
213	2076	35000.0	20000.0	-2100.0	65.0
214	77	40000.0	20000.0	0.0	60.0
215	1077	40000.0	20000.0	-100.0	60.0
216	2077	40000.0	20000.0	-2100.0	60.0
217	78	45000.0	20000.0	0.0	55.0
218	1078	45000.0	20000.0	-100.0	55.0
219	2078	45000.0	20000.0	-2100.0	55.0
220	79	50000.0	20000.0	0.0	50.0
221	1079	50000.0	20000.0	-100.0	50.0
222	2079	50000.0	20000.0	-2100.0	50.0
223	80	55000.0	20000.0	0.0	45.0
224	1080	55000.0	20000.0	-100.0	45.0
225	2080	55000.0	20000.0	-2100.0	45.0

226	81	60000,0	20000,0	0,0	40,0
227	1081	60000,0	20000,0	-100,0	40,0
228	2081	60000,0	20000,0	-2100,0	40,0
229	82	65000,0	20000,0	0,0	35,0
230	1082	65000,0	20000,0	-100,0	35,0
231	2082	65000,0	20000,0	-2100,0	35,0
232	83	70000,0	20000,0	0,0	30,0
233	1083	70000,0	20000,0	-100,0	30,0
234	2083	70000,0	20000,0	-2100,0	30,0
235	84	75000,0	20000,0	0,0	25,0
236	1084	75000,0	20000,0	-100,0	25,0
237	2084	75000,0	20000,0	-2100,0	25,0
238	85	80000,0	20000,0	0,0	20,0
239	1085	80000,0	20000,0	-100,0	20,0
240	2085	80000,0	20000,0	-2100,0	20,0
241	86	0,0	25000,0	0,0	100,0
242	1086	0,0	25000,0	-100,0	100,0
243	2086	0,0	25000,0	-2100,0	100,0
244	87	5000,0	25000,0	0,0	95,0
245	1087	5000,0	25000,0	-100,0	95,0
246	2087	5000,0	25000,0	-2100,0	95,0
247	88	10000,0	25000,0	0,0	90,0
248	1088	10000,0	25000,0	-100,0	90,0
249	2088	10000,0	25000,0	-2100,0	90,0
250	89	15000,0	25000,0	0,0	85,0
251	1089	15000,0	25000,0	-100,0	85,0
252	2089	15000,0	25000,0	-2100,0	85,0

253	90	20000.0	25000.0	0.0	80.0
254	1090	20000.0	25000.0	-100.0	80.0
255	2090	20000.0	25000.0	-2100.0	80.0
256	91	25000.0	25000.0	0.0	75.0
257	1091	25000.0	25000.0	-100.0	75.0
258	2091	25000.0	25000.0	-2100.0	75.0
259	92	30000.0	25000.0	0.0	70.0
260	1092	30000.0	25000.0	-100.0	70.0
261	2092	30000.0	25000.0	-2100.0	70.0
262	93	35000.0	25000.0	0.0	65.0
263	1093	35000.0	25000.0	-100.0	65.0
264	2093	35000.0	25000.0	-2100.0	65.0
265	94	40000.0	25000.0	0.0	60.0
266	1094	40000.0	25000.0	-100.0	60.0
267	2094	40000.0	25000.0	-2100.0	60.0
268	95	45000.0	25000.0	0.0	55.0
269	1095	45000.0	25000.0	-100.0	55.0
270	2095	45000.0	25000.0	-2100.0	55.0
271	96	50000.0	25000.0	0.0	50.0
272	1096	50000.0	25000.0	-100.0	50.0
273	2096	50000.0	25000.0	-2100.0	50.0
274	97	55000.0	25000.0	0.0	45.0
275	1097	55000.0	25000.0	-100.0	45.0
276	2097	55000.0	25000.0	-2100.0	45.0
277	98	60000.0	25000.0	0.0	40.0
278	1098	60000.0	25000.0	-100.0	40.0
279	2098	60000.0	25000.0	-2100.0	40.0

280	99	65000,0	25000,0	0,0	35,0
281	1099	65000,0	25000,0	-100,0	35,0
282	2099	65000,0	25000,0	-2100,0	35,0
283	100	70000,0	25000,0	0,0	30,0
284	1100	70000,0	25000,0	-100,0	30,0
285	2100	70000,0	25000,0	-2100,0	30,0
286	101	75000,0	25000,0	0,0	25,0
287	1101	75000,0	25000,0	-100,0	25,0
288	2101	75000,0	25000,0	-2100,0	25,0
289	102	80000,0	25000,0	0,0	20,0
290	1102	80000,0	25000,0	-100,0	20,0
291	2102	80000,0	25000,0	-2100,0	20,0
292	103	0,0	30000,0	0,0	100,0
293	1103	0,0	30000,0	-100,0	100,0
294	2103	0,0	30000,0	-2100,0	100,0
295	104	5000,0	30000,0	0,0	95,0
296	1104	5000,0	30000,0	-100,0	95,0
297	2104	5000,0	30000,0	-2100,0	95,0
298	105	10000,0	30000,0	0,0	90,0
299	1105	10000,0	30000,0	-100,0	90,0
300	2105	10000,0	30000,0	-2100,0	90,0
301	106	15000,0	30000,0	0,0	85,0
302	1106	15000,0	30000,0	-100,0	85,0
303	2106	15000,0	30000,0	-2100,0	85,0
304	107	20000,0	30000,0	0,0	80,0
305	1107	20000,0	30000,0	-100,0	80,0
306	2107	20000,0	30000,0	-2100,0	80,0

307	106	25000.0	30000.0	0.0	75.0
308	1106	25000.0	30000.0	-100.0	75.0
309	2106	25000.0	30000.0	-2100.0	75.0
310	109	30000.0	30000.0	0.0	70.0
311	1109	30000.0	30000.0	-100.0	70.0
312	2109	30000.0	30000.0	-2100.0	70.0
313	110	35000.0	30000.0	0.0	65.0
314	1110	35000.0	30000.0	-100.0	65.0
315	2110	35000.0	30000.0	-2100.0	65.0
316	111	40000.0	30000.0	0.0	60.0
317	1111	40000.0	30000.0	-100.0	60.0
318	2111	40000.0	30000.0	-2100.0	60.0
319	112	45000.0	30000.0	0.0	55.0
320	1112	45000.0	30000.0	-100.0	55.0
321	2112	45000.0	30000.0	-2100.0	55.0
322	113	50000.0	30000.0	0.0	50.0
323	1113	50000.0	30000.0	-100.0	50.0
324	2113	50000.0	30000.0	-2100.0	50.0
325	114	55000.0	30000.0	0.0	45.0
326	1114	55000.0	30000.0	-100.0	45.0
327	2114	55000.0	30000.0	-2100.0	45.0
328	115	60000.0	30000.0	0.0	40.0
329	1115	60000.0	30000.0	-100.0	40.0
330	2115	60000.0	30000.0	-2100.0	40.0
331	116	65000.0	30000.0	0.0	35.0
332	1116	65000.0	30000.0	-100.0	35.0
333	2116	65000.0	30000.0	-2100.0	35.0

334	117	70000,0	30000,0	0,0	30,0
335	1117	70000,0	30000,0	-100,0	30,0
336	2117	70000,0	30000,0	-2100,0	30,0
337	118	75000,0	30000,0	0,0	25,0
338	1118	75000,0	30000,0	-100,0	25,0
339	2118	75000,0	30000,0	-2100,0	25,0
340	119	80000,0	30000,0	0,0	20,0
341	1119	80000,0	30000,0	-100,0	20,0
342	2119	80000,0	30000,0	-2100,0	20,0
343	120	0,0	35000,0	0,0	100,0
344	1120	0,0	35000,0	-100,0	100,0
345	2120	0,0	35000,0	-2100,0	100,0
346	121	5000,0	35000,0	0,0	95,0
347	1121	5000,0	35000,0	-100,0	95,0
348	2121	5000,0	35000,0	-2100,0	95,0
349	122	10000,0	35000,0	0,0	90,0
350	1122	10000,0	35000,0	-100,0	90,0
351	2122	10000,0	35000,0	-2100,0	90,0
352	123	15000,0	35000,0	0,0	85,0
353	1123	15000,0	35000,0	-100,0	85,0
354	2123	15000,0	35000,0	-2100,0	85,0
355	124	20000,0	35000,0	0,0	80,0
356	1124	20000,0	35000,0	-100,0	80,0
357	2124	20000,0	35000,0	-2100,0	80,0
358	125	25000,0	35000,0	0,0	75,0
359	1125	25000,0	35000,0	-100,0	75,0
360	2125	25000,0	35000,0	-2100,0	75,0

361	126	30000.0	35000.0	0.0	70.0
362	1126	30000.0	35000.0	-100.0	70.0
363	2126	30000.0	35000.0	-2100.0	70.0
364	127	35000.0	35000.0	0.0	65.0
365	1127	35000.0	35000.0	-100.0	65.0
366	2127	35000.0	35000.0	-2100.0	65.0
367	128	40000.0	35000.0	0.0	60.0
368	1128	40000.0	35000.0	-100.0	60.0
369	2128	40000.0	35000.0	-2100.0	60.0
370	129	45000.0	35000.0	0.0	55.0
371	1129	45000.0	35000.0	-100.0	55.0
372	2129	45000.0	35000.0	-2100.0	55.0
373	130	50000.0	35000.0	0.0	50.0
374	1130	50000.0	35000.0	-100.0	50.0
375	2130	50000.0	35000.0	-2100.0	50.0
376	131	55000.0	35000.0	0.0	45.0
377	1131	55000.0	35000.0	-100.0	45.0
378	2131	55000.0	35000.0	-2100.0	45.0
379	132	60000.0	35000.0	0.0	40.0
380	1132	60000.0	35000.0	-100.0	40.0
381	2132	60000.0	35000.0	-2100.0	40.0
382	133	65000.0	35000.0	0.0	35.0
383	1133	65000.0	35000.0	-100.0	35.0
384	2133	65000.0	35000.0	-2100.0	35.0
385	134	70000.0	35000.0	0.0	30.0
386	1134	70000.0	35000.0	-100.0	30.0
387	2134	70000.0	35000.0	-2100.0	30.0

388	135	75000,0	35000,0	0,0	25,0
389	1135	75000,0	35000,0	-100,0	25,0
390	2135	75000,0	35000,0	-2100,0	25,0
391	136	80000,0	35000,0	0,0	20,0
392	1136	80000,0	35000,0	-100,0	20,0
393	2136	80000,0	35000,0	-2100,0	20,0
394	200	22500,0	0,0	0,0	77,5
395	1200	22500,0	0,0	-100,0	77,5
396	2200	22500,0	0,0	-900,0	77,5
397	201	21000,0	0,0	0,0	79,0
398	1201	21000,0	0,0	-100,0	79,0
399	2201	21000,0	0,0	-900,0	79,0
400	202	20825,0	0,0	0,0	79,2
401	1202	20825,0	0,0	-100,0	79,2
402	2202	20825,0	0,0	-900,0	79,2
403	203	20000,0	0,0	0,0	80,0
404	1203	20000,0	0,0	-100,0	80,0
405	2203	20000,0	0,0	-1560,0	80,0
406	204	19825,0	0,0	0,0	80,2
407	1204	19825,0	0,0	-100,0	80,2
408	2204	19825,0	0,0	-1250,0	80,2
409	3204	19825,0	0,0	-1600,0	80,2
410	4204	19825,0	0,0	-1668,8	80,2
411	5204	19825,0	0,0	-1700,0	80,2
412	205	19750,0	0,0	0,0	80,3
413	1205	19750,0	0,0	-100,0	80,3
414	2205	19750,0	0,0	-1250,0	80,3
415	3205	19750,0	0,0	-1600,0	80,3
416	4205	19750,0	0,0	-1668,8	80,3
417	5205	19750,0	0,0	-1700,0	80,3
418	6205	19750,0	0,0	-1740,0	80,3

419	206	19325.0	0.0	0.0	80.7
420	1206	19325.0	0.0	-100.0	80.7
421	2206	19325.0	0.0	-1250.0	80.7
422	3206	19325.0	0.0	-1600.0	80.7
423	4206	19325.0	0.0	-2100.0	80.7
424	207	18000.0	0.0	0.0	82.0
425	1207	18000.0	0.0	-100.0	82.0
426	2207	18000.0	0.0	-1250.0	82.0
427	3207	18000.0	0.0	-1600.0	82.0
428	4207	18000.0	0.0	-2100.0	82.0
429	208	17000.0	0.0	0.0	83.0
430	1208	17000.0	0.0	-100.0	83.0
431	2208	17000.0	0.0	-1250.0	83.0
432	3208	17000.0	0.0	-1600.0	83.0
433	4208	17000.0	0.0	-2100.0	83.0
434	209	16000.0	0.0	0.0	84.0
435	1209	16000.0	0.0	-100.0	84.0
436	2209	16000.0	0.0	-1250.0	84.0
437	3209	16000.0	0.0	-1600.0	84.0
438	4209	16000.0	0.0	-2100.0	84.0
439	210	23232.2	1767.8	0.0	76.8
440	1210	23232.2	1767.8	-100.0	76.8
441	2210	23232.2	1767.8	-900.0	76.8
442	211	22171.6	2828.4	0.0	77.8
443	1211	22171.6	2828.4	-100.0	77.8
444	2211	22171.6	2828.4	-900.0	77.8
445	212	22047.8	2952.2	0.0	77.9
446	1212	22047.8	2952.2	-100.0	77.9
447	2212	22047.8	2952.2	-900.0	77.9
448	213	21464.5	3535.5	0.0	78.5
449	1213	21464.5	3535.5	-100.0	78.5
450	2213	21464.5	3535.5	-1500.0	78.5

451	214	21340,7	3659,3	0,0	78,7
452	1214	21340,7	3659,3	-100,0	78,7
453	2214	21340,7	3659,3	-1250,0	78,7
454	3214	21340,7	3659,3	-1600,0	78,7
455	4214	21340,7	3659,3	-1668,3	78,7
456	5214	21340,7	3659,3	-1700,0	78,7
457	215	21287,7	3712,3	0,0	78,7
458	1215	21287,7	3712,3	-100,0	78,7
459	2215	21287,7	3712,3	-1250,0	78,7
460	3215	21287,7	3712,3	-1600,0	78,7
461	4215	21287,7	3712,3	-1668,8	78,7
462	5215	21287,7	3712,3	-1700,0	78,7
463	6215	21287,7	3712,3	-1740,0	78,7
464	216	20987,2	4012,8	0,0	79,0
465	1216	20987,2	4012,8	-100,0	79,0
466	2216	20987,2	4012,8	-1250,0	79,0
467	3216	20987,2	4012,8	-1600,0	79,0
468	4216	20987,2	4012,8	-2100,0	79,0
469	217	20050,3	4949,8	0,0	79,9
470	1217	20050,3	4949,8	-100,0	79,9
471	2217	20050,3	4949,8	-1250,0	79,9
472	3217	20050,3	4949,8	-1600,0	79,9
473	4217	20050,3	4949,8	-2100,0	79,9
474	218	19343,2	5656,9	0,0	80,7
475	1218	19343,2	5656,9	-100,0	80,7
476	2218	19343,2	5656,9	-1250,0	80,7
477	3218	19343,2	5656,9	-1600,0	80,7
478	4218	19343,2	5656,9	-2100,0	80,7
479	219	18636,0	6364,0	0,0	81,4
480	1219	18636,0	6364,0	-100,0	81,4
481	2219	18636,0	6364,0	-1250,0	81,4
482	3219	18636,0	6364,0	-1600,0	81,4
483	4219	18636,0	6364,0	-2100,0	81,4

484	220	25000.0	2500.0	0.0	75.0
485	1220	25000.0	2500.0	-100.0	75.0
486	2220	25000.0	2500.0	-900.0	75.0
487	221	25000.0	4000.0	0.0	75.0
488	1221	25000.0	4000.0	-100.0	75.0
489	2221	25000.0	4000.0	-900.0	75.0
490	222	25000.0	4175.0	0.0	75.0
491	1222	25000.0	4175.0	-100.0	75.0
492	2222	25000.0	4175.0	-900.0	75.0
493	223	25000.0	5000.0	0.0	75.0
494	1223	25000.0	5000.0	-100.0	75.0
495	2223	25000.0	5000.0	-1560.0	75.0
496	224	25000.0	5175.0	0.0	75.0
497	1224	25000.0	5175.0	-100.0	75.0
498	2224	25000.0	5175.0	-1250.0	75.0
499	3224	25000.0	5175.0	-1600.0	75.0
500	4224	25000.0	5175.0	-1668.8	75.0
501	5224	25000.0	5175.0	-1700.0	75.0
502	225	25000.0	5250.0	0.0	75.0
503	1225	25000.0	5250.0	-100.0	75.0
504	2225	25000.0	5250.0	-1250.0	75.0
505	3225	25000.0	5250.0	-1600.0	75.0
506	4225	25000.0	5250.0	-1668.8	75.0
507	5225	25000.0	5250.0	-1700.0	75.0
508	6225	25000.0	5250.0	-1740.0	75.0
509	226	25000.0	5675.0	0.0	75.0
510	1226	25000.0	5675.0	-100.0	75.0
511	2226	25000.0	5675.0	-1250.0	75.0
512	3226	25000.0	5675.0	-1600.0	75.0
513	4226	25000.0	5675.0	-2100.0	75.0

514	227	25000,0	7000,0	0,0	75,0
515	1227	25000,0	7000,0	-100,0	75,0
516	2227	25000,0	7000,0	-1250,0	75,0
517	3227	25000,0	7000,0	-1600,0	75,0
518	4227	25000,0	7000,0	-2100,0	75,0
519	228	25000,0	8000,0	0,0	75,0
520	1228	25000,0	8000,0	-100,0	75,0
521	2228	25000,0	8000,0	-1250,0	75,0
522	3228	25000,0	8000,0	-1600,0	75,0
523	4228	25000,0	8000,0	-2100,0	75,0
524	229	25000,0	9000,0	0,0	75,0
525	1229	25000,0	9000,0	-100,0	75,0
526	2229	25000,0	9000,0	-1250,0	75,0
527	3229	25000,0	9000,0	-1600,0	75,0
528	4229	25000,0	9000,0	-2100,0	75,0
529	230	26767,8	1767,8	0,0	73,2
530	1230	26767,8	1767,8	-100,0	73,2
531	2230	26767,8	1767,8	-900,0	73,2
532	231	27828,4	2828,4	0,0	72,2
533	1231	27828,4	2828,4	-100,0	72,2
534	2231	27828,4	2828,4	-900,0	72,2
535	232	27952,2	2952,2	0,0	72,1
536	1232	27952,2	2952,2	-100,0	72,1
537	2232	27952,2	2952,2	-900,0	72,1
538	233	28535,5	3535,5	0,0	71,5
539	1233	28535,5	3535,5	-100,0	71,5
540	2233	28535,5	3535,5	-1560,0	71,5
541	234	28659,3	3659,3	0,0	71,3
542	1234	28659,3	3659,3	-100,0	71,3
543	2234	28659,3	3659,3	-1250,0	71,3
544	3234	28659,3	3659,3	-1600,0	71,3
545	4234	28659,3	3659,3	-1668,8	71,3
546	5234	28659,3	3659,3	-1700,0	71,3

547	235	28712.3	3712.3	0.0	71.3
548	1235	28712.3	3712.3	-100.0	71.3
549	2235	28712.3	3712.3	-1250.0	71.3
550	3235	28712.3	3712.3	-1600.0	71.3
551	4235	28712.3	3712.3	-1660.0	71.3
552	5235	28712.3	3712.3	-1700.0	71.3
553	6235	28712.3	3712.3	-1740.0	71.3
554	236	29012.0	4012.0	0.0	71.0
555	1236	29012.0	4012.0	-100.0	71.0
556	2236	29012.0	4012.0	-1250.0	71.0
557	3236	29012.0	4012.0	-1600.0	71.0
558	4236	29012.0	4012.0	-2100.0	71.0
559	237	29949.8	4949.8	0.0	70.1
560	1237	29949.8	4949.8	-100.0	70.1
561	2237	29949.8	4949.8	-1250.0	70.1
562	3237	29949.8	4949.8	-1600.0	70.1
563	4237	29949.8	4949.8	-2100.0	70.1
564	238	30656.9	5656.9	0.0	69.3
565	1238	30656.9	5656.9	-100.0	69.3
566	2238	30656.9	5656.9	-1250.0	69.3
567	3238	30656.9	5656.9	-1600.0	69.3
568	4238	30656.9	5656.9	-2100.0	69.3
569	239	31364.0	6364.0	0.0	68.6
570	1239	31364.0	6364.0	-100.0	68.6
571	2239	31364.0	6364.0	-1250.0	68.6
572	3239	31364.0	6364.0	-1600.0	68.6
573	4239	31364.0	6364.0	-2100.0	68.6
574	240	27309.7	956.7	0.0	72.7
575	1240	27309.7	956.7	-100.0	72.7
576	2240	27309.7	956.7	-900.0	72.7
577	241	28695.5	1530.7	0.0	71.3
578	1241	28695.5	1530.7	-100.0	71.3
579	2241	28695.5	1530.7	-900.0	71.3

580	242	28857,2	1597,7	0,0	71,1
581	1242	28857,2	1597,7	-100,0	71,1
582	2242	28857,2	1597,7	-980,0	71,1
583	243	29619,4	1913,4	0,0	70,4
584	1243	29619,4	1913,4	-100,0	70,4
585	2243	29619,4	1913,4	-1560,0	70,4
586	244	29781,1	1980,4	0,0	70,2
587	1244	29781,1	1980,4	-100,0	70,2
588	2244	29781,1	1980,4	-1250,0	70,2
589	3244	29781,1	1980,4	-1600,0	70,2
590	4244	29781,1	1980,4	-1668,8	70,2
591	5244	29781,1	1980,4	-1700,0	70,2
592	245	29850,4	2009,1	0,0	70,2
593	1245	29850,4	2009,1	-100,0	70,2
594	2245	29850,4	2009,1	-1250,0	70,2
595	3245	29850,4	2009,1	-1600,0	70,2
596	4245	29850,4	2009,1	-1668,8	70,2
597	5245	29850,4	2009,1	-1700,0	70,2
598	6245	29850,4	2009,1	-1740,0	70,2
599	246	30243,0	2171,7	0,0	69,8
600	1246	30243,0	2171,7	-100,0	69,8
601	2246	30243,0	2171,7	-1250,0	69,8
602	3246	30243,0	2171,7	-1600,0	69,8
603	4246	30243,0	2171,7	-2100,0	69,8
604	247	31467,2	2678,8	0,0	68,5
605	1247	31467,2	2678,3	-100,0	68,5
606	2247	31467,2	2678,8	-1250,0	68,5
607	3247	31467,2	2678,8	-1600,0	68,5
608	4247	31467,2	2678,8	-2100,0	68,5
609	248	32391,0	3061,5	0,0	67,6
610	1248	32391,0	3061,5	-100,0	67,6
611	2248	32391,0	3061,5	-1250,0	67,6
612	3248	32391,0	3061,5	-1600,0	67,6
613	4248	32391,0	3061,5	-2100,0	67,6

614	249	32700.0	3800.0	0.0	66.7
615	1249	32700.0	3800.0	-100.0	66.7
616	2249	32700.0	3800.0	-1250.0	66.7
617	3249	32700.0	3800.0	-1600.0	66.7
618	4249	32700.0	3800.0	-2100.0	66.7
619	250	27452.0	487.7	0.0	72.6
620	1250	27452.0	487.7	-100.0	72.6
621	2250	27452.0	487.7	-900.0	72.6
622	251	28923.1	780.4	6.0	71.1
623	1251	28923.1	780.4	-100.0	71.1
624	2251	28923.1	780.4	-900.0	71.1
625	252	29094.8	814.5	0.0	70.9
626	1252	29094.8	814.5	-100.0	70.9
627	2252	29094.8	814.5	-900.0	70.9
628	253	29903.9	975.5	0.0	70.1
629	1253	29903.9	975.5	-100.0	70.1
630	2253	29903.9	975.5	-1560.0	70.1
631	254	30075.6	1009.6	0.0	69.9
632	1254	30075.6	1009.6	-100.0	69.9
633	2254	30075.6	1009.6	-1250.0	69.9
634	3254	30075.6	1009.6	-1600.0	69.9
635	4254	30075.6	1009.6	-1668.4	69.9
636	5254	30075.6	1009.6	-1700.0	69.9
637	255	30149.1	1024.2	0.0	69.8
638	1255	30149.1	1024.2	-100.0	69.8
639	2255	30149.1	1024.2	-1250.0	69.8
640	3255	30149.1	1024.2	-1600.0	69.8
641	4255	30149.1	1024.2	-1668.4	69.8
642	5255	30149.1	1024.2	-1700.0	69.8
643	6255	30149.1	1024.2	-1740.0	69.8

644	256	30566,0	1107,1	0,0	69,4
645	1256	30566,0	1107,1	-100,0	69,4
646	2256	30566,0	1107,1	-1250,0	69,4
647	3256	30566,0	1107,1	-1600,0	69,4
648	4256	30566,0	1107,1	-2100,0	69,4
649	257	31865,5	1365,6	0,0	68,1
650	1257	31865,5	1365,6	-100,0	68,1
651	2257	31865,5	1365,6	-1250,0	68,1
652	3257	31865,5	1365,6	-1600,0	68,1
653	4257	31865,5	1365,6	-2100,0	68,1
654	258	32846,3	1560,7	0,0	67,2
655	1258	32846,3	1560,7	-100,0	67,2
656	2258	32846,3	1560,7	-1250,0	67,2
657	3258	32846,3	1560,7	-1600,0	67,2
658	4258	32846,3	1560,7	-2100,0	67,2
659	259	33827,1	1755,8	0,0	66,2
660	1259	33827,1	1755,8	-100,0	66,2
661	2259	33827,1	1755,8	-1250,0	66,2
662	3259	33827,1	1755,8	-1600,0	66,2
663	4259	33827,1	1755,8	-2100,0	66,2
664	260	27488,0	245,0	0,0	72,5
665	1260	27488,0	245,0	-100,0	72,5
666	2260	27488,0	245,0	-900,0	72,5
667	261	28980,7	392,1	0,0	71,0
668	1261	28980,7	392,1	-100,0	71,0
669	2261	28980,7	392,1	-900,0	71,0
670	262	29154,9	409,2	0,0	70,8
671	1262	29154,9	409,2	-100,0	70,8
672	2262	29154,9	409,2	-900,0	70,8
673	263	29975,9	100,0	0,0	70,0
674	1263	29975,9	100,0	-100,0	70,0
675	2263	29975,9	100,0	-1560,0	70,0

676	264	30150.1	100.0	0.0	69.8
677	1264	30150.1	100.0	-100.0	69.8
678	2264	30150.1	100.0	-1250.0	69.8
679	3264	30150.1	100.0	-1600.0	69.8
680	4264	30150.1	100.0	-1668.4	69.8
681	5264	30150.1	100.0	-1700.0	69.8
682	265	30224.7	100.0	0.0	69.8
683	1265	30224.7	100.0	-100.0	69.8
684	2265	30224.7	100.0	-1250.0	69.8
685	3265	30224.7	100.0	-1600.0	69.8
686	4265	30224.7	100.0	-1668.4	69.8
687	5265	30224.7	100.0	-1700.0	69.8
688	6265	30224.7	100.0	-1740.0	69.8
689	266	30647.7	556.3	0.0	69.3
690	1266	30647.7	556.3	-100.0	69.3
691	2266	30647.7	556.3	-1250.0	69.3
692	3266	30647.7	556.3	-1600.0	69.3
693	4266	30647.7	556.3	-2100.0	69.3
694	267	31966.3	686.1	0.0	68.0
695	1267	31966.3	686.1	-100.0	68.0
696	2267	31966.3	686.1	-1250.0	68.0
697	3267	31966.3	686.1	-1600.0	68.0
698	4267	31966.3	686.1	-2100.0	68.0
699	268	32961.5	784.1	0.0	67.0
700	1268	32961.5	784.1	-100.0	67.0
701	2268	32961.5	784.1	-1250.0	67.0
702	3268	32961.5	784.1	-1600.0	67.0
703	4268	32961.5	784.1	-2100.0	67.0
704	269	33956.7	882.2	0.0	66.0
705	1269	33956.7	882.2	-100.0	66.0
706	2269	33956.7	882.2	-1250.0	66.0
707	3269	33956.7	882.2	-1600.0	66.0
708	4269	33956.7	882.2	-2100.0	66.0

709	270	27497,0	122,9	0,0	72,5
710	1270	27497,0	122,9	-100,0	72,5
711	2270	27497,0	122,9	-900,0	72,5
712	271	28995,2	196,7	0,0	71,0
713	1271	28995,2	196,7	-100,0	71,0
714	2271	28995,2	196,7	-900,0	71,0
715	272	29169,9	205,3	0,0	70,8
716	1272	29169,9	205,3	-100,0	70,8
717	2272	29169,9	205,3	-900,0	70,8
718	273	29993,9	15,8	0,0	70,0
719	1273	29993,9	15,8	-100,0	70,0
720	2273	29993,9	15,8	-1560,0	70,0
721	274	30168,7	15,8	0,0	69,8
722	1274	30168,7	15,8	-100,0	69,8
723	2274	30168,7	15,8	-1250,0	69,8
724	3274	30168,7	15,8	-1600,0	69,8
725	4274	30168,7	15,8	-1668,4	69,8
726	5274	30168,7	15,8	-1700,0	69,8
727	275	30243,7	15,8	0,0	69,8
728	1275	30243,7	15,8	-100,0	69,8
729	2275	30243,7	15,8	-1250,0	69,8
730	3275	30243,7	15,8	-1600,0	69,8
731	4275	30243,7	15,8	-1668,4	69,8
732	5275	30243,7	15,8	-1700,0	69,8
733	6275	30243,7	15,8	-1740,0	69,8
734	276	30668,1	50,0	0,0	69,3
735	1276	30668,1	50,0	-100,0	69,3
736	2276	30668,1	50,0	-1250,0	69,3
737	3276	30668,1	50,0	-1600,0	69,3
738	4276	30668,1	50,0	-2100,0	69,3

739	277	31991.5	344.2	0.0	66.0
740	1277	31991.5	344.2	-100.0	66.0
741	2277	31991.5	344.2	-1250.0	66.0
742	3277	31991.5	344.2	-1600.0	66.0
743	4277	31991.5	344.2	-2100.0	66.0
744	278	32990.3	393.4	0.0	67.0
745	1278	32990.3	393.4	-100.0	67.0
746	2278	32990.3	393.4	-1250.0	67.0
747	3278	32990.3	393.4	-1600.0	67.0
748	4278	32990.3	393.4	-2100.0	67.0
749	279	33500.0	442.6	0.0	66.0
750	1279	33500.0	442.6	-100.0	66.0
751	2279	33500.0	442.6	-1250.0	66.0
752	3279	33500.0	442.6	-1600.0	66.0
753	4279	33500.0	442.6	-2100.0	66.0
754	280	27500.0	0.0	0.0	72.5
755	1280	27500.0	0.0	-100.0	72.5
756	2280	27500.0	0.0	-900.0	72.5
757	281	29000.0	0.0	0.0	71.0
758	1281	29000.0	0.0	-100.0	71.0
759	2281	29000.0	0.0	-900.0	71.0
760	282	29175.0	0.0	0.0	70.6
761	1282	29175.0	0.0	-100.0	70.6
762	2282	29175.0	0.0	-900.0	70.6
763	283	30000.0	0.0	0.0	70.0
764	1283	30000.0	0.0	-100.0	70.0
765	2283	30000.0	0.0	-1560.0	70.0
766	284	30175.0	0.0	0.0	69.8
767	1284	30175.0	0.0	-100.0	69.8
768	2284	30175.0	0.0	-1250.0	69.8
769	3284	30175.0	0.0	-1600.0	69.8
770	4284	30175.0	0.0	-1666.4	69.8
771	5284	30175.0	0.0	-1700.0	69.8

772	285	30250,0	0,0	0,0	69,8
773	1285	30250,0	0,0	-100,0	69,8
774	2285	30250,0	0,0	-1250,0	69,8
775	3285	30250,0	0,0	-1600,0	69,8
776	4285	30250,0	0,0	-1668,4	69,8
777	5285	30250,0	0,0	-1700,0	69,8
778	6285	30250,0	0,0	-1740,0	69,8
779	286	30675,0	0,0	0,0	69,3
780	1286	30675,0	0,0	-100,0	69,3
781	2286	30675,0	0,0	-1250,0	69,3
782	3286	30675,0	0,0	-1600,0	69,3
783	4286	30675,0	0,0	-2100,0	69,3
784	287	32000,0	0,0	0,0	68,0
785	1287	32000,0	0,0	-100,0	68,0
786	2287	32000,0	0,0	-1250,0	68,0
787	3287	32000,0	0,0	-1600,0	68,0
788	4287	32000,0	0,0	-2100,0	68,0
789	288	33000,0	0,0	0,0	67,0
790	1288	33000,0	0,0	-100,0	67,0
791	2288	33000,0	0,0	-1250,0	67,0
792	3288	33000,0	0,0	-1600,0	67,0
793	4288	33000,0	0,0	-2100,0	67,0
794	289	34000,0	0,0	0,0	66,0
795	1289	34000,0	0,0	-100,0	66,0
796	2289	34000,0	0,0	-1250,0	66,0
797	3289	34000,0	0,0	-1600,0	66,0
798	4289	34000,0	0,0	-2100,0	66,0

TOTAL NODES IN SYSTEM= 798
NUMBER OF SURFACE NODES 221
MAXIMUM NUMBER ASSIGNED TO THE SURFACE NODE 289

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    TOTAL NUMBER OF NODES WITH PRESCRIBED HEAD B.C.ARE=        48
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NODE#    1 HEAD=  100.00 NODE# 1001 HEAD=  100.00 NODE# 2001 HEAD=  100.00 NODE#   18 HEAD=  100.00
NODE# 1018 HEAD=  100.00 NODE# 2018 HEAD=  100.00 NODE#   35 HEAD=  100.00 NODE# 1035 HEAD=  100.00
NODE# 2035 HEAD=  100.00 NODE#   52 HEAD=  100.00 NODE# 1052 HEAD=  100.00 NODE# 2052 HEAD=  100.00
NODE#   69 HEAD=  100.00 NODE# 1069 HEAD=  100.00 NODE# 2069 HEAD=  100.00 NODE#   86 HEAD=  100.00
NODE# 1086 HEAD=  100.00 NODE# 2086 HEAD=  100.00 NODE#  103 HEAD=  100.00 NODE# 1103 HEAD=  100.00
NODE# 2103 HEAD=  100.00 NODE#  120 HEAD=  100.00 NODE# 1120 HEAD=  100.00 NODE# 2120 HEAD=  100.00
NODE#   17 HEAD=   20.00 NODE# 1017 HEAD=   20.00 NODE# 2017 HEAD=   20.00 NODE#   34 HEAD=   20.00
NODE# 1034 HEAD=   20.00 NODE# 2034 HEAD=   20.00 NODE#   51 HEAD=   20.00 NODE# 1051 HEAD=   20.00
NODE# 2051 HEAD=   20.00 NODE#   68 HEAD=   20.00 NODE# 1068 HEAD=   20.00 NODE# 2068 HEAD=   20.00
NODE#   85 HEAD=   20.00 NODE# 1085 HEAD=   20.00 NODE# 2085 HEAD=   20.00 NODE#  102 HEAD=   20.00
NODE# 1102 HEAD=   20.00 NODE# 2102 HEAD=   20.00 NODE#  119 HEAD=   20.00 NODE# 1119 HEAD=   20.00
NODE# 2119 HEAD=   20.00 NODE#  136 HEAD=   20.00 NODE# 1136 HEAD=   20.00 NODE# 2136 HEAD=   20.00
NODE#

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    TOTAL NUMBER OF NODES WITH FLUX B.C.=        4
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NODE#  4274 FLUX= 0.000     NODE#  5274 FLUX= 0.000     NODE#  4284 FLUX= 0.000     NODE#  5284 FLUX= 0.000
NODE#

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ELEM#,   1  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES    4   21   20    3 1004 1021 1020 1003
ELEM#,   2  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   21   38   37   20 1021 1038 1037 1020
ELEM#,   3  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   38   55   54   37 1038 1055 1054 1037
ELEM#,   4  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   55   72   71   54 1055 1072 1071 1054
ELEM#,   5  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   72   89   88   71 1072 1089 1088 1071
ELEM#,   6  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   89  106  105   88 1089 1106 1105 1088
ELEM#,   7  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  106  123  122  105 1106 1123 1122 1105
ELEM#,   8  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES    3   20   19    2 1003 1020 1019 1002
ELEM#,   9  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   20   37   36   19 1020 1037 1036 1019
ELEM#,  10  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   37   54   53   36 1037 1054 1053 1036
ELEM#,  11  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   54   71   70   53 1054 1071 1070 1053
ELEM#,  12  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   71   88   87   70 1071 1088 1087 1070
ELEM#,  13  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   88  105  104   87 1088 1105 1104 1087
ELEM#,  14  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  105  122  121  104 1105 1122 1121 1104
ELEM#,  15  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES    2   19   18    1 1002 1019 1018 1001
ELEM#,  16  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   19   36   35   18 1019 1036 1035 1018
ELEM#,  17  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   36   53   52   35 1036 1053 1052 1035
ELEM#,  18  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   53   70   69   52 1053 1070 1069 1052
ELEM#,  19  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   70   87   86   69 1070 1087 1086 1069
ELEM#,  20  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   87  104  103   86 1087 1104 1103 1086
ELEM#,  21  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  104  121  120  103 1104 1121 1120 1103
ELEM#,  22  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   42   59   58   41 1042 1059 1058 1041
ELEM#,  23  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   59   76   75   58 1059 1076 1075 1058
ELEM#,  24  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   76   93   92   75 1076 1093 1092 1075
ELEM#,  25  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   93  110  109   92 1093 1110 1109 1092
ELEM#,  26  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  110  127  126  109 1110 1127 1126 1109
ELEM#,  27  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   41   58   57   40 1041 1058 1057 1040
ELEM#,  28  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   58   75   74   57 1058 1075 1074 1057
ELEM#,  29  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   75   92   91   74 1075 1092 1091 1074
ELEM#,  30  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   92  109  108   91 1092 1109 1108 1091
ELEM#,  31  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  109  126  125  108 1109 1126 1125 1108
ELEM#,  32  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   40   57   56   39 1040 1057 1056 1039
ELEM#,  33  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   57   74   73   56 1057 1074 1073 1056
ELEM#,  34  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   74   91   90   73 1074 1091 1090 1073
ELEM#,  35  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   91  108  107   90 1091 1108 1107 1090
ELEM#,  36  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  108  125  124  107 1108 1125 1124 1107
ELEM#,  37  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   39   56   55   38 1039 1056 1055 1038
ELEM#,  38  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   56   73   72   55 1056 1073 1072 1055
ELEM#,  39  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   73   90   89   72 1073 1090 1089 1072
ELEM#,  40  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   90  107  106   89 1090 1107 1106 1089
ELEM#,  41  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  107  124  123  106 1107 1124 1123 1106
ELEM#,  42  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   17   34   33   16 1017 1034 1033 1016
ELEM#,  43  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   34   51   50   33 1034 1051 1050 1033
ELEM#,  44  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   51   68   67   50 1051 1068 1067 1050
ELEM#,  45  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   68   85   84   67 1068 1085 1084 1067
ELEM#,  46  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   85  102  101   84 1085 1102 1101 1084
ELEM#,  47  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  102  119  118  101 1102 1119 1118 1101
ELEM#,  48  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  119  136  135  118 1119 1136 1135 1118
ELEM#,  49  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   16   33   32   15 1016 1033 1032 1015
ELEM#,  50  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   33   50   49   32 1033 1050 1049 1032
ELEM#,  51  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   50   67   66   49 1050 1067 1066 1049
ELEM#,  52  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   67   84   83   66 1067 1084 1083 1066
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ELEM#.	53	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	84	101	100	83	1084	1101	1100	1083
ELEM#.	54	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	101	118	117	100	1101	1118	1117	1100
ELEM#.	55	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	118	135	134	117	1118	1135	1134	1117
ELEM#.	56	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	15	32	31	14	1015	1032	1031	1014
ELEM#.	57	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	32	49	48	31	1032	1049	1048	1031
ELEM#.	58	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	49	66	65	48	1049	1066	1065	1048
ELEM#.	59	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	66	83	82	65	1066	1083	1082	1065
ELEM#.	60	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	83	100	99	82	1083	1100	1099	1082
ELEM#.	61	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	100	117	116	99	1100	1117	1116	1099
ELEM#.	62	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	117	134	133	116	1117	1134	1133	1116
ELEM#.	63	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	14	31	30	13	1014	1031	1030	1013
ELEM#.	64	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	31	48	47	30	1031	1048	1047	1030
ELEM#.	65	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	48	65	64	47	1048	1065	1064	1047
ELEM#.	66	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	65	82	81	64	1065	1082	1081	1064
ELEM#.	67	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	82	99	98	81	1082	1099	1098	1081
ELEM#.	68	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	99	116	115	98	1099	1116	1115	1098
ELEM#.	69	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	116	133	132	115	1116	1133	1132	1115
ELEM#.	70	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	13	30	29	12	1013	1030	1029	1012
ELEM#.	71	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	30	47	46	29	1030	1047	1046	1029
ELEM#.	72	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	47	64	63	46	1047	1064	1063	1046
ELEM#.	73	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	64	81	80	63	1064	1081	1080	1063
ELEM#.	74	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	81	98	97	80	1081	1098	1097	1080
ELEM#.	75	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	98	115	114	97	1098	1115	1114	1097
ELEM#.	76	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	115	132	131	114	1115	1132	1131	1114
ELEM#.	77	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	12	29	28	11	1012	1029	1028	1011
ELEM#.	78	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	29	46	45	28	1029	1046	1045	1028
ELEM#.	79	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	46	63	62	45	1046	1063	1062	1045
ELEM#.	80	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	63	80	79	62	1063	1080	1079	1062
ELEM#.	81	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	80	97	96	79	1080	1097	1096	1079
ELEM#.	82	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	97	114	113	96	1097	1114	1113	1096
ELEM#.	83	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	114	131	130	113	1114	1131	1130	1113
ELEM#.	84	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	11	28	27	10	1011	1028	1027	1010
ELEM#.	85	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	28	45	44	27	1028	1045	1044	1027
ELEM#.	86	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	45	62	61	44	1045	1062	1061	1044
ELEM#.	87	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	62	79	78	61	1062	1079	1078	1061
ELEM#.	88	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	79	96	95	78	1079	1096	1095	1078
ELEM#.	89	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	96	113	112	95	1096	1113	1112	1095
ELEM#.	90	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	113	130	129	112	1113	1130	1129	1112
ELEM#.	91	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	10	27	26	9	1010	1027	1026	1009
ELEM#.	92	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	27	44	43	26	1027	1044	1043	1026
ELEM#.	93	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	44	61	60	43	1044	1061	1060	1043
ELEM#.	94	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	61	78	77	60	1061	1078	1077	1060
ELEM#.	95	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	78	95	94	77	1078	1095	1094	1077
ELEM#.	96	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	95	112	111	94	1095	1112	1111	1094
ELEM#.	97	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	112	129	128	111	1112	1129	1128	1111
ELEM#.	98	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	9	26	25	8	1009	1026	1025	1008
ELEM#.	99	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	26	43	42	25	1026	1043	1042	1025
ELEM#.	100	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	43	60	59	42	1043	1060	1059	1042
ELEM#.	101	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	60	77	76	59	1060	1077	1076	1059
ELEM#.	102	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	77	94	93	76	1077	1094	1093	1076
ELEM#.	103	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	94	111	110	93	1094	1111	1110	1093
ELEM#.	104	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	111	128	127	110	1111	1128	1127	1110
ELEM#.	105	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	280	281	271	270	1280	1281	1271	1270
ELEM#.	106	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	281	282	272	271	1281	1282	1272	1271
ELEM#.	107	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	282	283	273	272	1282	1283	1273	1272
ELEM#.	108	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	283	284	274	273	1283	1284	1274	1273
ELEM#.	109	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	284	285	275	274	1284	1285	1275	1274
ELEM#.	110	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	285	286	276	275	1285	1286	1276	1275
ELEM#.	111	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	286	287	277	276	1286	1287	1277	1276
ELEM#.	112	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	287	288	278	277	1287	1288	1278	1277
ELEM#.	113	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	288	289	279	278	1288	1289	1279	1278
ELEM#.	114	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	270	271	261	260	1270	1271	1261	1260
ELEM#.	115	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	271	272	262	261	1271	1272	1262	1261
ELEM#.	116	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	272	273	263	262	1272	1273	1263	1262
ELEM#.	117	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	273	274	264	263	1273	1274	1264	1263
ELEM#.	118	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	274	275	265	264	1274	1275	1265	1264
ELEM#.	119	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	275	276	266	265	1275	1276	1266	1265
ELEM#.	120	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	276	277	267	266	1276	1277	1267	1266
ELEM#.	121	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	277	278	268	267	1277	1278	1268	1267
ELEM#.	122	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	278	279	269	268	1278	1279	1269	1268
ELEM#.	123	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	260	261	251	250	1260	1261	1251	1250
ELEM#.	124	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	261	262	252	251	1261	1262	1252	1251
ELEM#.	125	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	262	263	253	252	1262	1263	1253	1252
ELEM#.	126	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	263	264	254	253	1263	1264	1254	1253
ELEM#.	127	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	264	265	255	254	1264	1265	1255	1254
ELEM#.	128	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	265	266	256	255	1265	1266	1256	1255
ELEM#.	129	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	266	267	257	256	1266	1267	1257	1256
ELEM#.	130	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	267	268	258	257	1267	1268	1258	1257
ELEM#.	131	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	268	269	259	258	1268	1269	1259	1258
ELEM#.	132	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	250	251	241	240	1250	1251	1241	1240
ELEM#.	133	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	251	252	242	241	1251	1252	1242	1241
ELEM#.	134	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	252	253	243	242	1252	1253	1243	1242
ELEM#.	135	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	253	254	244	243	1253	1254	1244	1243
ELEM#.	136	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	254	255	245	244	1254	1255	1245	1244
ELEM#.	137	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	255	256	246	245	1255	1256	1246	1245
ELEM#.	138	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	256	257	247	246	1256	1257	1247	1246
ELEM#.	139	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	257	258	248	247	1257	1258	1248	1247
ELEM#.	140	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	258	259	249	248	1258	1259	1249	1248

ELEM#,	141	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	240	241	231	230	1240	1241	1231	1230
ELEM#,	142	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	241	242	232	231	1241	1242	1232	1231
ELEM#,	143	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	242	243	233	232	1242	1243	1233	1232
ELEM#,	144	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	243	244	234	233	1243	1244	1234	1233
ELEM#,	145	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	244	245	235	234	1244	1245	1235	1234
ELEM#,	146	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	245	246	236	235	1245	1246	1236	1235
ELEM#,	147	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	246	247	237	236	1246	1247	1237	1236
ELEM#,	148	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	247	248	238	237	1247	1248	1238	1237
ELEM#,	149	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	248	249	239	238	1248	1249	1239	1238
ELEM#,	150	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	230	231	221	220	1230	1231	1221	1220
ELEM#,	151	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	231	232	222	221	1231	1232	1222	1221
ELEM#,	152	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	232	233	223	222	1232	1233	1223	1222
ELEM#,	153	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	233	234	224	223	1233	1234	1224	1223
ELEM#,	154	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	234	235	225	224	1234	1235	1225	1224
ELEM#,	155	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	235	236	226	225	1235	1236	1226	1225
ELEM#,	156	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	236	237	227	226	1236	1237	1227	1226
ELEM#,	157	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	237	238	228	227	1237	1238	1228	1227
ELEM#,	158	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	238	239	229	228	1238	1239	1229	1228
ELEM#,	159	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	220	221	211	210	1220	1221	1211	1210
ELEM#,	160	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	221	222	212	211	1221	1222	1212	1211
ELEM#,	161	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	222	223	213	212	1222	1223	1213	1212
ELEM#,	162	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	223	224	214	213	1223	1224	1214	1213
ELEM#,	163	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	224	225	215	214	1224	1225	1215	1214
ELEM#,	164	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	225	226	216	215	1225	1226	1216	1215
ELEM#,	165	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	226	227	217	216	1226	1227	1217	1216
ELEM#,	166	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	227	228	218	217	1227	1228	1218	1217
ELEM#,	167	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	228	229	219	218	1228	1229	1219	1218
ELEM#,	168	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	210	211	201	200	1210	1211	1201	1200
ELEM#,	169	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	211	212	202	201	1211	1212	1202	1201
ELEM#,	170	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	212	213	203	202	1212	1213	1203	1202
ELEM#,	171	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	213	214	204	203	1213	1214	1204	1203
ELEM#,	172	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	214	215	205	204	1214	1215	1205	1204
ELEM#,	173	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	215	216	206	205	1215	1216	1206	1205
ELEM#,	174	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	216	217	207	206	1216	1217	1207	1206
ELEM#,	175	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	217	218	208	207	1217	1218	1208	1207
ELEM#,	176	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	218	219	209	208	1218	1219	1209	1208
ELEM#,	177	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	239	25	42	41	1239	1025	1042	1041
ELEM#,	178	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	229	239	41	40	1229	1239	1041	1040
ELEM#,	179	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	229	40	39	219	1229	1040	1039	1219
ELEM#,	180	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	219	39	38	21	1219	1039	1038	1021
ELEM#,	181	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	4	209	219	21	1004	1209	1219	1021
ELEM#,	182	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	6	220	210	200	1006	1220	1210	1200
ELEM#,	183	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	6	240	230	220	1006	1240	1230	1220
ELEM#,	184	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	6	260	250	240	1006	1260	1250	1240
ELEM#,	185	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	6	280	270	260	1006	1280	1270	1260
ELEM#,	187	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	259	269	8	25	1259	1269	1008	1025
ELEM#,	186	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	279	289	8	269	1279	1289	1008	1269
ELEM#,	188	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	239	249	259	25	1239	1249	1259	1025

TOTAL NUMBER OF UNKNOWNS ARE= 756 THESE NODES ARE AS GIVEN BELOW

2	1002	2002	3	1003	2003	4	1004	2004	6	1006	2006	8	1008	2008
9	1009	2009	10	1010	2010	11	1011	2011	12	1012	2012	13	1013	2013
14	1014	2014	15	1015	2015	16	1016	2016	19	1019	2019	20	1020	2020
21	1021	2021	25	1025	2025	26	1026	2026	27	1027	2027	28	1028	2028
29	1029	2029	30	1030	2030	31	1031	2031	32	1032	2032	33	1033	2033
36	1036	2036	37	1037	2037	38	1038	2038	39	1039	2039	40	1040	2040
41	1041	2041	42	1042	2042	43	1043	2043	44	1044	2044	45	1045	2045
46	1046	2046	47	1047	2047	48	1048	2048	49	1049	2049	50	1050	2050
53	1053	2053	54	1054	2054	55	1055	2055	56	1056	2056	57	1057	2057
58	1058	2058	59	1059	2059	60	1060	2060	61	1061	2061	62	1062	2062
63	1063	2063	64	1064	2064	65	1065	2065	66	1066	2066	67	1067	2067
70	1070	2070	71	1071	2071	72	1072	2072	73	1073	2073	74	1074	2074
75	1075	2075	76	1076	2076	77	1077	2077	78	1078	2078	79	1079	2079
80	1080	2080	81	1081	2081	82	1082	2082	83	1083	2083	84	1084	2084
87	1087	2087	88	1088	2088	89	1089	2089	90	1090	2090	91	1091	2091
92	1092	2092	93	1093	2093	94	1094	2094	95	1095	2095	96	1096	2096
97	1097	2097	98	1098	2098	99	1099	2099	100	1100	2100	101	1101	2101
104	1104	2104	105	1105	2105	106	1106	2106	107	1107	2107	108	1108	2108
109	1109	2109	110	1110	2110	111	1111	2111	112	1112	2112	113	1113	2113
114	1114	2114	115	1115	2115	116	1116	2116	117	1117	2117	118	1118	2118
121	1121	2121	122	1122	2122	123	1123	2123	124	1124	2124	125	1125	2125
126	1126	2126	127	1127	2127	128	1128	2128	129	1129	2129	130	1130	2130
131	1131	2131	132	1132	2132	133	1133	2133	134	1134	2134	135	1135	2135
200	1200	2200	201	1201	2201	202	1202	2202	203	1203	2203	204	1204	2204
3204	4204	5204	205	1205	2205	3205	4205	5205	6205	206	1206	2206	3206	4206
207	1207	2207	3207	4207	208	1208	2208	3208	4208	209	1209	2209	3209	4209
210	1210	2210	211	1211	2211	212	1212	2212	213	1213	2213	214	1214	2214
3214	4214	5214	215	1215	2215	3215	4215	5215	6215	216	1216	2216	3216	4216

217	1217	2217	3217	4217	218	1218	2218	3218	4218	219	1219	2219	3219	4219
220	1220	2220	221	1221	2221	222	1222	2222	223	1223	2223	224	1224	2224
3224	4224	5224	225	1225	2225	3225	4225	5225	6225	226	1226	2226	3226	4226
227	1227	2227	3227	4227	228	1228	2228	3228	4228	229	1229	2229	3229	4229
230	1230	2230	231	1231	2231	232	1232	2232	233	1233	2233	234	1234	2234
3234	4234	5234	235	1235	2235	3235	4235	5235	6235	236	1236	2236	3236	4236
237	1237	2237	3237	4237	238	1238	2238	3238	4238	239	1239	2239	3239	4239
240	1240	2240	241	1241	2241	242	1242	2242	243	1243	2243	244	1244	2244
3244	4244	5244	245	1245	2245	3245	4245	5245	6245	246	1246	2246	3246	4246
247	1247	2247	3247	4247	248	1248	2248	3248	4248	249	1249	2249	3249	4249
250	1250	2250	251	1251	2251	252	1252	2252	253	1253	2253	254	1254	2254
3254	4254	5254	255	1255	2255	3255	4255	5255	6255	256	1256	2256	3256	4256
257	1257	2257	3257	4257	258	1258	2258	3258	4258	259	1259	2259	3259	4259
260	1260	2260	261	1261	2261	262	1262	2262	263	1263	2263	264	1264	2264
3264	4264	5264	265	1265	2265	3265	4265	5265	6265	266	1266	2266	3266	4266
267	1267	2267	3267	4267	268	1268	2268	3268	4268	269	1269	2269	3269	4269
270	1270	2270	271	1271	2271	272	1272	2272	273	1273	2273	274	1274	2274
3274	4274	5274	275	1275	2275	3275	4275	5275	6275	276	1276	2276	3276	4276
277	1277	2277	3277	4277	278	1278	2278	3278	4278	279	1279	2279	3279	4279
280	1280	2280	281	1281	2281	282	1282	2282	283	1283	2283	284	1284	2284
3284	4284	5284	285	1285	2285	3285	4285	5285	6285	286	1286	2286	3286	4286
287	1287	2287	3287	4287	288	1288	2288	3288	4288	289	1289	2289	3289	4289

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   DIMENSIONS IN OTHER PROGRAMS HAVE TO BE SET FOR FOLLOWING MAXIMUM VALUES
               TOTAL NUMBER OF SURFACE NODES(NTSURF)=                          221
               MAXIMUM NUMBER ASSIGNED TO SURFACE NODES(LNPT)=                 289
               TOTAL NODES IN THE SYSTEM (NTT)=                                798

         THE FOLLOWING PARAMETERS ARE RELATED TO B.C
               TOTAL NUMBER OF POTENTIAL B.C. PRESCRIBED (NBPTC)=               45
               TOTAL NUMBER OF FLUX B.C. PRESCRIBED (NBFPTC)=                    0
               TOTAL NUMBER OF STREAMS  B.C. PRESCRIBED (NSTREM)=                0

         THE FOLLOWING TWO PARAMETERS ARE RELATED TO STIFFNESS MATRIX
               TOTAL NUMBER OF UNKNOWN(NPT)=                                   753
****************************************************************************************************************


         THE FOLLOWING PARAMETERS ARE ASSOCIATED WITH ELEMENTS
               TOTAL NUMBER OF SURFACE ELEMENTS(NESURF) =                      188

               MAXIMUM NUMBER ASSIGNED TO SURFACE ELEMENT(NSELEM)=             188
               TOTAL NUMBER OF ELEMENTS(NELEM) =                               328
               MAXIMUM NUMBER OF NODES IN ANY ELEMENT(NODMAX)=                   8
               MAXIMUM  NON-ZERO NODES IN ANY ELEMENTS(NONZER) =                 8

         THE FOLLOWING IS RELATED TO MATERIAL NUMBER ASSIGNED
               MAXIMUM NUMBER ASSIGNED TO MATERIAL(MATN) =                       8
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 TIME= 14:52:41    DATE= 22-AUG-79
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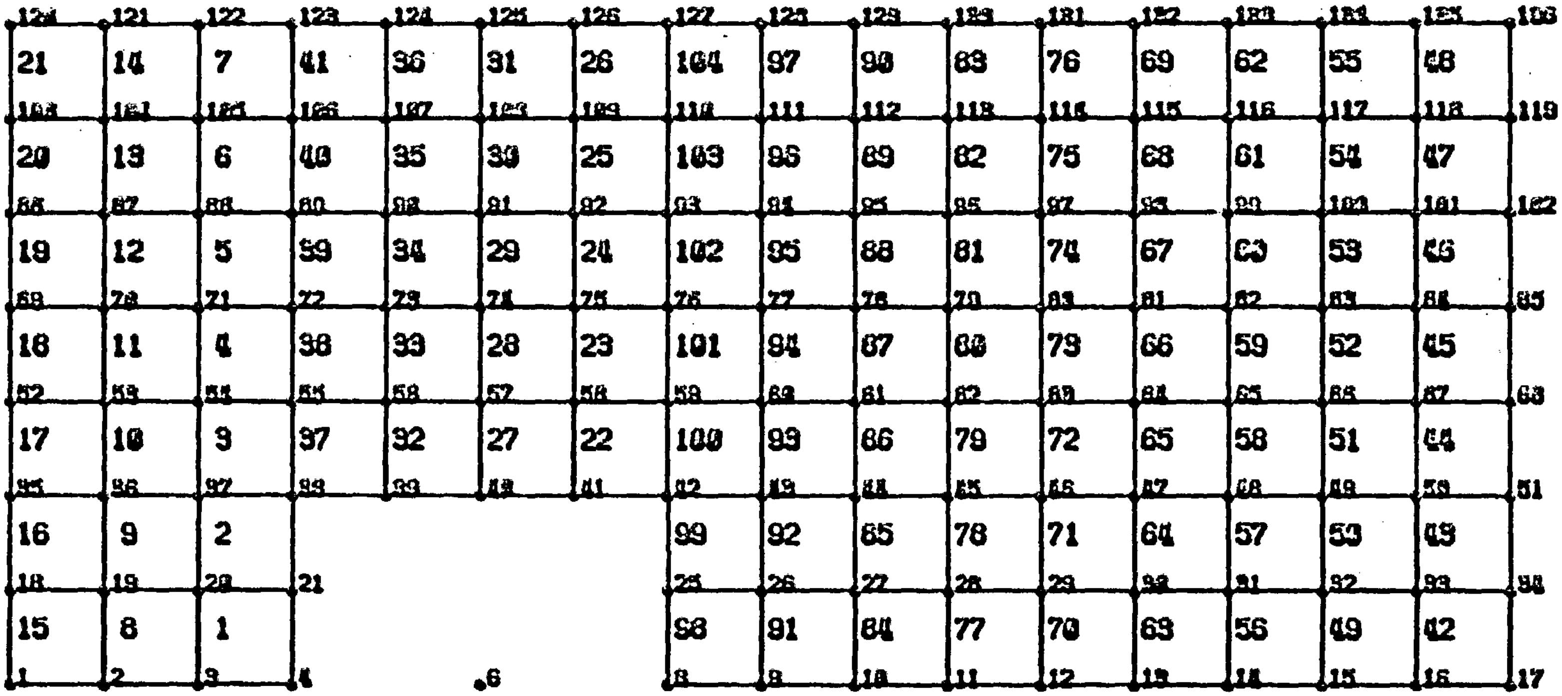
APPENDIX I.2: PLOTEL-OUTPUT

Model and element map plotted using the input deck used for simulation of flow through dome breach.

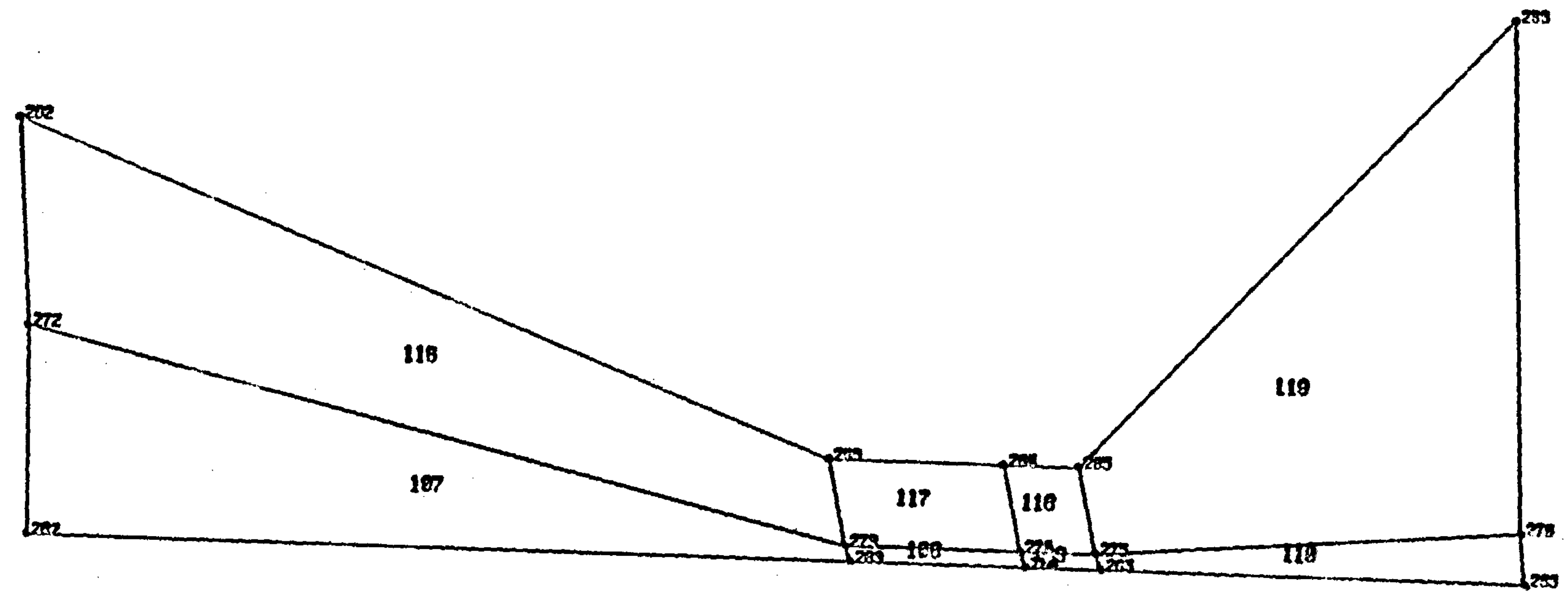
Solution Mining - Determination of Flow Through Salt Dome Breach

Model and Element Map of Whole Region Excluding Salt Dome Subregion



Solution Mining - Determination of Flow Through Salt Dome Breach

Model and Element Map of the Dome Breach



APPENDIX I.3: PROG2-OUTPUT

Horizontal surface area and volume of the elements used in determination of flow through dome breach.

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TIME= 15:01:25    DATE= 22-AUG-79

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      THESE DATA ARE PRINTED FOR INFORMATION OF USER TO MODIFY DIMENSIONS IF REQUIRED

      SECONDLY IF DIMENSIONS ARE NOT ADEQUATE THE PROGRAM IS STOPPED

           COORDINATES READ AT A TIME ARE=          256WHILE PROGRAM IS  DIMENSIONED FOR         256 NODES

           MAXIMUM # OF NODES IN ELEM, ARE=           8 WHILE THE PROGRAM IS DIMENSIONED FOR      44

           MAXIMUM NON-ZERO NODES IN ELEM,ARE=        8 WHILE THE PROGRAM IS DIMENSIONED FOR      20

           MAXIMUM SINK OR SOURCE IN A ELEM, ARE      0 DIMENSIONED FOR                           10

   PLEASE NOTE-NOTE-IMPORTANT*****THE ABOVE INFORMATION ON DIMENSION PROVISION ARE TRUE ONLY IF REPEAT IF
                                 THE VALUES OF NTT, NODMAX, NONZER, AND NQN ARE UPDATED

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NE    1 NN  8 NOD    4   21   20    3 1004 1021 1020 1003
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    1              25000000.  #AREA AND VOL = 0.250E+10
XIJCOB FOR ELEMENT    1
 1  0.12      2  0.12      3  0.12      4  0.12      5  0.12      6  0.12      7  0.12      8  0.12
NE 1001 NN  8 NOD 1004 1021 1020 1003 2004 2021 2020 2003
NE    2 NN  8 NOD   21   38   37   20 1021 1038 1037 1020
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    2              25000002.  #AREA AND VOL = 0.250E+10
NE 1002 NN  8 NOD 1021 1038 1037 1020 2021 2038 2037 2020
NE    3 NN  8 NOD   38   55   54   37 1038 1055 1054 1037
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    3              25000000.  #AREA AND VOL = 0.250E+10
NE 1003 NN  8 NOD 1038 1055 1054 1037 2038 2055 2054 2037
NE    4 NN  8 NOD   55   72   71   54 1055 1072 1071 1054
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    4              25000000.  #AREA AND VOL = 0.250E+10
NE 1004 NN  8 NOD 1055 1072 1071 1054 2055 2072 2071 2054
NE    5 NN  8 NOD   72   89   88   71 1072 1089 1088 1071
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    5              25000002.  #AREA AND VOL = 0.250E+10
NE 1005 NN  8 NOD 1072 1089 1088 1071 2072 2089 2088 2071
NE    6 NN  8 NOD   89  106  105   88 1089 1106 1105 1088
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    6              25000000.  #AREA AND VOL = 0.250E+10
NE 1006 NN  8 NOD 1089 1106 1105 1088 2089 2106 2105 2088
NE    7 NN  8 NOD  106  123  122  105 1106 1123 1122 1105
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    7              25000000.  #AREA AND VOL = 0.250E+10
NE 1007 NN  8 NOD 1106 1123 1122 1105 2106 2123 2122 2105
NE    8 NN  8 NOD    3   20   19    2 1003 1020 1019 1002
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    8              25000000.  #AREA AND VOL = 0.250E+10
NE 1008 NN  8 NOD 1003 1020 1019 1002 2003 2020 2019 2002
NE    9 NN  8 NOD   20   37   36   19 1020 1037 1036 1019
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    9              25000002.  #AREA AND VOL = 0.250E+10
NE 1009 NN  8 NOD 1020 1037 1036 1019 2020 2037 2036 2019
NE   10 NN  8 NOD   37   54   53   36 1037 1054 1053 1036
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   10              25000000.  #AREA AND VOL = 0.250E+10
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NE 1010 NN  8 NOD 1037 1054 1053 1036 2037 2054 2053 2036
NE   11 NN  8 NOD   54   71   70   53 1054 1071 1070 1053
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   11        25000004,  *AREA AND VOL = 0,250E+10
NE 1011 NN  8 NOD 1054 1071 1070 1053 2054 2071 2070 2053
NE   12 NN  8 NOD   71   88   87   70 1071 1088 1087 1070
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   12        25000006,  *AREA AND VOL = 0,250E+10
NE 1012 NN  8 NOD 1071 1088 1087 1070 2071 2088 2087 2070
NE   13 NN  8 NOD   88  105  104   87 1088 1105 1104 1087
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   13        25000000,  *AREA AND VOL = 0,250E+10
NE 1013 NN  8 NOD 1088 1105 1104 1087 2088 2105 2104 2087
NE   14 NN  8 NOD  105  122  121  104 1105 1122 1121 1104
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   14        25000000,  *AREA AND VOL = 0,250E+10
NE 1014 NN  8 NOD 1105 1122 1121 1104 2105 2122 2121 2104
NE   15 NN  8 NOD    2   19   18    1 1002 1019 1018 1001
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   15        25000000,  *AREA AND VOL = 0,250E+10
NE 1015 NN  8 NOD 1002 1019 1018 1001 2002 2019 2018 2001
NE   16 NN  8 NOD   19   36   35   18 1019 1036 1035 1018
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   16        25000002,  *AREA AND VOL = 0,250E+10
NE 1016 NN  8 NOD 1019 1036 1035 1018 2019 2036 2035 2018
NE   17 NN  8 NOD   36   53   52   35 1036 1053 1052 1035
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   17        25000000,  *AREA AND VOL = 0,250E+10
NE 1017 NN  8 NOD 1036 1053 1052 1035 2036 2053 2052 2035
NE   18 NN  8 NOD   53   70   69   52 1053 1070 1069 1052
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   18        25000002,  *AREA AND VOL = 0,250E+10
NE 1018 NN  8 NOD 1053 1070 1069 1052 2053 2070 2069 2052
NE   19 NN  8 NOD   70   87   86   69 1070 1087 1086 1069
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   19        25000004,  *AREA AND VOL = 0,250E+10
NE 1019 NN  8 NOD 1070 1087 1086 1069 2070 2087 2086 2069
NE   20 NN  8 NOD   87  104  103   86 1087 1104 1103 1086
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   20        25000000,  *AREA AND VOL = 0,250E+10
NE 1020 NN  8 NOD 1087 1104 1103 1086 2087 2104 2103 2086
NE   21 NN  8 NOD  104  121  120  103 1104 1121 1120 1103
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   21        25000000,  *AREA AND VOL = 0,250E+10
NE 1021 NN  8 NOD 1104 1121 1120 1103 2104 2121 2120 2103
NE   22 NN  8 NOD   42   59   58   41 1042 1059 1058 1041
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   22        25000000,  *AREA AND VOL = 0,250E+10
NE 1022 NN  8 NOD 1042 1059 1058 1041 2042 2059 2058 2041
NE   23 NN  8 NOD   59   76   75   58 1059 1076 1075 1058
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   23        25000002,  *AREA AND VOL = 0,250E+10
NE 1023 NN  8 NOD 1059 1076 1075 1058 2059 2076 2075 2058
NE   24 NN  8 NOD   76   93   92   75 1076 1093 1092 1075
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   24        25000004,  *AREA AND VOL = 0,250E+10
NE 1024 NN  8 NOD 1076 1093 1092 1075 2076 2093 2092 2075
NE   25 NN  8 NOD   93  110  109   92 1093 1110 1109 1092
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   25        25000000,  *AREA AND VOL = 0,250E+10
NE 1025 NN  8 NOD 1093 1110 1109 1092 2093 2110 2109 2092
NE   26 NN  8 NOD  110  127  126  109 1110 1127 1126 1109
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   26        25000000,  *AREA AND VOL = 0,250E+10
NE 1026 NN  8 NOD 1110 1127 1126 1109 2110 2127 2126 2109
NE   27 NN  8 NOD   41   58   57   40 1041 1058 1057 1040
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   27        24999998,  *AREA AND VOL = 0,250E+10
NE 1027 NN  8 NOD 1041 1058 1057 1040 2041 2058 2057 2040
NE   28 NN  8 NOD   58   75   74   57 1058 1075 1074 1057
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   28        25000000,  *AREA AND VOL = 0,250E+10
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NE 1028 NN  8 NOD 1058 1075 1074 1057 2058 2075 2074 2057
NE   29 NN  8 NOD   75   92   91   74 1075 1092 1091 1074
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   29              25000002.  *AREA AND VOL = 0.250E+10
NE 1029 NN  8 NOD 1075 1092 1091 1074 2075 2092 2091 2074
NE   30 NN  8 NOD   92  109  108   91 1092 1109 1108 1091
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   30              25000000.  *AREA AND VOL = 0.250E+10
NE 1030 NN  8 NOD 1092 1109 1108 1091 2092 2109 2108 2091
NE   31 NN  8 NOD  109  126  125  108 1109 1126 1125 1108
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   31              25000000.  *AREA AND VOL = 0.250E+10
NE 1031 NN  8 NOD 1109 1126 1125 1108 2109 2126 2125 2108
NE   32 NN  8 NOD   40   57   56   39 1040 1057 1056 1039
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   32              24999998.  *AREA AND VOL = 0.250E+10
NE 1032 NN  8 NOD 1040 1057 1056 1039 2040 2057 2056 2039
NE   33 NN  8 NOD   57   74   73   56 1057 1074 1073 1056
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   33              25000000.  *AREA AND VOL = 0.250E+10
NE 1033 NN  8 NOD 1057 1074 1073 1056 2057 2074 2073 2056
NE   34 NN  8 NOD   74   91   90   73 1074 1091 1090 1073
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   34              25000002.  *AREA AND VOL = 0.250E+10
NE 1034 NN  8 NOD 1074 1091 1090 1073 2074 2091 2090 2073
NE   35 NN  8 NOD   91  108  107   90 1091 1108 1107 1090
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   35              24999996.  *AREA AND VOL = 0.250E+10
NE 1035 NN  8 NOD 1091 1108 1107 1090 2091 2108 2107 2090
NE   36 NN  8 NOD  108  125  124  107 1108 1125 1124 1107
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   36              24999998.  *AREA AND VOL = 0.250E+10
NE 1036 NN  8 NOD 1108 1125 1124 1107 2108 2125 2124 2107
NE   37 NN  8 NOD   39   56   55   38 1039 1056 1055 1038
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   37              25000000.  *AREA AND VOL = 0.250E+10
NE 1037 NN  8 NOD 1039 1056 1055 1038 2039 2056 2055 2038
NE   38 NN  8 NOD   56   73   72   55 1056 1073 1072 1055
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   38              25000002.  *AREA AND VOL = 0.250E+10
NE 1038 NN  8 NOD 1056 1073 1072 1055 2056 2073 2072 2055
NE   39 NN  8 NOD   73   90   89   72 1073 1090 1089 1072
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   39              25000004.  *AREA AND VOL = 0.250E+10
NE 1039 NN  8 NOD 1073 1090 1089 1072 2073 2090 2089 2072
NE   40 NN  8 NOD   90  107  106   89 1090 1107 1106 1089
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   40              25000000.  *AREA AND VOL = 0.250E+10
NE 1040 NN  8 NOD 1090 1107 1106 1089 2090 2107 2106 2089
NE   41 NN  8 NOD  107  124  123  106 1107 1124 1123 1106
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   41              25000000.  *AREA AND VOL = 0.250E+10
NE 1041 NN  8 NOD 1107 1124 1123 1106 2107 2124 2123 2106
NE   42 NN  8 NOD   17   34   33   16 1017 1034 1033 1016
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   42              25000016.  *AREA AND VOL = 0.250E+10
NE 1042 NN  8 NOD 1017 1034 1033 1016 2017 2034 2033 2016
NE   43 NN  8 NOD   34   51   50   33 1034 1051 1050 1033
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   43              25000018.  *AREA AND VOL = 0.250E+10
NE 1043 NN  8 NOD 1034 1051 1050 1033 2034 2051 2050 2033
NE   44 NN  8 NOD   51   68   67   50 1051 1068 1067 1050
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   44              25000016.  *AREA AND VOL = 0.250E+10
NE 1044 NN  8 NOD 1051 1068 1067 1050 2051 2068 2067 2050
NE   45 NN  8 NOD   68   85   84   67 1068 1085 1084 1067
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   45              25000018.  *AREA AND VOL = 0.250E+10
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NE 1045 NN  8 NOD 1068 1085 1084 1067 2068 2085 2084 2067
NE   46 NN  8 NOD   85  102  101   84 1085 1102 1101 1084
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   46        25000020,  *AREA AND VOL = 0.250E+10
NE 1046 NN  8 NOD 1085 1102 1101 1084 2085 2102 2101 2084
NE   47 NN  8 NOD  102  119  118  101 1102 1119 1118 1101
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   47        25000014,  *AREA AND VOL = 0.250E+10
NE 1047 NN  8 NOD 1102 1119 1118 1101 2102 2119 2118 2101
NE   48 NN  8 NOD  119  136  135  118 1119 1136 1135 1118
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   48        25000016,  *AREA AND VOL = 0.250E+10
NE 1048 NN  8 NOD 1119 1136 1135 1118 2119 2136 2135 2118
NE   49 NN  8 NOD   16   33   32   15 1016 1033 1032 1015
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   49        25000002,  *AREA AND VOL = 0.250E+10
NE 1049 NN  8 NOD 1016 1033 1032 1015 2016 2033 2032 2015
NE   50 NN  8 NOD   33   50   49   32 1033 1050 1049 1032
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   50        25000004,  *AREA AND VOL = 0.250E+10
NE 1050 NN  8 NOD 1033 1050 1049 1032 2033 2050 2049 2032
NE   51 NN  8 NOD   50   67   66   49 1050 1067 1066 1049
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   51        25000002,  *AREA AND VOL = 0.250E+10
NE 1051 NN  8 NOD 1050 1067 1066 1049 2050 2067 2066 2049
NE   52 NN  8 NOD   67   84   83   66 1067 1084 1083 1066
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   52        25000004,  *AREA AND VOL = 0.250E+10
NE 1052 NN  8 NOD 1067 1084 1083 1066 2067 2084 2083 2066
NE   53 NN  8 NOD   84  101  100   83 1084 1101 1100 1083
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   53        25000006,  *AREA AND VOL = 0.250E+10
NE 1053 NN  8 NOD 1084 1101 1100 1083 2084 2101 2100 2083
NE   54 NN  8 NOD  101  118  117  100 1101 1118 1117 1100
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   54        25000002,  *AREA AND VOL = 0.250E+10
NE 1054 NN  8 NOD 1101 1118 1117 1100 2101 2118 2117 2100
NE   55 NN  8 NOD  118  135  134  117 1118 1135 1134 1117
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   55        25000002,  *AREA AND VOL = 0.250E+10
NE 1055 NN  8 NOD 1118 1135 1134 1117 2118 2135 2134 2117
NE   56 NN  8 NOD   15   32   31   14 1015 1032 1031 1014
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   56        25000002,  *AREA AND VOL = 0.250E+10
NE 1056 NN  8 NOD 1015 1032 1031 1014 2015 2032 2031 2014
NE   57 NN  8 NOD   32   49   48   31 1032 1049 1048 1031
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   57        25000004,  *AREA AND VOL = 0.250E+10
NE 1057 NN  8 NOD 1032 1049 1048 1031 2032 2049 2048 2031
NE   58 NN  8 NOD   49   66   65   48 1049 1066 1065 1048
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   58        25000002,  *AREA AND VOL = 0.250E+10
NE 1058 NN  8 NOD 1049 1066 1065 1048 2049 2066 2065 2048
NE   59 NN  8 NOD   66   83   82   65 1066 1083 1082 1065
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   59        25000004,  *AREA AND VOL = 0.250E+10
NE 1059 NN  8 NOD 1066 1083 1082 1065 2066 2083 2082 2065
NE   60 NN  8 NOD   83  100   99   82 1083 1100 1099 1082
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   60        25000006,  *AREA AND VOL = 0.250E+10
NE 1060 NN  8 NOD 1083 1100 1099 1082 2083 2100 2099 2082
NE   61 NN  8 NOD  100  117  116   99 1100 1117 1116 1099
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   61        25000002,  *AREA AND VOL = 0.250E+10
NE 1061 NN  8 NOD 1100 1117 1116 1099 2100 2117 2116 2099
NE   62 NN  8 NOD  117  134  133  116 1117 1134 1133 1116
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   62        25000002,  *AREA AND VOL = 0.250E+10
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NE 1062 NN  8 NOD 1117 1134 1133 1116 2117 2134 2133 2116
NE   63 NN  8 NOD   14   31   30   13 1014 1031 1030 1013
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   63      25000000.  *AREA AND VOL = 0.250E+10
NE 1063 NN  8 NOD 1014 1031 1030 1013 2014 2031 2030 2013
NE   64 NN  8 NOD   31   48   47   30 1031 1048 1047 1030
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   64      25000002.  *AREA AND VOL = 0.250E+10
NE 1064 NN  8 NOD 1031 1048 1047 1030 2031 2048 2047 2030
NE   65 NN  8 NOD   48   65   64   47 1048 1065 1064 1047
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   65      25000000.  *AREA AND VOL = 0.250E+10
NE 1065 NN  8 NOD 1048 1065 1064 1047 2048 2065 2064 2047
NE   66 NN  8 NOD   65   82   81   64 1065 1082 1081 1064
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   66      25000002.  *AREA AND VOL = 0.250E+10
NE 1066 NN  8 NOD 1065 1082 1081 1064 2065 2082 2081 2064
NE   67 NN  8 NOD   82   99   98   81 1082 1099 1098 1081
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   67      25000004.  *AREA AND VOL = 0.250E+10
NE 1067 NN  8 NOD 1082 1099 1098 1081 2082 2099 2098 2081
NE   68 NN  8 NOD   99  116  115   98 1099 1116 1115 1098
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   68      25000000.  *AREA AND VOL = 0.250E+10
NE 1068 NN  8 NOD 1099 1116 1115 1098 2099 2116 2115 2098
NE   69 NN  8 NOD  116  133  132  115 1116 1133 1132 1115
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   69      25000000.  *AREA AND VOL = 0.250E+10
NE 1069 NN  8 NOD 1116 1133 1132 1115 2116 2133 2132 2115
NE   70 NN  8 NOD   13   30   29   12 1013 1030 1029 1012
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   70      24999998.  *AREA AND VOL = 0.250E+10
NE 1070 NN  8 NOD 1013 1030 1029 1012 2013 2030 2029 2012
NE   71 NN  8 NOD   30   47   46   29 1030 1047 1046 1029
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   71      25000000.  *AREA AND VOL = 0.250E+10
NE 1071 NN  8 NOD 1030 1047 1046 1029 2030 2047 2046 2029
NE   72 NN  8 NOD   47   64   63   46 1047 1064 1063 1046
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   72      24999996.  *AREA AND VOL = 0.250E+10
NE 1072 NN  8 NOD 1047 1064 1063 1046 2047 2064 2063 2046
NE   73 NN  8 NOD   64   81   80   63 1064 1081 1080 1063
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   73      25000000.  *AREA AND VOL = 0.250E+10
NE 1073 NN  8 NOD 1064 1081 1080 1063 2064 2081 2080 2063
NE   74 NN  8 NOD   81   98   97   80 1081 1098 1097 1080
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   74      25000002.  *AREA AND VOL = 0.250E+10
NE 1074 NN  8 NOD 1081 1098 1097 1080 2081 2098 2097 2080
NE   75 NN  8 NOD   98  115  114   97 1098 1115 1114 1097
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   75      24999998.  *AREA AND VOL = 0.250E+10
NE 1075 NN  8 NOD 1098 1115 1114 1097 2098 2115 2114 2097
NE   76 NN  8 NOD  115  132  131  114 1115 1132 1131 1114
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   76      24999998.  *AREA AND VOL = 0.250E+10
NE 1076 NN  8 NOD 1115 1132 1131 1114 2115 2132 2131 2114
NE   77 NN  8 NOD   12   29   28   11 1012 1029 1028 1011
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   77      24999998.  *AREA AND VOL = 0.250E+10
NE 1077 NN  8 NOD 1012 1029 1028 1011 2012 2029 2028 2011
NE   78 NN  8 NOD   29   46   45   28 1029 1046 1045 1028
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   78      25000000.  *AREA AND VOL = 0.250E+10
NE 1078 NN  8 NOD 1029 1046 1045 1028 2029 2046 2045 2028
NE   79 NN  8 NOD   46   63   62   45 1046 1063 1062 1045
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   79      24999996.  *AREA AND VOL = 0.250E+10
NE 1079 NN  8 NOD 1046 1063 1062 1045 2046 2063 2062 2045
NE   80 NN  8 NOD   63   80   79   62 1063 1080 1079 1062
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   80      25000000.  *AREA AND VOL = 0.250E+10
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NE 1080 NN  8 NOD 1063 1080 1079 1062 2063 2080 2079 2062
NE   81 NN  8 NOD   80   97   96   79 1080 1097 1096 1079
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   81          25000002,  *AREA AND VOL = 0.250E+10
NE 1081 NN  8 NOD 1080 1097 1096 1079 2080 2097 2096 2079
NE   82 NN  8 NOD   97  114  113   96 1097 1114 1113 1096
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   82          24999998,  *AREA AND VOL = 0.250E+10
NE 1082 NN  8 NOD 1097 1114 1113 1096 2097 2114 2113 2096
NE   83 NN  8 NOD  114  131  130  113 1114 1131 1130 1113
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   83          24999998,  *AREA AND VOL = 0.250E+10
NE 1083 NN  8 NOD 1114 1131 1130 1113 2114 2131 2130 2113
NE   84 NN  8 NOD   11   28   27   10 1011 1028 1027 1010
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   84          25000016,  *AREA AND VOL = 0.250E+10
NE 1084 NN  8 NOD 1011 1028 1027 1010 2011 2028 2027 2010
NE   85 NN  8 NOD   28   45   44   27 1028 1045 1044 1027
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   85          25000016,  *AREA AND VOL = 0.250E+10
NE 1085 NN  8 NOD 1028 1045 1044 1027 2028 2045 2044 2027
NE   86 NN  8 NOD   45   62   61   44 1045 1062 1061 1044
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   86          25000016,  *AREA AND VOL = 0.250E+10
NE 1086 NN  8 NOD 1045 1062 1061 1044 2045 2062 2061 2044
NE   87 NN  8 NOD   62   79   78   61 1062 1079 1078 1061
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   87          25000016,  *AREA AND VOL = 0.250E+10
NE 1087 NN  8 NOD 1062 1079 1078 1061 2062 2079 2078 2061
NE   88 NN  8 NOD   79   96   95   78 1079 1096 1095 1078
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   88          25000020,  *AREA AND VOL = 0.250E+10
NE 1088 NN  8 NOD 1079 1096 1095 1078 2079 2096 2095 2078
NE   89 NN  8 NOD   96  113  112   95 1096 1113 1112 1095
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   89          25000014,  *AREA AND VOL = 0.250E+10
NE 1089 NN  8 NOD 1096 1113 1112 1095 2096 2113 2112 2095
NE   90 NN  8 NOD  113  130  129  112 1113 1130 1129 1112
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   90          25000016,  *AREA AND VOL = 0.250E+10
NE 1090 NN  8 NOD 1113 1130 1129 1112 2113 2130 2129 2112
NE   91 NN  8 NOD   10   27   26    9 1010 1027 1026 1009
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   91          24999994,  *AREA AND VOL = 0.250E+10
NE 1091 NN  8 NOD 1010 1027 1026 1009 2010 2027 2026 2009
NE   92 NN  8 NOD   27   44   43   26 1027 1044 1043 1026
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   92          24999996,  *AREA AND VOL = 0.250E+10
NE 1092 NN  8 NOD 1027 1044 1043 1026 2027 2044 2043 2026
NE   93 NN  8 NOD   44   61   60   43 1044 1061 1060 1043
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   93          24999992,  *AREA AND VOL = 0.250E+10
NE 1093 NN  8 NOD 1044 1061 1060 1043 2044 2061 2060 2043
NE   94 NN  8 NOD   61   78   77   60 1061 1078 1077 1060
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   94          24999994,  *AREA AND VOL = 0.250E+10
NE 1094 NN  8 NOD 1061 1078 1077 1060 2061 2078 2077 2060
NE   95 NN  8 NOD   78   95   94   77 1078 1095 1094 1077
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   95          24999998,  *AREA AND VOL = 0.250E+10
NE 1095 NN  8 NOD 1078 1095 1094 1077 2078 2095 2094 2077
NE   96 NN  8 NOD   95  112  111   94 1095 1112 1111 1094
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   96          24999992,  *AREA AND VOL = 0.250E+10
NE 1096 NN  8 NOD 1095 1112 1111 1094 2095 2112 2111 2094
NE   97 NN  8 NOD  112  129  128  111 1112 1129 1128 1111
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   97          24999994,  *AREA AND VOL = 0.250E+10
NE 1097 NN  8 NOD 1112 1129 1128 1111 2112 2129 2128 2111
NE   98 NN  8 NOD    9   26   25    8 1009 1026 1025 1008
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   98          25000002,  *AREA AND VOL = 0.250E+10
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NE 1098 NN  8 NOD 1009 1026 1025 1008 2009 2026 2025 2008
NE   99 NN  8 NOD   26   43   42   25 1026 1043 1042 1025
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   99       25000002.  #AREA AND VOL # 0.250E+10
NE 1099 NN  8 NOD 1026 1043 1042 1025 2026 2043 2042 2025
NE  100 NN  8 NOD   43   60   59   42 1043 1060 1059 1042
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  100       25000000.  #AREA AND VOL # 0.250E+10
NE 1100 NN  8 NOD 1043 1060 1059 1042 2043 2060 2059 2042
NE  101 NN  8 NOD   60   77   76   59 1060 1077 1076 1059
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  101       25000002.  #AREA AND VOL # 0.250E+10
NE 1101 NN  8 NOD 1060 1077 1076 1059 2060 2077 2076 2059
NE  102 NN  8 NOD   77   94   93   76 1077 1094 1093 1076
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  102       25000004.  #AREA AND VOL # 0.250E+10
NE 1102 NN  8 NOD 1077 1094 1093 1076 2077 2094 2093 2076
NE  103 NN  8 NOD   94  111  110   93 1094 1111 1110 1093
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  103       25000002.  #AREA AND VOL # 0.250E+10
NE 1103 NN  8 NOD 1094 1111 1110 1093 2094 2111 2110 2093
NE  104 NN  8 NOD  111  128  127  110 1111 1128 1127 1110
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  104       25000002.  #AREA AND VOL # 0.250E+10
NE 1104 NN  8 NOD 1111 1128 1127 1110 2111 2128 2127 2110
NE  105 NN  8 NOD  280  281  271  270 1280 1281 1271 1270
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  105         239738.  #AREA AND VOL # 0.240E+08
NE 1105 NN  8 NOD 1280 1281 1271 1270 2280 2281 2271 2270
NE  106 NN  8 NOD  281  282  272  271 1281 1282 1272 1271
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  106          35178.  #AREA AND VOL # 0.352E+07
NE 1106 NN  8 NOD 1281 1282 1272 1271 2281 2282 2272 2271
NE  107 NN  8 NOD  282  283  273  272 1282 1283 1273 1272
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  107          90635.  #AREA AND VOL # 0.906E+07
NE 1107 NN  8 NOD 1282 1283 1273 1272 2282 2283 2273 2272
NE  108 NN  8 NOD  283  284  274  273 1283 1284 1274 1273
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  108           2765.  #AREA AND VOL # 0.277E+06
NE 1108 NN  8 NOD 1283 1284 1274 1273 2283 2284 2274 2273
NE 2108 NN  8 NOD 2283 2284 2274 2273 2283 3284 3274 2273
NE 3108 NN  8 NOD 2283 3284 3274 2273 2283 4284 4274 2273
NE 4108 NN  8 NOD 2283 4284 4274 2273 2283 5284 5274 2273
NE  109 NN  8 NOD  284  285  275  274 1284 1285 1275 1274
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  109           1185.  #AREA AND VOL # 0.119E+06
NE 1109 NN  8 NOD 1284 1285 1275 1274 2284 2285 2275 2274
NE 2109 NN  8 NOD 2284 2285 2275 2274 3284 3285 3275 3274
NE 3109 NN  8 NOD 3284 3285 3275 3274 4284 4285 4275 4274
NE 4109 NN  8 NOD 4284 4285 4275 4274 5284 5285 5275 5274
NE 5109 NN  8 NOD 5284 5285 5275 5274 5284 6285 6275 5274
NE  110 NN  8 NOD  285  286  276  275 1285 1286 1276 1275
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  110          14089.  #AREA AND VOL # 0.141E+07
NE 1110 NN  8 NOD 1285 1286 1276 1275 2285 2286 2276 2275
NE 2110 NN  8 NOD 2285 2286 2276 2275 3285 3286 3276 3275
NE 3110 NN  8 NOD 3285 3286 3276 3275 4285 4286 4276 4275
NE 4110 NN  8 NOD 4285 4286 4276 4275 5285 4286 4276 5275
NE 5110 NN  8 NOD 5285 4286 4276 5275 6285 4286 4276 6275
NE  111 NN  8 NOD  286  287  277  276 1286 1287 1277 1276
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  111         262155.  #AREA AND VOL # 0.262E+08
NE 1111 NN  8 NOD 1286 1287 1277 1276 2286 2287 2277 2276
NE 2111 NN  8 NOD 2286 2287 2277 2276 3286 3287 3277 3276
NE 3111 NN  8 NOD 3286 3287 3277 3276 4286 4287 4277 4276
NE  112 NN  8 NOD  287  288  278  277 1287 1288 1278 1277
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  112         368830.  #AREA AND VOL # 0.369E+08
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NE 1112 NN  8 NOD 1287 1288 1278 1277 2287 2288 2278 2277
NE 2112 NN  8 NOD 2287 2288 2278 2277 3287 3288 3278 3277
NE 3112 NN  8 NOD 3287 3288 3278 3277 4287 4288 4278 4277
NE  113 NN  8 NOD  288  289  279  278 1288 1289 1279 1278
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  113          321797,  *AREA AND VOL = 0,322E+08
NE 1113 NN  8 NOD 1288 1289 1279 1278 2288 2289 2279 2278
NE 2113 NN  8 NOD 2288 2289 2279 2278 3288 3289 3279 3278
NE 3113 NN  8 NOD 3288 3289 3279 3278 4288 4289 4279 4278
NE  114 NN  8 NOD  270  271  261  260 1270 1271 1261 1260
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  114          238672,  *AREA AND VOL = 0,239E+08
NE 1114 NN  8 NOD 1270 1271 1261 1260 2270 2271 2261 2260
NE  115 NN  8 NOD  271  272  262  261 1271 1272 1262 1261
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  115           35020,  *AREA AND VOL = 0,350E+07
NE 1115 NN  8 NOD 1271 1272 1262 1261 2271 2272 2262 2261
NE  116 NN  8 NOD  272  273  263  262 1272 1273 1263 1262
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  116          114354,  *AREA AND VOL = 0,114E+08
NE 1116 NN  8 NOD 1272 1273 1263 1262 2272 2273 2263 2262
NE  117 NN  8 NOD  273  274  264  263 1273 1274 1264 1263
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  117           14689,  *AREA AND VOL = 0,147E+07
NE 1117 NN  8 NOD 1273 1274 1264 1263 2273 2274 2264 2263
NE 2117 NN  8 NOD 2273 2274 2264 2263 2273 3274 3264 2263
NE 3117 NN  8 NOD 2273 3274 3264 2263 2273 4274 4264 2263
NE 4117 NN  8 NOD 2273 4274 4264 2263 2273 5274 5264 2263
NE  118 NN  8 NOD  274  275  265  264 1274 1275 1265 1264
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  118            6295,  *AREA AND VOL = 0,632E+06
NE 1118 NN  8 NOD 1274 1275 1265 1264 2274 2275 2265 2264
NE 2118 NN  8 NOD 2274 2275 2265 2264 3274 3275 3265 3264
NE 3118 NN  8 NOD 3274 3275 3265 3264 4274 4275 4265 4264
NE 4118 NN  8 NOD 4274 4275 4265 4264 5274 5275 5265 5264
NE 5118 NN  8 NOD 5274 5275 5265 5264 5274 6275 6265 5264
NE  119 NN  8 NOD  275  276  266  265 1275 1276 1266 1265
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  119          129918,  *AREA AND VOL = 0,130E+08
NE 1119 NN  8 NOD 1275 1276 1266 1265 2275 2276 2266 2265
NE 2119 NN  8 NOD 2275 2276 2266 2265 3275 3276 3266 3265
NE 3119 NN  8 NOD 3275 3276 3266 3265 4275 4276 4266 4265
NE 4119 NN  8 NOD 4275 4276 4266 4265 5275 4276 4266 5265
NE 5119 NN  8 NOD 5275 4276 4266 5265 6275 4276 4266 6265
NE  120 NN  8 NOD  276  277  267  266 1276 1277 1267 1266
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  120          565030,  *AREA AND VOL = 0,565E+08
NE 1120 NN  8 NOD 1276 1277 1267 1266 2276 2277 2267 2266
NE 2120 NN  8 NOD 2276 2277 2267 2266 3276 3277 3267 3266
NE 3120 NN  8 NOD 3276 3277 3267 3266 4276 4277 4267 4266
NE  121 NN  8 NOD  277  278  268  267 1277 1278 1268 1267
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  121          367188,  *AREA AND VOL = 0,367E+08
NE 1121 NN  8 NOD 1277 1278 1268 1267 2277 2278 2268 2267
NE 2121 NN  8 NOD 2277 2278 2268 2267 3277 3278 3268 3267
NE 3121 NN  8 NOD 3277 3278 3268 3267 4277 4278 4268 4267
NE  122 NN  8 NOD  278  279  269  268 1278 1279 1269 1268
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  122          296618,  *AREA AND VOL = 0,297E+08
NE 1122 NN  8 NOD 1278 1279 1269 1268 2278 2279 2269 2268
NE 2122 NN  8 NOD 2278 2279 2269 2268 3278 3279 3269 3268
NE 3122 NN  8 NOD 3278 3279 3269 3268 4278 4279 4269 4268
NE  123 NN  8 NOD  260  261  251  250 1260 1261 1251 1250
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  123          477838,  *AREA AND VOL = 0,478E+08
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NE 1123 NN  8 NOD 1260 1261 1251 1250 2260 2261 2251 2250
NE  124 NN  8 NOD  261  262  252  251 1261 1262 1252 1251
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  124         70113.  *AREA AND VOL = 0.701E+07
NE 1124 NN  8 NOD 1261 1262 1252 1251 2261 2262 2252 2251
NE  125 NN  8 NOD  262  263  253  252 1262 1263 1253 1252
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  125        517055.  *AREA AND VOL = 0.517E+08
NE 1125 NN  8 NOD 1262 1263 1253 1252 2262 2263 2253 2252
NE  126 NN  8 NOD  263  264  254  253 1263 1264 1254 1253
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  126        155563.  *AREA AND VOL = 0.156E+08
NE 1126 NN  8 NOD 1263 1264 1254 1253 2263 2264 2254 2253
NE 2126 NN  8 NOD 2263 2264 2254 2253 2263 3264 3254 2253
NE 3126 NN  8 NOD 2263 3264 3254 2253 2263 4264 4254 2253
NE 4126 NN  8 NOD 2263 4264 4254 2253 2263 5264 5254 2253
NE  127 NN  8 NOD  264  265  255  254 1264 1265 1255 1254
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  127         68492.  *AREA AND VOL = 0.685E+07
NE 1127 NN  8 NOD 1264 1265 1255 1254 2264 2265 2255 2254
NE 2127 NN  8 NOD 2264 2265 2255 2254 3264 3265 3255 3254
NE 3127 NN  8 NOD 3264 3265 3255 3254 4264 4265 4255 4254
NE 4127 NN  8 NOD 4264 4265 4255 4254 5264 5265 5255 5254
NE 5127 NN  8 NOD 5264 5265 5255 5254 5264 6265 6255 5254
NE  128 NN  8 NOD  265  266  256  255 1265 1266 1256 1255
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  128        330899.  *AREA AND VOL = 0.331E+08
NE 1128 NN  8 NOD 1265 1266 1256 1255 2265 2266 2256 2255
NE 2128 NN  8 NOD 2265 2266 2256 2255 3265 3266 3256 3255
NE 3128 NN  8 NOD 3265 3266 3256 3255 4265 4266 4256 4255
NE 4128 NN  8 NOD 4265 4266 4256 4255 5265 4266 4256 5255
NE 5128 NN  8 NOD 5265 4266 4256 5255 6265 4266 4256 6255
NE  129 NN  8 NOD  266  267  257  256 1266 1267 1257 1256
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  129        823065.  *AREA AND VOL = 0.823E+08
NE 1129 NN  8 NOD 1266 1267 1257 1256 2266 2267 2257 2256
NE 2129 NN  8 NOD 2266 2267 2257 2256 3266 3267 3257 3256
NE 3129 NN  8 NOD 3266 3267 3257 3256 4266 4267 4257 4256
NE  130 NN  8 NOD  267  268  258  257 1267 1268 1258 1257
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  130        735128.  *AREA AND VOL = 0.735E+08
NE 1130 NN  8 NOD 1267 1268 1258 1257 2267 2268 2258 2257
NE 2130 NN  8 NOD 2267 2268 2258 2257 3267 3268 3258 3257
NE 3130 NN  8 NOD 3267 3268 3258 3257 4267 4268 4258 4257
NE  131 NN  8 NOD  268  269  259  258 1268 1269 1259 1258
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  131        833139.  *AREA AND VOL = 0.833E+08
NE 1131 NN  8 NOD 1268 1269 1259 1258 2268 2269 2259 2258
NE 2131 NN  8 NOD 2268 2269 2259 2258 3268 3269 3259 3258
NE 3131 NN  8 NOD 3268 3269 3259 3258 4268 4269 4259 4258
NE  132 NN  8 NOD  250  251  241  240 1250 1251 1241 1240
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  132        951061.  *AREA AND VOL = 0.951E+08
NE 1132 NN  8 NOD 1250 1251 1241 1240 2250 2251 2241 2240
NE  133 NN  8 NOD  251  252  242  241 1251 1252 1242 1241
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  133        139550.  *AREA AND VOL = 0.140E+08
NE 1133 NN  8 NOD 1251 1252 1242 1241 2251 2252 2242 2241
NE  134 NN  8 NOD  252  253  243  242 1252 1253 1243 1242
NE 1133 NN  8 NOD 1251 1252 1242 1241 2251 2252 2242 2241
NE  134 NN  8 NOD  252  253  243  242 1252 1253 1243 1242
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  134        738360.  *AREA AND VOL = 0.738E+08
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NE 1134 NN  8 NOD 1252 1253 1243 1242 2252 2253 2243 2242
NE  135 NN  8 NOD  253  254  244  243 1253 1254 1244 1243
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  135          173689.  *AREA AND VOL = 0.174E+08
NE 1135 NN  8 NOD 1253 1254 1244 1243 2253 2254 2244 2243
NE 2135 NN  8 NOD 2253 2254 2244 2243 2253 3254 3244 2243
NE 3135 NN  8 NOD 2253 3254 3244 2243 2253 4254 4244 2243
NE 4135 NN  8 NOD 2253 4254 4244 2243 2253 5254 5244 2243
NE  136 NN  8 NOD  254  255  245  244 1254 1255 1245 1244
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  136           76268.  *AREA AND VOL = 0.763E+07
NE 1136 NN  8 NOD 1254 1255 1245 1244 2254 2255 2245 2244
NE 2136 NN  8 NOD 2254 2255 2245 2244 3254 3255 3245 3244
NE 3136 NN  8 NOD 3254 3255 3245 3244 4254 4255 4245 4244
NE 4136 NN  8 NOD 4254 4255 4245 4244 5254 5255 5245 5244
NE 5136 NN  8 NOD 5254 5255 5245 5244 5254 6255 6245 5244
NE  137 NN  8 NOD  255  256  246  245 1255 1256 1246 1245
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  137          452921.  *AREA AND VOL = 0.453E+08
NE 1137 NN  8 NOD 1255 1256 1246 1245 2255 2256 2246 2245
NE 2137 NN  8 NOD 2255 2256 2246 2245 3255 3256 3246 3245
NE 3137 NN  8 NOD 3255 3256 3246 3245 4255 4256 4246 4245
NE 4137 NN  8 NOD 4255 4256 4246 4245 5255 4256 4246 5245
NE 5137 NN  8 NOD 5255 4256 4246 5245 6255 4256 4246 6245
NE  138 NN  8 NOD  256  257  247  246 1256 1257 1247 1246
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  138         1638206.  *AREA AND VOL = 0.164E+09
NE 1138 NN  8 NOD 1256 1257 1247 1246 2256 2257 2247 2246
NE 2138 NN  8 NOD 2256 2257 2247 2246 3256 3257 3247 3246
NE 3138 NN  8 NOD 3256 3257 3247 3246 4256 4257 4247 4246
NE  139 NN  8 NOD  257  258  248  247 1257 1258 1248 1247
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  139         1463183.  *AREA AND VOL = 0.146E+09
NE 1139 NN  8 NOD 1257 1258 1248 1247 2257 2258 2248 2247
NE 2139 NN  8 NOD 2257 2258 2248 2247 3257 3258 3248 3247
NE 3139 NN  8 NOD 3257 3258 3248 3247 4257 4258 4248 4247
NE  140 NN  8 NOD  258  259  249  248 1258 1259 1249 1248
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  140         1512334.  *AREA AND VOL = 0.151E+09
NE 1140 NN  8 NOD 1258 1259 1249 1248 2258 2259 2249 2248
NE 2140 NN  8 NOD 2258 2259 2249 2248 3258 3259 3249 3248
NE 3140 NN  8 NOD 3258 3259 3249 3248 4258 4259 4249 4248
NE  141 NN  8 NOD  240  241  231  230 1240 1241 1231 1230
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  141         1865586.  *AREA AND VOL = 0.187E+09
NE 1141 NN  8 NOD 1240 1241 1231 1230 2240 2241 2231 2230
NE  142 NN  8 NOD  241  242  232  231 1241 1242 1232 1231
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  142          273735.  *AREA AND VOL = 0.274E+08
NE 1142 NN  8 NOD 1241 1242 1232 1231 2241 2242 2232 2231
NE  143 NN  8 NOD  242  243  233  232 1242 1243 1233 1232
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  143         1448342.  *AREA AND VOL = 0.145E+09
NE 1143 NN  8 NOD 1242 1243 1233 1232 2242 2243 2233 2232
NE  144 NN  8 NOD  243  244  234  233 1243 1244 1234 1233
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  144          340711.  *AREA AND VOL = 0.341E+08
NE 1144 NN  8 NOD 1243 1244 1234 1233 2243 2244 2234 2233
NE 2144 NN  8 NOD 2243 2244 2234 2233 2243 3244 3234 2233
NE 3144 NN  8 NOD 2243 3244 3234 2233 2243 4244 4234 2233
NE 4144 NN  8 NOD 2243 4244 4234 2233 2243 5244 5234 2233
NE  145 NN  8 NOD  244  245  235  234 1244 1245 1235 1234
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  145          149600.  *AREA AND VOL = 0.150E+08
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NE 1145 NN  8 NOD 1244 1245 1235 1234 2244 2245 2235 2234
NE 2145 NN  8 NOD 2244 2245 2235 2234 3244 3245 3235 3234
NE 3145 NN  8 NOD 3244 3245 3235 3234 4244 4245 4235 4234
NE 4145 NN  8 NOD 4244 4245 4235 4234 5244 5245 5235 5234
NE 5145 NN  8 NUD 5244 5245 5235 5234 5244 6245 6235 5234
NE  146 NN  8 NOD  245  246  236  235 1245 1246 1236 1235
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  146            888423.  *AREA AND VOL = 0.888E+08
NE 1146 NN  8 NOD 1245 1246 1236 1235 2245 2246 2236 2235
NE 2146 NN  8 NOD 2245 2246 2236 2235 3245 3246 3236 3235
NE 3146 NN  8 NOD 3245 3246 3236 3235 4245 4246 4236 4235
NE 4146 NN  8 NOD 4245 4246 4236 4235 5245 4246 4236 5235
NE 5146 NN  8 NOD 5245 4246 4236 5235 6245 4246 4236 6235
NE  147 NN  8 NOD  246  247  237  236 1246 1247 1237 1236
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  147           3213472.  *AREA AND VOL = 0.321E+09
NE 1147 NN  8 NOD 1246 1247 1237 1236 2246 2247 2237 2236
NE 2147 NN  8 NOD 2246 2247 2237 2236 3246 3247 3237 3236
NE 3147 NN  8 NOD 3246 3247 3237 3236 4246 4247 4237 4236
NE  148 NN  8 NOD  247  248  238  237 1247 1248 1238 1237
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  148           2870128.  *AREA AND VOL = 0.287E+09
NE 1148 NN  8 NOD 1247 1248 1238 1237 2247 2248 2238 2237
NE 2148 NN  8 NOD 2247 2248 2238 2237 3247 3248 3238 3237
NE 3148 NN  8 NOD 3247 3248 3238 3237 4247 4248 4238 4237
NE  149 NN  8 NOD  248  249  239  238 1248 1249 1239 1238
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  149           2420160.  *AREA AND VOL = 0.242E+09
NE 1149 NN  8 NOD 1248 1249 1239 1238 2248 2249 2239 2238
NE 2149 NN  8 NOD 2248 2249 2239 2238 3248 3249 3239 3238
NE 3149 NN  8 NOD 3248 3249 3239 3238 4248 4249 4239 4238
NE  150 NN  8 NOD  230  231  221  220 1230 1231 1221 1220
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  150           3447147.  *AREA AND VOL = 0.345E+09
NE 1150 NN  8 NOD 1230 1231 1221 1220 2230 2231 2221 2220
NE  151 NN  8 NOD  231  232  222  221 1231 1232 1222 1221
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  151            585796.  *AREA AND VOL = 0.586E+08
NE 1151 NN  8 NOD 1231 1232 1222 1221 2231 2232 2222 2221
NE  152 NN  8 NOD  232  233  223  222 1232 1233 1223 1222
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  152           2676180.  *AREA AND VOL = 0.268E+09
NE 1152 NN  8 NOD 1232 1233 1223 1222 2232 2233 2223 2222
NE  153 NN  8 NOD  233  234  224  223 1233 1234 1224 1223
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  153            629557.  *AREA AND VOL = 0.630E+08
NE 1153 NN  8 NOD 1233 1234 1224 1223 2233 2234 2224 2223
NE 2153 NN  8 NOD 2233 2234 2224 2223 2233 3234 3224 2223
NE 3153 NN  8 NOD 2233 3234 3224 2223 2233 4234 4224 2223
NE 4153 NN  8 NOD 2233 4234 4224 2223 2233 5234 5224 2223
NE  154 NN  8 NOD  234  235  225  224 1234 1235 1225 1224
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  154            276428.  *AREA AND VOL = 0.276E+08
NE 1154 NN  8 NOD 1234 1235 1225 1224 2234 2235 2225 2224
NE 2154 NN  8 NOD 2234 2235 2225 2224 3234 3235 3225 3224
NE 3154 NN  8 NOD 3234 3235 3225 3224 4234 4235 4225 4224
NE 4154 NN  8 NOD 4234 4235 4225 4224 5234 5235 5225 5224
NE 5154 NN  8 NOD 5234 5235 5225 5224 5234 6235 6225 5224
NE  155 NN  8 NOD  235  236  226  225 1235 1236 1226 1225
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  155           1641591.  *AREA AND VOL = 0.164E+09
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NE 1155 NN  8 NOD 1235 1236 1226 1225 2235 2236 2226 2225
NE 2155 NN  8 NOD 2235 2236 2226 2225 3235 3236 3226 3225
NE 3155 NN  8 NOD 3235 3236 3226 3225 4235 4236 4226 4225
NE 4155 NN  8 NOD 4235 4236 4226 4225 5235 4236 4226 5225
NE 5155 NN  8 NOD 5235 4236 4226 5225 6235 4236 4226 6225
NE  156 NN  8 NOD  236  237  227  226 1236 1237 1227 1226
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  156          5937720.  *AREA AND VOL = 0.594E+09
NE 1156 NN  8 NOD 1236 1237 1227 1226 2236 2237 2227 2226
NE 2156 NN  8 NOD 2236 2237 2227 2226 3236 3237 3227 3226
NE 3156 NN  8 NOD 3236 3237 3227 3226 4236 4237 4227 4226
NE  157 NN  8 NOD  237  238  228  227 1237 1238 1228 1227
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  157          5303289.  *AREA AND VOL = 0.530E+09
NE 1157 NN  8 NOD 1237 1238 1228 1227 2237 2238 2228 2227
NE 2157 NN  8 NOD 2237 2238 2228 2227 3237 3238 3228 3227
NE 3157 NN  8 NOD 3237 3238 3228 3227 4237 4238 4228 4227
NE  158 NN  8 NOD  238  239  229  228 1238 1239 1229 1228
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  158          6010415.  *AREA AND VOL = 0.601E+09
NE 1158 NN  8 NOD 1238 1239 1229 1228 2238 2239 2229 2228
NE 2158 NN  8 NOD 2238 2239 2229 2228 3238 3239 3229 3228
NE 3158 NN  8 NOD 3238 3239 3229 3228 4238 4239 4229 4228
NE  159 NN  8 NOD  220  221  211  210 1220 1221 1211 1210
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  159          3447147.  *AREA AND VOL = 0.345E+09
NE 1159 NN  8 NOD 1220 1221 1211 1210 2220 2221 2211 2210
NE  160 NN  8 NOD  221  222  212  211 1221 1222 1212 1211
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  160           505795.  *AREA AND VOL = 0.506E+08
NE 1160 NN  8 NOD 1221 1222 1212 1211 2221 2222 2212 2211
NE  161 NN  8 NOD  222  223  213  212 1222 1223 1213 1212
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  161          2676170.  *AREA AND VOL = 0.268E+09
NE 1161 NN  8 NOD 1222 1223 1213 1212 2222 2223 2213 2212
NE  162 NN  8 NOD  223  224  214  213 1223 1224 1214 1213
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  162           629861.  *AREA AND VOL = 0.630E+08
NE 1162 NN  8 NOD 1223 1224 1214 1213 2223 2224 2214 2213
NE 2162 NN  8 NOD 2223 2224 2214 2213 2223 3224 3214 2213
NE 3162 NN  8 NOD 2223 3224 3214 2213 2223 4224 4214 2213
NE 4162 NN  8 NOD 2223 4224 4214 2213 2223 5224 5214 2213
NE  163 NN  8 NOD  224  225  215  214 1224 1225 1215 1214
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  163           276429.  *AREA AND VOL = 0.276E+08
NE 1163 NN  8 NOD 1224 1225 1215 1214 2224 2225 2215 2214
NE 2163 NN  8 NOD 2224 2225 2215 2214 3224 3225 3215 3214
NE 3163 NN  8 NOD 3224 3225 3215 3214 4224 4225 4215 4214
NE 4163 NN  8 NOD 4224 4225 4215 4214 5224 5225 5215 5214
NE 5163 NN  8 NOD 5224 5225 5215 5214 5224 6225 6215 5214
NE  164 NN  8 NOD  225  226  216  215 1225 1226 1216 1215
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  164          1641592.  *AREA AND VOL = 0.164E+09
NE 1164 NN  8 NOD 1225 1226 1216 1215 2225 2226 2216 2215
NE 2164 NN  8 NOD 2225 2226 2216 2215 3225 3226 3216 3215
NE 3164 NN  8 NOD 3225 3226 3216 3215 4225 4226 4216 4215
NE 4164 NN  8 NOD 4225 4226 4216 4215 5225 4226 4216 5215
NE 5164 NN  8 NOD 5225 4226 4216 5215 6225 4226 4216 6215
NE  165 NN  8 NOD  226  227  217  216 1226 1227 1217 1216
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  165          5937719.  *AREA AND VOL = 0.594E+09
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NE 1165 NN  8 NOD 1226 1227 1217 1216 2226 2227 2217 2216
NE 2165 NN  8 NOD 2226 2227 2217 2216 3226 3227 3217 3216
NE 3165 NN  8 NOD 3226 3227 3217 3216 4226 4227 4217 4216
NE  166 NN  8 NOD  227  228  218  217 1227 1228 1218 1217
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  166          5303275.  *AREA AND VOL = 0.530E+09
NE 1166 NN  8 NOD 1227 1228 1218 1217 2227 2228 2218 2217
NE 2166 NN  8 NOD 2227 2228 2218 2217 3227 3228 3218 3217
NE 3166 NN  8 NOD 3227 3228 3218 3217 4227 4228 4218 4217
NE  167 NN  8 NOD  228  229  219  218 1228 1229 1219 1218
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  167          6010423.  *AREA AND VOL = 0.601E+09
NE 1167 NN  8 NOD 1228 1229 1219 1218 2228 2229 2219 2218
NE 2167 NN  8 NOD 2228 2229 2219 2218 3228 3229 3219 3218
NE 3167 NN  8 NOD 3228 3229 3219 3218 4228 4229 4219 4218
NE  168 NN  8 NOD  210  211  201  200 1210 1211 1201 1200
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  168          3447146.  *AREA AND VOL = 0.345E+09
NE 1168 NN  8 NOD 1210 1211 1201 1200 2210 2211 2201 2200
NE  169 NN  8 NOD  211  212  202  201 1211 1212 1202 1201
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  169           505792.  *AREA AND VOL = 0.506E+08
NE 1169 NN  8 NOD 1211 1212 1202 1201 2211 2212 2202 2201
NE  170 NN  8 NOD  212  213  203  202 1212 1213 1203 1202
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  170          2676171.  *AREA AND VOL = 0.268E+09
NE 1170 NN  8 NOD 1212 1213 1203 1202 2212 2213 2203 2202
NE  171 NN  8 NOD  213  214  204  203 1213 1214 1204 1203
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  171           629561.  *AREA AND VOL = 0.630E+08
NE 1171 NN  8 NOD 1213 1214 1204 1203 2213 2214 2204 2203
NE 2171 NN  8 NOD 2213 2214 2204 2203 2213 3214 3204 2203
NE 3171 NN  8 NOD 2213 3214 3204 2203 2213 4214 4204 2203
NE 4171 NN  8 NOD 2213 4214 4204 2203 2213 5214 5204 2203
NE  172 NN  8 NOD  214  215  205  204 1214 1215 1205 1204
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  172           276033.  *AREA AND VOL = 0.276E+08
NE 1172 NN  8 NOD 1214 1215 1205 1204 2214 2215 2205 2204
NE 2172 NN  8 NOD 2214 2215 2205 2204 3214 3215 3205 3204
NE 3172 NN  8 NOD 3214 3215 3205 3204 4214 4215 4205 4204
NE 4172 NN  8 NOD 4214 4215 4205 4204 5214 5215 5205 5204
NE 5172 NN  8 NOD 5214 5215 5205 5204 5214 6215 6205 5204
NE  173 NN  8 NOD  215  216  206  205 1215 1216 1206 1205
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  173          1641590.  *AREA AND VOL = 0.164E+09
NE 1173 NN  8 NOD 1215 1216 1206 1205 2215 2216 2206 2205
NE 2173 NN  8 NOD 2215 2216 2206 2205 3215 3216 3206 3205
NE 3173 NN  8 NOD 3215 3216 3206 3205 4215 4216 4206 4205
NE 4173 NN  8 NOD 4215 4216 4206 4205 5215 4216 4206 5205
NE 5173 NN  8 NOD 5215 4216 4206 5205 6215 4216 4206 6205
NE  174 NN  8 NOD  216  217  207  206 1216 1217 1207 1206
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  174          5937717.  *AREA AND VOL = 0.594E+09
NE 1174 NN  8 NOD 1216 1217 1207 1206 2216 2217 2207 2206
NE 2174 NN  8 NOD 2216 2217 2207 2206 3216 3217 3207 3206
NE 3174 NN  8 NOD 3216 3217 3207 3206 4216 4217 4207 4206
NE  175 NN  8 NOD  217  218  208  207 1217 1218 1208 1207
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  175          5303274.  *AREA AND VOL = 0.530E+09
NE 1175 NN  8 NOD 1217 1218 1208 1207 2217 2218 2208 2207
NE 2175 NN  8 NOD 2217 2218 2208 2207 3217 3218 3208 3207
NE 3175 NN  8 NOD 3217 3218 3208 3207 4217 4218 4208 4207
NE  176 NN  8 NOD  218  219  209  208 1218 1219 1209 1208
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  176          6010426.  *AREA AND VOL = 0.601E+09
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NE 1176 NN  8 NOD 1218 1219 1209 1208 2218 2219 2209 2208
NE 2176 NN  8 NOD 2218 2219 2209 2208 3218 3219 3209 3208
NE 3176 NN  8 NOD 3218 3219 3209 3208 4218 4219 4209 4208
NE  177 NN  8 NOD  239   25   42   41 1239 1025 1042 1041
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  177        18180198,  *AREA AND VOL = 0.182E+10
NE 1177 NN  8 NOD 1239 1025 1042 1041 2239 2025 2042 2041
NE 2177 NN  8 NOD 2239 2025 2042 2041 3239 2025 2042 2041
NE 3177 NN  8 NOD 3239 2025 2042 2041 4239 2025 2042 2041.
NE  178 NN  8 NOD  229  239   41   40 1229 1239 1041 1040
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  178        12272080,  *AREA AND VOL = 0.123E+10
NE 1178 NN  8 NOD 1229 1239 1041 1040 2229 2239 2041 2040
NE 2178 NN  8 NOD 2229 2239 2041 2040 3229 3239 2041 2040
NE 3178 NN  8 NOD 3229 3239 2041 2040 4229 4239 2041 2040
NE  179 NN  8 NOD  229   40   39  219 1229 1040 1039 1219
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  179        12272081,  *AREA AND VOL = 0.123E+10
NE 1179 NN  8 NOD 1229 1040 1039 1219 2229 2040 2039 2219
NE 2179 NN  8 NOD 2229 2040 2039 2219 3229 2040 2039 3219
NE 3179 NN  8 NOD 3229 2040 2039 3219 4229 2040 2039 4219
NE  180 NN  8 NOD  219   39   38   21 1219 1039 1038 1021
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  180        18180200,  *AREA AND VOL = 0.182E+10
NE 1180 NN  8 NOD 1219 1039 1038 1021 2219 2039 2038 2021
NE 2180 NN  8 NOD 2219 2039 2038 2021 3219 2039 2038 2021
NE 3180 NN  8 NOD 3219 2039 2038 2021 4219 2039 2038 2021
NE  181 NN  8 NOD    4  209  219   21 1004 1209 1219 1021
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  181        12272078,  *AREA AND VOL = 0.123E+10
NE 1181 NN  8 NOD 1004 1209 1219 1021 2004 2209 2219 2021
NE 2181 NN  8 NOD 2004 2209 2219 2021 2004 3209 3219 2021
NE 3181 NN  8 NOD 2004 3209 3219 2021 2004 4209 4219 2021
NE  182 NN  8 NOD    6  220  210  200 1006 1220 1210 1200
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  182         4419426,  *AREA AND VOL = 0.442E+09
NE 1182 NN  8 NOD 1006 1220 1210 1200 2006 2220 2210 2200
NE  183 NN  8 NOD    6  240  230  220 1006 1240 1230 1220
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  183         3405599,  *AREA AND VOL = 0.341E+09
NE 1183 NN  8 NOD 1006 1240 1230 1220 2006 2240 2230 2220
NE  184 NN  8 NOD    6  260  250  240 1006 1260 1250 1240
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  184          915965,  *AREA AND VOL = 0.916E+08
NE 1184 NN  8 NOD 1006 1260 1250 1240 2006 2260 2250 2240
NE  185 NN  8 NOD    6  280  270  260 1006 1280 1270 1260
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  185          306669,  *AREA AND VOL = 0.307E+08
NE 1185 NN  8 NOD 1006 1280 1270 1260 2006 2280 2270 2260
NE  187 NN  8 NOD  259  269    8   25 1259 1269 1008 1025
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  187         3330927,  *AREA AND VOL = 0.333E+09
NE 1187 NN  8 NOD 1259 1269 1008 1025 2259 2269 2008 2025
NE 2187 NN  8 NOD 2259 2269 2008 2025 3259 3269 2008 2025
NE 3187 NN  8 NOD 3259 3269 2008 2025 4259 4269 2008 2025
NE  186 NN  8 NOD  279  289    8  269 1279 1289 1008 1269
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  186          652020,  *AREA AND VOL = 0.652E+08
NE 1186 NN  8 NOD 1279 1289 1008 1269 2279 2289 2008 2269
NE 2186 NN  8 NOD 2279 2289 2008 2269 3279 3289 2008 3269
NE 3186 NN  8 NOD 3279 3289 2008 3269 4279 4289 2008 4269
NE  188 NN  8 NOD  239  249  259   25 1239 1249 1259 1025
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  188         6777240,  *AREA AND VOL = 0.678E+09
NE 1188 NN  8 NOD 1239 1249 1259 1025 2239 2249 2259 2025
NE 2188 NN  8 NOD 2239 2249 2259 2025 3239 3249 3259 2025
NE 3188 NN  8 NOD 3239 3249 3259 2025 4239 4249 4259 2025

 TIME= 15:08:42    DATE= 22-AUG-79
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APPENDIX I.4: PROG3-OUTPUT

Simulated potentials with zero flow (condition before breach) through dome breach (node 4274, 5274, 4275, and 5275 define hole of 15.8 feet wide and 31.6 feet high).

STEADY STATE SOLUTION

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
1	0.0000	100.00	2	0.0000	95.11	3	0.0000	90.24	4	0.0000	85.31
1001	-100.0	100.00	1002	-100.0	95.11	1003	-100.0	90.24	1004	-100.0	85.31
2001	-2100.	100.00	2002	-2100.	95.11	2003	-2100.	90.24	2004	-2100.	85.31
6	0.0000	74.05	8	0.0000	64.15	9	0.0000	59.43	10	0.0000	54.57
1006	-100.0	74.05	1008	-100.0	64.15	1009	-100.0	59.43	1010	-100.0	54.57
2006	-900.0	74.05	2008	-2100.	64.15	2009	-2100.	59.43	2010	-2100.	54.57
11	0.0000	49.66	12	0.0000	44.73	13	0.0000	39.80	14	0.0000	34.85
1011	-100.0	49.66	1012	-100.0	44.73	1013	-100.0	39.80	1014	-100.0	34.85
2011	-2100.	49.66	2012	-2100.	44.74	2013	-2100.	39.80	2014	-2100.	34.85
15	0.0000	29.90	16	0.0000	24.95	17	0.0000	20.00	18	0.0000	100.00
1015	-100.0	29.90	1016	-100.0	24.95	1017	-100.0	20.00	1018	-100.0	100.00
2015	-2100.	29.90	2016	-2100.	24.95	2017	-2100.	20.00	2018	-2100.	100.00
19	0.0000	95.09	20	0.0000	90.21	21	0.0000	85.35	25	0.0000	64.31
1019	-100.0	95.09	1020	-100.0	90.21	1021	-100.0	85.35	1025	-100.0	64.31
2019	-2100.	95.09	2020	-2100.	90.21	2021	-2100.	85.35	2025	-2100.	64.31
26	0.0000	59.40	27	0.0000	54.59	28	0.0000	49.67	29	0.0000	44.75
1026	-100.0	59.40	1027	-100.0	54.59	1028	-100.0	49.67	1029	-100.0	44.75
2026	-2100.	59.40	2027	-2100.	54.59	2028	-2100.	49.67	2029	-2100.	44.74
30	0.0000	39.80	31	0.0000	34.85	32	0.0000	29.90	33	0.0000	24.95
1030	-100.0	39.80	1031	-100.0	34.85	1032	-100.0	29.90	1033	-100.0	24.95
2030	-2100.	39.80	2031	-2100.	34.85	2032	-2100.	29.90	2033	-2100.	24.95
34	0.0000	20.00	35	0.0000	100.00	36	0.0000	95.06	37	0.0000	90.13
1034	-100.0	20.00	1035	-100.0	100.00	1036	-100.0	95.06	1037	-100.0	90.13
2034	-2100.	20.00	2035	-2100.	100.00	2036	-2100.	95.07	2037	-2100.	90.13

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
38	0.0000	85.17	39	0.0000	80.11	40	0.0000	74.85	41	0.0000	69.59
1038	-100.0	85.17	1039	-100.0	80.11	1040	-100.0	74.85	1041	-100.0	69.59
2038	-2100.	85.17	2039	-2100.	80.10	2040	-2100.	74.85	2041	-2100.	69.60
42	0.0000	64.53	43	0.0000	59.57	44	0.0000	54.64	45	0.0000	49.70
1042	-100.0	64.53	1043	-100.0	59.57	1044	-100.0	54.64	1045	-100.0	49.70
2042	-2100.	64.53	2043	-2100.	59.57	2044	-2100.	54.64	2045	-2100.	49.70
46	0.0000	44.76	47	0.0000	39.81	48	0.0000	34.86	49	0.0000	29.90
1046	-100.0	44.76	1047	-100.0	39.81	1048	-100.0	34.86	1049	-100.0	29.90
2046	-2100.	44.76	2047	-2100.	39.81	2048	-2100.	34.86	2049	-2100.	29.90
50	0.0000	24.95	51	0.0000	20.00	52	0.0000	100.00	53	0.0000	95.03
1050	-100.0	24.95	1051	-100.0	20.00	1052	-100.0	100.00	1053	-100.0	95.03
2050	-2100.	24.95	2051	-2100.	20.00	2052	-2100.	100.00	2053	-2100.	95.03
54	0.0000	90.05	55	0.0000	85.05	56	0.0000	79.98	57	0.0000	74.86
1054	-100.0	90.05	1055	-100.0	85.05	1056	-100.0	79.98	1057	-100.0	74.86
2054	-2100.	90.05	2055	-2100.	85.05	2056	-2100.	79.98	2057	-2100.	74.86
58	0.0000	69.74	59	0.0000	64.68	60	0.0000	59.67	61	0.0000	54.69
1058	-100.0	69.74	1059	-100.0	64.68	1060	-100.0	59.67	1061	-100.0	54.69
2058	-2100.	69.74	2059	-2100.	64.68	2060	-2100.	59.67	2061	-2100.	54.69
62	0.0000	49.73	63	0.0000	44.77	64	0.0000	39.82	65	0.0000	34.86
1062	-100.0	49.73	1063	-100.0	44.77	1064	-100.0	39.82	1065	-100.0	34.86
2062	-2100.	49.73	2063	-2100.	44.77	2064	-2100.	39.82	2065	-2100.	34.86
66	0.0000	29.91	67	0.0000	24.95	68	0.0000	20.00	69	0.0000	100.00
1066	-100.0	29.91	1067	-100.0	24.95	1068	-100.0	20.00	1069	-100.0	100.00
2066	-2100.	29.91	2067	-2100.	24.95	2068	-2100.	20.00	2069	-2100.	100.00
70	0.0000	95.01	71	0.0000	90.01	72	0.0000	84.98	73	0.0000	79.94
1070	-100.0	95.01	1071	-100.0	90.01	1072	-100.0	84.98	1073	-100.0	79.94
2070	-2100.	95.01	2071	-2100.	90.01	2072	-2100.	84.99	2073	-2100.	79.94

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
74	0.0000	74.87	75	0.0000	69.80	76	0.0000	64.75	77	0.0000	59.73
1074	-100.0	74.87	1075	-100.0	69.80	1076	-100.0	64.75	1077	-100.0	59.73
2074	-2100.	74.87	2075	-2100.	69.80	2076	-2100.	64.75	2077	-2100.	59.73
78	0.0000	54.74	79	0.0000	49.76	80	0.0000	44.79	81	0.0000	39.83
1078	-100.0	54.74	1079	-100.0	49.76	1080	-100.0	44.79	1081	-100.0	39.83
2078	-2100.	54.74	2079	-2100.	49.76	2080	-2100.	44.79	2081	-2100.	39.83
82	0.0000	34.87	83	0.0000	29.91	84	0.0000	24.96	85	0.0000	20.00
1082	-100.0	34.87	1083	-100.0	29.91	1084	-100.0	24.96	1085	-100.0	20.00
2082	-2100.	34.87	2083	-2100.	29.91	2084	-2100.	24.96	2085	-2100.	20.00
86	0.0000	100.00	87	0.0000	94.99	88	0.0000	89.98	89	0.0000	84.96
1086	-100.0	100.00	1087	-100.0	94.99	1088	-100.0	89.98	1089	-100.0	84.96
2086	-2100.	100.00	2087	-2100.	94.99	2088	-2100.	89.98	2089	-2100.	84.96
90	0.0000	79.92	91	0.0000	74.87	92	0.0000	69.82	93	0.0000	64.79
1090	-100.0	79.92	1091	-100.0	74.87	1092	-100.0	69.82	1093	-100.0	64.79
2090	-2100.	79.92	2091	-2100.	74.87	2092	-2100.	69.82	2093	-2100.	64.79
94	0.0000	59.77	95	0.0000	54.77	96	0.0000	49.79	97	0.0000	44.81
1094	-100.0	59.77	1095	-100.0	54.77	1096	-100.0	49.79	1097	-100.0	44.81
2094	-2100.	59.77	2095	-2100.	54.77	2096	-2100.	49.79	2097	-2100.	44.81
98	0.0000	39.84	99	0.0000	34.88	100	0.0000	29.92	101	0.0000	24.96
1098	-100.0	39.84	1099	-100.0	34.88	1100	-100.0	29.92	1101	-100.0	24.96
2098	-2100.	39.84	2099	-2100.	34.88	2100	-2100.	29.92	2101	-2100.	24.96
102	0.0000	20.00	103	0.0000	100.00	104	0.0000	94.99	105	0.0000	89.97
1102	-100.0	20.00	1103	-100.0	100.00	1104	-100.0	94.99	1105	-100.0	89.97
2102	-2100.	20.00	2103	-2100.	100.00	2104	-2100.	94.99	2105	-2100.	89.97
106	0.0000	84.95	107	0.0000	79.92	108	0.0000	74.87	109	0.0000	69.84
1106	-100.0	84.95	1107	-100.0	79.92	1108	-100.0	74.87	1109	-100.0	69.84
2106	-2100.	84.95	2107	-2100.	79.91	2108	-2100.	74.87	2109	-2100.	69.84

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
110	0.0000	64.81	111	0.0000	59.79	112	0.0000	54.79	113	0.0000	49.80
1110	-100.0	64.81	1111	-100.0	59.79	1112	-100.0	54.79	1113	-100.0	49.80
2110	-2100.	64.81	2111	-2100.	59.79	2112	-2100.	54.79	2113	-2100.	49.80
114	0.0000	44.82	115	0.0000	39.84	116	0.0000	34.88	117	0.0000	29.92
1114	-100.0	44.82	1115	-100.0	39.84	1116	-100.0	34.88	1117	-100.0	29.92
2114	-2100.	44.82	2115	-2100.	39.84	2116	-2100.	34.88	2117	-2100.	29.92
118	0.0000	24.96	119	0.0000	20.00	120	0.0000	100.00	121	0.0000	94.99
1118	-100.0	24.96	1119	-100.0	20.00	1120	-100.0	100.00	1121	-100.0	94.99
2118	-2100.	24.96	2119	-2100.	20.00	2120	-2100.	100.00	2121	-2100.	94.99
122	0.0000	89.97	123	0.0000	84.94	124	0.0000	79.91	125	0.0000	74.88
1122	-100.0	89.97	1123	-100.0	84.94	1124	-100.0	79.91	1125	-100.0	74.88
2122	-2100.	89.97	2123	-2100.	84.94	2124	-2100.	79.91	2125	-2100.	74.87
126	0.0000	69.84	127	0.0000	64.82	128	0.0000	59.80	129	0.0000	54.80
1126	-100.0	69.84	1127	-100.0	64.82	1128	-100.0	59.80	1129	-100.0	54.80
2126	-2100.	69.84	2127	-2100.	64.82	2128	-2100.	59.80	2129	-2100.	54.80
130	0.0000	49.81	131	0.0000	44.82	132	0.0000	39.84	133	0.0000	34.88
1130	-100.0	49.81	1131	-100.0	44.82	1132	-100.0	39.84	1133	-100.0	34.88
2130	-2100.	49.81	2131	-2100.	44.82	2132	-2100.	39.84	2133	-2100.	34.88
134	0.0000	29.92	135	0.0000	24.96	136	0.0000	20.00	200	0.0000	78.03
1134	-100.0	29.92	1135	-100.0	24.96	1136	-100.0	20.00	1200	-100.0	78.03
2134	-2100.	29.92	2135	-2100.	24.96	2136	-2100.	20.00	2200	-900.0	78.03
201	0.0000	79.91	202	0.0000	80.10	203	0.0000	80.97	204	0.0000	81.15
1201	-100.0	79.91	1202	-100.0	80.10	1203	-100.0	80.97	1204	-100.0	81.15
2201	-900.0	80.06	2202	-900.0	80.36	2203	-1560.	81.44	2204	-1050.	81.46
									3204	-1602.	81.59
									4204	-1669.	81.62
									5204	-1700.	81.64

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
205	0.0000	81.22	206	0.0000	81.64	207	0.0000	82.84	208	0.0000	83.73
1205	-100.0	81.22	1206	-100.0	81.64	1207	-100.0	82.84	1208	-100.0	83.73
2205	-1250.	81.52	2206	-1250.	81.83	2207	-1250.	82.87	2208	-1250.	83.73
3205	-1600.	81.63	3206	-1600.	81.90	3207	-1600.	82.88	3208	-1600.	83.74
4205	-1669.	81.67	4206	-2100.	81.98	4207	-2100.	82.88	4208	-2100.	83.74
5205	-1700.	81.69									
6205	-1740.	81.70									
209	0.0000	84.63	210	0.0000	77.11	211	0.0000	78.43	212	0.0000	78.56
1209	-100.0	84.63	1210	-100.0	77.11	1211	-100.0	78.43	1212	-100.0	78.56
2209	-1250.	84.63	2210	-900.0	77.09	2211	-900.0	78.53	2212	-900.0	78.75
3209	-1600.	84.63									
4209	-2100.	84.63									
213	0.0000	79.17	214	0.0000	79.30	215	0.0000	79.35	216	0.0000	79.65
1213	-100.0	79.17	1214	-100.0	79.30	1215	-100.0	79.35	1216	-100.0	79.65
2213	-1560.	79.51	2214	-1250.	79.58	2215	-1250.	79.50	2216	-1250.	79.76
			3214	-1600.	79.61	3215	-1600.	79.60	3216	-1600.	79.83
			4214	-1669.	79.64	4215	-1669.	79.60	4216	-2100.	79.89
			5214	-1700.	79.65	5215	-1700.	79.60			
						6215	-1740.	79.69			
217	0.0000	80.49	218	0.0000	81.12	219	0.0000	81.75	220	0.0000	74.85
1217	-100.0	80.49	1218	-100.0	81.12	1219	-100.0	81.75	1220	-100.0	74.85
2217	-1250.	80.52	2218	-1250.	81.13	2219	-1250.	81.76	2220	-900.0	74.85
3217	-1600.	80.52	3218	-1600.	81.13	3219	-1600.	81.76			
4217	-2100.	80.52	4218	-2100.	81.13	4219	-2100.	81.76			
221	0.0000	74.85	222	0.0000	74.85	223	0.0000	74.86	224	0.0000	74.86
1221	-100.0	74.85	1222	-100.0	74.85	1223	-100.0	74.86	1224	-100.0	74.86
2221	-900.0	74.85	2222	-900.0	74.85	2223	-1560.	74.85	2224	-1250.	74.85
									3224	-1600.	74.85
									4224	-1669.	74.84
									5224	-1700.	74.84

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
225	0.0000	74.86	226	0.0000	74.85	227	0.0000	74.85	228	0.0000	74.85
1225	-100.0	74.86	1226	-100.0	74.85	1227	-100.0	74.85	1228	-100.0	74.85
2225	-1250.	74.85	2226	-1250.	74.85	2227	-1250.	74.85	2228	-1250.	74.85
3225	-1600.	74.85	3226	-1600.	74.85	3227	-1600.	74.85	3228	-1600.	74.85
4225	-1669.	74.85	4226	-2100.	74.85	4227	-2100.	74.85	4228	-2100.	74.85
5225	-1700.	74.85									
6225	-1740.	74.84									
229	0.0000	74.85	230	0.0000	72.59	231	0.0000	71.20	232	0.0002	71.14
1229	-100.0	74.85	1230	-100.0	72.59	1231	-100.0	71.21	1232	-100.0	71.14
2229	-1250.	74.85	2230	-900.0	72.60	2231	-900.0	71.19	2232	-900.0	70.98
3229	-1600.	74.85									
4229	-2100.	74.85									
233	0.0000	70.53	234	0.0000	70.40	235	0.0000	70.35	236	0.0000	70.06
1233	-100.0	70.53	1234	-100.0	70.40	1235	-100.0	70.35	1236	-100.0	70.06
2233	-1560.	70.24	2234	-1250.	70.21	2235	-1250.	70.17	2236	-1250.	69.95
			3234	-1600.	70.14	3235	-1600.	70.10	3236	-1600.	69.93
			4234	-1669.	70.12	4235	-1669.	70.09	4236	-2100.	69.85
			5234	-1700.	70.11	5235	-1700.	70.07			
						6235	-1740.	70.07			
237	0.0000	69.21	238	0.0000	68.59	239	0.0000	67.94	240	0.0000	71.89
1237	-100.0	69.21	1238	-100.0	68.58	1239	-100.0	67.94	1240	-100.0	71.89
2237	-1250.	69.19	2238	-1250.	68.58	2239	-1250.	67.94	2240	-900.0	71.91
3237	-1600.	69.19	3238	-1600.	68.58	3239	-1600.	67.94			
4237	-2100.	69.19	4238	-2100.	68.57	4239	-2100.	67.94			
241	0.0000	70.15	242	0.0000	69.98	243	0.0000	69.18	244	0.0000	69.01
1241	-100.0	70.15	1242	-100.0	69.98	1243	-100.0	69.18	1244	-100.0	69.01
2241	-900.0	70.03	2242	-900.0	69.75	2243	-1560.	68.76	2244	-1250.	68.74
									3244	-1600.	68.62
									4244	-1669.	68.59
									5244	-1700.	68.58

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
245	0.0000	68.94	246	0.0000	68.56	247	0.0000	67.47	248	0.0000	66.66
1245	-100.0	68.94	1246	-100.0	68.56	1247	-100.0	67.47	1248	-100.0	66.66
2245	-1250.	68.69	2246	-1250.	68.40	2247	-1250.	67.45	2248	-1250.	66.66
3245	-1600.	68.58	3246	-1600.	68.34	3247	-1600.	67.44	3248	-1600.	66.66
4245	-1660.	68.54	4246	-2100.	68.27	4247	-2100.	67.45	4248	-2100.	66.66
5245	-1700.	68.53									
6245	-1740.	68.52									
249	0.0000	66.44	250	0.0000	71.70	251	0.0000	69.86	252	0.0000	69.67
1249	-100.0	66.44	1250	-100.0	71.70	1251	-100.0	69.85	1252	-100.0	69.67
2249	-1250.	66.44	2250	-900.0	71.73	2251	-900.0	69.78	2252	-900.0	69.41
3249	-1600.	66.44									
4249	-2100.	66.44									
253	0.0000	68.82	254	0.0000	68.64	255	0.0000	68.37	256	0.0000	68.17
1253	-100.0	68.82	1254	-100.0	68.64	1255	-100.0	68.37	1256	-100.0	68.17
2253	-1500.	68.38	2254	-1250.	68.35	2255	-1250.	68.30	2256	-1250.	68.00
			3254	-1600.	68.23	3255	-1600.	68.19	3256	-1600.	67.94
			4254	-1660.	68.20	4255	-1660.	68.15	4256	-2100.	67.85
			5254	-1700.	68.19	5255	-1700.	68.14			
						6255	-1740.	68.13			
257	0.0000	67.02	258	0.0000	66.16	259	0.0000	65.28	260	0.0000	71.66
1257	-100.0	67.02	1258	-100.0	66.16	1259	-100.0	65.28	1260	-100.0	71.66
2257	-1250.	66.99	2258	-1250.	66.16	2259	-1250.	65.28	2260	-900.0	71.60
3257	-1600.	66.98	3258	-1600.	66.15	3259	-1600.	65.28			
4257	-2100.	66.99	4258	-2100.	66.15	4259	-2100.	65.28			
261	0.0000	69.78	262	0.0000	69.59	263	0.0000	68.72	264	0.0000	68.54
1261	-100.0	69.78	1262	-100.0	69.59	1263	-100.0	68.72	1264	-100.0	68.54
2261	-900.0	69.65	2262	-900.0	69.34	2263	-1500.	68.25	2264	-1250.	68.23
									3264	-1600.	68.11
									4264	-1660.	68.08
									5264	-1700.	68.06

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
265	0.0000	68.47	266	0.0000	68.07	267	0.0000	66.90	268	0.0000	66.03
1265	-100.0	68.47	1266	-100.0	68.07	1267	-100.0	66.90	1268	-100.0	66.03
2265	-1250.	68.18	2266	-1250.	67.98	2267	-1250.	66.87	2268	-1250.	66.02
3265	-1600.	68.06	3266	-1600.	67.93	3267	-1600.	66.87	3268	-1600.	66.02
4265	-1660.	68.02	4266	-2100.	67.75	4267	-2100.	66.86	4268	-2100.	66.02
5265	-1700.	68.01									
6265	-1740.	68.00									
269	0.0000	65.14	270	0.0000	71.65	271	0.0000	69.77	272	0.0000	69.57
1269	-100.0	65.14	1270	-100.0	71.65	1271	-100.0	69.76	1272	-100.0	69.57
2269	-1250.	65.13	2270	-900.0	71.67	2271	-900.0	69.64	2272	-900.0	69.34
3269	-1600.	65.13									
4269	-2100.	65.13									
273	0.0000	68.70	274	0.0000	68.32	275	0.0000	68.45	276	0.0000	68.04
1273	-100.0	68.70	1274	-100.0	68.32	1275	-100.0	68.45	1276	-100.0	68.04
2273	-1560.	68.22	2274	-1250.	68.22	2275	-1250.	68.17	2276	-1250.	67.87
			3274	-1600.	68.09	3275	-1600.	68.09	3276	-1600.	67.80
			4274	-1660.	68.06	4275	-1660.	68.00	4276	-2100.	67.73
			5274	-1700.	68.05	5275	-1700.	67.99			
						6275	-1740.	67.98			
277	0.0000	66.07	278	0.0000	66.00	279	0.0000	65.54	280	0.0000	71.64
1277	-100.0	66.07	1278	-100.0	65.99	1279	-100.0	65.54	1280	-100.0	71.64
2277	-1250.	66.04	2278	-1250.	65.99	2279	-1250.	65.53	2280	-900.0	71.66
3277	-1600.	66.04	3278	-1600.	65.99	3279	-1600.	65.53			
4277	-2100.	66.04	4278	-2100.	65.99	4279	-2100.	65.53			
281	0.0000	69.76	282	0.0000	69.57	283	0.0000	68.70	284	0.0000	68.52
1281	-100.0	69.76	1282	-100.0	69.57	1283	-100.0	68.70	1284	-100.0	68.52
2281	-900.0	69.63	2282	-900.0	69.34	2283	-1560.	68.21	2284	-1250.	68.22
									3284	-1600.	68.09
									4284	-1660.	68.06
									5284	-1700.	68.04

POTENTIAL PRIOR TO BREACH (NO FLOW THROUGH NODES 4274,5274,4275,5275)

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
285	0.0000	68.40	286	0.0000	68.04	287	0.0000	66.86	288	0.0000	65.98
1285	-100.0	68.44	1286	-100.0	68.03	1287	-100.0	66.86	1288	-100.0	65.98
2285	-1250.	68.16	2286	-1250.	67.86	2287	-1250.	66.85	2288	-1250.	65.98
3285	-1600.	68.05	3286	-1600.	67.80	3287	-1600.	66.83	3288	-1600.	65.98
4285	-1660.	68.00	4286	-2100.	67.73	4287	-2100.	66.83	4288	-2100.	65.98
5285	-1700.	67.99									
6285	-1740.	67.98									
289	0.0000	65.88									
1289	-100.0	65.88									
2289	-1250.	65.88									
3289	-1600.	65.88									
4289	-2100.	65.88									

TIME= 15:40:05 DATE= 22-AUG-79

APPENDIX I.5: PROG3-OUTPUT

Simulated potentials with injected flow of 10,000, 2500, 3200, and 700 ft^3/day, respectively, at node 4274, 5274, 4278, and 5278, which gave 50 ft additional head at the dome breach. The total flow of 16,400 ft^3/day was increased arbitrarily by a safety factor of 1.5 and rounded to arrive at flow rate of 24,000 ft^3/day.

STEADY STATE SOLUTION

POTENTIAL WITH Q(4274)=10000 Q(5274)=2500 Q(4284)=3200 Q(5284)=700 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
1	0.0000	100.00	2	0.0000	95.37	3	0.0000	90.70	4	0.0000	86.35
1001	-100.0	100.00	1002	-100.0	95.37	1003	-100.0	90.70	1004	-100.0	86.35
2001	-2100.	100.00	2002	-2100.	95.37	2003	-2100.	90.70	2004	-2100.	86.35
6	0.0000	76.78	8	0.0000	66.51	9	0.0000	61.11	10	0.0000	55.89
1006	-100.0	76.78	1008	-100.0	66.51	1009	-100.0	61.11	1010	-100.0	55.89
2006	-2100.	76.78	2008	-2100.	66.51	2009	-2100.	61.11	2010	-2100.	55.89
11	0.0000	50.72	12	0.0000	45.50	13	0.0000	40.46	14	0.0000	35.34
1011	-100.0	50.72	1012	-100.0	45.50	1013	-100.0	40.46	1014	-100.0	35.34
2011	-2100.	50.72	2012	-2100.	45.50	2013	-2100.	40.46	2014	-2100.	35.34
15	0.0000	30.22	16	0.0000	25.11	17	0.0000	20.00	18	0.0000	100.00
1015	-100.0	30.22	1016	-100.0	25.11	1017	-100.0	20.00	1018	-100.0	100.00
2015	-2100.	30.22	2016	-2100.	25.11	2017	-2100.	20.00	2018	-2100.	100.00
19	0.0000	95.36	20	0.0000	90.74	21	0.0000	86.17	25	0.0000	66.30
1019	-100.0	95.36	1020	-100.0	90.74	1021	-100.0	86.17	1025	-100.0	66.30
2019	-2100.	95.36	2020	-2100.	90.74	2021	-2100.	86.17	2025	-2100.	66.30
26	0.0000	61.07	27	0.0000	55.87	28	0.0000	50.71	29	0.0000	45.58
1026	-100.0	61.07	1027	-100.0	55.87	1028	-100.0	50.71	1029	-100.0	45.58
2026	-2100.	61.07	2027	-2100.	55.87	2028	-2100.	50.71	2029	-2100.	45.58
30	0.0000	40.45	31	0.0000	35.33	32	0.0000	30.22	33	0.0000	25.11
1030	-100.0	40.45	1031	-100.0	35.33	1032	-100.0	30.22	1033	-100.0	25.11
2030	-2100.	40.45	2031	-2100.	35.33	2032	-2100.	30.22	2033	-2100.	25.11
34	0.0000	20.00	35	0.0000	100.00	36	0.0000	95.31	37	0.0000	90.63
1034	-100.0	20.00	1035	-100.0	100.00	1036	-100.0	95.31	1037	-100.0	90.63
2034	-2100.	20.00	2035	-2100.	100.00	2036	-2100.	95.31	2037	-2100.	90.63

POTENTIAL WITH Q(4274)=10000 Q(3274)=2500 Q(4284)=3200 Q(5284)=700 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
38	0.0000	85.94	39	0.0000	81.16	40	0.0000	76.21	41	0.0000	71.16
1038	-100.0	85.94	1039	-100.0	81.16	1040	-100.0	76.21	1041	-100.0	71.16
2038	-2100.	85.94	2039	-2100.	81.15	2040	-2100.	76.21	2041	-2100.	71.16
42	0.0000	66.08	43	0.0000	60.96	44	0.0000	55.02	45	0.0000	50.68
1042	-100.0	66.08	1043	-100.0	60.96	1044	-100.0	55.02	1045	-100.0	50.68
2042	-2100.	66.08	2043	-2100.	60.96	2044	-2100.	55.02	2045	-2100.	50.68
46	0.0000	45.96	47	0.0000	40.44	48	0.0000	35.33	49	0.0000	30.21
1046	-100.0	45.96	1047	-100.0	40.44	1048	-100.0	35.33	1049	-100.0	30.21
2046	-2100.	45.96	2047	-2100.	40.44	2048	-2100.	35.33	2049	-2100.	30.21
50	0.0000	25.11	51	0.0000	20.00	52	0.0000	100.00	53	0.0000	95.27
1050	-100.0	25.11	1051	-100.0	20.00	1052	-100.0	100.00	1053	-100.0	95.27
2050	-2100.	25.11	2051	-2100.	20.00	2052	-2100.	100.00	2053	-2100.	95.27
54	0.0000	90.52	55	0.0000	85.75	56	0.0000	80.90	57	0.0000	75.90
1054	-100.0	90.52	1055	-100.0	85.75	1056	-100.0	80.90	1057	-100.0	75.90
2054	-2100.	90.52	2055	-2100.	85.74	2056	-2100.	80.90	2057	-2100.	75.90
58	0.0000	70.99	59	0.0000	65.94	60	0.0000	60.86	61	0.0000	55.76
1058	-100.0	70.99	1059	-100.0	65.94	1060	-100.0	60.86	1061	-100.0	55.76
2058	-2100.	70.98	2059	-2100.	65.94	2060	-2100.	60.86	2061	-2100.	55.76
62	0.0000	50.64	63	0.0000	45.53	64	0.0000	40.43	65	0.0000	35.32
1062	-100.0	50.64	1063	-100.0	45.53	1064	-100.0	40.43	1065	-100.0	35.32
2062	-2100.	50.64	2063	-2100.	45.53	2064	-2100.	40.43	2065	-2100.	35.32
66	0.0000	30.21	67	0.0000	25.11	68	0.0000	20.00	69	0.0000	100.00
1066	-100.0	30.21	1067	-100.0	25.11	1068	-100.0	20.00	1069	-100.0	100.00
2066	-2100.	30.21	2067	-2100.	25.10	2068	-2100.	20.00	2069	-2100.	100.00
70	0.0000	95.22	71	0.0000	90.43	72	0.0000	85.61	73	0.0000	80.75
1070	-100.0	95.22	1071	-100.0	90.43	1072	-100.0	85.61	1073	-100.0	80.75
2070	-2100.	95.22	2071	-2100.	90.43	2072	-2100.	85.61	2073	-2100.	80.75

POTENTIAL WITH Q(4274)=1000 Q(5274)=2500 Q(4284)=3200 Q(5284)=750 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
74	0.0000	75.82	75	0.0000	70.89	76	0.0000	65.83	77	0.0000	60.78
1074	-100.0	75.82	1075	-100.0	70.89	1076	-100.0	65.83	1077	-100.0	60.78
2074	-2100.	75.82	2075	-2100.	70.89	2076	-2100.	65.83	2077	-2100.	60.78
78	0.0000	55.70	79	0.0000	50.61	80	0.0000	45.51	81	0.0000	40.41
1078	-100.0	55.70	1079	-100.0	50.61	1080	-100.0	45.51	1081	-100.0	40.41
2078	-2100.	55.70	2079	-2100.	50.61	2080	-2100.	45.51	2081	-2100.	40.41
82	0.0000	35.31	83	0.0000	30.20	84	0.0000	25.10	85	0.0000	20.00
1082	-100.0	35.31	1083	-100.0	30.20	1084	-100.0	25.10	1085	-100.0	20.00
2082	-2100.	35.31	2083	-2100.	30.20	2084	-2100.	25.10	2085	-2100.	20.00
86	0.0000	100.00	87	0.0000	95.19	88	0.0000	90.37	89	0.0000	85.53
1086	-100.0	100.00	1087	-100.0	95.19	1088	-100.0	90.37	1089	-100.0	85.53
2086	-2100.	100.00	2087	-2100.	95.19	2088	-2100.	90.37	2089	-2100.	85.53
90	0.0000	80.65	91	0.0000	75.73	92	0.0000	70.76	93	0.0000	65.75
1090	-100.0	80.65	1091	-100.0	75.73	1092	-100.0	70.76	1093	-100.0	65.75
2090	-2100.	80.65	2091	-2100.	75.73	2092	-2100.	70.76	2093	-2100.	65.75
94	0.0000	60.72	95	0.0000	55.66	96	0.0000	50.58	97	0.0000	45.49
1094	-100.0	60.72	1095	-100.0	55.66	1096	-100.0	50.58	1097	-100.0	45.49
2094	-2100.	60.72	2095	-2100.	55.66	2096	-2100.	50.58	2097	-2100.	45.49
98	0.0000	40.39	99	0.0000	35.30	100	0.0000	30.20	101	0.0000	25.10
1098	-100.0	40.39	1099	-100.0	35.30	1100	-100.0	30.20	1101	-100.0	25.10
2098	-2100.	40.40	2099	-2100.	35.30	2100	-2100.	30.20	2101	-2100.	25.10
102	0.0000	20.00	103	0.0000	100.00	104	0.0000	95.10	105	0.0000	90.34
1102	-100.0	20.00	1103	-100.0	100.00	1104	-100.0	95.10	1105	-100.0	90.34
2102	-2100.	20.00	2103	-2100.	100.00	2104	-2100.	95.10	2105	-2100.	90.34
106	0.0000	85.46	107	0.0000	80.60	108	0.0000	75.67	109	0.0000	70.71
1106	-100.0	85.46	1107	-100.0	80.60	1108	-100.0	75.67	1109	-100.0	70.71
2106	-2100.	85.46	2107	-2100.	80.59	2108	-2100.	75.67	2109	-2100.	70.70

POTENTIAL WITH Q(4274)=10000 Q(5274)=8500 Q(4204)=3200 Q(5204)=4700 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
110	0.0000	65.71	111	0.0000	60.60	112	0.0000	55.63	113	0.0000	50.56
1110	-100.0	65.71	1111	-100.0	60.60	1112	-100.0	55.63	1113	-100.0	50.56
2110	-2100.	65.71	2111	-2100.	60.60	2112	-2100.	55.63	2113	-2100.	50.56
114	0.0000	45.40	115	0.0000	40.39	116	0.0000	35.29	117	0.0000	30.20
1114	-100.0	45.40	1115	-100.0	40.39	1116	-100.0	35.29	1117	-100.0	30.20
2114	-2100.	45.40	2115	-2100.	40.39	2116	-2100.	35.29	2117	-2100.	30.20
118	0.0000	25.10	119	0.0000	20.00	120	0.0000	100.00	121	0.0000	95.17
1118	-100.0	25.10	1119	-100.0	20.00	1120	-100.0	100.00	1121	-100.0	95.17
2118	-2100.	25.10	2119	-2100.	20.00	2120	-2100.	100.00	2121	-2100.	95.17
122	0.0000	90.33	123	0.0000	85.47	124	0.0000	80.97	125	0.0000	75.63
1122	-100.0	90.33	1123	-100.0	85.47	1124	-100.0	80.97	1125	-100.0	75.63
2122	-2100.	90.33	2123	-2100.	85.47	2124	-2100.	80.97	2125	-2100.	75.63
126	0.0000	70.69	127	0.0000	65.69	128	0.0000	60.67	129	0.0000	55.02
1126	-100.0	70.69	1127	-100.0	65.69	1128	-100.0	60.67	1129	-100.0	55.02
2126	-2100.	70.69	2127	-2100.	65.69	2128	-2100.	60.67	2129	-2100.	55.02
130	0.0000	50.55	131	0.0000	45.47	132	0.0000	40.30	133	0.0000	35.29
1130	-100.0	50.55	1131	-100.0	45.47	1132	-100.0	40.30	1133	-100.0	35.29
2130	-2100.	50.56	2131	-2100.	45.47	2132	-2100.	40.30	2133	-2100.	35.29
134	0.0000	30.20	135	0.0000	25.10	136	0.0000	20.00	200	0.0000	79.53
1134	-100.0	30.20	1135	-100.0	25.10	1136	-100.0	20.00	1200	-100.0	79.53
2134	-2100.	30.20	2135	-2100.	25.10	2136	-2100.	20.00	2200	-900.0	79.51
201	0.0000	81.29	202	0.0000	81.37	203	0.0000	82.18	204	0.0000	82.32
1201	-100.0	81.29	1202	-100.0	81.37	1203	-100.0	82.18	1204	-100.0	82.32
2201	-900.0	81.33	2202	-900.0	81.41	2203	-1500.	82.39	2204	-1230.	82.61
									3204	-1600.	82.72
									4204	-1669.	82.73
									5204	-1700.	82.74

POTENTIAL WITH Q(4274)=10000 Q(5274)=2500 Q(4264)6500 Q(3264)5700 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
205	0.0000	82.39	206	0.0000	82.77	207	0.0000	83.67	208	0.0000	84.70
1205	-100.0	82.39	1206	-100.0	82.77	1207	-100.0	83.67	1208	-100.0	84.70
2205	-1250.	82.65	2206	-1250.	82.94	2207	-1250.	83.91	2208	-1250.	84.71
3205	-1600.	82.76	3206	-1600.	83.00	3207	-1600.	83.91	3208	-1600.	84.71
4205	-1669.	82.80	4206	-2100.	83.00	4207	-2100.	83.91	4208	-2100.	84.71
5205	-1700.	82.81									
6205	-1740.	82.82									
209	0.0000	85.54	210	0.0000	78.69	211	0.0000	79.82	212	0.0000	79.94
1209	-100.0	85.54	1210	-100.0	78.69	1211	-100.0	79.82	1212	-100.0	79.94
2209	-1250.	85.54	2210	-900.0	78.67	2211	-900.0	79.91	2212	-900.0	80.10
3209	-1600.	85.54									
4209	-2100.	85.54									
213	0.0000	80.47	214	0.0000	80.59	215	0.0000	80.63	216	0.0000	80.98
1213	-100.0	80.47	1214	-100.0	80.59	1215	-100.0	80.64	1216	-100.0	80.98
2213	-1560.	80.77	2214	-1250.	80.76	2215	-1250.	80.88	2216	-1250.	81.01
			3214	-1600.	80.86	3215	-1600.	80.89	3216	-1600.	81.06
			4214	-1669.	80.88	4215	-1669.	80.92	4216	-2100.	81.11
			5214	-1700.	80.89	5215	-1700.	80.92			
						6215	-1740.	80.93			
217	0.0000	81.65	218	0.0000	82.22	219	0.0000	82.80	220	0.0000	76.70
1217	-100.0	81.65	1218	-100.0	82.22	1219	-100.0	82.80	1220	-100.0	76.70
2217	-1250.	81.66	2218	-1250.	82.23	2219	-1250.	82.81	2220	-900.0	76.70
3217	-1600.	81.68	3218	-1600.	82.23	3219	-1600.	82.81			
4217	-2100.	81.68	4218	-2100.	82.23	4219	-2100.	82.81			
221	0.0000	76.57	222	0.0000	76.53	223	0.0000	76.49	224	0.0000	76.48
1221	-100.0	76.57	1222	-100.0	76.53	1223	-100.0	76.49	1224	-100.0	76.48
2221	-900.0	76.53	2222	-900.0	76.51	2223	-1560.	76.45	2224	-1250.	76.45
									3224	-1600.	76.45
									4224	-1669.	76.45
									5224	-1700.	76.44

POTENTIAL WITH Q(4274)=10000 Q(5274)=2500 Q(4284)=3200 Q(5284)=4700 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
225	0.0000	76.48	226	0.0000	76.45	227	0.0000	76.37	228	0.0000	76.32
1225	-100.0	76.48	1226	-100.0	76.45	1227	-100.0	76.37	1228	-100.0	76.32
2225	-1250.	76.45	2226	-1250.	76.43	2227	-1250.	76.37	2228	-1250.	76.32
3225	-1600.	76.44	3226	-1600.	76.43	3227	-1600.	76.37	3228	-1600.	76.32
4225	-1669.	76.44	4226	-2100.	76.42	4227	-2100.	76.37	4228	-2100.	76.31
5225	-1700.	76.44									
6225	-1740.	76.44									
229	0.0000	76.27	230	0.0000	74.06	231	0.0000	73.61	232	0.0000	73.40
1229	-100.0	76.27	1230	-100.0	74.06	1231	-100.0	73.61	1232	-100.0	73.40
2229	-1250.	76.27	2230	-900.0	74.08	2231	-900.0	73.92	2232	-900.0	73.30
3229	-1600.	76.27									
4229	-2100.	76.27									
233	0.0000	72.84	234	0.0000	72.70	235	0.0000	72.44	236	0.0000	72.32
1233	-100.0	72.84	1234	-100.0	72.70	1235	-100.0	72.44	1236	-100.0	72.32
2233	-1560.	72.58	2234	-1250.	72.49	2235	-1250.	72.43	2236	-1250.	72.20
			3234	-1600.	72.39	3235	-1600.	72.38	3236	-1600.	72.15
			4234	-1669.	72.36	4235	-1669.	72.32	4236	-2100.	72.09
			5234	-1700.	72.35	5235	-1700.	72.31			
						6235	-1740.	72.31			
237	0.0000	71.38	238	0.0000	70.66	239	0.0000	69.93	240	0.0000	74.38
1237	-100.0	71.38	1238	-100.0	70.66	1239	-100.0	69.93	1240	-100.0	74.38
2237	-1250.	71.39	2238	-1250.	70.65	2239	-1250.	69.93	2240	-900.0	74.39
3237	-1600.	71.39	3238	-1600.	70.65	3239	-1600.	69.93			
4237	-2100.	71.39	4238	-2100.	70.65	4239	-2100.	69.93			
241	0.0000	73.02	242	0.0000	72.80	243	0.0000	72.16	244	0.0000	71.99
1241	-100.0	73.02	1242	-100.0	72.80	1243	-100.0	72.15	1244	-100.0	71.99
2241	-900.0	72.90	2242	-900.0	72.69	2243	-1560.	71.70	2244	-1250.	71.74
									3244	-1600.	71.74
									4244	-1669.	71.72
									5244	-1700.	71.71

POTENTIAL WITH Q(4274)=10000 Q(5274)=2500 Q(4264)=3400 Q(5264)=9700 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
245	0.0000	71.98	246	0.0000	71.51	247	0.0000	70.19	248	0.0000	69.17
1245	-100.0	71.98	1246	-100.0	71.51	1247	-100.0	70.19	1248	-100.0	69.17
2245	-1250.	71.69	2246	-1250.	71.38	2247	-1250.	70.18	2248	-1250.	69.18
3245	-1600.	71.66	3246	-1600.	71.38	3247	-1600.	70.18	3248	-1600.	69.18
4245	-1669.	71.65	4246	-2100.	71.23	4247	-2100.	70.20	4248	-2100.	69.18
5245	-1700.	71.64									
6245	-1740.	71.62									
249	0.0000	68.77	250	0.0000	74.86	251	0.0000	72.96	252	0.0000	72.89
1249	-100.0	68.77	1250	-100.0	74.86	1251	-100.0	72.96	1252	-100.0	72.89
2249	-1250.	68.77	2250	-900.0	74.87	2251	-900.0	72.96	2252	-900.0	72.87
3249	-1600.	68.77									
4249	-2100.	68.77									
253	0.0000	72.23	254	0.0000	72.06	255	0.0000	71.99	256	0.0000	71.56
1253	-100.0	72.25	1254	-100.0	72.07	1255	-100.0	72.00	1256	-100.0	71.57
2253	-1560.	72.35	2254	-1250.	72.42	2255	-1250.	72.35	2256	-1250.	71.06
			3254	-1600.	71.78	3255	-1600.	71.77	3256	-1600.	71.05
			4254	-1660.	71.58	4255	-1660.	71.56	4256	-2100.	71.01
			5254	-1700.	71.48	5255	-1700.	71.57			
						6255	-1740.	71.50			
257	0.0000	70.05	258	0.0000	68.07	259	0.0000	67.73	260	0.0000	74.83
1257	-100.0	70.05	1258	-100.0	68.07	1259	-100.0	67.73	1260	-100.0	74.83
2257	-1250.	70.12	2258	-1250.	68.68	2259	-1250.	67.74	2260	-900.0	74.83
3257	-1600.	70.15	3258	-1600.	68.69	3259	-1600.	67.74			
4257	-2100.	70.17	4258	-2100.	68.69	4259	-2100.	67.74			
261	0.0000	72.99	262	0.0000	72.88	263	0.0000	72.83	264	0.0000	71.93
1261	-100.0	72.99	1262	-100.0	72.90	1263	-100.0	72.60	1264	-100.0	71.93
2261	-900.0	72.99	2262	-900.0	72.67	2263	-1560.	72.57	2264	-1250.	74.57
									3264	-1600.	76.79
									4264	-1660.	79.39
									5264	-1700.	79.77

POTENTIAL WITH Q(4274)=10000 Q(5274)=2500 Q(4284)=3200 Q(5284)=700 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
265	0.0000	71.08	266	0.0000	71.28	267	0.0000	70.06	268	0.0000	68.01
1265	-100.0	71.08	1266	-100.0	71.90	1267	-100.0	70.06	1268	-100.0	68.01
2265	-1250.	74.49	2266	-1250.	72.66	2267	-1250.	70.10	2268	-1250.	68.02
3265	-1600.	78.87	3266	-1600.	72.96	3267	-1600.	70.08	3268	-1600.	68.04
4265	-1660.	79.12	4266	-2100.	72.64	4267	-2100.	70.23	4268	-2100.	68.01
5265	-1700.	79.10									
6265	-1740.	78.99									
269	0.0000	67.64	270	0.0000	74.22	271	0.0000	72.99	272	0.0000	72.05
1269	-100.0	67.64	1270	-100.0	74.22	1271	-100.0	72.99	1272	-100.0	72.04
2269	-1250.	67.65	2270	-900.0	74.22	2271	-900.0	73.03	2272	-900.0	73.09
3269	-1600.	67.65									
4269	-2100.	67.65									
273	0.0000	72.04	274	0.0000	71.92	275	0.0000	71.08	276	0.0000	71.59
1273	-100.0	72.07	1274	-100.0	72.06	1275	-100.0	71.07	1276	-100.0	71.59
2273	-1560.	75.27	2274	-1250.	74.09	2275	-1250.	74.44	2276	-1250.	73.18
			3274	-1600.	85.65	3275	-1600.	79.96	3276	-1600.	73.60
			4274	-1660.	118.07	4275	-1660.	81.39	4276	-2100.	73.24
			5274	-1700.	118.60	5275	-1700.	81.39			
						6275	-1740.	81.10			
277	0.0000	70.06	278	0.0000	68.09	279	0.0000	66.29	280	0.0000	74.22
1277	-100.0	70.05	1278	-100.0	68.09	1279	-100.0	66.28	1280	-100.0	74.22
2277	-1250.	70.09	2278	-1250.	68.01	2279	-1250.	66.28	2280	-900.0	74.21
3277	-1600.	70.00	3278	-1600.	68.04	3279	-1600.	66.29			
4277	-2100.	70.19	4278	-2100.	68.00	4279	-2100.	66.21			
281	0.0000	72.99	282	0.0000	72.05	283	0.0000	72.05	284	0.0000	71.93
1281	-100.0	72.99	1282	-100.0	72.06	1283	-100.0	72.04	1284	-100.0	72.03
2281	-900.0	73.05	2282	-900.0	73.10	2283	-1560.	75.31	2284	-1250.	74.14
									3284	-1600.	85.74
									4284	-1660.	119.02
									5284	-1700.	119.09

POTENTIAL WITH Q(4274)=10000 Q(5274)=2500 Q(4284)=3200 Q(5284)=700 CU FT/DAY

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
265	0.0000	71.07	266	0.0000	71.58	267	0.0000	70.06	268	0.0000	68.60
1265	-100.0	71.07	1266	-100.0	71.59	1267	-100.0	70.06	1268	-100.0	68.60
2265	-1250.	74.41	2266	-1250.	73.13	2267	-1250.	70.12	2268	-1250.	68.60
3265	-1600.	79.07	3266	-1600.	73.71	3267	-1600.	70.18	3268	-1600.	68.61
4265	-1600.	80.70	4266	-2100.	73.39	4267	-2100.	70.19	4268	-2100.	68.61
5265	-1740.	80.76									
6265	-1740.	80.31									

NODE	DEPTH	HEAD
269	0.0000	67.62
1269	-100.0	67.62
2269	-1250.	67.62
3269	-1600.	67.63
4269	-2100.	67.63

APPENDIX I.6: PROG1-OUTPUT

Hydraulic properties, nodal coordinates, held boundary conditions, element details and summary regarding total number of nodes, elements, boundary nodes for determining flow after salt dome collapse.

TIME= 06:17:20   DATE= 22-AUG-79

##

HAINSVILLE SALT DOME - LONG TERM EVALUATION AFTER DESOLUTION TO -1700 FT. ELEV.

##

VALUES OF CONVERSION FACTORS SPECIFIED

CONVERSION FACTOR FOR PERMEABILITY DATA	1.0000
CONVERSION FACTOR FOR XY-COORDINATES	1.0000
CONVERSION FACTOR FOR Z-COORDINATES	1.0000
CONVERSION FACTOR FOR HEAD(BOTH INITIAL AND B.C.)	1.00
KTYPE =	0
FLAG FOR CONTROLLING THE LEVEL OF PRINT OUTPUT=	3

PROPERTIES FOR MATERIAL 1 ########

CARRIZZO AQUIFER

K-X=	13.2300	L/T
K-Y=	13.2300	L/T
K-Z=	13.2300	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

```
PROPERTIES FOR MATERIAL   2    ########

WILCOX AQUIFER

     K-X=                                        2.48000      L/T
     K-Y=                                        2.48000      L/T
     K-Z=                                        2.48000      L/T
     THETA=                                      0.100000
     MEDIUM COMPRESSIBILITY                      1.00000      1/L
     FLUID COMPRESSIBILTY                        1.00000      1/L
     REFERENCE PRESSURE HEAD OF THETA                  1.00 L
     SPECIFIC STORAGE COEFF=                     0.100000E-03 1/L


PROPERTIES FOR MATERIAL   3    ########

WILCOX AQUIFER

     K-X=                                        2.48000      L/T
     K-Y=                                        2.48000      L/T
     K-Z=                                        2.48000      L/T
     THETA=                                      0.100000
     MEDIUM COMPRESSIBILITY                      1.00000      1/L
     FLUID COMPRESSIBILTY                        1.00000      1/L
     REFERENCE PRESSURE HEAD OF THETA                  1.00 L
     SPECIFIC STORAGE COEFF=                     0.100000E-03 1/L


PROPERTIES FOR MATERIAL   4    ########

WILCOX AQUIFER

     K-X=                                        2.48000      L/T
     K-Y=                                        2.48000      L/T
     K-Z=                                        2.48000      L/T
     THETA=                                      0.100000
     MEDIUM COMPRESSIBILITY                      1.00000      1/L
     FLUID COMPRESSIBILTY                        1.00000      1/L
     REFERENCE PRESSURE HEAD OF THETA                  1.00 L
     SPECIFIC STORAGE COEFF=                     0.100000E-03 1/L
```

```
PROPERTIES FOR MATERIAL    5    ########

WILCOX AQUIFER

     K-X=                                            2.48000      L/T
     K-Y=                                            2.48000      L/T
     K-Z=                                            2.48000      L/T
     THETA=                                         0.100000
     MEDIUM COMPRESSIBILITY                          1.00000      1/L
     FLUID COMPRESSIBILTY                            1.00000      1/L
     REFERENCE PRESSURE HEAD OF THETA                       1.00 L
     SPECIFIC STORAGE COEFF=                        0.100000E-03 1/L


PROPERTIES FOR MATERIAL    6    ########

WILCOX AQUIFER

     K-X=                                            2.48000      L/T
     K-Y=                                            2.48000      L/T
     K-Z=                                            2.48000      L/T
     THETA=                                         0.100000
     MEDIUM COMPRESSIBILITY                          1.00000      1/L
     FLUID COMPRESSIBILTY                            1.00000      1/L
     REFERENCE PRESSURE HEAD OF THETA                       1.00 L
     SPECIFIC STORAGE COEFF=                        0.100000E-03 1/L


PROPERTIES FOR MATERIAL    7    ########

WILCOX AQUIFER

     K-X=                                            2.48000      L/T
     K-Y=                                            2.48000      L/T
     K-Z=                                            2.48000      L/T
     THETA=                                         0.100000
     MEDIUM COMPRESSIBILITY                          1.00000      1/L
     FLUID COMPRESSIBILTY                            1.00000      1/L
     REFERENCE PRESSURE HEAD OF THETA                       1.00 L
     SPECIFIC STORAGE COEFF=                        0.100000E-03 1/L
```

PROPERTIES FOR MATERIAL 8 ********

COLLAPSED MATERIAL (2 TIMES PERMEABLE THAN SURROUNDING)

K-X=	4.96000	L/T
K-Y=	4.96000	L/T
K-Z=	4.96000	L/T
THETA=	0.100000	
MEDIUM COMPRESSIBILITY	1.00000	1/L
FLUID COMPRESSIBILTY	1.00000	1/L
REFERENCE PRESSURE HEAD OF THETA	1.00	L
SPECIFIC STORAGE COEFF=	0.100000E-03	1/L

COORDINATES AND OTHER DETAILS OF EACH NODE

INTERNAL NODE#	USER NODE#	X-COORD.	Y-COORD.	Z-COORD.	INITIAL HEAD
1	1	0.0	0.0	0.0	200.0
2	1001	0.0	0.0	-100.0	200.0
3	2001	0.0	0.0	-2100.0	200.0
4	2	10000.0	0.0	0.0	190.0
5	1002	10000.0	0.0	-100.0	190.0
6	2002	10000.0	0.0	-2100.0	190.0
7	3	20000.0	0.0	0.0	180.0
8	1003	20000.0	0.0	-100.0	180.0
9	2003	20000.0	0.0	-2100.0	180.0
10	4	30000.0	0.0	0.0	170.0
11	1004	30000.0	0.0	-100.0	170.0
12	2004	30000.0	0.0	-2100.0	170.0
13	5	40000.0	0.0	0.0	160.0
14	1005	40000.0	0.0	-100.0	160.0
15	2005	40000.0	0.0	-2100.0	160.0

16	6	50000,0	0,0	0,0	150,0
17	1006	50000,0	0,0	-100,0	150,0
18	2006	50000,0	0,0	-2100,0	150,0
19	7	60000,0	0,0	0,0	140,0
20	1007	60000,0	0,0	-100,0	140,0
21	2007	60000,0	0,0	-2100,0	140,0
22	9	80000,0	0,0	0,0	120,0
23	1009	80000,0	0,0	-100,0	120,0
24	2009	80000,0	0,0	-300,0	120,0
25	3009	80000,0	0,0	-500,0	120,0
26	4009	80000,0	0,0	-700,0	120,0
27	5009	80000,0	0,0	-1000,0	120,0
28	6009	80000,0	0,0	-1300,0	120,0
29	7009	80000,0	0,0	-1670,0	120,0
30	8009	80000,0	0,0	-1700,0	120,0
31	11	100000,0	0,0	0,0	100,0
32	1011	100000,0	0,0	-100,0	100,0
33	2011	100000,0	0,0	-2100,0	100,0
34	12	110000,0	0,0	0,0	90,0
35	1012	110000,0	0,0	-100,0	90,0
36	2012	110000,0	0,0	-2100,0	90,0
37	13	120000,0	0,0	0,0	80,0
38	1013	120000,0	0,0	-100,0	80,0
39	2013	120000,0	0,0	-2100,0	80,0
40	14	130000,0	0,0	0,0	70,0
41	1014	130000,0	0,0	-100,0	70,0
42	2014	130000,0	0,0	-2100,0	70,0
43	15	140000,0	0,0	0,0	60,0
44	1015	140000,0	0,0	-100,0	60,0
45	2015	140000,0	0,0	-2100,0	60,0

46	16	150000.0	0.0	0.0	50.0
47	1016	150000.0	0.0	-100.0	50.0
48	2016	150000.0	0.0	-2100.0	50.0
49	17	160000.0	0.0	0.0	40.0
50	1017	160000.0	0.0	-100.0	40.0
51	2017	160000.0	0.0	-2100.0	40.0
52	18	170000.0	0.0	0.0	30.0
53	1018	170000.0	0.0	-100.0	30.0
54	2018	170000.0	0.0	-2100.0	30.0
55	19	180000.0	0.0	0.0	20.0
56	1019	180000.0	0.0	-100.0	20.0
57	2019	180000.0	0.0	-2100.0	20.0
58	20	190000.0	0.0	0.0	10.0
59	1020	190000.0	0.0	-100.0	10.0
60	2020	190000.0	0.0	-2100.0	10.0
61	21	0.0	10000.0	0.0	200.0
62	1021	0.0	10000.0	-100.0	200.0
63	2021	0.0	10000.0	-2100.0	200.0
64	22	10000.0	10000.0	0.0	190.0
65	1022	10000.0	10000.0	-100.0	190.0
66	2022	10000.0	10000.0	-2100.0	190.0
67	23	20000.0	10000.0	0.0	180.0
68	1023	20000.0	10000.0	-100.0	180.0
69	2023	20000.0	10000.0	-2100.0	180.0
70	24	30000.0	10000.0	0.0	170.0
71	1024	30000.0	10000.0	-100.0	170.0
72	2024	30000.0	10000.0	-2100.0	170.0

73	25	40000,0	10000,0	0,0	160,0
74	1025	40000,0	10000,0	-100,0	160,0
75	2025	40000,0	10000,0	-2100,0	160,0
76	26	50000,0	10000,0	0,0	150,0
77	1026	50000,0	10000,0	-100,0	150,0
78	2026	50000,0	10000,0	-2100,0	150,0
79	27	60000,0	10000,0	0,0	140,0
80	1027	60000,0	10000,0	-100,0	140,0
81	2027	60000,0	10000,0	-2100,0	140,0
82	31	100000,0	10000,0	0,0	100,0
83	1031	100000,0	10000,0	-100,0	100,0
84	2031	100000,0	10000,0	-2100,0	100,0
85	32	110000,0	10000,0	0,0	90,0
86	1032	110000,0	10000,0	-100,0	90,0
87	2032	110000,0	10000,0	-2100,0	90,0
88	33	120000,0	10000,0	0,0	80,0
89	1033	120000,0	10000,0	-100,0	80,0
90	2033	120000,0	10000,0	-2100,0	80,0
91	34	130000,0	10000,0	0,0	70,0
92	1034	130000,0	10000,0	-100,0	70,0
93	2034	130000,0	10000,0	-2100,0	70,0
94	35	140000,0	10000,0	0,0	60,0
95	1035	140000,0	10000,0	-100,0	60,0
96	2035	140000,0	10000,0	-2100,0	60,0
97	36	150000,0	10000,0	0,0	50,0
98	1036	150000,0	10000,0	-100,0	50,0
99	2036	150000,0	10000,0	-2100,0	50,0

100	37	160000.0	10000.0	0.0	40.0
101	1037	160000.0	10000.0	-100.0	40.0
102	2037	160000.0	10000.0	-2100.0	40.0
103	38	170000.0	10000.0	0.0	30.0
104	1038	170000.0	10000.0	-100.0	30.0
105	2038	170000.0	10000.0	-2100.0	30.0
106	39	180000.0	10000.0	0.0	20.0
107	1039	180000.0	10000.0	-100.0	20.0
108	2039	180000.0	10000.0	-2100.0	20.0
109	40	190000.0	10000.0	0.0	10.0
110	1040	190000.0	10000.0	-100.0	10.0
111	2040	190000.0	10000.0	-2100.0	10.0
112	41	0.0	20000.0	0.0	200.0
113	1041	0.0	20000.0	-100.0	200.0
114	2041	0.0	20000.0	-2100.0	200.0
115	42	10000.0	20000.0	0.0	190.0
116	1042	10000.0	20000.0	-100.0	190.0
117	2042	10000.0	20000.0	-2100.0	190.0
118	43	20000.0	20000.0	0.0	180.0
119	1043	20000.0	20000.0	-100.0	180.0
120	2043	20000.0	20000.0	-2100.0	180.0
121	44	30000.0	20000.0	0.0	170.0
122	1044	30000.0	20000.0	-100.0	170.0
123	2044	30000.0	20000.0	-2100.0	170.0
124	45	40000.0	20000.0	0.0	160.0
125	1045	40000.0	20000.0	-100.0	160.0
126	2045	40000.0	20000.0	-2100.0	160.0

127	46	50000,0	20000,0	0,0	150,0
128	1046	50000,0	20000,0	-100,0	150,0
129	2046	50000,0	20000,0	-2100,0	150,0
130	47	60000,0	20000,0	0,0	140,0
131	1047	60000,0	20000,0	-100,0	140,0
132	2047	60000,0	20000,0	-2100,0	140,0
133	48	70000,0	20000,0	0,0	130,0
134	1048	70000,0	20000,0	-100,0	130,0
135	2048	70000,0	20000,0	-2100,0	130,0
136	49	80000,0	20000,0	0,0	120,0
137	1049	80000,0	20000,0	-100,0	120,0
138	2049	80000,0	20000,0	-2100,0	120,0
139	50	90000,0	20000,0	0,0	110,0
140	1050	90000,0	20000,0	-100,0	110,0
141	2050	90000,0	20000,0	-2100,0	110,0
142	51	100000,0	20000,0	0,0	100,0
143	1051	100000,0	20000,0	-100,0	100,0
144	2051	100000,0	20000,0	-2100,0	100,0
145	52	110000,0	20000,0	0,0	90,0
146	1052	110000,0	20000,0	-100,0	90,0
147	2052	110000,0	20000,0	-2100,0	90,0
148	53	120000,0	20000,0	0,0	80,0
149	1053	120000,0	20000,0	-100,0	80,0
150	2053	120000,0	20000,0	-2100,0	80,0
151	54	130000,0	20000,0	0,0	70,0
152	1054	130000,0	20000,0	-100,0	70,0
153	2054	130000,0	20000,0	-2100,0	70,0

154	55	140000.0	20000.0	0.0	60.0
155	1055	140000.0	20000.0	-100.0	60.0
156	2055	140000.0	20000.0	-2100.0	60.0
157	56	150000.0	20000.0	0.0	50.0
158	1056	150000.0	20000.0	-100.0	50.0
159	2056	150000.0	20000.0	-2100.0	50.0
160	57	160000.0	20000.0	0.0	40.0
161	1057	160000.0	20000.0	-100.0	40.0
162	2057	160000.0	20000.0	-2100.0	40.0
163	58	170000.0	20000.0	0.0	30.0
164	1058	170000.0	20000.0	-100.0	30.0
165	2058	170000.0	20000.0	-2100.0	30.0
166	59	180000.0	20000.0	0.0	20.0
167	1059	180000.0	20000.0	-100.0	20.0
168	2059	180000.0	20000.0	-2100.0	20.0
169	60	190000.0	20000.0	0.0	10.0
170	1060	190000.0	20000.0	-100.0	10.0
171	2060	190000.0	20000.0	-2100.0	10.0
172	61	0.0	30000.0	0.0	200.0
173	1061	0.0	30000.0	-100.0	200.0
174	2061	0.0	30000.0	-2100.0	200.0
175	62	10000.0	30000.0	0.0	190.0
176	1062	10000.0	30000.0	-100.0	190.0
177	2062	10000.0	30000.0	-2100.0	190.0
178	63	20000.0	30000.0	0.0	180.0
179	1063	20000.0	30000.0	-100.0	180.0
180	2063	20000.0	30000.0	-2100.0	180.0

181	64	30000,0	30000,0	0,0	170,0
182	1064	30000,0	30000,0	=100,0	170,0
183	2064	30000,0	30000,0	=2100,0	170,0
184	65	40000,0	30000,0	0,0	160,0
185	1065	40000,0	30000,0	=100,0	160,0
186	2065	40000,0	30000,0	=2100,0	160,0
187	66	50000,0	30000,0	0,0	150,0
188	1066	50000,0	30000,0	=100,0	150,0
189	2066	50000,0	30000,0	=2100,0	150,0
190	67	60000,0	30000,0	0,0	140,0
191	1067	60000,0	30000,0	=100,0	140,0
192	2067	60000,0	30000,0	=2100,0	140,0
193	68	70000,0	30000,0	0,0	130,0
194	1068	70000,0	30000,0	=100,0	130,0
195	2068	70000,0	30000,0	=2100,0	130,0
196	69	80000,0	30000,0	0,0	120,0
197	1069	80000,0	30000,0	=100,0	120,0
198	2069	80000,0	30000,0	=2100,0	120,0
199	70	90000,0	30000,0	0,0	110,0
200	1070	90000,0	30000,0	=100,0	110,0
201	2070	90000,0	30000,0	=2100,0	110,0
202	71	100000,0	30000,0	0,0	100,0
203	1071	100000,0	30000,0	=100,0	100,0
204	2071	100000,0	30000,0	=2100,0	100,0
205	72	110000,0	30000,0	0,0	90,0
206	1072	110000,0	30000,0	=100,0	90,0
207	2072	110000,0	30000,0	=2100,0	90,0

208	73	120000.0	30000.0	0.0	80.0
209	1073	120000.0	30000.0	-100.0	80.0
210	2073	120000.0	30000.0	-2100.0	80.0
211	74	130000.0	30000.0	0.0	70.0
212	1074	130000.0	30000.0	-100.0	70.0
213	2074	130000.0	30000.0	-2100.0	70.0
214	75	140000.0	30000.0	0.0	60.0
215	1075	140000.0	30000.0	-100.0	60.0
216	2075	140000.0	30000.0	-2100.0	60.0
217	76	150000.0	30000.0	0.0	50.0
218	1076	150000.0	30000.0	-100.0	50.0
219	2076	150000.0	30000.0	-2100.0	50.0
220	77	160000.0	30000.0	0.0	40.0
221	1077	160000.0	30000.0	-100.0	40.0
222	2077	160000.0	30000.0	-2100.0	40.0
223	78	170000.0	30000.0	0.0	30.0
224	1078	170000.0	30000.0	-100.0	30.0
225	2078	170000.0	30000.0	-2100.0	30.0
226	79	180000.0	30000.0	0.0	20.0
227	1079	180000.0	30000.0	-100.0	20.0
228	2079	180000.0	30000.0	-2100.0	20.0
229	80	190000.0	30000.0	0.0	10.0
230	1080	190000.0	30000.0	-100.0	10.0
231	2080	190000.0	30000.0	-2100.0	10.0
232	81	0.0	40000.0	0.0	200.0
233	1081	0.0	40000.0	-100.0	200.0
234	2081	0.0	40000.0	-2100.0	200.0

235	82	10000.0	40000.0	0.0	190.0
236	1082	10000.0	40000.0	-100.0	190.0
237	2082	10000.0	40000.0	-2100.0	190.0
238	83	20000.0	40000.0	0.0	180.0
239	1083	20000.0	40000.0	-100.0	180.0
240	2083	20000.0	40000.0	-2100.0	180.0
241	84	30000.0	40000.0	0.0	170.0
242	1084	30000.0	40000.0	-100.0	170.0
243	2084	30000.0	40000.0	-2100.0	170.0
244	85	40000.0	40000.0	0.0	160.0
245	1085	40000.0	40000.0	-100.0	160.0
246	2085	40000.0	40000.0	-2100.0	160.0
247	86	50000.0	40000.0	0.0	150.0
248	1086	50000.0	40000.0	-100.0	150.0
249	2086	50000.0	40000.0	-2100.0	150.0
250	87	60000.0	40000.0	0.0	140.0
251	1087	60000.0	40000.0	-100.0	140.0
252	2087	60000.0	40000.0	-2100.0	140.0
253	88	70000.0	40000.0	0.0	130.0
254	1088	70000.0	40000.0	-100.0	130.0
255	2088	70000.0	40000.0	-2100.0	130.0
256	89	80000.0	40000.0	0.0	120.0
257	1089	80000.0	40000.0	-100.0	120.0
258	2089	80000.0	40000.0	-2100.0	120.0
259	90	90000.0	40000.0	0.0	110.0
260	1090	90000.0	40000.0	-100.0	110.0
261	2090	90000.0	40000.0	-2100.0	110.0

262	91	100000.0	40000.0	0.0	100.0
263	1091	100000.0	40000.0	-100.0	100.0
264	2091	100000.0	40000.0	-2100.0	100.0
265	92	110000.0	40000.0	0.0	90.0
266	1092	110000.0	40000.0	-100.0	90.0
267	2092	110000.0	40000.0	-2100.0	90.0
268	93	120000.0	40000.0	0.0	80.0
269	1093	120000.0	40000.0	-100.0	80.0
270	2093	120000.0	40000.0	-2100.0	80.0
271	94	130000.0	40000.0	0.0	70.0
272	1094	130000.0	40000.0	-100.0	70.0
273	2094	130000.0	40000.0	-2100.0	70.0
274	95	140000.0	40000.0	0.0	60.0
275	1095	140000.0	40000.0	-100.0	60.0
276	2095	140000.0	40000.0	-2100.0	60.0
277	96	150000.0	40000.0	0.0	50.0
278	1096	150000.0	40000.0	-100.0	50.0
279	2096	150000.0	40000.0	-2100.0	50.0
280	97	160000.0	40000.0	0.0	40.0
281	1097	160000.0	40000.0	-100.0	40.0
262	2097	160000.0	40000.0	-2100.0	40.0
283	98	170000.0	40000.0	0.0	30.0
284	1098	170000.0	40000.0	-100.0	30.0
285	2098	170000.0	40000.0	-2100.0	30.0
286	99	180000.0	40000.0	0.0	20.0
287	1099	180000.0	40000.0	-100.0	20.0
288	2099	180000.0	40000.0	-2100.0	20.0

289	100	190000,0	40000,0	0,0	10,0
290	1100	190000,0	40000,0	-100,0	10,0
291	2100	190000,0	40000,0	-2100,0	10,0
292	101	0,0	50000,0	0,0	200,0
293	1101	0,0	50000,0	-100,0	200,0
294	2101	0,0	50000,0	-2100,0	200,0
295	102	10000,0	50000,0	0,0	190,0
296	1102	10000,0	50000,0	-100,0	190,0
297	2102	10000,0	50000,0	-2100,0	190,0
298	103	20000,0	50000,0	0,0	180,0
299	1103	20000,0	50000,0	-100,0	180,0
300	2103	20000,0	50000,0	-2100,0	180,0
301	104	30000,0	50000,0	0,0	170,0
302	1104	30000,0	50000,0	-100,0	170,0
303	2104	30000,0	50000,0	-2100,0	170,0
304	105	40000,0	50000,0	0,0	160,0
305	1105	40000,0	50000,0	-100,0	160,0
306	2105	40000,0	50000,0	-2100,0	160,0
307	106	50000,0	50000,0	0,0	150,0
308	1106	50000,0	50000,0	-100,0	150,0
309	2106	50000,0	50000,0	-2100,0	150,0
310	107	60000,0	50000,0	0,0	140,0
311	1107	60000,0	50000,0	-100,0	140,0
312	2107	60000,0	50000,0	-2100,0	140,0
313	108	70000,0	50000,0	0,0	130,0
314	1108	70000,0	50000,0	-100,0	130,0
315	2108	70000,0	50000,0	-2100,0	130,0

316	109	80000.0	50000.0	0.0	120.0
317	1109	60000.0	50000.0	-100.0	120.0
318	2109	80000.0	50000.0	-2100.0	120.0
319	110	90000.0	50000.0	0.0	110.0
320	1110	90000.0	50000.0	-100.0	110.0
321	2110	90000.0	50000.0	-2100.0	110.0
322	111	100000.0	50000.0	0.0	100.0
323	1111	100000.0	50000.0	-100.0	100.0
324	2111	100000.0	50000.0	-2100.0	100.0
325	112	110000.0	50000.0	0.0	90.0
326	1112	110000.0	50000.0	-100.0	90.0
327	2112	110000.0	50000.0	-2100.0	90.0
328	113	120000.0	50000.0	0.0	80.0
329	1113	120000.0	50000.0	-100.0	80.0
330	2113	120000.0	50000.0	-2100.0	80.0
331	114	130000.0	50000.0	0.0	70.0
332	1114	130000.0	50000.0	-100.0	70.0
333	2114	130000.0	50000.0	-2100.0	70.0
334	115	140000.0	50000.0	0.0	60.0
335	1115	140000.0	50000.0	-100.0	60.0
336	2115	140000.0	50000.0	-2100.0	60.0
337	116	150000.0	50000.0	0.0	50.0
338	1116	150000.0	50000.0	-100.0	50.0
339	2116	150000.0	50000.0	-2100.0	50.0
340	117	160000.0	50000.0	0.0	40.0
341	1117	160000.0	50000.0	-100.0	40.0
342	2117	160000.0	50000.0	-2100.0	40.0

343	118	170000,0	50000,0	0,0	30,0
344	1118	170000,0	50000,0	-100,0	30,0
345	2118	170000,0	50000,0	-2100,0	30,0
346	119	180000,0	50000,0	0,0	20,0
347	1119	180000,0	50000,0	-100,0	20,0
348	2119	180000,0	50000,0	-2100,0	20,0
349	120	190000,0	50000,0	0,0	10,0
350	1120	190000,0	50000,0	-100,0	10,0
351	2120	190000,0	50000,0	-2100,0	10,0
352	121	0,0	60000,0	0,0	200,0
353	1121	0,0	60000,0	-100,0	200,0
354	2121	0,0	60000,0	-2100,0	200,0
355	122	10000,0	60000,0	0,0	190,0
356	1122	10000,0	60000,0	-100,0	190,0
357	2122	10000,0	60000,0	-2100,0	190,0
358	123	20000,0	60000,0	0,0	180,0
359	1123	20000,0	60000,0	-100,0	180,0
360	2123	20000,0	60000,0	-2100,0	180,0
361	124	30000,0	60000,0	0,0	170,0
362	1124	30000,0	60000,0	-100,0	170,0
363	2124	30000,0	60000,0	-2100,0	170,0
364	125	40000,0	60000,0	0,0	160,0
365	1125	40000,0	60000,0	-100,0	160,0
366	2125	40000,0	60000,0	-2100,0	160,0
367	126	50000,0	60000,0	0,0	150,0
368	1126	50000,0	60000,0	-100,0	150,0
369	2126	50000,0	60000,0	-2100,0	150,0

370	127	60000.0	60000.0	0.0	140.0
371	1127	60000.0	60000.0	-100.0	140.0
372	2127	60000.0	60000.0	-2100.0	140.0
373	128	70000.0	60000.0	0.0	130.0
374	1128	70000.0	60000.0	-100.0	130.0
375	2128	70000.0	60000.0	-2100.0	130.0
376	129	80000.0	60000.0	0.0	120.0
377	1129	80000.0	60000.0	-100.0	120.0
378	2129	80000.0	60000.0	-2100.0	120.0
379	130	90000.0	60000.0	0.0	110.0
380	1130	90000.0	60000.0	-100.0	110.0
381	2130	90000.0	60000.0	-2100.0	110.0
382	131	100000.0	60000.0	0.0	100.0
383	1131	100000.0	60000.0	-100.0	100.0
384	2131	100000.0	60000.0	-2100.0	100.0
385	132	110000.0	60000.0	0.0	90.0
386	1132	110000.0	60000.0	-100.0	90.0
387	2132	110000.0	60000.0	-2100.0	90.0
388	133	120000.0	60000.0	0.0	80.0
389	1133	120000.0	60000.0	-100.0	80.0
390	2133	120000.0	60000.0	-2100.0	80.0
391	134	130000.0	60000.0	0.0	70.0
392	1134	130000.0	60000.0	-100.0	70.0
393	2134	130000.0	60000.0	-2100.0	70.0
394	135	140000.0	60000.0	0.0	60.0
395	1135	140000.0	60000.0	-100.0	60.0
396	2135	140000.0	60000.0	-2100.0	60.0

397	136	150000,0	60000,0	0,0	50,0
398	1136	150000,0	60000,0	=100,0	50,0
399	2136	150000,0	60000,0	=2100,0	50,0
400	137	160000,0	60000,0	0,0	40,0
401	1137	160000,0	60000,0	=100,0	40,0
402	2137	160000,0	60000,0	=2100,0	40,0
403	138	170000,0	60000,0	0,0	30,0
404	1138	170000,0	60000,0	=100,0	30,0
405	2138	170000,0	60000,0	=2100,0	30,0
406	139	180000,0	60000,0	0,0	20,0
407	1139	180000,0	60000,0	=100,0	20,0
408	2139	180000,0	60000,0	=2100,0	20,0
409	140	190000,0	60000,0	0,0	10,0
410	1140	190000,0	60000,0	=100,0	10,0
411	2140	190000,0	60000,0	=2100,0	10,0
412	141	0,0	70000,0	0,0	200,0
413	1141	0,0	70000,0	=100,0	200,0
414	2141	0,0	70000,0	=2100,0	200,0
415	142	10000,0	70000,0	0,0	190,0
416	1142	10000,0	70000,0	=100,0	190,0
417	2142	10000,0	70000,0	=2100,0	190,0
418	143	20000,0	70000,0	0,0	180,0
419	1143	20000,0	70000,0	=100,0	180,0
420	2143	20000,0	70000,0	=2100,0	180,0
421	144	30000,0	70000,0	0,0	170,0
422	1144	30000,0	70000,0	=100,0	170,0
423	2144	30000,0	70000,0	=2100,0	170,0

424	145	40000.0	70000.0	0.0	160.0
425	1145	40000.0	70000.0	-100.0	160.0
426	2145	40000.0	70000.0	-2100.0	160.0
427	146	50000.0	70000.0	0.0	150.0
428	1146	50000.0	70000.0	-100.0	150.0
429	2146	50000.0	70000.0	-2100.0	150.0
430	147	60000.0	70000.0	0.0	140.0
431	1147	60000.0	70000.0	-100.0	140.0
432	2147	60000.0	70000.0	-2100.0	140.0
433	148	70000.0	70000.0	0.0	130.0
434	1148	70000.0	70000.0	-100.0	130.0
435	2148	70000.0	70000.0	-2100.0	130.0
436	149	80000.0	70000.0	0.0	120.0
437	1149	80000.0	70000.0	-100.0	120.0
438	2149	80000.0	70000.0	-2100.0	120.0
439	150	90000.0	70000.0	0.0	110.0
440	1150	90000.0	70000.0	-100.0	110.0
441	2150	90000.0	70000.0	-2100.0	110.0
442	151	100000.0	70000.0	0.0	100.0
443	1151	100000.0	70000.0	-100.0	100.0
444	2151	100000.0	70000.0	-2100.0	100.0
445	152	110000.0	70000.0	0.0	90.0
446	1152	110000.0	70000.0	-100.0	90.0
447	2152	110000.0	70000.0	-2100.0	90.0
448	153	120000.0	70000.0	0.0	80.0
449	1153	120000.0	70000.0	-100.0	80.0
450	2153	120000.0	70000.0	-2100.0	80.0

451	154	130000,0	70000,0	0,0	70,0
452	1154	130000,0	70000,0	=100,0	70,0
453	2154	130000,0	70000,0	=2100,0	70,0
454	155	140000,0	70000,0	0,0	60,0
455	1155	140000,0	70000,0	=100,0	60,0
456	2155	140000,0	70000,0	=2100,0	60,0
457	156	150000,0	70000,0	0,0	50,0
458	1156	150000,0	70000,0	=100,0	50,0
459	2156	150000,0	70000,0	=2100,0	50,0
460	157	160000,0	70000,0	0,0	40,0
461	1157	160000,0	70000,0	=100,0	40,0
462	2157	160000,0	70000,0	=2100,0	40,0
463	158	170000,0	70000,0	0,0	30,0
464	1158	170000,0	70000,0	=100,0	30,0
465	2158	170000,0	70000,0	=2100,0	30,0
466	159	180000,0	70000,0	0,0	20,0
467	1159	180000,0	70000,0	=100,0	20,0
468	2159	180000,0	70000,0	=2100,0	20,0
469	160	190000,0	70000,0	0,0	10,0
470	1160	190000,0	70000,0	=100,0	10,0
471	2160	190000,0	70000,0	=2100,0	10,0
472	161	0,0	80000,0	0,0	200,0
473	1161	0,0	80000,0	=100,0	200,0
474	2161	0,0	80000,0	=2100,0	200,0
475	162	10000,0	80000,0	0,0	190,0
476	1162	10000,0	80000,0	=100,0	190,0
477	2162	10000,0	80000,0	=2100,0	190,0

478	163	20000.0	80000.0	0.0	180.0
479	1163	20000.0	80000.0	-100.0	180.0
480	2163	20000.0	80000.0	-2100.0	180.0
481	164	30000.0	80000.0	0.0	170.0
482	1164	30000.0	80000.0	-100.0	170.0
483	2164	30000.0	80000.0	-2100.0	170.0
484	165	40000.0	80000.0	0.0	160.0
485	1165	40000.0	80000.0	-100.0	160.0
486	2165	40000.0	80000.0	-2100.0	160.0
487	166	50000.0	80000.0	0.0	150.0
488	1166	50000.0	80000.0	-100.0	150.0
489	2166	50000.0	80000.0	-2100.0	150.0
490	167	60000.0	80000.0	0.0	140.0
491	1167	60000.0	80000.0	-100.0	140.0
492	2167	60000.0	80000.0	-2100.0	140.0
493	168	70000.0	80000.0	0.0	130.0
494	1168	70000.0	80000.0	-100.0	130.0
495	2168	70000.0	80000.0	-2100.0	130.0
496	169	80000.0	80000.0	0.0	120.0
497	1169	80000.0	80000.0	-100.0	120.0
498	2169	80000.0	80000.0	-2100.0	120.0
499	170	90000.0	80000.0	0.0	110.0
500	1170	90000.0	80000.0	-100.0	110.0
501	2170	90000.0	80000.0	-2100.0	110.0
502	171	100000.0	80000.0	0.0	100.0
503	1171	100000.0	80000.0	-100.0	100.0
504	2171	100000.0	80000.0	-2100.0	100.0

505	172	110000,0	80000,0	0,0	90,0
506	1172	110000,0	80000,0	-100,0	90,0
507	2172	110000,0	80000,0	-2100,0	90,0
508	173	120000,0	80000,0	0,0	80,0
509	1173	120000,0	80000,0	-100,0	80,0
510	2173	120000,0	80000,0	-2100,0	80,0
511	174	130000,0	80000,0	0,0	70,0
512	1174	130000,0	80000,0	-100,0	70,0
513	2174	130000,0	80000,0	-2100,0	70,0
514	175	140000,0	80000,0	0,0	60,0
515	1175	140000,0	80000,0	-100,0	60,0
516	2175	140000,0	80000,0	-2100,0	60,0
517	176	150000,0	80000,0	0,0	50,0
518	1176	150000,0	80000,0	-100,0	50,0
519	2176	150000,0	80000,0	-2100,0	50,0
520	177	160000,0	80000,0	0,0	40,0
521	1177	160000,0	80000,0	-100,0	40,0
522	2177	160000,0	80000,0	-2100,0	40,0
523	178	170000,0	80000,0	0,0	30,0
524	1178	170000,0	80000,0	-100,0	30,0
525	2178	170000,0	80000,0	-2100,0	30,0
526	179	180000,0	80000,0	0,0	20,0
527	1179	180000,0	80000,0	-100,0	20,0
528	2179	180000,0	80000,0	-2100,0	20,0
529	180	190000,0	80000,0	0,0	10,0
530	1180	190000,0	80000,0	-100,0	10,0
531	2180	190000,0	80000,0	-2100,0	10,0

532	181	0.0	90000.0	0.0	200.0
533	1181	0.0	90000.0	-100.0	200.0
534	2181	0.0	90000.0	-2100.0	200.0
535	182	10000.0	90000.0	0.0	190.0
536	1182	10000.0	90000.0	-100.0	190.0
537	2182	10000.0	90000.0	-2100.0	190.0
538	183	20000.0	90000.0	0.0	180.0
539	1183	20000.0	90000.0	-100.0	180.0
540	2183	20000.0	90000.0	-2100.0	180.0
541	184	30000.0	90000.0	0.0	170.0
542	1184	30000.0	90000.0	-100.0	170.0
543	2184	30000.0	90000.0	-2100.0	170.0
544	185	40000.0	90000.0	0.0	160.0
545	1185	40000.0	90000.0	-100.0	160.0
546	2185	40000.0	90000.0	-2100.0	160.0
547	186	50000.0	90000.0	0.0	150.0
548	1186	50000.0	90000.0	-100.0	150.0
549	2186	50000.0	90000.0	-2100.0	150.0
550	187	60000.0	90000.0	0.0	140.0
551	1187	60000.0	90000.0	-100.0	140.0
552	2187	60000.0	90000.0	-2100.0	140.0
553	188	70000.0	90000.0	0.0	130.0
554	1188	70000.0	90000.0	-100.0	130.0
555	2188	70000.0	90000.0	-2100.0	130.0
556	189	80000.0	90000.0	0.0	120.0
557	1189	80000.0	90000.0	-100.0	120.0
558	2189	80000.0	90000.0	-2100.0	120.0

559	190	90000,0	90000,0	0,0	110,0
560	1190	90000,0	90000,0	-100,0	110,0
561	2190	90000,0	90000,0	-2100,0	110,0
562	191	100000,0	90000,0	0,0	100,0
563	1191	100000,0	90000,0	-100,0	100,0
564	2191	100000,0	90000,0	-2100,0	100,0
565	192	110000,0	90000,0	0,0	90,0
566	1192	110000,0	90000,0	-100,0	90,0
567	2192	110000,0	90000,0	-2100,0	90,0
568	193	120000,0	90000,0	0,0	80,0
569	1193	120000,0	90000,0	-100,0	80,0
570	2193	120000,0	90000,0	-2100,0	80,0
571	194	130000,0	90000,0	0,0	70,0
572	1194	130000,0	90000,0	-100,0	70,0
573	2194	130000,0	90000,0	-2100,0	70,0
574	195	140000,0	90000,0	0,0	60,0
575	1195	140000,0	90000,0	-100,0	60,0
576	2195	140000,0	90000,0	-2100,0	60,0
577	196	150000,0	90000,0	0,0	50,0
578	1196	150000,0	90000,0	-100,0	50,0
579	2196	150000,0	90000,0	-2100,0	50,0
580	197	160000,0	90000,0	0,0	40,0
581	1197	160000,0	90000,0	-100,0	40,0
582	2197	160000,0	90000,0	-2100,0	40,0
583	198	170000,0	90000,0	0,0	30,0
584	1198	170000,0	90000,0	-100,0	30,0
585	2198	170000,0	90000,0	-2100,0	30,0

586	199	180000.0	90000.0	0.0	20.0
587	1199	180000.0	90000.0	-100.0	20.0
588	2199	180000.0	90000.0	-2100.0	20.0
589	200	190000.0	90000.0	0.0	10.0
590	1200	190000.0	90000.0	-100.0	10.0
591	2200	190000.0	90000.0	-2100.0	10.0
592	201	77500.0	0.0	0.0	122.5
593	1201	77500.0	0.0	-100.0	122.5
594	2201	77500.0	0.0	-300.0	122.5
595	3201	77500.0	0.0	-500.0	122.5
596	4201	77500.0	0.0	-700.0	122.5
597	5201	77500.0	0.0	-1000.0	122.5
598	6201	77500.0	0.0	-1300.0	122.5
599	7201	77500.0	0.0	-1670.0	122.5
600	8201	77500.0	0.0	-1700.0	122.5
601	202	76000.0	0.0	0.0	124.0
602	1202	76000.0	0.0	-100.0	124.0
603	2202	76000.0	0.0	-300.0	124.0
604	3202	76000.0	0.0	-500.0	124.0
605	4202	76000.0	0.0	-700.0	124.0
606	5202	76000.0	0.0	-1000.0	124.0
607	6202	76000.0	0.0	-1300.0	124.0
608	7202	76000.0	0.0	-1670.0	124.0
609	8202	76000.0	0.0	-1700.0	124.0
610	203	75000.0	0.0	0.0	125.0
611	1203	75000.0	0.0	-100.0	125.0
612	2203	75000.0	0.0	-300.0	125.0
613	3203	75000.0	0.0	-500.0	125.0
614	4203	75000.0	0.0	-700.0	125.0
615	5203	75000.0	0.0	-1000.0	125.0
616	6203	75000.0	0.0	-1300.0	125.0
617	7203	75000.0	0.0	-1670.0	125.0
618	8203	75000.0	0.0	-1700.0	125.0

619	204	74825,0	0,0	0,0	125,2
620	1204	74825,0	0,0	-100,0	125,2
621	2204	74825,0	0,0	-300,0	125,2
622	3204	74825,0	0,0	-390,0	125,2
623	4204	74825,0	0,0	-700,0	125,2
624	5204	74825,0	0,0	-1200,0	125,2
625	6204	74825,0	0,0	-1300,0	125,2
626	7204	74825,0	0,0	-1670,0	125,2
627	8204	74825,0	0,0	-1700,0	125,2
628	205	74750,0	0,0	0,0	125,3
629	1205	74750,0	0,0	-100,0	125,3
630	2205	74750,0	0,0	-1250,0	125,3
631	3205	74750,0	0,0	-1600,0	125,3
632	4205	74750,0	0,0	-1670,0	125,3
633	5205	74750,0	0,0	-1700,0	125,3
634	6205	74750,0	0,0	-1740,0	125,3
635	206	74325,0	0,0	0,0	125,7
636	1206	74325,0	0,0	-100,0	125,7
637	2206	74325,0	0,0	-1250,0	125,7
638	3206	74325,0	0,0	-1600,0	125,7
639	4206	74325,0	0,0	-2100,0	125,7
640	207	73000,0	0,0	0,0	127,0
641	1207	73000,0	0,0	-100,0	127,0
642	2207	73000,0	0,0	-1250,0	127,0
643	3207	73000,0	0,0	-1600,0	127,0
644	4207	73000,0	0,0	-2100,0	127,0
645	208	71000,0	0,0	0,0	129,0
646	1208	71000,0	0,0	-100,0	129,0
647	2208	71000,0	0,0	-1250,0	129,0
648	3208	71000,0	0,0	-2100,0	129,0
649	209	67000,0	0,0	0,0	133,0
650	1209	67000,0	0,0	-100,0	133,0
651	2209	67000,0	0,0	-2100,0	133,0

652	210	62000.0	0.0	0.0	138.0
653	1210	62000.0	0.0	-100.0	138.0
654	2210	62000.0	0.0	-2100.0	138.0
655	211	77690.3	956.7	0.0	122.3
656	1211	77690.3	956.7	-100.0	122.3
657	2211	77690.3	956.7	-300.0	122.3
658	3211	77690.3	956.7	-500.0	122.3
659	4211	77690.3	956.7	-700.0	122.3
660	5211	77690.3	956.7	-1000.0	122.3
661	6211	77690.3	956.7	-1300.0	122.3
662	7211	77690.3	956.7	-1670.0	122.3
663	8211	77690.3	956.7	-1700.0	122.3
664	212	76304.5	1530.7	0.0	123.7
665	1212	76304.5	1530.7	-100.0	123.7
666	2212	76304.5	1530.7	-300.0	123.7
667	3212	76304.5	1530.7	-500.0	123.7
668	4212	76304.5	1530.7	-700.0	123.7
669	5212	76304.5	1530.7	-1000.0	123.7
670	6212	76304.5	1530.7	-1300.0	123.7
671	7212	76304.5	1530.7	-1670.0	123.7
672	8212	76304.5	1530.7	-1700.0	123.7
673	213	75380.6	1913.4	0.0	124.6
674	1213	75380.6	1913.4	-100.0	124.6
675	2213	75380.6	1913.4	-300.0	124.6
676	3213	75380.6	1913.4	-500.0	124.6
677	4213	75380.6	1913.4	-700.0	124.6
678	5213	75380.6	1913.4	-1000.0	124.6
679	6213	75380.6	1913.4	-1300.0	124.6
680	7213	75380.6	1913.4	-1670.0	124.6
681	8213	75380.6	1913.4	-1700.0	124.6
682	214	75218.9	1980.4	0.0	124.8
683	1214	75218.9	1980.4	-100.0	124.8
684	2214	75218.9	1980.4	-300.0	124.8
685	3214	75218.9	1980.4	-500.0	124.8
686	4214	75218.9	1980.4	-700.0	124.8
687	5214	75218.9	1980.4	-1000.0	124.8
688	6214	75218.9	1980.4	-1300.0	124.8
689	7214	75218.9	1980.4	-1670.0	124.8
690	8214	75218.9	1980.4	-1700.0	124.8

691	213	75149,6	2009,1	0,0	124,8
692	1213	75149,6	2009,1	-100,0	124,8
693	2213	75149,6	2009,1	-1250,0	124,8
694	3213	75149,6	2009,1	-1600,0	124,8
695	4213	75149,6	2009,1	-1670,0	124,8
696	5213	75149,6	2009,1	-1700,0	124,8
697	6213	75149,6	2009,1	-1740,0	124,8
698	216	74757,0	2171,7	0,0	125,2
699	1216	74757,0	2171,7	-100,0	125,2
700	2216	74757,0	2171,7	-1250,0	125,2
701	3216	74757,0	2171,7	-1600,0	125,2
702	4216	74757,0	2171,7	-2100,0	125,2
703	217	73532,8	2678,8	0,0	126,5
704	1217	73532,8	2678,8	-100,0	126,5
705	2217	73532,8	2678,8	-1250,0	126,5
706	3217	73532,8	2678,8	-1600,0	126,5
707	4217	73532,8	2678,8	-2100,0	126,5
708	218	71685,1	3444,1	0,0	128,3
709	1218	71685,1	3444,1	-100,0	128,3
710	2218	71685,1	3444,1	-1250,0	128,3
711	3218	71685,1	3444,1	-2100,0	128,3
712	219	67989,6	4974,9	0,0	132,0
713	1219	67989,6	4974,9	-100,0	132,0
714	2219	67989,6	4974,9	-2100,0	132,0
715	220	63370,2	6888,3	0,0	136,6
716	1220	63370,2	6888,3	-100,0	136,6
717	2220	63370,2	6888,3	-2100,0	136,6

718	221	78232,2	1767,8	0,0	121,8
719	1221	78232,2	1767,8	-100,0	121,8
720	2221	78232,2	1767,8	-300,0	121,8
721	3221	78232,2	1767,8	-500,0	121,8
722	4221	78232,2	1767,8	-700,0	121,8
723	5221	78232,2	1767,8	-1000,0	121,8
724	6221	78232,2	1767,8	-1300,0	121,8
725	7221	78232,2	1767,8	-1670,0	121,8
726	8221	78232,2	1767,8	-1700,0	121,8
727	222	77171,6	2828,4	0,0	122,8
728	1222	77171,6	2828,4	-100,0	122,8
729	2222	77171,6	2828,4	-300,0	122,8
730	3222	77171,6	2828,4	-500,0	122,8
731	4222	77171,6	2828,4	-700,0	122,8
732	5222	77171,6	2828,4	-1000,0	122,8
733	6222	77171,6	2828,4	-1300,0	122,8
734	7222	77171,6	2828,4	-1670,0	122,8
735	8222	77171,6	2828,4	-1700,0	122,8
736	223	76464,5	3535,5	0,0	123,5
737	1223	76464,5	3535,5	-100,0	123,5
738	2223	76464,5	3535,5	-300,0	123,5
739	3223	76464,5	3535,5	-500,0	123,5
740	4223	76464,5	3535,5	-700,0	123,5
741	5223	76464,5	3535,5	-1000,0	123,5
742	6223	76464,5	3535,5	-1300,0	123,5
743	7223	76464,5	3535,5	-1670,0	123,5
744	8223	76464,5	3535,5	-1700,0	123,5
745	224	76340,7	3659,3	0,0	123,7
746	1224	76340,7	3659,3	-100,0	123,7
747	2224	76340,7	3659,3	-300,0	123,7
748	3224	76340,7	3659,3	-500,0	123,7
749	4224	76340,7	3659,3	-700,0	123,7
750	5224	76340,7	3659,3	-1000,0	123,7
751	6224	76340,7	3659,3	-1300,0	123,7
752	7224	76340,7	3659,3	-1670,0	123,7
753	8224	76340,7	3659,3	-1700,0	123,7

754	225	76287,7	3712,3	0,0	123,7
755	1225	76287,7	3712,3	-100,0	123,7
756	2225	76287,7	3712,3	-1250,0	123,7
757	3225	76287,7	3712,3	-1600,0	123,7
758	4225	76287,7	3712,3	-1670,0	123,7
759	5225	76287,7	3712,3	-1700,0	123,7
760	6225	76287,7	3712,3	-1740,0	123,7
761	226	75987,2	4012,3	0,0	124,0
762	1226	75987,2	4012,3	-100,0	124,0
763	2226	75987,2	4012,3	-1250,0	124,0
764	3226	75987,2	4012,3	-1600,0	124,0
765	4226	75987,2	4012,3	-2100,0	124,0
766	227	75050,3	4949,3	0,0	124,9
767	1227	75050,3	4949,3	-100,0	124,9
768	2227	75050,3	4949,3	-1250,0	124,9
769	3227	75050,3	4949,3	-1600,0	124,9
770	4227	75050,3	4949,3	-2100,0	124,9
771	228	73636,0	6364,0	0,0	126,4
772	1228	73636,0	6364,0	-100,0	126,4
773	2228	73636,0	6364,0	-1250,0	126,4
774	3228	73636,0	6364,0	-2100,0	126,4
775	229	70807,6	9192,4	0,0	129,2
776	1229	70807,6	9192,4	-100,0	129,2
777	2229	70807,6	9192,4	-2100,0	129,2
778	230	67272,1	12727,9	0,0	132,7
779	1230	67272,1	12727,9	-100,0	132,7
780	2230	67272,1	12727,9	-2100,0	132,7

781	231	79043.3	2309.7	0.0	121.0
782	1231	79043.3	2309.7	-100.0	121.0
783	2231	79043.3	2309.7	-300.0	121.0
784	3231	79043.3	2309.7	-500.0	121.0
785	4231	79043.3	2309.7	-700.0	121.0
786	5231	79043.3	2309.7	-1000.0	121.0
787	6231	79043.3	2309.7	-1300.0	121.0
788	7231	79043.3	2309.7	-1670.0	121.0
789	8231	79043.3	2309.7	-1700.0	121.0
790	232	78469.3	3695.5	0.0	121.5
791	1232	78469.3	3695.5	-100.0	121.5
792	2232	78469.3	3695.5	-300.0	121.5
793	3232	78469.3	3695.5	-500.0	121.5
794	4232	78469.3	3695.5	-700.0	121.5
795	5232	78469.3	3695.5	-1000.0	121.5
796	6232	78469.3	3695.5	-1300.0	121.5
797	7232	78469.3	3695.5	-1670.0	121.5
798	8232	78469.3	3695.5	-1700.0	121.5
799	233	78086.6	4619.4	0.0	121.9
800	1233	78086.6	4619.4	-100.0	121.9
801	2233	78086.6	4619.4	-300.0	121.9
802	3233	78086.6	4619.4	-500.0	121.9
803	4233	78086.6	4619.4	-700.0	121.9
804	5233	78086.6	4619.4	-1000.0	121.9
805	6233	78086.6	4619.4	-1300.0	121.9
806	7233	78086.6	4619.4	-1670.0	121.9
807	8233	78086.6	4619.4	-1700.0	121.9
808	234	78019.6	4781.1	0.0	122.0
809	1234	78019.6	4781.1	-100.0	122.0
810	2234	78019.6	4781.1	-300.0	122.0
811	3234	78019.6	4781.1	-500.0	122.0
812	4234	78019.6	4781.1	-700.0	122.0
813	5234	78019.6	4781.1	-1000.0	122.0
814	6234	78019.6	4781.1	-1300.0	122.0
815	7234	78019.6	4781.1	-1670.0	122.0
816	8234	78019.6	4781.1	-1700.0	122.0

817	235	77990,9	4850,4	0,0	122,0
818	1235	77990,9	4850,4	-100,0	122,0
819	2235	77990,9	4850,4	-1250,0	122,0
820	3235	77990,9	4850,4	-1600,0	122,0
821	4235	77990,9	4850,4	-1670,0	122,0
822	5235	77990,9	4850,4	-1700,0	122,0
823	6235	77990,9	4850,4	-1740,0	122,0
824	236	77828,3	5243,0	0,0	122,2
825	1236	77828,3	5243,0	-100,0	122,2
826	2236	77828,3	5243,0	-1250,0	122,2
827	3236	77828,3	5243,0	-1600,0	122,2
828	4236	77828,3	5243,0	-2100,0	122,2
829	237	77321,2	6467,2	0,0	122,7
830	1237	77321,2	6467,2	-100,0	122,7
831	2237	77321,2	6467,2	-1250,0	122,7
832	3237	77321,2	6467,2	-1600,0	122,7
833	4237	77321,2	6467,2	-2100,0	122,7
834	238	76555,9	8314,9	0,0	123,4
835	1238	76555,9	8314,9	-100,0	123,4
836	2238	76555,9	8314,9	-1250,0	123,4
837	3238	76555,9	8314,9	-2100,0	123,4
838	239	75025,1	12010,4	0,0	125,0
839	1239	75025,1	12010,4	-100,0	125,0
840	2239	75025,1	12010,4	-2100,0	125,0
841	240	73111,7	16629,8	0,0	126,9
842	1240	73111,7	16629,8	-100,0	126,9
843	2240	73111,7	16629,8	-2100,0	126,9

844	241	80000.0	2500.0	0.0	120.0
845	1241	80000.0	2500.0	-100.0	120.0
846	2241	80000.0	2500.0	-300.0	120.0
847	3241	80000.0	2500.0	-500.0	120.0
848	4241	80000.0	2500.0	-700.0	120.0
849	5241	80000.0	2500.0	-1000.0	120.0
850	6241	80000.0	2500.0	-1300.0	120.0
851	7241	80000.0	2500.0	-1670.0	120.0
852	8241	80000.0	2500.0	-1700.0	120.0

853	242	80000.0	4000.0	0.0	120.0
854	1242	80000.0	4000.0	-100.0	120.0
855	2242	80000.0	4000.0	-300.0	120.0
856	3242	80000.0	4000.0	-500.0	120.0
857	4242	80000.0	4000.0	-700.0	120.0
858	5242	80000.0	4000.0	-1000.0	120.0
859	6242	80000.0	4000.0	-1300.0	120.0
860	7242	80000.0	4000.0	-1670.0	120.0
861	8242	80000.0	4000.0	-1700.0	120.0

862	243	80000.0	5000.0	0.0	120.0
863	1243	80000.0	5000.0	-100.0	120.0
864	2243	80000.0	5000.0	-300.0	120.0
865	3243	80000.0	5000.0	-500.0	120.0
866	4243	80000.0	5000.0	-700.0	120.0
867	5243	80000.0	5000.0	-1000.0	120.0
868	6243	80000.0	5000.0	-1300.0	120.0
869	7243	80000.0	5000.0	-1670.0	120.0
870	8243	80000.0	5000.0	-1700.0	120.0

871	244	80000.0	5175.0	0.0	120.0
872	1244	80000.0	5175.0	-100.0	120.0
873	2244	80000.0	5175.0	-300.0	120.0
874	3244	80000.0	5175.0	-500.0	120.0
875	4244	80000.0	5175.0	-700.0	120.0
876	5244	80000.0	5175.0	-1000.0	120.0
877	6244	80000.0	5175.0	-1300.0	120.0
878	7244	80000.0	5175.0	-1670.0	120.0
879	8244	80000.0	5175.0	-1700.0	120.0

880	245	80000,0	5250,0	0,0	120,0
881	1245	80000,0	5250,0	-100,0	120,0
882	2245	80000,0	5250,0	-1250,0	120,0
883	3245	80000,0	5250,0	-1600,0	120,0
884	4245	80000,0	5250,0	-1670,0	120,0
885	5245	80000,0	5250,0	-1700,0	120,0
886	6245	80000,0	5250,0	-1740,0	120,0
887	246	80000,0	5675,0	0,0	120,0
888	1246	80000,0	5675,0	-100,0	120,0
889	2246	80000,0	5675,0	-1250,0	120,0
890	3246	80000,0	5675,0	-1600,0	120,0
891	4246	80000,0	5675,0	-2100,0	120,0
892	247	80000,0	7000,0	0,0	120,0
893	1247	80000,0	7000,0	-100,0	120,0
894	2247	80000,0	7000,0	-1250,0	120,0
895	3247	80000,0	7000,0	-1600,0	120,0
896	4247	80000,0	7000,0	-2100,0	120,0
897	248	80000,0	9000,0	0,0	120,0
898	1248	80000,0	9000,0	-100,0	120,0
899	2248	80000,0	9000,0	-1250,0	120,0
900	3248	80000,0	9000,0	-2100,0	120,0
901	249	80000,0	13000,0	0,0	120,0
902	1249	80000,0	13000,0	-100,0	120,0
903	2249	80000,0	13000,0	-2100,0	120,0
904	250	80000,0	18000,0	0,0	120,0
905	1250	80000,0	18000,0	-100,0	120,0
906	2250	80000,0	18000,0	-2100,0	120,0

907	251	80956.7	2309.7	0.0	119.0
908	1251	80956.7	2309.7	-100.0	119.0
909	2251	80956.7	2309.7	-300.0	119.0
910	3251	80956.7	2309.7	-500.0	119.0
911	4251	80956.7	2309.7	-700.0	119.0
912	5251	80956.7	2309.7	-1000.0	119.0
913	6251	80956.7	2309.7	-1300.0	119.0
914	7251	80956.7	2309.7	-1670.0	119.0
915	8251	80956.7	2309.7	-1700.0	119.0
916	252	81530.7	3695.5	0.0	118.5
917	1252	81530.7	3695.5	-100.0	118.5
918	2252	81530.7	3695.5	-300.0	118.5
919	3252	81530.7	3695.5	-500.0	118.5
920	4252	81530.7	3695.5	-700.0	118.5
921	5252	81530.7	3695.5	-1000.0	118.5
922	6252	81530.7	3695.5	-1300.0	118.5
923	7252	81530.7	3695.5	-1670.0	118.5
924	8252	81530.7	3695.5	-1700.0	118.5
925	253	81913.4	4619.4	0.0	118.1
926	1253	81913.4	4619.4	-100.0	118.1
927	2253	81913.4	4619.4	-300.0	118.1
928	3253	81913.4	4619.4	-500.0	118.1
929	4253	81913.4	4619.4	-700.0	118.1
930	5253	81913.4	4619.4	-1000.0	118.1
931	6253	81913.4	4619.4	-1300.0	118.1
932	7253	81913.4	4619.4	-1670.0	118.1
933	8253	81913.4	4619.4	-1700.0	118.1
934	254	81980.4	4781.1	0.0	118.0
935	1254	81980.4	4781.1	-100.0	118.0
936	2254	81980.4	4781.1	-300.0	118.0
937	3254	81980.4	4781.1	-500.0	118.0
938	4254	81980.4	4781.1	-700.0	118.0
939	5254	81980.4	4781.1	-1000.0	118.0
940	6254	81980.4	4781.1	-1300.0	118.0
941	7254	81980.4	4781.1	-1670.0	118.0
942	8254	81980.4	4781.1	-1700.0	118.0

943	255	82009,1	4850,4	0,0	118,0
944	1255	82009,1	4850,4	-100,0	118,0
945	2255	82009,1	4850,4	-1250,0	118,0
946	3255	82009,1	4850,4	-1600,0	118,0
947	4255	82009,1	4850,4	-1670,0	118,0
948	5255	82009,1	4850,4	-1700,0	118,0
949	6255	82009,1	4850,4	-1740,0	118,0
950	256	82171,7	5243,0	0,0	117,8
951	1256	82171,7	5243,0	-100,0	117,8
952	2256	82171,7	5243,0	-1250,0	117,8
953	3256	82171,7	5243,0	-1600,0	117,8
954	4256	82171,7	5243,0	-2100,0	117,8
955	257	82678,8	6467,2	0,0	117,3
956	1257	82678,8	6467,2	-100,0	117,3
957	2257	82678,8	6467,2	-1250,0	117,3
958	3257	82678,8	6467,2	-1600,0	117,3
959	4257	82678,8	6467,2	-2100,0	117,3
960	258	83444,1	8314,9	0,0	116,6
961	1258	83444,1	8314,9	-100,0	116,6
962	2258	83444,1	8314,9	-1250,0	116,6
963	3258	83444,1	8314,9	-2100,0	116,6
964	259	84974,9	12010,4	0,0	115,0
965	1259	84974,9	12010,4	-100,0	115,0
966	2259	84974,9	12010,4	-2100,0	115,0
967	260	86888,3	16629,8	0,0	113,1
968	1260	86888,3	16629,8	-100,0	113,1
969	2260	86888,3	16629,8	-2100,0	113,1

970	261	81767,6	1767,6	0,0	116,2
971	1261	81767,6	1767,6	-100,0	116,2
972	2261	81767,6	1767,6	-300,0	116,2
973	3261	81767,6	1767,6	-500,0	116,2
974	4261	81767,6	1767,6	-700,0	116,2
975	5261	81767,6	1767,6	-1000,0	116,2
976	6261	81767,6	1767,6	-1300,0	116,2
977	7261	81767,6	1767,6	-1670,0	116,2
978	8261	81767,6	1767,6	-1700,0	116,2
979	262	82828,4	2828,4	0,0	117,2
980	1262	82828,4	2828,4	-100,0	117,2
981	2262	82828,4	2828,4	-300,0	117,2
982	3262	82828,4	2828,4	-500,0	117,2
983	4262	82828,4	2828,4	-700,0	117,2
984	5262	82828,4	2828,4	-1000,0	117,2
985	6262	82828,4	2828,4	-1300,0	117,2
986	7262	82828,4	2828,4	-1670,0	117,2
987	8262	82828,4	2828,4	-1700,0	117,2
988	263	83535,5	3535,5	0,0	116,5
989	1263	83535,5	3535,5	-100,0	116,5
990	2263	83535,5	3535,5	-300,0	116,5
991	3263	83535,5	3535,5	-500,0	116,5
992	4263	83535,5	3535,5	-700,0	116,5
993	5263	83535,5	3535,5	-1000,0	116,5
994	6263	83535,5	3535,5	-1300,0	116,5
995	7263	83535,5	3535,5	-1670,0	116,5
996	8263	83535,5	3535,5	-1700,0	116,5
997	264	83659,3	3659,3	0,0	116,3
998	1264	83659,3	3659,3	-100,0	116,3
999	2264	83659,3	3659,3	-300,0	116,3
1000	3264	83659,3	3659,3	-500,0	116,3
1001	4264	83659,3	3659,3	-700,0	116,3
1002	5264	83659,3	3659,3	-1000,0	116,3
1003	6264	83659,3	3659,3	-1300,0	116,3
1004	7264	83659,3	3659,3	-1670,0	116,3
1005	8264	83659,3	3659,3	-1700,0	116,3

1006	265	83712,3	3712,3	0,0	116,3
1007	1265	83712,3	3712,3	=100,0	116,3
1008	2265	83712,3	3712,3	=1250,0	116,3
1009	3265	83712,3	3712,3	=1600,0	116,3
1010	4265	83712,3	3712,3	=1670,0	116,3
1011	5265	83712,3	3712,3	=1700,0	116,3
1012	6265	83712,3	3712,3	=1740,0	116,3
1013	266	84012,8	4012,8	0,0	116,0
1014	1266	84012,8	4012,8	=100,0	116,0
1015	2266	84012,8	4012,8	=1250,0	116,0
1016	3266	84012,8	4012,8	=1600,0	116,0
1017	4266	84012,8	4012,8	=2100,0	116,0
1018	267	84949,8	4949,8	0,0	115,1
1019	1267	84949,8	4949,8	=100,0	115,1
1020	2267	84949,8	4949,8	=1250,0	115,1
1021	3267	84949,8	4949,8	=1600,0	115,1
1022	4267	84949,8	4949,8	=2100,0	115,1
1023	268	86364,0	6364,0	0,0	113,6
1024	1268	86364,0	6364,0	=100,0	113,6
1025	2268	86364,0	6364,0	=1250,0	113,6
1026	3268	86364,0	6364,0	=2100,0	113,6
1027	269	89192,4	9192,4	0,0	110,8
1028	1269	89192,4	9192,4	=100,0	110,3
1029	2269	89192,4	9192,4	=2100,0	110,3
1030	270	92727,9	12727,9	0,0	107,3
1031	1270	92727,9	12727,9	=100,0	107,3
1032	2270	92727,9	12727,9	=2100,0	107,3

1033	271	82309,7	956,7	0,0	117,7
1034	1271	82309,7	956,7	-100,0	117,7
1035	2271	82309,7	956,7	-300,0	117,7
1036	3271	82309,7	956,7	-500,0	117,7
1037	4271	82309,7	956,7	-700,0	117,7
1038	5271	82309,7	956,7	-1000,0	117,7
1039	6271	82309,7	956,7	-1300,0	117,7
1040	7271	82309,7	956,7	-1670,0	117,7
1041	8271	82309,7	956,7	-1700,0	117,7
1042	272	83695,5	1530,7	0,0	116,3
1043	1272	83695,5	1530,7	-100,0	116,3
1044	2272	83695,5	1530,7	-300,0	116,3
1045	3272	83695,5	1530,7	-500,0	116,3
1046	4272	83695,5	1530,7	-700,0	116,3
1047	5272	83695,5	1530,7	-1000,0	116,3
1048	6272	83695,5	1530,7	-1300,0	116,3
1049	7272	83695,5	1530,7	-1670,0	116,3
1050	8272	83695,5	1530,7	-1700,0	116,3
1051	273	84619,4	1913,4	0,0	115,4
1052	1273	84619,4	1913,4	-100,0	115,4
1053	2273	84619,4	1913,4	-300,0	115,4
1054	3273	84619,4	1913,4	-500,0	115,4
1055	4273	84619,4	1913,4	-700,0	115,4
1056	5273	84619,4	1913,4	-1000,0	115,4
1057	6273	84619,4	1913,4	-1300,0	115,4
1058	7273	84619,4	1913,4	-1670,0	115,4
1059	8273	84619,4	1913,4	-1700,0	115,4
1060	274	84781,1	1980,4	0,0	115,2
1061	1274	84781,1	1980,4	-100,0	115,2
1062	2274	84781,1	1980,4	-300,0	115,2
1063	3274	84781,1	1980,4	-500,0	115,2
1064	4274	84781,1	1980,4	-700,0	115,2
1065	5274	84781,1	1980,4	-1000,0	115,2
1066	6274	84781,1	1980,4	-1300,0	115,2
1067	7274	84781,1	1980,4	-1670,0	115,2
1068	8274	84781,1	1980,4	-1700,0	115,2

1069	275	84850,4	2009,1	0,0	115,2
1070	1275	84850,4	2009,1	-100,0	115,2
1071	2275	84850,4	2009,1	-1250,0	115,2
1072	3275	84850,4	2009,1	-1600,0	115,2
1073	4275	84850,4	2009,1	-1670,0	115,2
1074	5275	84850,4	2009,1	-1700,0	115,2
1075	6275	84850,4	2009,1	-1740,0	115,2

1076	276	85243,0	2171,7	0,0	114,8
1077	1276	85243,0	2171,7	-100,0	114,8
1078	2276	85243,0	2171,7	-1250,0	114,8
1079	3276	85243,0	2171,7	-1600,0	114,8
1080	4276	85243,0	2171,7	-2100,0	114,8

1081	277	86467,2	2678,8	0,0	113,5
1082	1277	86467,2	2678,8	-100,0	113,5
1083	2277	86467,2	2678,8	-1250,0	113,5
1084	3277	86467,2	2678,8	-1600,0	113,5
1085	4277	86467,2	2678,8	-2100,0	113,5

1086	278	88314,9	3444,1	0,0	111,7
1087	1278	88314,9	3444,1	-100,0	111,7
1088	2278	88314,9	3444,1	-1250,0	111,7
1089	3278	88314,9	3444,1	-2100,0	111,7

1090	279	92010,4	4974,9	0,0	108,0
1091	1279	92010,4	4974,9	-100,0	108,0
1092	2279	92010,4	4974,9	-2100,0	108,0

1093	280	96629,8	6888,3	0,0	103,4
1094	1280	96629,8	6888,3	-100,0	103,4
1095	2280	96629,8	6888,3	-2100,0	103,4

1096	281	62500.0	0.0	0.0	117.5
1097	1281	62500.0	0.0	-100.0	117.5
1098	2281	62500.0	0.0	-300.0	117.5
1099	3281	62500.0	0.0	-500.0	117.5
1100	4281	62500.0	0.0	-700.0	117.5
1101	5281	62500.0	0.0	-1000.0	117.5
1102	6281	62500.0	0.0	-1300.0	117.5
1103	7281	62500.0	0.0	-1670.0	117.5
1104	8281	62500.0	0.0	-1700.0	117.5
1105	282	64000.0	0.0	0.0	116.0
1106	1282	64000.0	0.0	-100.0	116.0
1107	2282	64000.0	0.0	-300.0	116.0
1108	3282	64000.0	0.0	-500.0	116.0
1109	4282	64000.0	0.0	-700.0	116.0
1110	5282	64000.0	0.0	-1000.0	116.0
1111	6282	64000.0	0.0	-1300.0	116.0
1112	7282	64000.0	0.0	-1670.0	116.0
1113	8282	64000.0	0.0	-1700.0	116.0
1114	283	65000.0	0.0	0.0	115.0
1115	1283	65000.0	0.0	-100.0	115.0
1116	2283	65000.0	0.0	-300.0	115.0
1117	3283	65000.0	0.0	-500.0	115.0
1118	4283	65000.0	0.0	-700.0	115.0
1119	5283	65000.0	0.0	-1000.0	115.0
1120	6283	65000.0	0.0	-1300.0	115.0
1121	7283	65000.0	0.0	-1670.0	115.0
1122	8283	65000.0	0.0	-1700.0	115.0
1123	284	65175.0	0.0	0.0	114.8
1124	1284	65175.0	0.0	-100.0	114.8
1125	2284	65175.0	0.0	-300.0	114.8
1126	3284	65175.0	0.0	-500.0	114.8
1127	4284	65175.0	0.0	-700.0	114.8
1128	5284	65175.0	0.0	-1000.0	114.8
1129	6284	65175.0	0.0	-1300.0	114.8
1130	7284	65175.0	0.0	-1670.0	114.8
1131	8284	65175.0	0.0	-1700.0	114.8

1132	285	85250,0	0,0	0,0	114,3
1133	1285	85250,0	0,0	-100,0	114,3
1134	2285	85250,0	0,0	-1250,0	114,3
1135	3285	85250,0	0,0	-1600,0	114,3
1136	4285	85250,0	0,0	-1670,0	114,3
1137	5285	85250,0	0,0	-1700,0	114,3
1138	6285	85250,0	0,0	-1740,0	114,3
1139	286	85675,0	0,0	0,0	114,3
1140	1286	85675,0	0,0	-100,0	114,3
1141	2286	85675,0	0,0	-1250,0	114,3
1142	3286	85675,0	0,0	-1600,0	114,3
1143	4286	85675,0	0,0	-2100,0	114,3
1144	287	87000,0	0,0	0,0	113,0
1145	1287	87000,0	0,0	-100,0	113,0
1146	2287	87000,0	0,0	-1250,0	113,0
1147	3287	87000,0	0,0	-1600,0	113,0
1148	4287	87000,0	0,0	-2100,0	113,0
1149	288	89000,0	0,0	0,0	111,0
1150	1288	89000,0	0,0	-100,0	111,0
1151	2288	89000,0	0,0	-1250,0	111,0
1152	3288	89000,0	0,0	-2100,0	111,0
1153	289	93000,0	0,0	0,0	107,0
1154	1289	93000,0	0,0	-100,0	107,0
1155	2289	93000,0	0,0	-2100,0	107,0
1156	290	98000,0	0,0	0,0	102,0
1157	1290	98000,0	0,0	-100,0	102,0
1158	2290	98000,0	0,0	-2100,0	102,0

TOTAL NODES IN SYSTEM= 1158
NUMBER OF SURFACE NODES 285
MAXIMUM NUMBER ASSIGNED TO THE SURFACE NODE 290

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**********************************************************************************************************
    TOTAL NUMBER OF NODES WITH PRESCRIBED HEAD B.C.ARE=        97
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NODE#     1 HEAD=  200.00 NODE#  1001 HEAD=  200.00 NODE#  2001 HEAD=  200.00 NODE#    21 HEAD=  200.00
NODE#  1021 HEAD=  200.00 NODE#  2021 HEAD=  200.00 NODE#    41 HEAD=  200.00 NODE#  1041 HEAD=  200.00
NODE#  2041 HEAD=  200.00 NODE#    61 HEAD=  200.00 NODE#  1061 HEAD=  200.00 NODE#  2061 HEAD=  200.00
NODE#    81 HEAD=  200.00 NODE#  1081 HEAD=  200.00 NODE#  2081 HEAD=  200.00 NODE#   101 HEAD=  200.00
NODE#  1101 HEAD=  200.00 NODE#  2101 HEAD=  200.00 NODE#   121 HEAD=  200.00 NODE#  1121 HEAD=  200.00
NODE#  2121 HEAD=  200.00 NODE#   141 HEAD=  200.00 NODE#  1141 HEAD=  200.00 NODE#  2141 HEAD=  200.00
NODE#   161 HEAD=  200.00 NODE#  1161 HEAD=  200.00 NODE#  2161 HEAD=  200.00 NODE#   181 HEAD=  200.00
NODE#  1181 HEAD=  200.00 NODE#  2181 HEAD=  200.00 NODE#    20 HEAD=   10.00 NODE#  1020 HEAD=   10.00
NODE#  2020 HEAD=   10.00 NODE#    40 HEAD=   10.00 NODE#  1040 HEAD=   10.00 NODE#  2040 HEAD=   10.00
NODE#    60 HEAD=   10.00 NODE#  1060 HEAD=   10.00 NODE#  2060 HEAD=   10.00 NODE#    80 HEAD=   10.00
NODE#  1080 HEAD=   10.00 NODE#  2080 HEAD=   10.00 NODE#   100 HEAD=   10.00 NODE#  1100 HEAD=   10.00
NODE#  2100 HEAD=   10.00 NODE#   120 HEAD=   10.00 NODE#  1120 HEAD=   10.00 NODE#  2120 HEAD=   10.00
NODE#   140 HEAD=   10.00 NODE#  1140 HEAD=   10.00 NODE#  2140 HEAD=   10.00 NODE#   160 HEAD=   10.00
NODE#  1160 HEAD=   10.00 NODE#  2160 HEAD=   10.00 NODE#   180 HEAD=   10.00 NODE#  1180 HEAD=   10.00
NODE#  2180 HEAD=   10.00 NODE#   200 HEAD=   10.00 NODE#  1200 HEAD=   10.00 NODE#  2200 HEAD=   10.00
NODE#     9 HEAD=  170.00 NODE#   201 HEAD=  170.00 NODE#   202 HEAD=  170.00 NODE#   203 HEAD=  170.00
NODE#   204 HEAD=  170.00 NODE#   211 HEAD=  170.00 NODE#   212 HEAD=  170.00 NODE#   213 HEAD=  170.00
NODE#   214 HEAD=  170.00 NODE#   221 HEAD=  170.00 NODE#   222 HEAD=  170.00 NODE#   223 HEAD=  170.00
NODE#   224 HEAD=  170.00 NODE#   231 HEAD=  170.00 NODE#   232 HEAD=  170.00 NODE#   233 HEAD=  170.00
NODE#   234 HEAD=  170.00 NODE#   241 HEAD=  170.00 NODE#   242 HEAD=  170.00 NODE#   243 HEAD=  170.00
NODE#   244 HEAD=  170.00 NODE#   251 HEAD=  170.00 NODE#   252 HEAD=  170.00 NODE#   253 HEAD=  170.00
NODE#   254 HEAD=  170.00 NODE#   261 HEAD=  170.00 NODE#   262 HEAD=  170.00 NODE#   263 HEAD=  170.00
NODE#   264 HEAD=  170.00 NODE#   271 HEAD=  170.00 NODE#   272 HEAD=  170.00 NODE#   273 HEAD=  170.00
NODE#   274 HEAD=  170.00 NODE#   281 HEAD=  170.00 NODE#   282 HEAD=  170.00 NODE#   283 HEAD=  170.00
NODE#   284 HEAD=  170.00 NODE#

**********************************************************************************************************

ELEM#.   1  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES    7   27   26    6 1007 1027 1026 1006
ELEM#.   2  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   27   47   46   26 1027 1047 1046 1026
ELEM#.   3  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   47   67   66   46 1047 1067 1066 1046
ELEM#.   4  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   67   87   86   66 1067 1087 1086 1066
ELEM#.   5  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   87  107  106   86 1087 1107 1106 1086
ELEM#.   6  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  107  127  126  106 1107 1127 1126 1106
ELEM#.   7  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  127  147  146  126 1127 1147 1146 1126
ELEM#.   8  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  147  167  166  146 1147 1167 1166 1146
ELEM#.   9  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  167  187  186  166 1167 1187 1186 1166
ELEM#.  10  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES    6   26   25    5 1006 1026 1025 1005
ELEM#.  11  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   26   46   45   25 1026 1046 1045 1025
ELEM#.  12  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   46   66   65   45 1046 1066 1065 1045
ELEM#.  13  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   66   86   85   65 1066 1086 1085 1065
ELEM#.  14  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   86  106  105   85 1086 1106 1105 1085
ELEM#.  15  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  106  126  125  105 1106 1126 1125 1105
ELEM#.  16  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  126  146  145  125 1126 1146 1145 1125
ELEM#.  17  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  146  166  165  145 1146 1166 1165 1145
ELEM#.  18  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES  166  186  185  165 1166 1186 1185 1165
ELEM#.  19  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES    5   25   24    4 1005 1025 1024 1004
ELEM#.  20  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   25   45   44   24 1025 1045 1044 1024
ELEM#.  21  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   45   65   64   44 1045 1065 1064 1044
ELEM#.  22  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   65   85   84   64 1065 1085 1084 1064
```

ELEM#,	23	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	85	105	104	84	1085	1105	1104	1084
ELEM#,	24	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	105	125	124	104	1105	1125	1124	1104
ELEM#,	25	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	125	145	144	124	1125	1145	1144	1124
ELEM#,	26	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	145	165	164	144	1145	1165	1164	1144
ELEM#,	27	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	165	185	184	164	1165	1185	1184	1164
ELEM#,	28	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	4	24	23	3	1004	1024	1023	1003
ELEM#,	29	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	24	44	43	23	1024	1044	1043	1023
ELEM#,	30	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	44	64	63	43	1044	1064	1063	1043
ELEM#,	31	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	64	84	83	63	1064	1084	1083	1063
ELEM#,	32	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	84	104	103	83	1084	1104	1103	1083
ELEM#,	33	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	104	124	123	103	1104	1124	1123	1103
ELEM#,	34	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	124	144	143	123	1124	1144	1143	1123
ELEM#,	35	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	144	164	163	143	1144	1164	1163	1143
ELEM#,	36	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	164	184	183	163	1164	1184	1183	1163
ELEM#,	37	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	3	23	22	2	1003	1023	1022	1002
ELEM#,	38	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	23	43	42	22	1023	1043	1042	1022
ELEM#.	39	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	43	63	62	42	1043	1063	1062	1042
ELEM#,	40	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	63	83	82	62	1063	1083	1082	1062
ELEM#,	41	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	83	103	102	82	1083	1103	1102	1082
ELEM#,	42	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	103	123	122	102	1103	1123	1122	1102
ELEM#,	43	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	123	143	142	122	1123	1143	1142	1122
ELEM#,	44	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	143	163	162	142	1143	1163	1162	1142
ELEM#,	45	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	163	183	182	162	1163	1183	1182	1162
ELEM#,	46	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	2	22	21	1	1002	1022	1021	1001
ELEM#,	47	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	22	42	41	21	1022	1042	1041	1021
ELEM#,	48	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	42	62	61	41	1042	1062	1061	1041
ELEM#,	49	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	62	82	81	61	1062	1082	1081	1061
ELEM#,	50	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	82	102	101	81	1082	1102	1101	1081
ELEM#,	51	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	102	122	121	101	1102	1122	1121	1101
ELEM#,	52	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	122	142	141	121	1122	1142	1141	1121
ELEM#,	53	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	142	162	161	141	1142	1162	1161	1141
ELEM#,	54	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	162	182	181	161	1162	1182	1181	1161
ELEM#,	55	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	51	71	70	50	1051	1071	1070	1050
ELEM#,	56	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	71	91	90	70	1071	1091	1090	1070
ELEM#,	57	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	91	111	110	90	1091	1111	1110	1090
ELEM#,	58	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	111	131	130	110	1111	1131	1130	1110
ELEM#,	59	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	131	151	150	130	1131	1151	1150	1130
ELEM#,	60	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	151	171	170	150	1151	1171	1170	1150
ELEM#,	61	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	171	191	190	170	1171	1191	1190	1170
ELEM#,	62	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	50	70	69	49	1050	1070	1069	1049
ELEM#,	63	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	70	90	89	69	1070	1090	1089	1069
ELEM#,	64	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	90	110	109	89	1090	1110	1109	1089
ELEM#,	65	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	110	130	129	109	1110	1130	1129	1109
ELEM#,	66	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	130	150	149	129	1130	1150	1149	1129
ELEM#,	67	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	150	170	169	149	1150	1170	1169	1149
ELEM#,	68	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	170	190	189	169	1170	1190	1189	1169
ELEM#,	69	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	49	69	68	48	1049	1069	1068	1048
ELEM#,	70	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	69	89	88	68	1069	1089	1088	1068
ELEM#,	71	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	89	109	108	88	1089	1109	1108	1088
ELEM#,	72	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	109	129	128	108	1109	1129	1128	1108
ELEM#,	73	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	129	149	148	128	1129	1149	1148	1128
ELEM#,	74	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	149	169	168	148	1149	1169	1168	1148

ELEM#,	75	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	169	189	188	168	1169	1189	1188	1168
ELEM#,	76	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	48	68	67	47	1048	1068	1067	1047
ELEM#,	77	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	68	88	87	67	1068	1088	1087	1067
ELEM#,	78	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	88	108	107	87	1088	1108	1107	1087
ELEM#,	79	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	108	128	127	107	1108	1128	1127	1107
ELEM#,	80	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	128	148	147	127	1128	1148	1147	1127
ELEM#,	81	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	148	168	167	147	1148	1168	1167	1147
ELEM#,	82	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	168	188	187	167	1168	1188	1187	1167
ELEM#,	83	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	20	40	39	19	1020	1040	1039	1019
ELEM#,	84	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	40	60	59	39	1040	1060	1059	1039
ELEM#,	85	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	60	80	79	59	1060	1080	1079	1059
ELEM#,	86	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	80	100	99	79	1080	1100	1099	1079
ELEM#,	87	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	100	120	119	99	1100	1120	1119	1099
ELEM#,	88	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	120	140	139	119	1120	1140	1139	1119
ELEM#,	89	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	140	160	159	139	1140	1160	1159	1139
ELEM#,	90	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	160	180	179	159	1160	1180	1179	1159
ELEM#,	91	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	180	200	199	179	1180	1200	1199	1179
ELEM#,	92	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	19	39	38	18	1019	1039	1038	1018
ELEM#,	93	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	39	59	58	38	1039	1059	1058	1038
ELEM#,	94	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	59	79	78	58	1059	1079	1078	1058
ELEM#,	95	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	79	99	98	78	1079	1099	1098	1078
ELEM#,	96	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	99	119	118	98	1099	1119	1118	1098
ELEM#,	97	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	119	139	138	118	1119	1139	1138	1118
ELEM#,	98	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	139	159	158	138	1139	1159	1158	1138
ELEM#,	99	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	159	179	178	158	1159	1179	1178	1158
ELEM#,	100	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	179	199	198	178	1179	1199	1198	1178
ELEM#,	101	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	18	38	37	17	1018	1038	1037	1017
ELEM#,	102	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	38	58	57	37	1038	1058	1057	1037
ELEM#,	103	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	58	78	77	57	1058	1078	1077	1057
ELEM#,	104	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	78	98	97	77	1078	1098	1097	1077
ELEM#,	105	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	98	118	117	97	1098	1118	1117	1097
ELEM#,	106	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	118	138	137	117	1118	1138	1137	1117
ELEM#,	107	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	138	158	157	137	1138	1158	1157	1137
ELEM#,	108	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	158	178	177	157	1158	1178	1177	1157
ELEM#,	109	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	178	198	197	177	1178	1198	1197	1177
ELEM#,	110	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	17	37	36	16	1017	1037	1036	1016
ELEM#,	111	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	37	57	56	36	1037	1057	1056	1036
ELEM#,	112	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	57	77	76	56	1057	1077	1076	1056
ELEM#,	113	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	77	97	96	76	1077	1097	1096	1076
ELEM#,	114	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	97	117	116	96	1097	1117	1116	1096
ELEM#,	115	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	117	137	136	116	1117	1137	1136	1116
ELEM#,	116	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	137	157	156	136	1137	1157	1156	1136
ELEM#,	117	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	157	177	176	156	1157	1177	1176	1156
ELEM#,	118	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	177	197	196	176	1177	1197	1196	1176
ELEM#,	119	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	16	36	35	15	1016	1036	1035	1015
ELEM#,	120	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	36	56	55	35	1036	1056	1055	1035
ELEM#,	121	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	56	76	75	55	1056	1076	1075	1055
ELEM#,	122	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	76	96	95	75	1076	1096	1095	1075
ELEM#,	123	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	96	116	115	95	1096	1116	1115	1095
ELEM#,	124	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	116	136	135	115	1116	1136	1135	1115
ELEM#,	125	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	136	156	155	135	1136	1156	1155	1135
ELEM#,	126	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	156	176	175	155	1156	1176	1175	1155

ELEM#. 127	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	176	196	195	175	1176	1196	1195	1175
ELEM#. 128	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	15	35	34	14	1015	1035	1034	1014
ELEM#. 129	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	35	55	54	34	1035	1055	1054	1034
ELEM#. 130	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	55	75	74	54	1055	1075	1074	1054
ELEM#. 131	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	75	95	94	74	1075	1095	1094	1074
ELEM#. 132	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	95	115	114	94	1095	1115	1114	1094
ELEM#. 133	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	115	135	134	114	1115	1135	1134	1114
ELEM#. 134	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	135	155	154	134	1135	1155	1154	1134
ELEM#. 135	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	155	175	174	154	1155	1175	1174	1154
ELEM#. 136	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	175	195	194	174	1175	1195	1194	1174
ELEM#. 137	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	14	34	33	13	1014	1034	1033	1013
ELEM#. 138	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	34	54	53	33	1034	1054	1053	1033
ELEM#. 139	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	54	74	73	53	1054	1074	1073	1053
ELEM#. 140	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	74	94	93	73	1074	1094	1093	1073
ELEM#. 141	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	94	114	113	93	1094	1114	1113	1093
ELEM#. 142	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	114	134	133	113	1114	1134	1133	1113
ELEM#. 143	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	134	154	153	133	1134	1154	1153	1133
ELEM#. 144	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	154	174	173	153	1154	1174	1173	1153
ELEM#. 145	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	174	194	193	173	1174	1194	1193	1173
ELEM#. 146	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	13	33	32	12	1013	1033	1032	1012
ELEM#. 147	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	33	53	52	32	1033	1053	1052	1032
ELEM#. 148	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	53	73	72	52	1053	1073	1072	1052
ELEM#. 149	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	73	93	92	72	1073	1093	1092	1072
ELEM#. 150	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	93	113	112	92	1093	1113	1112	1092
ELEM#. 151	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	113	133	132	112	1113	1133	1132	1112
ELEM#. 152	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	133	153	152	132	1133	1153	1152	1132
ELEM#. 153	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	153	173	172	152	1153	1173	1172	1152
ELEM#. 154	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	173	193	192	172	1173	1193	1192	1172
ELEM#. 155	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	12	32	31	11	1012	1032	1031	1011
ELEM#. 156	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	32	52	51	31	1032	1052	1051	1031
ELEM#. 157	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	52	72	71	51	1052	1072	1071	1051
ELEM#. 158	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	72	92	91	71	1072	1092	1091	1071
ELEM#. 159	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	92	112	111	91	1092	1112	1111	1091
ELEM#. 160	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	112	132	131	111	1112	1132	1131	1111
ELEM#. 161	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	132	152	151	131	1132	1152	1151	1131
ELEM#. 162	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	152	172	171	151	1152	1172	1171	1151
ELEM#. 163	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	172	192	191	171	1172	1192	1191	1171
ELEM#. 164	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	281	282	272	271	1281	1282	1272	1271
ELEM#. 165	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	282	283	273	272	1282	1283	1273	1272
ELEM#. 166	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	283	284	274	273	1283	1284	1274	1273
ELEM#. 167	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	284	285	275	274	1284	1285	1275	1274
ELEM#. 168	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	285	286	276	275	1285	1286	1276	1275
ELEM#. 169	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	286	287	277	276	1286	1287	1277	1276
ELEM#. 170	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	287	288	278	277	1287	1288	1278	1277
ELEM#. 171	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	288	289	279	278	1288	1289	1279	1278
ELEM#. 172	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	289	290	280	279	1289	1290	1280	1279
ELEM#. 173	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	271	272	262	261	1271	1272	1262	1261
ELEM#. 174	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	272	273	263	262	1272	1273	1263	1262
ELEM#. 175	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	273	274	264	263	1273	1274	1264	1263
ELEM#. 176	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	274	275	265	264	1274	1275	1265	1264
ELEM#. 177	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	275	276	266	265	1275	1276	1266	1265
ELEM#. 178	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	276	277	267	266	1276	1277	1267	1266
ELEM#. 179	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	277	278	268	267	1277	1278	1268	1267

ELEM#, 180	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	278	279	269	268	1278	1279	1269	1268
ELEM#, 181	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	279	280	270	269	1279	1280	1270	1269
ELEM#, 182	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	261	262	252	251	1261	1262	1252	1251
ELEM#, 183	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	262	263	253	252	1262	1263	1253	1252
ELEM#, 184	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	263	264	254	253	1263	1264	1254	1253
ELEM#, 185	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	264	265	255	254	1264	1265	1255	1254
ELEM#, 186	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	265	266	256	255	1265	1266	1256	1255
ELEM#, 187	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	266	267	257	256	1266	1267	1257	1256
ELEM#, 188	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	267	268	258	257	1267	1268	1258	1257
ELEM#, 189	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	268	269	259	258	1268	1269	1259	1258
ELEM#, 190	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	269	270	260	259	1269	1270	1260	1259
ELEM#, 191	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	251	252	242	241	1251	1252	1242	1241
ELEM#, 192	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	252	253	243	242	1252	1253	1243	1242
ELEM#, 193	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	253	254	244	243	1253	1254	1244	1243
ELEM#, 194	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	254	255	245	244	1254	1255	1245	1244
ELEM#, 195	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	255	256	246	245	1255	1256	1246	1245
ELEM#, 196	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	256	257	247	246	1256	1257	1247	1246
ELEM#, 197	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	257	258	248	247	1257	1258	1248	1247
ELEM#, 198	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	258	259	249	248	1258	1259	1249	1248
ELEM#, 199	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	259	260	250	249	1259	1260	1250	1249
ELEM#, 200	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	241	242	232	231	1241	1242	1232	1231
ELEM#, 201	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	242	243	233	232	1242	1243	1233	1232
ELEM#, 202	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	243	244	234	233	1243	1244	1234	1233
ELEM#, 203	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	244	245	235	234	1244	1245	1235	1234
ELEM#, 204	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	245	246	236	235	1245	1246	1236	1235
ELEM#, 205	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	246	247	237	236	1246	1247	1237	1236
ELEM#, 206	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	247	248	238	237	1247	1248	1238	1237
ELEM#, 207	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	248	249	239	238	1248	1249	1239	1238
ELEM#, 208	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	249	250	240	239	1249	1250	1240	1239
ELEM#, 209	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	231	232	222	221	1231	1232	1222	1221
ELEM#, 210	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	232	233	223	222	1232	1233	1223	1222
ELEM#, 211	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	233	234	224	223	1233	1234	1224	1223
ELEM#, 212	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	234	235	225	224	1234	1235	1225	1224
ELEM#, 213	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	235	236	226	225	1235	1236	1226	1225
ELEM#, 214	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	236	237	227	226	1236	1237	1227	1226
ELEM#, 215	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	237	238	228	227	1237	1238	1228	1227
ELEM#, 216	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	238	239	229	228	1238	1239	1229	1228
ELEM#, 217	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	239	240	230	229	1239	1240	1230	1229
ELEM#, 218	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	221	222	212	211	1221	1222	1212	1211
ELEM#, 219	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	222	223	213	212	1222	1223	1213	1212
ELEM#, 220	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	223	224	214	213	1223	1224	1214	1213
ELEM#, 221	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	224	225	215	214	1224	1225	1215	1214
ELEM#, 222	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	225	226	216	215	1225	1226	1216	1215
ELEM#, 223	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	226	227	217	216	1226	1227	1217	1216
ELEM#, 224	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	227	228	218	217	1227	1228	1218	1217
ELEM#, 225	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	228	229	219	218	1228	1229	1219	1218
ELEM#, 226	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	229	230	220	219	1229	1230	1220	1219
ELEM#, 227	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	211	212	202	201	1211	1212	1202	1201
ELEM#, 228	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	212	213	203	202	1212	1213	1203	1202
ELEM#, 229	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	213	214	204	203	1213	1214	1204	1203
ELEM#, 230	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	214	215	205	204	1214	1215	1205	1204
ELEM#, 231	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	215	216	206	205	1215	1216	1206	1205
ELEM#, 232	ORDERONE	MAT#	1	TOTAL NODES	8	CORNER NODES	216	217	207	206	1216	1217	1207	1206

```
ELEM#, 233  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   217   218   208   207  1217  1218  1208  1207
ELEM#, 234  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   218   219   209   208  1218  1219  1209  1208
ELEM#, 235  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   219   220   210   209  1219  1220  1210  1209
ELEM#, 236  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   210   220    27     7  1210  1220  1027  1007
ELEM#, 237  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   220   230    47    27  1220  1230  1047  1027
ELEM#, 238  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   230   240    48    47  1230  1240  1048  1047
ELEM#, 239  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   240   250    49    48  1240  1250  1049  1048
ELEM#, 240  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   250   260    50    49  1250  1260  1050  1049
ELEM#, 241  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   260   270    51    50  1260  1270  1051  1050
ELEM#, 242  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   290    11    31   280  1290  1011  1031  1280
ELEM#, 243  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES   280    31    51   270  1280  1031  1051  1270
ELEM#, 244  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES     9   221   211   201  1009  1221  1211  1201
ELEM#, 245  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES     9   241   231   221  1009  1241  1231  1221
ELEM#, 246  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES     9   261   251   241  1009  1261  1251  1241
ELEM#, 247  ORDERONE  MAT#  1 TOTAL NODES  8 CORNER NODES     9   281   271   261  1009  1281  1271  1261
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TOTAL NUMBER OF UNKNOWNS ARE=   1061 THESE NODES ARE AS GIVEN BELOW

2	1002	2002	3	1003	2003	4	1004	2004	5	1005	2005	6	1006	2006
7	1007	2007	1009	2009	3009	4009	5009	6009	7009	8009	11	1011	2011	12
1012	2012	13	1013	2013	14	1014	2014	15	1015	2015	16	1016	2016	17
1017	2017	18	1018	2018	19	1019	2019	22	1022	2022	23	1023	2023	24
1024	2024	25	1025	2025	26	1026	2026	27	1027	2027	31	1031	2031	32
1032	2032	33	1033	2033	34	1034	2034	35	1035	2035	36	1036	2036	37
1037	2037	38	1038	2038	39	1039	2039	42	1042	2042	43	1043	2043	44
1044	2044	45	1045	2045	46	1046	2046	47	1047	2047	48	1048	2048	49
1049	2049	50	1050	2050	51	1051	2051	52	1052	2052	53	1053	2053	54
1054	2054	55	1055	2055	56	1056	2056	57	1057	2057	58	1058	2058	59
1059	2059	62	1062	2062	63	1063	2063	64	1064	2064	65	1065	2065	66
1066	2066	67	1067	2067	68	1068	2068	69	1069	2069	70	1070	2070	71
1071	2071	72	1072	2072	73	1073	2073	74	1074	2074	75	1075	2075	76
1076	2076	77	1077	2077	78	1078	2078	79	1079	2079	82	1082	2082	83
1083	2083	84	1084	2084	85	1085	2085	86	1086	2086	87	1087	2087	88
1088	2088	89	1089	2089	90	1090	2090	91	1091	2091	92	1092	2092	93
1093	2093	94	1094	2094	95	1095	2095	96	1096	2096	97	1097	2097	98
1098	2098	99	1099	2099	102	1102	2102	103	1103	2103	104	1104	2104	105
1105	2105	106	1106	2106	107	1107	2107	108	1108	2108	109	1109	2109	110
1110	2110	111	1111	2111	112	1112	2112	113	1113	2113	114	1114	2114	115
1115	2115	116	1116	2116	117	1117	2117	118	1118	2118	119	1119	2119	122
1122	2122	123	1123	2123	124	1124	2124	125	1125	2125	126	1126	2126	127
1127	2127	128	1128	2128	129	1129	2129	130	1130	2130	131	1131	2131	132
1132	2132	133	1133	2133	134	1134	2134	135	1135	2135	136	1136	2136	137
1137	2137	138	1138	2138	139	1139	2139	142	1142	2142	143	1143	2143	144
1144	2144	145	1145	2145	146	1146	2146	147	1147	2147	148	1148	2148	149
1149	2149	150	1150	2150	151	1151	2151	152	1152	2152	153	1153	2153	154
1154	2154	155	1155	2155	156	1156	2156	157	1157	2157	158	1158	2158	159
1159	2159	162	1162	2162	163	1163	2163	164	1164	2164	165	1165	2165	166
1166	2166	167	1167	2167	168	1168	2168	169	1169	2169	170	1170	2170	171
1171	2171	172	1172	2172	173	1173	2173	174	1174	2174	175	1175	2175	176

1176	2176	177	1177	2177	178	1178	2178	179	1179	2179	182	1182	2182	183
1183	2183	184	1184	2184	185	1185	2185	186	1186	2186	187	1187	2187	188
1188	2188	189	1189	2189	190	1190	2190	191	1191	2191	192	1192	2192	193
1193	2193	194	1194	2194	195	1195	2195	196	1196	2196	197	1197	2197	198
1198	2198	199	1199	2199	1201	2201	3201	4201	5201	6201	7201	8201	1202	2202
3202	4202	5202	6202	7202	8202	1203	2203	3203	4203	5203	6203	7203	8203	1204
2204	3204	4204	5204	6204	7204	8204	205	1205	2205	3205	4205	5205	6205	206
1206	2206	3206	4206	207	1207	2207	3207	4207	208	1208	2208	3208	209	1209
2209	210	1210	2210	1211	2211	3211	4211	5211	6211	7211	8211	1212	2212	3212
4212	5212	6212	7212	8212	1213	2213	3213	4213	5213	6213	7213	8213	1214	2214
3214	4214	5214	6214	7214	8214	215	1215	2215	3215	4215	5215	6215	216	1216
2216	3216	4216	217	1217	2217	3217	4217	218	1218	2218	3218	219	1219	2219
220	1220	2220	1221	2221	3221	4221	5221	6221	7221	8221	1222	2222	3222	4222
5222	6222	7222	8222	1223	2223	3223	4223	5223	6223	7223	8223	1224	2224	3224
4224	5224	6224	7224	8224	225	1225	2225	3225	4225	5225	6225	226	1226	2226
3226	4226	227	1227	2227	3227	4227	228	1228	2228	3228	229	1229	2229	230
1230	2230	1231	2231	3231	4231	5231	6231	7231	8231	1232	2232	3232	4232	5232
6232	7232	8232	1233	2233	3233	4233	5233	6233	7233	8233	1234	2234	3234	4234
5234	6234	7234	8234	235	1235	2235	3235	4235	5235	6235	236	1236	2236	3236
4236	237	1237	2237	3237	4237	238	1238	2238	3238	239	1239	2239	240	1240
2240	1241	2241	3241	4241	5241	6241	7241	8241	1242	2242	3242	4242	5242	6242
7242	8242	1243	2243	3243	4243	5243	6243	7243	8243	1244	2244	3244	4244	5244
6244	7244	8244	245	1245	2245	3245	4245	5245	6245	246	1246	2246	3246	4246
247	1247	2247	3247	4247	248	1248	2248	3248	249	1249	2249	250	1250	2250
1251	2251	3251	4251	5251	6251	7251	8251	1252	2252	3252	4252	5252	6252	7252
8252	1253	2253	3253	4253	5253	6253	7253	8253	1254	2254	3254	4254	5254	6254
7254	8254	255	1255	2255	3255	4255	5255	6255	256	1256	2256	3256	4256	257
1257	2257	3257	4257	258	1258	2258	3258	259	1259	2259	260	1260	2260	1261
2261	3261	4261	5261	6261	7261	8261	1262	2262	3262	4262	5262	6262	7262	8262
1263	2263	3263	4263	5263	6263	7263	8263	1264	2264	3264	4264	5264	6264	7264
8264	265	1265	2265	3265	4265	5265	6265	266	1266	2266	3266	4266	267	1267
2267	3267	4267	268	1268	2268	3268	269	1269	2269	270	1270	2270	1271	2271
3271	4271	5271	6271	7271	8271	1272	2272	3272	4272	5272	6272	7272	8272	1273
2273	3273	4273	5273	6273	7273	8273	1274	2274	3274	4274	5274	6274	7274	8274
275	1275	2275	3275	4275	5275	6275	276	1276	2276	3276	4276	277	1277	2277
3277	4277	278	1278	2278	3278	279	1279	2279	280	1280	2280	1281	2281	3281
4281	5281	6281	7281	8281	1282	2282	3282	4282	5282	6282	7282	8282	1283	2283
3283	4283	5283	6283	7283	8283	1284	2284	3284	4284	5284	6284	7284	8284	285
1285	2285	3285	4285	5285	6285	286	1286	2286	3286	4286	287	1287	2287	3287
4287	288	1288	2288	3288	289	1289	2289	290	1290	2290				

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DIMENSIONS IN OTHER PROGRAMS HAVE TO BE SET FOR FOLLOWING MAXIMUM VALUES
                 TOTAL NUMBER OF SURFACE NODES(NTSURF)=                        285
                 MAXIMUM NUMBER ASSIGNED TO SURFACE NODES(LNPT)=               290
                 TOTAL NODES IN THE SYSTEM (NTT)=                             1158

        THE FOLLOWING PARAMETERS ARE RELATED TO B.C
                 TOTAL NUMBER OF POTENTIAL B.C. PRESCRIBED (NBPTC)=             97
                 TOTAL NUMBER OF FLUX B.C. PRESCRIBED (NBFPTC)=                  0
                 TOTAL NUMBER OF STREAMS  B.C. PRESCRIBED (NSTREM)=              0

        THE FOLLOWING TWO PARAMETERS ARE RELATED TO STIFFNESS MATRIX
                 TOTAL NUMBER OF UNKNOWN(NPT)=                                1061
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THE FOLLOWING PARAMETERS ARE ASSOCIATED WITH ELEMENTS
        TOTAL NUMBER OF SURFACE ELEMENTS(NESURF) =                          247

        MAXIMUM NUMBER ASSIGNED TO SURFACE ELEMENT(NSELEM)=                 247
        TOTAL NUMBER OF ELEMENTS(NELEM) =                                   782
        MAXIMUM NUMBER OF NODES IN ANY ELEMENT(NODMAX)=                       8
        MAXIMUM  NON-ZERO NODES IN ANY ELEMENTS(NONZER) =                     8

THE FOLLOWING IS RELATED TO MATERIAL NUMBER ASSIGNED
        MAXIMUM NUMBER ASSIGNED TO MATERIAL(MATN) =                           8

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TIME= 06:21:39    DATE= 22-AUG-79
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APPENDIX I.7: NEWMAT-OUTPUT

Material number associated with each element. All the elements below 164, 165, 166, 173, 174, 175, 182, 183, 184, 191, 192, 193, 200, 201, 202, 209, 210, 211, 218, 219, 220, 227, 228, 229, 244, 245, 246, and 247, surface elements are associated with the collapsed region and, therefore, are assigned material number 8, which has twice the hydraulic conductivity as that of the Wilcox aquifer.

MATERIAL NUMBER AS READ

1	1	1001	2	2	1	1002	2	3	1	1003	2	4	1	1004	2	5	1	1005	2
6	1	1006	2	7	1	1007	2	8	1	1008	2	9	1	1009	2	10	1	1010	2
11	1	1011	2	12	1	1012	2	13	1	1013	2	14	1	1014	2	15	1	1015	2
16	1	1016	2	17	1	1017	2	18	1	1018	2	19	1	1019	2	20	1	1020	2
21	1	1021	2	22	1	1022	2	23	1	1023	2	24	1	1024	2	25	1	1025	2
26	1	1026	2	27	1	1027	2	28	1	1028	2	29	1	1029	2	30	1	1030	2
31	1	1031	2	32	1	1032	2	33	1	1033	2	34	1	1034	2	35	1	1035	2
36	1	1036	2	37	1	1037	2	38	1	1038	2	39	1	1039	2	40	1	1040	2
41	1	1041	2	42	1	1042	2	43	1	1043	2	44	1	1044	2	45	1	1045	2
46	1	1046	2	47	1	1047	2	48	1	1048	2	49	1	1049	2	50	1	1050	2
51	1	1051	2	52	1	1052	2	53	1	1053	2	54	1	1054	2	55	1	1055	2
56	1	1056	2	57	1	1057	2	58	1	1058	2	59	1	1059	2	60	1	1060	2
61	1	1061	2	62	1	1062	2	63	1	1063	2	64	1	1064	2	65	1	1065	2
66	1	1066	2	67	1	1067	2	68	1	1068	2	69	1	1069	2	70	1	1070	2
71	1	1071	2	72	1	1072	2	73	1	1073	2	74	1	1074	2	75	1	1075	2
76	1	1076	2	77	1	1077	2	78	1	1078	2	79	1	1079	2	80	1	1080	2
81	1	1081	2	82	1	1082	2	83	1	1083	2	84	1	1084	2	85	1	1085	2
86	1	1086	2	87	1	1087	2	88	1	1088	2	89	1	1089	2	90	1	1090	2
91	1	1091	2	92	1	1092	2	93	1	1093	2	94	1	1094	2	95	1	1095	2
96	1	1096	2	97	1	1097	2	98	1	1098	2	99	1	1099	2	100	1	1100	2
101	1	1101	2	102	1	1102	2	103	1	1103	2	104	1	1104	2	105	1	1105	2
106	1	1106	2	107	1	1107	2	108	1	1108	2	109	1	1109	2	110	1	1110	2
111	1	1111	2	112	1	1112	2	113	1	1113	2	114	1	1114	2	115	1	1115	2
116	1	1116	2	117	1	1117	2	118	1	1118	2	119	1	1119	2	120	1	1120	2
121	1	1121	2	122	1	1122	2	123	1	1123	2	124	1	1124	2	125	1	1125	2
126	1	1126	2	127	1	1127	2	128	1	1128	2	129	1	1129	2	130	1	1130	2
131	1	1131	2	132	1	1132	2	133	1	1133	2	134	1	1134	2	135	1	1135	2
136	1	1136	2	137	1	1137	2	138	1	1138	2	139	1	1139	2	140	1	1140	2
141	1	1141	2	142	1	1142	2	143	1	1143	2	144	1	1144	2	145	1	1145	2
146	1	1146	2	147	1	1147	2	148	1	1148	2	149	1	1149	2	150	1	1150	2
151	1	1151	2	152	1	1152	2	153	1	1153	2	154	1	1154	2	155	1	1155	2
156	1	1156	2	157	1	1157	2	158	1	1158	2	159	1	1159	2	160	1	1160	2
161	1	1161	2	162	1	1162	2	163	1	1163	2	164	8	1164	8	2164	8	3164	8
4164	8	5164	8	6164	8	7164	8	165	8	1165	8	2165	8	3165	8	4165	8	5165	8
6165	8	7165	8	166	8	1166	8	2166	8	3166	8	4166	8	5166	8	6166	8	7166	8
167	1	1167	2	2167	3	3167	4	4167	5	5167	6	6167	7	7167	8	168	1	1168	2
2168	3	3168	4	4168	5	5168	6	169	1	1169	2	2169	3	3169	4	170	1	1170	2
2170	3	3170	4	171	1	1171	2	2171	3	172	1	1172	2	173	8	1173	8	2173	8

3173	8	4173	8	5173	8	6173	8	7173	8	174	8	1174	8	2174	8	3174	80	4174	8
5174	8	6174	8	7174	8	175	8	1175	8	2175	8	3175	8	4175	8	5175	8	6175	8
7175	8	176	1	1176	2	2176	3	3176	4	4176	5	5176	6	6176	7	7176	8	177	1
1177	2	2177	3	3177	4	4177	5	5177	6	178	1	1178	2	2178	3	3178	4	179	1
1179	2	2179	3	3179	4	180	1	1180	2	2180	3	181	1	1181	2	182	8	1182	8
2182	8	3182	8	4182	8	5182	8	6182	8	7182	8	183	8	1183	8	2183	8	3183	8
4183	8	5183	8	6183	8	7183	8	184	8	1184	8	2184	8	3184	8	4184	8	5184	8
6184	8	7184	8	185	1	1185	2	2185	3	3185	4	4185	5	5185	6	6185	7	7185	8
186	1	1186	2	2186	3	3186	4	4186	5	5186	6	187	1	1187	2	2187	3	3187	4
188	1	1188	2	2188	3	3188	4	189	1	1189	2	2189	3	190	1	1190	2	191	8
1191	8	2191	8	3191	8	4191	8	5191	8	6191	8	7191	8	192	8	1192	8	2192	8
3192	8	4192	8	5192	8	6192	8	7192	8	193	8	1193	8	2193	8	3193	8	4193	8
5193	8	6193	8	7193	8	194	1	1194	2	2194	3	3194	4	4194	5	5194	6	6194	7
7194	8	195	1	1195	2	2195	3	3195	4	4195	5	5195	6	196	1	1196	2	2196	3
3196	4	197	1	1197	2	2197	3	3197	4	198	1	1198	2	2198	3	199	1	1199	2
200	8	1200	8	2200	8	3200	8	4200	8	5200	8	6200	8	7200	8	201	8	1201	8
2201	8	3201	8	4201	8	5201	8	6201	8	7201	8	202	8	1202	8	2202	8	3202	8
4202	8	5202	8	6202	8	7202	8	203	1	1203	2	2203	3	3203	4	4203	5	5203	6
6203	7	7203	8	204	1	1204	2	2204	3	3204	4	4204	5	5204	6	205	1	1205	2
2205	3	3205	4	206	1	1206	2	2206	3	3206	4	207	1	1207	2	2207	3	208	1
1208	2	209	8	1209	8	2209	8	3209	8	4209	8	5209	8	6209	8	7209	8	210	8
1210	8	2210	8	3210	8	4210	8	5210	8	6210	8	7210	8	211	8	1211	8	2211	8

3211	8	4211	8	5211	8	6211	8	7211	8	212	1	1212	2	2212	3	3212	4	4212	5
5212	6	6212	7	7212	8	213	1	1213	2	2213	3	3213	4	4213	5	5213	6	214	1
1214	2	2214	3	3214	4	215	1	1215	2	2215	3	3215	4	216	1	1216	2	2216	3
217	1	1217	2	218	8	1218	8	2218	8	3218	8	4218	8	5218	8	6218	8	7218	8
219	8	1219	8	2219	8	3219	8	4219	8	5219	8	6219	8	7219	8	220	8	1220	8
2220	8	3220	8	4220	8	5220	8	6220	8	7220	8	221	1	1221	2	2221	3	3221	4
4221	5	5221	6	6221	7	7221	8	222	1	1222	2	2222	3	3222	4	4222	5	5222	6
223	1	1223	2	2223	3	3223	4	224	1	1224	2	2224	3	3224	4	225	1	1225	2
2225	3	226	1	1226	2	227	8	1227	8	2227	8	3227	8	4227	8	5227	8	6227	8
7227	8	228	8	1228	8	2228	8	3228	8	4228	8	5228	8	6228	8	7228	8	229	8
1229	8	2229	8	3229	8	4229	8	5229	8	6229	8	7229	8	230	1	1230	2	2230	3
3230	4	4230	5	5230	6	6230	7	7230	8	231	1	1231	2	2231	3	3231	4	4231	5
5231	6	232	1	1232	2	2232	3	3232	4	233	1	1233	2	2233	3	3233	4	234	1
1234	2	2234	3	235	1	1235	2	236	1	1236	2	237	1	1237	2	238	1	1238	2
239	1	1239	2	240	1	1240	2	241	1	1241	2	242	1	1242	2	243	1	1243	2
244	8	1244	8	2244	8	3244	8	4244	8	5244	8	6244	8	7244	8	245	8	1245	8
2245	8	3245	8	4245	8	5245	8	6245	8	7245	8	246	8	1246	8	2246	8	3246	8
4246	8	5246	8	6246	8	7246	8	247	8	1247	8	2247	8	3247	8	4247	8	5247	8
6247	8	7247	8																

APPENDIX I.8: PROG2-OUTPUT

Horizontal area and volume of the surface elements used for determination of flow after salt dome collapse.

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TIME= 14:56:05     DATE= 21-AUG-79
*****************************************************************************************************
        THESE DATA ARE PRINTED FOR INFORMATION OF USER TO MODIFY DIMENSIONS IF REQUIRED

        SECONDLY IF DIMENSIONS ARE NOT ADEQUATE THE PROGRAM IS STOPPED

             COORDINATES READ AT A TIME ARE=          256WHILE PROGRAM IS  DIMENSIONED FOR         256 NODES

             MAXIMUM # OF NODES IN ELEM, ARE=           8 WHILE THE PROGRAM IS DIMENSIONED FOR      40

             MAXIMUM NON-ZERO NODES IN ELEM,ARE=        8 WHILE THE PROGRAM IS DIMENSIONED FOR      25

             MAXIMUM SINK OR SOURCE IN A ELEM, ARE      0 DIMENSIONED FOR                           10

    PLEASE NOTE-NOTE-IMPORTANT*****THE ABOVE INFORMATION ON DIMENSION PROVISION ARE TRUE ONLY IF REPEAT IF
                                   THE VALUES OF NTT, NODMAX, NONZER, AND NON ARE UPDATED

*****************************************************************************************************

NE    1 NN  8 NOD    4   21   20    3 1004 1021 1020 1003
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    1                25000000.  *AREA AND VOL = 0.250E+10
XIJCON FOR ELEMENT    1
 1  0.12      2  0.12      3  0.12      4  0.12      5  0.12      6  0.12      7  0.12      8  0.12
NE 1001 NN  8 NOD 1004 1021 1020 1003 2004 2021 2020 2003
NE    2 NN  8 NOD   21   38   37   20 1021 1038 1037 1020
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    2                25000002.  *AREA AND VOL = 0.250E+10
NE 1002 NN  8 NOD 1021 1038 1037 1020 2021 2038 2037 2020
NE    3 NN  8 NOD   38   55   54   37 1038 1055 1054 1037
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    3                25000000.  *AREA AND VOL = 0.250E+10
NE 1003 NN  8 NOD 1038 1055 1054 1037 2038 2055 2054 2037
NE    4 NN  8 NOD   55   72   71   54 1055 1072 1071 1054
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    4                25000000.  *AREA AND VOL = 0.250E+10
NE 1004 NN  8 NOD 1055 1072 1071 1054 2055 2072 2071 2054
NE    5 NN  8 NOD   72   89   88   71 1072 1089 1088 1071
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    5                25000002.  *AREA AND VOL = 0.250E+10
NE 1005 NN  8 NOD 1072 1089 1088 1071 2072 2089 2088 2071
NE    6 NN  8 NOD   89  106  105   88 1089 1106 1105 1088
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    6                25000000.  *AREA AND VOL = 0.250E+10
NE 1006 NN  8 NOD 1089 1106 1105 1088 2089 2106 2105 2088
NE    7 NN  8 NOD  106  123  122  105 1106 1123 1122 1105
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    7                25000000.  *AREA AND VOL = 0.250E+10
NE 1007 NN  8 NOD 1106 1123 1122 1105 2106 2123 2122 2105
NE    8 NN  8 NOD    3   20   19    2 1003 1020 1019 1002
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    8                25000000.  *AREA AND VOL = 0.250E+10
NE 1008 NN  8 NOD 1003 1020 1019 1002 2003 2020 2019 2002
NE    9 NN  8 NOD   20   37   36   19 1020 1037 1036 1019
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    9                25000002.  *AREA AND VOL = 0.250E+10
NE 1009 NN  8 NOD 1020 1037 1036 1019 2020 2037 2036 2019
NE   10 NN  8 NOD   37   54   53   36 1037 1054 1053 1036
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   10                25000000.  *AREA AND VOL = 0.250E+10
NE 1010 NN  8 NOD 1037 1054 1053 1036 2037 2054 2053 2036
NE   11 NN  8 NOD   54   71   70   53 1054 1071 1070 1053
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   11                25000004.  *AREA AND VOL = 0.250E+10
NE 1011 NN  8 NOD 1054 1071 1070 1053 2054 2071 2070 2053
NE   12 NN  8 NOD   71   88   87   70 1071 1088 1087 1070
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   12                25000006.  *AREA AND VOL = 0.250E+10
NE 1012 NN  8 NOD 1071 1088 1087 1070 2071 2088 2087 2070
NE   13 NN  8 NOD   88  105  104   87 1088 1105 1104 1087
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   13                25000000.  *AREA AND VOL = 0.250E+10
NE 1013 NN  8 NOD 1088 1105 1104 1087 2088 2105 2104 2087
NE   14 NN  8 NOD  105  122  121  104 1105 1122 1121 1104
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   14                25000000.  *AREA AND VOL = 0.250E+10
NE 1014 NN  8 NOD 1105 1122 1121 1104 2105 2122 2121 2104
NE   15 NN  8 NOD    2   19   18    1 1002 1019 1018 1001
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   15                25000000.  *AREA AND VOL = 0.250E+10
NE 1015 NN  8 NOD 1002 1019 1018 1001 2002 2019 2018 2001
NE   16 NN  8 NOD   19   36   35   18 1019 1036 1035 1018
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   16                25000002.  *AREA AND VOL = 0.250E+10
NE 1016 NN  8 NOD 1019 1036 1035 1018 2019 2036 2035 2018
NE   17 NN  8 NOD   36   53   52   35 1036 1053 1052 1035
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   17                25000000.  *AREA AND VOL = 0.250E+10
NE 1017 NN  8 NOD 1036 1053 1052 1035 2036 2053 2052 2035
NE   18 NN  8 NOD   53   70   69   52 1053 1070 1069 1052
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   18                25000002.  *AREA AND VOL = 0.250E+10
NE 1018 NN  8 NOD 1053 1070 1069 1052 2053 2070 2069 2052
NE   19 NN  8 NOD   70   87   86   69 1070 1087 1086 1069
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   19                25000004.  *AREA AND VOL = 0.250E+10
NE 1019 NN  8 NOD 1070 1087 1086 1069 2070 2087 2086 2069
NE   20 NN  8 NOD   87  104  103   86 1087 1104 1103 1086
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   20                25000000.  *AREA AND VOL = 0.250E+10
NE 1020 NN  8 NOD 1087 1104 1103 1086 2087 2104 2103 2086
NE   21 NN  8 NOD  104  121  120  103 1104 1121 1120 1103
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   21                25000000.  *AREA AND VOL = 0.250E+10
NE 1021 NN  8 NOD 1104 1121 1120 1103 2104 2121 2120 2103
NE   22 NN  8 NOD   42   59   58   41 1042 1059 1058 1041
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   22                25000002.  *AREA AND VOL = 0.250E+10
NE 1022 NN  8 NOD 1042 1059 1058 1041 2042 2059 2058 2041
NE   23 NN  8 NOD   59   76   75   58 1059 1076 1075 1058
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ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    23          25000002.  *AREA AND VOL = 0.250E+10
NE 1023 NN   8 NOD 1059 1076 1075 1058 2059 2076 2075 2058
NE   24 NN   8 NOD   76   93   92   75 1076 1093 1092 1075
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    24          25000024.  *AREA AND VOL = 0.250E+10
NE 1024 NN   8 NOD 1076 1093 1092 1075 2076 2093 2092 2075
NE   25 NN   8 NOD   93  110  109   92 1093 1110 1109 1092
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    25          25000000.  *AREA AND VOL = 0.250E+10
NE 1025 NN   8 NOD 1093 1110 1109 1092 2093 2110 2109 2092
NE   26 NN   8 NOD  110  127  126  109 1110 1127 1126 1109
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    26          25000000.  *AREA AND VOL = 0.250E+10
NE 1026 NN   8 NOD 1110 1127 1126 1109 2110 2127 2126 2109
NE   27 NN   8 NOD   41   58   57   40 1041 1058 1057 1040
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    27          24999998.  *AREA AND VOL = 0.250E+10
NE 1027 NN   8 NOD 1041 1058 1057 1040 2041 2058 2057 2040
NE   28 NN   8 NOD   58   75   74   57 1058 1075 1074 1057
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    28          25000000.  *AREA AND VOL = 0.250E+10
NE 1028 NN   8 NOD 1058 1075 1074 1057 2058 2075 2074 2057
NE   29 NN   8 NOD   75   92   91   74 1075 1092 1091 1074
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    29          25000002.  *AREA AND VOL = 0.250E+10
NE 1029 NN   8 NOD 1075 1092 1091 1074 2075 2092 2091 2074
NE   30 NN   8 NOD   92  109  108   91 1092 1109 1108 1091
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    30          25000000.  *AREA AND VOL = 0.250E+10
NE 1030 NN   8 NOD 1092 1109 1108 1091 2092 2109 2108 2091
NE   31 NN   8 NOD  109  126  125  108 1109 1126 1125 1108
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    31          25000000.  *AREA AND VOL = 0.250E+10
NE 1031 NN   8 NOD 1109 1126 1125 1108 2109 2126 2125 2108
NE   32 NN   8 NOD   40   57   56   39 1040 1057 1056 1039
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    32          24999998.  *AREA AND VOL = 0.250E+10
NE 1032 NN   8 NOD 1040 1057 1056 1039 2040 2057 2056 2039
NE   33 NN   8 NOD   57   74   73   56 1057 1074 1073 1056
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    33          25000000.  *AREA AND VOL = 0.250E+10
NE 1033 NN   8 NOD 1057 1074 1073 1056 2057 2074 2073 2056
NE   34 NN   8 NOD   74   91   90   73 1074 1091 1090 1073
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    34          25000002.  *AREA AND VOL = 0.250E+10
NE 1034 NN   8 NOD 1074 1091 1090 1073 2074 2091 2090 2073
NE   35 NN   8 NOD   91  108  107   90 1091 1108 1107 1090
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    35          24999996.  *AREA AND VOL = 0.250E+10
NE 1035 NN   8 NOD 1091 1108 1107 1090 2091 2108 2107 2090
NE   36 NN   8 NOD  108  125  124  107 1108 1125 1124 1107
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    36          24999998.  *AREA AND VOL = 0.250E+10
NE 1036 NN   8 NOD 1108 1125 1124 1107 2108 2125 2124 2107
NE   37 NN   8 NOD   39   56   55   38 1039 1056 1055 1038
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    37          25000000.  *AREA AND VOL = 0.250E+10
NE 1037 NN   8 NOD 1039 1056 1055 1038 2039 2056 2055 2038
NE   38 NN   8 NOD   56   73   72   55 1056 1073 1072 1055
ESTIMATION OF RAURSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    38          25000002.  *AREA AND VOL = 0.250E+10
NE 1038 NN   8 NOD 1056 1073 1072 1055 2056 2073 2072 2055
NE   39 NN   8 NOD   73   90   89   72 1073 1090 1089 1072
ESTIMATION OF RAURSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    39          25000004.  *AREA AND VOL = 0.250E+10
NE 1039 NN   8 NOD 1073 1090 1089 1072 2073 2090 2089 2072
NE   40 NN   8 NOD   90  107  106   89 1090 1107 1106 1089
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    40          25000000.  *AREA AND VOL = 0.250E+10
NE 1040 NN   8 NOD 1090 1107 1106 1089 2090 2107 2106 2089
NE   41 NN   8 NOD  107  124  123  106 1107 1124 1123 1106
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    41          25000000.  *AREA AND VOL = 0.250E+10
NE 1041 NN   8 NOD 1107 1124 1123 1106 2107 2124 2123 2106
NE   42 NN   8 NOD   17   34   33   16 1017 1034 1033 1016
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    42          25000016.  *AREA AND VOL = 0.250E+10
NE 1042 NN   8 NOD 1017 1034 1033 1016 2017 2034 2033 2016
NE   43 NN   8 NOD   34   51   50   33 1034 1051 1050 1033
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    43          25000010.  *AREA AND VOL = 0.250E+10
NE 1043 NN   8 NOD 1034 1051 1050 1033 2034 2051 2050 2033
NE   44 NN   8 NOD   51   68   67   50 1051 1068 1067 1050
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    44          25000016.  *AREA AND VOL = 0.250E+10
NE 1044 NN   8 NOD 1051 1068 1067 1050 2051 2068 2067 2050
NE   45 NN   8 NOD   68   85   84   67 1068 1085 1084 1067
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    45          25000010.  *AREA AND VOL = 0.250E+10
NE 1045 NN   8 NOD 1068 1085 1084 1067 2068 2085 2084 2067
NE   46 NN   8 NOD   85  102  101   84 1085 1102 1101 1084
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    46          25000020.  *AREA AND VOL = 0.250E+10
NE 1046 NN   8 NOD 1085 1102 1101 1084 2085 2102 2101 2084
NE   47 NN   8 NOD  102  119  118  101 1102 1119 1118 1101
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    47          25000014.  *AREA AND VOL = 0.250E+10
NE 1047 NN   8 NUD 1102 1119 1118 1101 2102 2119 2118 2101
NE   48 NN   8 NOD  119  136  135  118 1119 1136 1135 1118
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    48          25000016.  *AREA AND VOL = 0.250E+10
NE 1048 NN   8 NOD 1119 1136 1135 1118 2119 2136 2135 2118
NE   49 NN   8 NOD   16   33   32   15 1016 1033 1032 1015
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    49          25000002.  *AREA AND VOL = 0.250E+10
NE 1049 NN   8 NOD 1016 1033 1032 1015 2016 2033 2032 2015
NE   50 NN   8 NOD   33   50   49   32 1033 1050 1049 1032
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    50          25000004.  *AREA AND VOL = 0.250E+10
NE 1050 NN   8 NOD 1033 1050 1049 1032 2033 2050 2049 2032
NE   51 NN   8 NOD   50   67   66   49 1050 1067 1066 1049
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    51          25000002.  *AREA AND VOL = 0.250E+10
NE 1051 NN   8 NOD 1050 1067 1066 1049 2050 2067 2066 2049
NE   52 NN   8 NOD   67   84   83   66 1067 1084 1083 1066
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    52          25000004.  *AREA AND VOL = 0.250E+10
NE 1052 NN   8 NOD 1067 1084 1083 1066 2067 2084 2083 2066
NE   53 NN   8 NOD   84  101  100   83 1084 1101 1100 1083
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#    53          25000006.  *AREA AND VOL = 0.250E+10
NE 1053 NN   8 NOD 1084 1101 1100 1083 2084 2101 2100 2083
NE   54 NN   8 NOD  101  118  117  100 1101 1118 1117 1100
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ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   54        25000002.  *AREA AND VOL = 0.250E+10
NE 1054 NN  8 NOD 1101 1118 1117 1100 2101 2118 2117 2100
NE   55 NN  8 NOD  118  135  134  117 1118 1135 1134 1117
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   55        25000002.  *AREA AND VOL = 0.250E+10
NE 1055 NN  8 NOD 1118 1135 1134 1117 2118 2135 2134 2117
NE   56 NN  8 NOD   15   32   31   14 1015 1032 1031 1014

ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   56        25000002.  *AREA AND VOL = 0.250E+10
NE 1056 NN  8 NOD 1015 1032 1031 1014 2015 2032 2031 2014
NE   57 NN  8 NOD   32   49   48   31 1032 1049 1048 1031
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   57        25000004.  *AREA AND VOL = 0.250E+10
NE 1057 NN  8 NOD 1032 1049 1048 1031 2032 2049 2048 2031
NE   58 NN  8 NOD   49   66   65   48 1049 1066 1065 1048
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   58        25000002.  *AREA AND VOL = 0.250E+10
NE 1058 NN  8 NOD 1049 1066 1065 1048 2049 2066 2065 2048
NE   59 NN  8 NOD   66   83   82   65 1066 1083 1082 1065
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   59        25000004.  *AREA AND VOL = 0.250E+10
NE 1059 NN  8 NOD 1066 1083 1082 1065 2066 2083 2082 2065
NE   60 NN  8 NOD   83  100   99   82 1083 1100 1099 1082
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   60        25000006.  *AREA AND VOL = 0.250E+10
NE 1060 NN  8 NOD 1083 1100 1099 1082 2083 2100 2099 2082
NE   61 NN  8 NOD  100  117  116   99 1100 1117 1116 1099
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   61        25000002.  *AREA AND VOL = 0.250E+10
NE 1061 NN  8 NOD 1100 1117 1116 1099 2100 2117 2116 2099
NE   62 NN  8 NOD  117  134  133  116 1117 1134 1133 1116
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   62        25000002.  *AREA AND VOL = 0.250E+10
NE 1062 NN  8 NOD 1117 1134 1133 1116 2117 2134 2133 2116
NE   63 NN  8 NOD   14   31   30   13 1014 1031 1030 1013
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   63        25000000.  *AREA AND VOL = 0.250E+10
NE 1063 NN  8 NOD 1014 1031 1030 1013 2014 2031 2030 2013
NE   64 NN  8 NOD   31   48   47   30 1031 1048 1047 1030
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   64        25000002.  *AREA AND VOL = 0.250E+10
NE 1064 NN  8 NOD 1031 1048 1047 1030 2031 2048 2047 2030
NE   65 NN  8 NOD   48   65   64   47 1048 1065 1064 1047
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   65        25000000.  *AREA AND VOL = 0.250E+10
NE 1065 NN  8 NOD 1048 1065 1064 1047 2048 2065 2064 2047
NE   66 NN  8 NOD   65   82   81   64 1065 1082 1081 1064
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   66        25000002.  *AREA AND VOL = 0.250E+10
NE 1066 NN  8 NOD 1065 1082 1081 1064 2065 2082 2081 2064
NE   67 NN  8 NOD   82   99   98   81 1082 1099 1098 1081
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   67        25000004.  *AREA AND VOL = 0.250E+10
NE 1067 NN  8 NOD 1082 1099 1098 1081 2082 2099 2098 2081
NE   68 NN  8 NOD   99  116  115   98 1099 1116 1115 1098
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   68        25000000.  *AREA AND VOL = 0.250E+10
NE 1068 NN  8 NOD 1099 1116 1115 1098 2099 2116 2115 2098
NE   69 NN  8 NOD  116  133  132  115 1116 1133 1132 1115
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   69        25000000.  *AREA AND VOL = 0.250E+10
NE 1069 NN  8 NOD 1116 1133 1132 1115 2116 2133 2132 2115
NE   70 NN  8 NOD   13   30   29   12 1013 1030 1029 1012
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   70        24999998.  *AREA AND VOL = 0.250E+10
NE 1070 NN  8 NOD 1013 1030 1029 1012 2013 2030 2029 2012
NE   71 NN  8 NOD   30   47   46   29 1030 1047 1046 1029
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   71        25000000.  *AREA AND VOL = 0.250E+10
NE 1071 NN  8 NOD 1030 1047 1046 1029 2030 2047 2046 2029
NE   72 NN  8 NOD   47   64   63   46 1047 1064 1063 1046
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   72        24999996.  *AREA AND VOL = 0.250E+10
NE 1072 NN  8 NOD 1047 1064 1063 1046 2047 2064 2063 2046
NE   73 NN  8 NOD   64   81   80   63 1064 1081 1080 1063
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   73        25000000.  *AREA AND VOL = 0.250E+10
NE 1073 NN  8 NOD 1064 1081 1080 1063 2064 2081 2080 2063
NE   74 NN  8 NOD   81   98   97   80 1081 1098 1097 1080
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   74        25000002.  *AREA AND VOL = 0.250E+10
NE 1074 NN  8 NOD 1081 1098 1097 1080 2081 2098 2097 2080
NE   75 NN  8 NOD   98  115  114   97 1098 1115 1114 1097
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   75        24999998.  *AREA AND VOL = 0.250E+10
NE 1075 NN  8 NOD 1098 1115 1114 1097 2098 2115 2114 2097
NE   76 NN  8 NOD  115  132  131  114 1115 1132 1131 1114
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   76        24999998.  *AREA AND VOL = 0.250E+10
NE 1076 NN  8 NOD 1115 1132 1131 1114 2115 2132 2131 2114
NE   77 NN  8 NOD   12   29   28   11 1012 1029 1028 1011
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   77        24999998.  *AREA AND VOL = 0.250E+10
NE 1077 NN  8 NOD 1012 1029 1028 1011 2012 2029 2028 2011
NE   78 NN  8 NOD   29   46   45   28 1029 1046 1045 1028
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   78        25000000.  *AREA AND VOL = 0.250E+10
NE 1078 NN  8 NOD 1029 1046 1045 1028 2029 2046 2045 2028
NE   79 NN  8 NOD   46   63   62   45 1046 1063 1062 1045
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   79        24999996.  *AREA AND VOL = 0.250E+10
NE 1079 NN  8 NOD 1046 1063 1062 1045 2046 2063 2062 2045
NE   80 NN  8 NOD   63   80   79   62 1063 1080 1079 1062
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   80        25000000.  *AREA AND VOL = 0.250E+10
NE 1080 NN  8 NOD 1063 1080 1079 1062 2063 2080 2079 2062
NE   81 NN  8 NOD   80   97   96   79 1080 1097 1096 1079
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   81        25000002.  *AREA AND VOL = 0.250E+10
NE 1081 NN  8 NOD 1080 1097 1096 1079 2080 2097 2096 2079
NE   82 NN  8 NOD   97  114  113   96 1097 1114 1113 1096
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEME   82        24999998.  *AREA AND VOL = 0.250E+10
NE 1082 NN  8 NOD 1097 1114 1113 1096 2097 2114 2113 2096
NE   83 NN  8 NOD  114  131  130  113 1114 1131 1130 1113
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ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   83     24999992.  *AREA AND VOL = 0.250E+10
NE 1083 NN  8 NOD 1114 1131 1130 1113 2114 2131 2130 2113
NE   84 NN  8 NOD   11   28   27   10 1011 1028 1027 1010
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   84     25000016.  *AREA AND VOL = 0.250E+10
NE 1084 NN  8 NOD 1011 1028 1027 1010 2011 2028 2027 2010
NE   85 NN  8 NOD   28   45   44   27 1028 1045 1044 1027
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   85     25000010.  *AREA AND VOL = 0.250E+10
NE 1085 NN  8 NOD 1028 1045 1044 1027 2028 2045 2044 2027
NE   86 NN  8 NOD   45   62   61   44 1045 1062 1061 1044
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   86     25000016.  *AREA AND VOL = 0.250E+10
NE 1086 NN  8 NOD 1045 1062 1061 1044 2045 2062 2061 2044
NE   87 NN  8 NOD   62   79   78   61 1062 1079 1078 1061
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   87     25000010.  *AREA AND VOL = 0.250E+10
NE 1087 NN  8 NOD 1062 1079 1078 1061 2062 2079 2078 2061
NE   88 NN  8 NOD   79   96   95   78 1079 1096 1095 1078
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   88     25000020.  *AREA AND VOL = 0.250E+10
NE 1088 NN  8 NOD 1079 1096 1095 1078 2079 2096 2095 2078
NE   89 NN  8 NOD   96  113  112   95 1096 1113 1112 1095
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   89     25000014.  *AREA AND VOL = 0.250E+10
NE 1089 NN  8 NOD 1096 1113 1112 1095 2096 2113 2112 2095
NE   90 NN  8 NOD  113  130  129  112 1113 1130 1129 1112
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   90     25000016.  *AREA AND VOL = 0.250E+10
NE 1090 NN  8 NOD 1113 1130 1129 1112 2113 2130 2129 2112
NE   91 NN  8 NOD   10   27   26    9 1010 1027 1026 1009
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   91     24999994.  *AREA AND VOL = 0.250E+10
NE 1091 NN  8 NOD 1010 1027 1026 1009 2010 2027 2026 2009
NE   92 NN  8 NOD   27   44   43   26 1027 1044 1043 1026
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   92     24999996.  *AREA AND VOL = 0.250E+10
NE 1092 NN  8 NOD 1027 1044 1043 1026 2027 2044 2043 2026
NE   93 NN  8 NOD   44   61   60   43 1044 1061 1060 1043
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   93     24999992.  *AREA AND VOL = 0.250E+10
NE 1093 NN  8 NOD 1044 1061 1060 1043 2044 2061 2060 2043
NE   94 NN  8 NOD   61   78   77   60 1061 1078 1077 1060
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   94     24999990.  *AREA AND VOL = 0.250E+10
NE 1094 NN  8 NOD 1061 1078 1077 1060 2061 2078 2077 2060
NE   95 NN  8 NOD   78   95   94   77 1078 1095 1094 1077
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   95     24999998.  *AREA AND VOL = 0.250E+10
NE 1095 NN  8 NOD 1078 1095 1094 1077 2078 2095 2094 2077
NE   96 NN  8 NOD   95  112  111   94 1095 1112 1111 1094
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   96     24999992.  *AREA AND VOL = 0.250E+10
NE 1096 NN  8 NOD 1095 1112 1111 1094 2095 2112 2111 2094
NE   97 NN  8 NOD  112  129  128  111 1112 1129 1128 1111
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   97     24999998.  *AREA AND VOL = 0.250E+10
NE 1097 NN  8 NOD 1112 1129 1128 1111 2112 2129 2128 2111
NE   98 NN  8 NOD    9   26   25    8 1009 1026 1025 1008
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   98     25000002.  *AREA AND VOL = 0.250E+10
NE 1098 NN  8 NOD 1009 1026 1025 1008 2009 2026 2025 2008
NE   99 NN  8 NOD   26   43   42   25 1026 1043 1042 1025
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#   99     25000002.  *AREA AND VOL = 0.250E+10
NE 1099 NN  8 NOD 1026 1043 1042 1025 2026 2043 2042 2025
NE  100 NN  8 NOD   43   60   59   42 1043 1060 1059 1042
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  100     25000000.  *AREA AND VOL = 0.250E+10
NE 1100 NN  8 NOD 1043 1060 1059 1042 2043 2060 2059 2042
NE  101 NN  8 NOD   60   77   76   59 1060 1077 1076 1059
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  101     25000002.  *AREA AND VOL = 0.250E+10
NE 1101 NN  8 NOD 1060 1077 1076 1059 2060 2077 2076 2059
NE  102 NN  8 NOD   77   94   93   76 1077 1094 1093 1076
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  102     25000004.  *AREA AND VOL = 0.250E+10
NE 1102 NN  8 NOD 1077 1094 1093 1076 2077 2094 2093 2076
NE  103 NN  8 NOD   94  111  110   93 1094 1111 1110 1093
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  103     25000002.  *AREA AND VOL = 0.250E+10
NE 1103 NN  8 NOD 1094 1111 1110 1093 2094 2111 2110 2093
NE  104 NN  8 NOD  111  128  127  110 1111 1128 1127 1110
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  104     25000002.  *AREA AND VOL = 0.250E+10
NE 1104 NN  8 NOD 1111 1128 1127 1110 2111 2128 2127 2110
NE  105 NN  8 NOD  280  281  271  270 1280 1281 1271 1270
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  105       239730.  *AREA AND VOL = 0.240E+08
NE 1105 NN  8 NOD 1280 1281 1271 1270 2280 2281 2271 2270
NE  106 NN  8 NOD  281  282  272  271 1281 1282 1272 1271
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  106        35178.  *AREA AND VOL = 0.352E+07
NE 1106 NN  8 NOD 1281 1282 1272 1271 2281 2282 2272 2271
NE  107 NN  8 NOD  282  283  273  272 1282 1283 1273 1272
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  107        98635.  *AREA AND VOL = 0.986E+07
NE 1107 NN  8 NOD 1282 1283 1273 1272 2282 2283 2273 2272
NE  108 NN  8 NOD  283  284  274  273 1283 1284 1274 1273
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  108         2765.  *AREA AND VOL = 0.277E+06
NE 1108 NN  8 NOD 1283 1284 1274 1273 2283 2284 2274 2273
NE 2108 NN  8 NOD 2283 2284 2274 2273 2283 3284 3274 2273
NE 3108 NN  8 NOD 2283 3284 3274 2273 2283 4284 4274 2273
NE 4108 NN  8 NOD 2283 4284 4274 2273 2283 5284 5274 2273
NE  109 NN  8 NOD  284  285  275  274 1284 1285 1275 1274
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  109         1185.  *AREA AND VOL = 0.119E+06
NE 1109 NN  8 NOD 1284 1285 1275 1274 2284 2285 2275 2274
NE 2109 NN  8 NOD 2284 2285 2275 2274 3284 3285 3275 3274
NE 3109 NN  8 NOD 3284 3285 3275 3274 4284 4285 4275 4274
NE 4109 NN  8 NOD 4284 4285 4275 4274 5284 5285 5275 5274
NE 5109 NN  8 NOD 5284 5285 5275 5274 5284 6285 6275 5274
NE  110 NN  8 NOD  285  286  276  275 1285 1286 1276 1275
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ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  110          14839.  *AREA AND VOL = 0.148E+07
NE 1110 NN  8 NOD 1285 1286 1276 1275 2285 2286 2276 2275
NE 2110 NN  8 NOD 2285 2286 2276 2275 3285 3286 3276 3275
NE 3110 NN  8 NOD 3285 3286 3276 3275 4285 4286 4276 4275
NE 4110 NN  8 NOD 4285 4286 4276 4275 5285 4286 4276 5275
NE 5110 NN  8 NOD 5285 4286 4276 5275 6285 4286 4276 6275
NE  111 NN  8 NOD  286  287  277  276 1286 1287 1277 1276
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  111         262155.  *AREA AND VOL = 0.262E+08
NE 1111 NN  8 NOD 1286 1287 1277 1276 2286 2287 2277 2276
NE 2111 NN  8 NOD 2286 2287 2277 2276 3286 3287 3277 3276
NE 3111 NN  8 NOD 3286 3287 3277 3276 4286 4287 4277 4276
NE  112 NN  8 NOD  287  288  278  277 1287 1288 1278 1277
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  112         368838.  *AREA AND VOL = 0.369E+08
NE 1112 NN  8 NOD 1287 1288 1278 1277 2287 2288 2278 2277
NE 2112 NN  8 NOD 2287 2288 2278 2277 3287 3288 3278 3277
NE 3112 NN  8 NOD 3287 3288 3278 3277 4287 4288 4278 4277
NE  113 NN  8 NOD  288  289  279  278 1288 1289 1279 1278
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  113         321797.  *AREA AND VOL = 0.322E+08
NE 1113 NN  8 NOD 1288 1289 1279 1278 2288 2289 2279 2278
NE 2113 NN  8 NOD 2288 2289 2279 2278 3288 3289 3279 3278
NE 3113 NN  8 NOD 3288 3289 3279 3278 4288 4289 4279 4278
NE  114 NN  8 NOD  270  271  261  260 1270 1271 1261 1260
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  114         238672.  *AREA AND VOL = 0.239E+08
NE 1114 NN  8 NOD 1270 1271 1261 1260 2270 2271 2261 2260
NE  115 NN  8 NOD  271  272  262  261 1271 1272 1262 1261
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  115          35828.  *AREA AND VOL = 0.358E+07
NE 1115 NN  8 NOD 1271 1272 1262 1261 2271 2272 2262 2261
NE  116 NN  8 NOD  272  273  263  262 1272 1273 1263 1262
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  116         114354.  *AREA AND VOL = 0.114E+08
NE 1116 NN  8 NOD 1272 1273 1263 1262 2272 2273 2263 2262
NE  117 NN  8 NOD  273  274  264  263 1273 1274 1264 1263
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  117          14689.  *AREA AND VOL = 0.147E+07
NE 1117 NN  8 NOD 1273 1274 1264 1263 2273 2274 2264 2263
NE 2117 NN  8 NOD 2273 2274 2264 2263 2273 3274 3264 2263
NE 3117 NN  8 NOD 2273 3274 3264 2263 2273 4274 4264 2263
NE 4117 NN  8 NOD 2273 4274 4264 2263 2273 5274 5264 2263
NE  118 NN  8 NOD  274  275  265  264 1274 1275 1265 1264
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  118           6295.  *AREA AND VOL = 0.630E+06
NE 1118 NN  8 NOD 1274 1275 1265 1264 2274 2275 2265 2264
NE 2118 NN  8 NOD 2274 2275 2265 2264 3274 3275 3265 3264
NE 3118 NN  8 NOD 3274 3275 3265 3264 4274 4275 4265 4264
NE 4118 NN  8 NOD 4274 4275 4265 4264 5274 5275 5265 5264
NE 5118 NN  8 NOD 5274 5275 5265 5264 5274 6275 6265 5264
NE  119 NN  8 NOD  275  276  266  265 1275 1276 1266 1265
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  119         129918.  *AREA AND VOL = 0.130E+08
NE 1119 NN  8 NOD 1275 1276 1266 1265 2275 2276 2266 2265
NE 2119 NN  8 NOD 2275 2276 2266 2265 3275 3276 3266 3265
NE 3119 NN  8 NOD 3275 3276 3266 3265 4275 4276 4266 4265
NE 4119 NN  8 NOD 4275 4276 4266 4265 5275 4276 4266 5265
NE 5119 NN  8 NOD 5275 4276 4266 5265 6275 4276 4266 6265
NE  120 NN  8 NOD  276  277  267  266 1276 1277 1267 1266
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  120         565848.  *AREA AND VOL = 0.565E+08
NE 1120 NN  8 NOD 1276 1277 1267 1266 2276 2277 2267 2266
NE 2120 NN  8 NOD 2276 2277 2267 2266 3276 3277 3267 3266
NE 3120 NN  8 NOD 3276 3277 3267 3266 4276 4277 4267 4266
NE  121 NN  8 NOD  277  278  268  267 1277 1278 1268 1267
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  121         367188.  *AREA AND VOL = 0.367E+08
NE 1121 NN  8 NOD 1277 1278 1268 1267 2277 2278 2268 2267
NE 2121 NN  8 NOD 2277 2278 2268 2267 3277 3278 3268 3267
NE 3121 NN  8 NOD 3277 3278 3268 3267 4277 4278 4268 4267
NE  122 NN  8 NOD  278  279  269  268 1278 1279 1269 1268
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  122         296618.  *AREA AND VOL = 0.297E+08
NE 1122 NN  8 NOD 1278 1279 1269 1268 2278 2279 2269 2268
NE 2122 NN  8 NOD 2278 2279 2269 2268 3278 3279 3269 3268
NE 3122 NN  8 NOD 3278 3279 3269 3268 4278 4279 4269 4268
NE  123 NN  8 NOD  260  261  251  250 1260 1261 1251 1250
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  123         477838.  *AREA AND VOL = 0.478E+08
NE 1123 NN  8 NOD 1260 1261 1251 1250 2260 2261 2251 2250
NE  124 NN  8 NOD  261  262  252  251 1261 1262 1252 1251
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  124          78113.  *AREA AND VOL = 0.781E+07
NE 1124 NN  8 NOD 1261 1262 1252 1251 2261 2262 2252 2251
NE  125 NN  8 NOD  262  263  253  252 1262 1263 1253 1252
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  125         517055.  *AREA AND VOL = 0.517E+08
NE 1125 NN  8 NOD 1262 1263 1253 1252 2262 2263 2253 2252
NE  126 NN  8 NOD  263  264  254  253 1263 1264 1254 1253
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  126         155563.  *AREA AND VOL = 0.156E+08
NE 1126 NN  8 NOD 1263 1264 1254 1253 2263 2264 2254 2253
NE 2126 NN  8 NOD 2263 2264 2254 2253 2263 3264 3254 2253
NE 3126 NN  8 NOD 2263 3264 3254 2253 2263 4264 4254 2253
NE 4126 NN  8 NOD 2263 4264 4254 2253 2263 5264 5254 2253
NE  127 NN  8 NOD  264  265  255  254 1264 1265 1255 1254
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  127          68492.  *AREA AND VOL = 0.685E+07
NE 1127 NN  8 NOD 1264 1265 1255 1254 2264 2265 2255 2254
NE 2127 NN  8 NOD 2264 2265 2255 2254 3264 3265 3255 3254
NE 3127 NN  8 NOD 3264 3265 3255 3254 4264 4265 4255 4254
NE 4127 NN  8 NOD 4264 4265 4255 4254 5264 5265 5255 5254
NE 5127 NN  8 NOD 5264 5265 5255 5254 5264 6265 6255 5254
NE  128 NN  8 NOD  265  266  256  255 1265 1266 1256 1255
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ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  128          330899.  *AREA AND VOL = 0.331E+08
NE 1128 NN  8 NOD 1265 1266 1256 1255 2265 2266 2256 2255
NE 2128 NN  8 NOD 2265 2266 2256 2255 3265 3266 3256 3255
NE 3128 NN  8 NOD 3265 3266 3256 3255 4265 4266 4256 4255
NE 4128 NN  8 NOD 4265 4266 4256 4255 5265 4266 4256 5255
NE 5128 NN  8 NOD 5265 4266 4256 5255 6265 4266 4256 6255
NE  129 NN  8 NOD  266  267  257  256 1266 1267 1257 1256
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  129          323863.  *AREA AND VOL = 0.323E+08
NE 1129 NN  8 NOD 1266 1267 1257 1256 2266 2267 2257 2256
NE 2129 NN  8 NOD 2266 2267 2257 2256 3266 3267 3257 3256
NE 3129 NN  8 NOD 3266 3267 3257 3256 4266 4267 4257 4256
NE  130 NN  8 NOD  267  268  258  257 1267 1268 1258 1257
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  130          735120.  *AREA AND VOL = 0.735E+08
NE 1130 NN  8 NOD 1267 1268 1258 1257 2267 2268 2258 2257
NE 2130 NN  8 NOD 2267 2268 2258 2257 3267 3268 3258 3257
NE 3130 NN  8 NOD 3267 3268 3258 3257 4267 4268 4258 4257
NE  131 NN  8 NOD  268  269  259  258 1268 1269 1259 1258
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  131          833139.  *AREA AND VOL = 0.833E+08
NE 1131 NN  8 NOD 1268 1269 1259 1258 2268 2269 2259 2258
NE 2131 NN  8 NOD 2268 2269 2259 2258 3268 3269 3259 3258
NE 3131 NN  8 NOD 3268 3269 3259 3258 4268 4269 4259 4258
NE  132 NN  8 NOD  250  251  241  240 1250 1251 1241 1240
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  132          951061.  *AREA AND VOL = 0.951E+08
NE 1132 NN  8 NOD 1250 1251 1241 1240 2250 2251 2241 2240
NE  133 NN  8 NOD  251  252  242  241 1251 1252 1242 1241
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  133          139550.  *AREA AND VOL = 0.140E+08
NE 1133 NN  8 NOD 1251 1252 1242 1241 2251 2252 2242 2241
NE  134 NN  8 NOD  252  253  243  242 1252 1253 1243 1242
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  134          738360.  *AREA AND VOL = 0.738E+08
NE 1134 NN  8 NOD 1252 1253 1243 1242 2252 2253 2243 2242
NE  135 NN  8 NOD  253  254  244  243 1253 1254 1244 1243
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  135          173689.  *AREA AND VOL = 0.174E+08
NE 1135 NN  8 NOD 1253 1254 1244 1243 2253 2254 2244 2243
NE 2135 NN  8 NOD 2253 2254 2244 2243 2253 3254 3244 2243
NE 3135 NN  8 NOD 2253 3254 3244 2243 2253 4254 4244 2243
NE 4135 NN  8 NOD 2253 4254 4244 2243 2253 5254 5244 2243
NE  136 NN  8 NOD  254  255  245  244 1254 1255 1245 1244
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  136           76260.  *AREA AND VOL = 0.763E+07
NE 1136 NN  8 NOD 1254 1255 1245 1244 2254 2255 2245 2244
NE 2136 NN  8 NOD 2254 2255 2245 2244 3254 3255 3245 3244
NE 3136 NN  8 NOD 3254 3255 3245 3244 4254 4255 4245 4244
NE 4136 NN  8 NOD 4254 4255 4245 4244 5254 5255 5245 5244
NE 5136 NN  8 NOD 5254 5255 5245 5244 5254 6255 6245 5244
NE  137 NN  8 NOD  255  256  246  245 1255 1256 1246 1245
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  137          452921.  *AREA AND VOL = 0.453E+08
NE 1137 NN  8 NOD 1255 1256 1246 1245 2255 2256 2246 2245
NE 2137 NN  8 NOD 2255 2256 2246 2245 3255 3256 3246 3245
NE 3137 NN  8 NOD 3255 3256 3246 3245 4255 4256 4246 4245
NE 4137 NN  8 NOD 4255 4256 4246 4245 5255 4256 4246 5245
NE 5137 NN  8 NOD 5255 4256 4246 5245 6255 4256 4246 6245
NE  138 NN  8 NOD  256  257  247  246 1256 1257 1247 1246
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  138         1638286.  *AREA AND VOL = 0.164E+09
NE 1138 NN  8 NOD 1256 1257 1247 1246 2256 2257 2247 2246
NE 2138 NN  8 NOD 2256 2257 2247 2246 3256 3257 3247 3246
NE 3138 NN  8 NOD 3256 3257 3247 3246 4256 4257 4247 4246
NE  139 NN  8 NOD  257  258  248  247 1257 1258 1248 1247
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  139         1463183.  *AREA AND VOL = 0.146E+09
NE 1139 NN  8 NOD 1257 1258 1248 1247 2257 2258 2248 2247
NE 2139 NN  8 NOD 2257 2258 2248 2247 3257 3258 3248 3247
NE 3139 NN  8 NOD 3257 3258 3248 3247 4257 4258 4248 4247
NE  140 NN  8 NOD  258  259  249  248 1258 1259 1249 1248
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  140         1512334.  *AREA AND VOL = 0.151E+09
NE 1140 NN  8 NOD 1258 1259 1249 1248 2258 2259 2249 2248
NE 2140 NN  8 NOD 2258 2259 2249 2248 3258 3259 3249 3248
NE 3140 NN  8 NOD 3258 3259 3249 3248 4258 4259 4249 4248
NE  141 NN  8 NOD  240  241  231  230 1240 1241 1231 1230
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  141         1865586.  *AREA AND VOL = 0.187E+09
NE 1141 NN  8 NOD 1240 1241 1231 1230 2240 2241 2231 2230
NE  142 NN  8 NOD  241  242  232  231 1241 1242 1232 1231
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  142          273733.  *AREA AND VOL = 0.274E+08
NE 1142 NN  8 NOD 1241 1242 1232 1231 2241 2242 2232 2231
NE  143 NN  8 NOD  242  243  233  232 1242 1243 1233 1232
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  143         1448342.  *AREA AND VOL = 0.145E+09
NE 1143 NN  8 NOD 1242 1243 1233 1232 2242 2243 2233 2232
NE  144 NN  8 NOD  243  244  234  233 1243 1244 1234 1233
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  144          300711.  *AREA AND VOL = 0.301E+08
NE 1144 NN  8 NOD 1243 1244 1234 1233 2243 2244 2234 2233
NE 2144 NN  8 NOD 2243 2244 2234 2233 2243 3244 3234 2233
NE 3144 NN  8 NOD 2243 3244 3234 2233 2243 4244 4234 2233
NE 4144 NN  8 NOD 2243 4244 4234 2233 2243 5244 5234 2233
NE  145 NN  8 NOD  244  245  235  234 1244 1245 1235 1234
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  145          149600.  *AREA AND VOL = 0.150E+08
NE 1145 NN  8 NOD 1244 1245 1235 1234 2244 2245 2235 2234
NE 2145 NN  8 NOD 2244 2245 2235 2234 3244 3245 3235 3234
NE 3145 NN  8 NOD 3244 3245 3235 3234 4244 4245 4235 4234
NE 4145 NN  8 NOD 4244 4245 4235 4234 5244 5245 5235 5234
NE 5145 NN  8 NOD 5244 5245 5235 5234 5244 6245 6235 5234
NE  146 NN  8 NOD  245  246  236  235 1245 1246 1236 1235
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ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  146                888423.  *AREA AND VOL = 0.888E+08
NE 1146 NN  8 NOD 1245 1246 1236 1235 2245 2246 2236 2235
NE 2146 NN  8 NOD 2245 2246 2236 2235 3245 3246 3236 3235
NE 3146 NN  8 NOD 3245 3246 3236 3235 4245 4246 4236 4235
NE 4146 NN  8 NOD 4245 4246 4236 4235 5245 4246 4236 5235
NE 5146 NN  8 NOD 5245 4246 4236 5235 6245 4246 4236 6235
NE  147 NN  8 NOD  246  247  237  236 1246 1247 1237 1236
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  147               3213472.  *AREA AND VOL = 0.321E+09
NE 1147 NN  8 NOD 1246 1247 1237 1236 2246 2247 2237 2236
NE 2147 NN  8 NOD 2246 2247 2237 2236 3246 3247 3237 3236
NE 3147 NN  8 NOD 3246 3247 3237 3236 4246 4247 4237 4236
NE  148 NN  8 NOD  247  248  238  237 1247 1248 1238 1237
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  148               2870128.  *AREA AND VOL = 0.287E+09
NE 1148 NN  8 NOD 1247 1248 1238 1237 2247 2248 2238 2237
NE 2148 NN  8 NOD 2247 2248 2238 2237 3247 3248 3238 3237
NE 3148 NN  8 NOD 3247 3248 3238 3237 4247 4248 4238 4237
NE  149 NN  8 NOD  248  249  239  238 1248 1249 1239 1238
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  149               2420160.  *AREA AND VOL = 0.242E+09
NE 1149 NN  8 NOD 1248 1249 1239 1238 2248 2249 2239 2238
NE 2149 NN  8 NOD 2248 2249 2239 2238 3248 3249 3239 3238
NE 3149 NN  8 NOD 3248 3249 3239 3238 4248 4249 4239 4238
NE  150 NN  8 NOD  230  231  221  220 1230 1231 1221 1220
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  150               3447147.  *AREA AND VOL = 0.345E+09
NE 1150 NN  8 NOD 1230 1231 1221 1220 2230 2231 2221 2220
NE  151 NN  8 NOD  231  232  222  221 1231 1232 1222 1221
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  151                585796.  *AREA AND VOL = 0.586E+08
NE 1151 NN  8 NOD 1231 1232 1222 1221 2231 2232 2222 2221
NE  152 NN  8 NOD  232  233  223  222 1232 1233 1223 1222
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  152               2676188.  *AREA AND VOL = 0.268E+09
NE 1152 NN  8 NOD 1232 1233 1223 1222 2232 2233 2223 2222
NE  153 NN  8 NOD  233  234  224  223 1233 1234 1224 1223
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  153                629557.  *AREA AND VOL = 0.630E+08
NE 1153 NN  8 NOD 1233 1234 1224 1223 2233 2234 2224 2223
NE 2153 NN  8 NOD 2233 2234 2224 2223 2233 3234 3224 2223
NE 3153 NN  8 NOD 2233 3234 3224 2223 2233 4234 4224 2223
NE 4153 NN  8 NOD 2233 4234 4224 2223 2233 5234 5224 2223
NE  154 NN  8 NOD  234  235  225  224 1234 1235 1225 1224
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  154                276428.  *AREA AND VOL = 0.276E+08
NE 1154 NN  8 NOD 1234 1235 1225 1224 2234 2235 2225 2224
NE 2154 NN  8 NOD 2234 2235 2225 2224 3234 3235 3225 3224
NE 3154 NN  8 NOD 3234 3235 3225 3224 4234 4235 4225 4224
NE 4154 NN  8 NOD 4234 4235 4225 4224 5234 5235 5225 5224
NE 5154 NN  8 NOD 5234 5235 5225 5224 5234 6235 6225 5224
NE  155 NN  8 NOD  235  236  226  225 1235 1236 1226 1225
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  155               1641591.  *AREA AND VOL = 0.164E+09
NE 1155 NN  8 NOD 1235 1236 1226 1225 2235 2236 2226 2225
NE 2155 NN  8 NOD 2235 2236 2226 2225 3235 3236 3226 3225
NE 3155 NN  8 NOD 3235 3236 3226 3225 4235 4236 4226 4225
NE 4155 NN  8 NOD 4235 4236 4226 4225 5235 4236 4226 5225
NE 5155 NN  8 NOD 5235 4236 4226 5225 6235 4236 4226 6225
NE  156 NN  8 NOD  236  237  227  226 1236 1237 1227 1226
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  156               5937720.  *AREA AND VOL = 0.594E+09
NE 1156 NN  8 NOD 1236 1237 1227 1226 2236 2237 2227 2226
NE 2156 NN  8 NOD 2236 2237 2227 2226 3236 3237 3227 3226
NE 3156 NN  8 NOD 3236 3237 3227 3226 4236 4237 4227 4226
NE  157 NN  8 NOD  237  238  228  227 1237 1238 1228 1227
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  157               5383289.  *AREA AND VOL = 0.538E+09
NE 1157 NN  8 NOD 1237 1238 1228 1227 2237 2238 2228 2227
NE 2157 NN  8 NOD 2237 2238 2228 2227 3237 3238 3228 3227
NE 3157 NN  8 NOD 3237 3238 3228 3227 4237 4238 4228 4227
NE  158 NN  8 NOD  238  239  229  228 1238 1239 1229 1228
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  158               6810415.  *AREA AND VOL = 0.681E+09
NE 1158 NN  8 NOD 1238 1239 1229 1228 2238 2239 2229 2228
NE 2158 NN  8 NOD 2238 2239 2229 2228 3238 3239 3229 3228
NE 3158 NN  8 NOD 3238 3239 3229 3228 4238 4239 4229 4228
NE  159 NN  8 NOD  220  221  211  210 1220 1221 1211 1210
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  159               3447147.  *AREA AND VOL = 0.345E+09
NE 1159 NN  8 NOD 1220 1221 1211 1210 2220 2221 2211 2210
NE  160 NN  8 NOD  221  222  212  211 1221 1222 1212 1211
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  160                585795.  *AREA AND VOL = 0.586E+08
NE 1160 NN  8 NOD 1221 1222 1212 1211 2221 2222 2212 2211
NE  161 NN  8 NOD  222  223  213  212 1222 1223 1213 1212
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  161               2676178.  *AREA AND VOL = 0.268E+09
NE 1161 NN  8 NOD 1222 1223 1213 1212 2222 2223 2213 2212
NE  162 NN  8 NOD  223  224  214  213 1223 1224 1214 1213
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  162                629561.  *AREA AND VOL = 0.630E+08
NE 1162 NN  8 NOD 1223 1224 1214 1213 2223 2224 2214 2213
NE 2162 NN  8 NOD 2223 2224 2214 2213 2223 3224 3214 2213
NE 3162 NN  8 NOD 2223 3224 3214 2213 2223 4224 4214 2213
NE 4162 NN  8 NOD 2223 4224 4214 2213 2223 5224 5214 2213
NE  163 NN  8 NOD  224  225  215  214 1224 1225 1215 1214
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  163                276429.  *AREA AND VOL = 0.276E+08
NE 1163 NN  8 NOD 1224 1225 1215 1214 2224 2225 2215 2214
NE 2163 NN  8 NOD 2224 2225 2215 2214 3224 3225 3215 3214
NE 3163 NN  8 NOD 3224 3225 3215 3214 4224 4225 4215 4214
NE 4163 NN  8 NOD 4224 4225 4215 4214 5224 5225 5215 5214
NE 5163 NN  8 NOD 5224 5225 5215 5214 5224 6225 6215 5214
NE  164 NN  8 NOD  225  226  216  215 1225 1226 1216 1215
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ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  164          1641592.  *AREA AND VOL = 0.164E+09
NE 1164 NN  8 NOD 1225 1226 1216 1215 2225 2226 2216 2215
NE 2164 NN  8 NOD 2225 2226 2216 2215 3225 3226 3216 3215
NE 3164 NN  8 NOD 3225 3226 3216 3215 4225 4226 4216 4215
NE 4164 NN  8 NOD 4225 4226 4216 4215 5225 4226 4216 5215
NE 5164 NN  8 NOD 5225 4226 4216 5215 6225 4226 4216 6215
NE  165 NN  8 NOD  226  227  217  216 1226 1227 1217 1216
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  165          5937719.  *AREA AND VOL = 0.594E+09
NE 1165 NN  8 NOD 1226 1227 1217 1216 2226 2227 2217 2216
NE 2165 NN  8 NOD 2226 2227 2217 2216 3226 3227 3217 3216
NE 3165 NN  8 NOD 3226 3227 3217 3216 4226 4227 4217 4216
NE  166 NN  8 NOD. 227  228  218  217 1227 1228 1218 1217
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  166          5303275.  *AREA AND VOL = 0.530E+09
NE 1166 NN  8 NOD 1227 1228 1218 1217.2227 2228 2218 2217
NE 2166 NN  8 NOD 2227 2228 2218 2217 3227 3228 3218 3217
NE 3166 NN  8 NOD 3227 3228 3218 3217 4227 4228 4218 4217
NE  167 NN  8 NOD  228  229  219  218 1228 1229 1219 1218
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  167          6810023.  *AREA AND VOL = 0.681E+09
NE 1167 NN  8 NOD 1228 1229 1219 1218 2228 2229 2219 2218
NE 2167 NN  8 NOD 2228 2229 2219 2218 3228 3229 3219 3218
NE 3167 NN  8 NOD 3228 3229 3219 3218 4228 4229 4219 4218
NE  168 NN  8 NOD  210  211  201  200 1210 1211 1201 1200
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  168          3407146.  *AREA AND VOL = 0.345E+09
NE 1168 NN  8 NOD 1210 1211 1201 1200 2210 2211 2201 2200
NE  169 NN  8 NOD  211  212  202  201 1211 1212 1202 1201
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  169           585792.  *AREA AND VOL = 0.586E+08
NE 1169 NN  8 NOD 1211 1212 1202 1201 2211 2212 2202 2201
NE  170 NN  8 NOD  212  213  203  202 1212 1213 1203 1202
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  170          2676171.  *AREA AND VOL = 0.268E+09
NE 1170 NN  8 NOD 1212 1213 1203 1202 2212 2213 2203 2202
NE  171 NN  8 NOD  213  214  204  203 1213 1214 1204 1203
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  171           629561.  *AREA AND VOL = 0.630E+08
NE 1171 NN  8 NOD 1213 1214 1204 1203 2213 2214 2204 2203
NE 2171 NN  8 NOD 2213 2214 2204 2203 2213 3214 3204 2203
NE 3171 NN  8 NOD 2213 3214 3204 2203 2213 4214 4204 2203
NE 4171 NN  8 NOD 2213 4214 4204 2203 2213 5214 5204 2203
NE  172 NN  8 NOD  214  215  205  204 1214 1215 1205 1204
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  172           276433.  *AREA AND VOL = 0.276E+08
NE 1172 NN  8 NOD 1214 1215 1205 1204 2214 2215 2205 2204
NE 2172 NN  8 NOD 2214 2215 2205 2204 3214 3215 3205 3204
NE 3172 NN  8 NOD 3214 3215 3205 3204 4214 4215 4205 4204
NE 4172 NN  8 NOD 4214 4215 4205 4204 5214 5215 5205 5204
NE 5172 NN  8 NOD 5214 5215 5205 5204 5214 6215 6205 5204
NE  173 NN  8 NOD  215  216  206  205 1215 1216 1206 1205
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  173          1641598.  *AREA AND VOL = 0.164E+09
NE 1173 NN  8 NOD 1215 1216 1206 1205 2215 2216 2206 2205
NE 2173 NN  8 NOD 2215 2216 2206 2205 3215 3216 3206 3205
NE 3173 NN  8 NOD 3215 3216 3206 3205 4215 4216 4206 4205
NE 4173 NN  8 NOD 4215 4216 4206 4205 5215 4216 4206 5205
NE 5173 NN  8 NOD 5215 4216 4206 5205 6215 4216 4206 6205
NE  174 NN  8 NOD  216  217  207  206 1216 1217 1207 1206
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  174          5937717.  *AREA AND VOL = 0.594E+09
NE 1174 NN  8 NOD 1216 1217 1207 1206 2216 2217 2207 2206
NE 2174 NN  8 NOD 2216 2217 2207 2206 3216 3217 3207 3206
NE 3174 NN  8 NOD 3216 3217 3207 3206 4216 4217 4207 4206
NE  175 NN  8 NOD  217  218  208  207 1217 1218 1208 1207
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  175          5303274.  *AREA AND VOL = 0.530E+09
NE 1175 NN  8 NOD 1217 1218 1208 1207 2217 2218 2208 2207
NE 2175 NN  8 NOD 2217 2218 2208 2207 3217 3218 3208 3207
NE 3175 NN  8 NOD 3217 3218 3208 3207 4217 4218 4208 4207
NE  176 NN  8 NOD  218  219  209  208 1218 1219 1209 1208
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  176          6810026.  *AREA AND VOL = 0.681E+09
NE 1176 NN  8 NOD 1218 1219 1209 1208 2218 2219 2209 2208
NE 2176 NN  8 NOD 2218 2219 2209 2208 3218 3219 3209 3208
NE 3176 NN  8 NOD 3218 3219 3209 3208 4218 4219 4209 4208
NE  177 NN  8 NOD  239   25   42   41 1239 1025 1042 1041
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  177         18180198.  *AREA AND VOL = 0.182E+10
NE 1177 NN  8 NOD 1239 1025 1042 1041 2239 2025 2042 2041
NE 2177 NN  8 NOD 2239 2025 2042 2041 3239 2025 2042 2041
NE 3177 NN  8 NOD 3239 2025 2042 2041 4239 2025 2042 2041
NE  178 NN  8 NOD  229  239   41   40 1229 1239 1041 1040
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  178         12272080.  *AREA AND VOL = 0.123E+10
NE 1178 NN  8 NOD 1229 1239 1041 1040 2229 2239 2041 2040
NE 2178 NN  8 NOD 2229 2239 2041 2040 3229 3239 2041 2040
NE 3178 NN  8 NOD 3229 3239 2041 2040 4229 4239 2041 2040
NE  179 NN  8 NOD  229   40   39  219 1229 1040 1039 1219
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  179         12272081.  *AREA AND VOL = 0.123E+10
NE 1179 NN  8 NOD 1229 1040 1039 1219 2229 2040 2039 2219
NE 2179 NN  8 NOD 2229 2040 2039 2219 3229 2040 2039 3219
NE 3179 NN  8 NOD 3229 2040 2039 3219 4229 2040 2039 4219
NE  180 NN  8 NOD  219   39   38   21 1219 1039 1038 1021
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  180         18180208.  *AREA AND VOL = 0.182E+10
NE 1180 NN  8 NOD 1219 1039 1038 1021 2219 2039 2038 2021
NE 2180 NN  8 NOD 2219 2039 2038 2021 3219 2039 2038 2021
NE 3180 NN  8 NOD 3219 2039 2038 2021 4219 2039 2038 2021
NE  181 NN  8 NOD    4  209  219   21 1004 1209 1219 1021
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  181         12272078.  *AREA AND VOL = 0.123E+10
NE 1181 NN  8 NOD 1004 1209 1219 1021 2004 2209 2219 2021
NE 2181 NN  8 NOD 2004 2209 2219 2021 2004 3209 3219 2021
NE 3181 NN  8 NOD 2004 3209 3219 2021 2004 4209 4219 2021
NE  182 NN  8 NOD    6  220  210  200 1006 1220 1210 1200
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ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  182          8419426.  *AREA AND VOL = 0.842E+09
NE 1182 NN  8 NOD 1006 1220 1210 1200 2006 2220 2210 2200
NE  183 NN  8 NOD    6  240  230  220 1006 1240 1230 1220
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  183          3405599.  *AREA AND VOL = 0.341E+09
NE 1183 NN  8 NOD 1006 1240 1230 1220 2006 2240 2230 2220
NE  184 NN  8 NOD    6  260  250  240 1006 1260 1250 1240
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  184           915965.  *AREA AND VOL = 0.916E+08
NE 1184 NN  8 NOD 1006 1260 1250 1240 2006 2260 2250 2240
NE  185 NN  8 NOD    6  280  270  260 1006 1280 1270 1260
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  185           306669.  *AREA AND VOL = 0.307E+08
NE 1185 NN  8 NOD 1006 1280 1270 1260 2006 2280 2270 2260
NE  187 NN  8 NOD  259  269    8   25 1259 1269 1008 1025
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  187          3330927.  *AREA AND VOL = 0.333E+09
NE 1187 NN  8 NOD 1259 1269 1008 1025 2259 2269 2008 2025
NE 2187 NN  8 NOD 2259 2269 2008 2025 3259 3269 2008 2025
NE 3187 NN  8 NOD 3259 3269 2008 2025 4259 4269 2008 2025
NE  186 NN  8 NOD  279  289    8  269 1279 1289 1008 1269
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  186           652820.  *AREA AND VOL = 0.652E+08
NE 1186 NN  8 NOD 1279 1289 1008 1269 2279 2289 2008 2269
NE 2186 NN  8 NOD 2279 2289 2008 2269 3279 3289 2008 3269
NE 3186 NN  8 NOD 3279 3289 2008 3269 4279 4289 2008 4269
NE  188 NN  8 NOD  239  249  259   25 1239 1249 1259 1025
ESTIMATION OF GAUSSIAN INTEGRATION HAS BEEN DONE FOR ELEM#  188          6777240.  *AREA AND VOL = 0.678E+09
NE 1188 NN  8 NOD 1239 1249 1259 1025 2239 2249 2259 2025
NE 2188 NN  8 NOD 2239 2249 2259 2025 3239 3249 3259 2025
NE 3188 NN  8 NOD 3239 3249 3259 2025 4239 4249 4259 2025

 TIME= 15:08:43    DATE= 21-AUG-79
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APPENDIX I.9: PROG3-OUTPUT

Simulated potentials with 50-ft recharge head at the collapsed region.

STEADY STATE SOLUTION

HAINESVILLE SALT DOME - LONG TERM EVALUATION AFTER DESOLUTION TO -1700 FT. ELEV.

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
1	0.0000	200.00	2	0.0000	193.50	3	0.0000	187.10	4	0.0000	180.91
1001	-100.0	200.00	1002	-100.0	193.50	1003	-100.0	187.10	1004	-100.0	180.91
2001	-2100.	200.00	2002	-2100.	193.50	2003	-2100.	187.10	2004	-2100.	180.91
5	0.0000	175.09	6	0.0000	176.12	7	0.0000	166.68	9	0.0000	170.80
1005	-100.0	175.09	1006	-100.0	176.12	1007	-100.0	166.68	1009	-100.0	170.80
2005	-2100.	175.10	2006	-2100.	176.11	2007	-2100.	166.68	2009	-300.0	170.80
									3009	-500.0	169.99
									4009	-700.0	169.98
									5009	-1000.	169.98
									6009	-1300.	169.98
									7009	-1670.	169.98
									8009	-1700.	169.98
11	0.0000	130.23	12	0.0000	113.76	13	0.0000	99.26	14	0.0000	85.67
1011	-100.0	130.23	1012	-100.0	113.76	1013	-100.0	99.26	1014	-100.0	85.67
2011	-2100.	130.23	2012	-2100.	113.76	2013	-2100.	99.26	2014	-2100.	85.67
15	0.0000	72.57	16	0.0000	59.79	17	0.0000	47.21	18	0.0000	34.74
1015	-100.0	72.57	1016	-100.0	59.79	1017	-100.0	47.21	1018	-100.0	34.74
2015	-2100.	72.57	2016	-2100.	59.79	2017	-2100.	47.21	2018	-2100.	34.74
19	0.0000	22.36	20	0.0000	10.00	21	0.0000	200.00	22	0.0000	193.45
1019	-100.0	22.36	1020	-100.0	10.00	1021	-100.0	200.00	1022	-100.0	193.45
2019	-2100.	22.36	2020	-2100.	10.00	2021	-2100.	200.00	2022	-2100.	193.45
23	0.0000	186.99	24	0.0000	180.72	25	0.0000	174.80	26	0.0000	169.50
1023	-100.0	186.99	1024	-100.0	180.72	1025	-100.0	174.80	1026	-100.0	169.50
2023	-2100.	186.99	2024	-2100.	180.72	2025	-2100.	174.80	2026	-2100.	169.50
27	0.0000	165.29	31	0.0000	128.40	32	0.0000	113.03	33	0.0000	98.89
1027	-100.0	165.29	1031	-100.0	128.40	1032	-100.0	113.03	1033	-100.0	98.89
2027	-2100.	165.29	2031	-2100.	128.39	2032	-2100.	113.03	2033	-2100.	98.88
34	0.0000	85.42	35	0.0000	72.43	36	0.0000	59.69	37	0.0000	47.15
1034	-100.0	85.42	1035	-100.0	72.43	1036	-100.0	59.69	1037	-100.0	47.15
2034	-2100.	85.42	2035	-2100.	72.43	2036	-2100.	59.69	2037	-2100.	47.15
38	0.0000	34.71	39	0.0000	22.34	40	0.0000	10.00	41	0.0000	200.00
1038	-100.0	34.71	1039	-100.0	22.34	1040	-100.0	10.00	1041	-100.0	200.00
2038	-2100.	34.71	2039	-2100.	22.34	2040	-2100.	10.00	2041	-2100.	200.00
42	0.0000	193.31	43	0.0000	186.70	44	0.0000	180.19	45	0.0000	173.94
1042	-100.0	193.31	1043	-100.0	186.70	1044	-100.0	180.19	1045	-100.0	173.94
2042	-2100.	193.31	2043	-2100.	186.70	2044	-2100.	180.19	2045	-2100.	173.94
46	0.0000	167.97	47	0.0000	162.17	48	0.0000	156.51	49	0.0000	149.07
1046	-100.0	167.97	1047	-100.0	162.17	1048	-100.0	156.51	1049	-100.0	149.07
2046	-2100.	167.97	2047	-2100.	162.17	2048	-2100.	156.51	2049	-2100.	149.07
50	0.0000	138.07	51	0.0000	124.61	52	0.0000	111.28	53	0.0000	97.83
1050	-100.0	138.07	1051	-100.0	124.61	1052	-100.0	111.28	1053	-100.0	97.83
2050	-2100.	138.06	2051	-2100.	124.61	2052	-2100.	111.28	2053	-2100.	97.84
54	0.0000	84.82	55	0.0000	72.04	56	0.0000	59.45	57	0.0000	46.99
1054	-100.0	84.82	1055	-100.0	72.04	1056	-100.0	59.45	1057	-100.0	46.99
2054	-2100.	84.81	2055	-2100.	72.04	2056	-2100.	59.45	2057	-2100.	46.99
58	0.0000	34.62	59	0.0000	22.30	60	0.0000	10.00	61	0.0000	200.00
1058	-100.0	34.62	1059	-100.0	22.30	1060	-100.0	10.00	1061	-100.0	200.00
2058	-2100.	34.62	2059	-2100.	22.30	2060	-2100.	10.00	2061	-2100.	200.00
62	0.0000	193.14	63	0.0000	186.32	64	0.0000	179.49	65	0.0000	172.75
1062	-100.0	193.14	1063	-100.0	186.32	1064	-100.0	179.49	1065	-100.0	172.75
2062	-2100.	193.14	2063	-2100.	186.31	2064	-2100.	179.49	2065	-2100.	172.76

HAINESVILLE SALT DOME - LONG TERM EVALUATION AFTER DISSOLUTION TO -1700 FT. ELEV.

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
66	0.0000	166.88	67	0.0000	159.24	68	0.0000	131.36	69	0.0000	143.20
1066	-100.0	166.88	1067	-100.0	159.24	1068	-100.0	131.36	1069	-100.0	143.20
2066	-2100.	166.87	2067	-2100.	159.24	2068	-2100.	131.36	2069	-2100.	143.21
70	0.0000	132.96	71	0.0000	121.29	72	0.0000	109.80	73	0.0000	96.49
1070	-100.0	132.96	1071	-100.0	121.29	1072	-100.0	109.80	1073	-100.0	96.49
2070	-2100.	132.96	2071	-2100.	121.30	2072	-2100.	109.81	2073	-2100.	96.49
74	0.0000	83.95	75	0.0000	71.49	76	0.0000	59.88	77	0.0000	46.75
1074	-100.0	83.95	1075	-100.0	71.49	1076	-100.0	59.88	1077	-100.0	46.75
2074	-2100.	83.95	2075	-2100.	71.49	2076	-2100.	59.88	2077	-2100.	46.75
78	0.0000	34.47	79	0.0000	22.22	80	0.0000	10.00	81	0.0000	200.00
1078	-100.0	34.47	1079	-100.0	22.22	1080	-100.0	10.00	1081	-100.0	200.00
2078	-2100.	34.47	2079	-2100.	22.22	2080	-2100.	10.00	2081	-2100.	200.00
82	0.0000	192.93	83	0.0000	185.04	84	0.0000	178.72	85	0.0000	171.52
1082	-100.0	192.93	1083	-100.0	185.04	1084	-100.0	178.72	1085	-100.0	171.52
2082	-2100.	192.93	2083	-2100.	185.04	2084	-2100.	178.72	2085	-2100.	171.52
86	0.0000	164.27	87	0.0000	156.72	88	0.0000	148.57	89	0.0000	139.53
1086	-100.0	164.27	1087	-100.0	156.72	1088	-100.0	148.57	1089	-100.0	139.53
2086	-2100.	164.27	2087	-2100.	156.72	2088	-2100.	148.57	2089	-2100.	139.53
90	0.0000	129.53	91	0.0000	118.62	92	0.0000	107.85	93	0.0000	95.14
1090	-100.0	129.53	1091	-100.0	118.62	1092	-100.0	107.85	1093	-100.0	95.14
2090	-2100.	129.53	2091	-2100.	118.62	2092	-2100.	107.85	2093	-2100.	95.14
94	0.0000	83.04	95	0.0000	70.85	96	0.0000	58.67	97	0.0000	46.49
1094	-100.0	83.04	1095	-100.0	70.85	1096	-100.0	58.67	1097	-100.0	46.49
2094	-2100.	83.04	2095	-2100.	70.85	2096	-2100.	58.67	2097	-2100.	46.49
98	0.0000	34.31	99	0.0000	22.15	100	0.0000	10.00	101	0.0000	200.00
1098	-100.0	34.31	1099	-100.0	22.15	1100	-100.0	10.00	1101	-100.0	200.00
2098	-2100.	34.31	2099	-2100.	22.15	2100	-2100.	10.00	2101	-2100.	200.00
102	0.0000	192.69	103	0.0000	185.40	104	0.0000	177.98	105	0.0000	170.45
1102	-100.0	192.69	1103	-100.0	185.40	1104	-100.0	177.98	1105	-100.0	170.45
2102	-2100.	192.70	2103	-2100.	185.39	2104	-2100.	177.98	2105	-2100.	170.45
106	0.0000	162.73	107	0.0000	154.73	108	0.0000	146.19	109	0.0000	137.03
1106	-100.0	162.73	1107	-100.0	154.73	1108	-100.0	146.19	1109	-100.0	137.03
2106	-2100.	162.73	2107	-2100.	154.73	2108	-2100.	146.19	2109	-2100.	137.02
110	0.0000	127.09	111	0.0000	116.54	112	0.0000	105.42	113	0.0000	93.93
1110	-100.0	127.09	1111	-100.0	116.54	1112	-100.0	105.42	1113	-100.0	93.93
2110	-2100.	127.09	2111	-2100.	116.54	2112	-2100.	105.42	2113	-2100.	93.93
114	0.0000	82.15	115	0.0000	70.23	116	0.0000	58.25	117	0.0000	46.22
1114	-100.0	82.15	1115	-100.0	70.23	1116	-100.0	58.25	1117	-100.0	46.22
2114	-2100.	82.15	2115	-2100.	70.23	2116	-2100.	58.25	2117	-2100.	46.22
118	0.0000	34.15	119	0.0000	22.08	120	0.0000	10.00	121	0.0000	200.00
1118	-100.0	34.15	1119	-100.0	22.08	1120	-100.0	10.00	1121	-100.0	200.00
2118	-2100.	34.15	2119	-2100.	22.08	2120	-2100.	10.00	2121	-2100.	200.00
122	0.0000	192.51	123	0.0000	184.93	124	0.0000	177.36	125	0.0000	169.57
1122	-100.0	192.51	1123	-100.0	184.93	1124	-100.0	177.36	1125	-100.0	169.57
2122	-2100.	192.51	2123	-2100.	184.94	2124	-2100.	177.36	2125	-2100.	169.58
126	0.0000	161.36	127	0.0000	153.25	128	0.0000	144.48	129	0.0000	135.21
1126	-100.0	161.36	1127	-100.0	153.25	1128	-100.0	144.48	1129	-100.0	135.21
2126	-2100.	161.36	2127	-2100.	153.24	2128	-2100.	144.48	2129	-2100.	135.21
130	0.0000	125.30	131	0.0000	115.01	132	0.0000	104.14	133	0.0000	92.91
1130	-100.0	125.30	1131	-100.0	115.01	1132	-100.0	104.14	1133	-100.0	92.91
2130	-2100.	125.30	2131	-2100.	115.01	2132	-2100.	104.14	2133	-2100.	92.91
134	0.0000	81.40	135	0.0000	69.70	136	0.0000	57.87	137	0.0000	45.97
1134	-100.0	81.40	1135	-100.0	69.70	1136	-100.0	57.87	1137	-100.0	45.97
2134	-2100.	81.40	2135	-2100.	69.70	2136	-2100.	57.87	2137	-2100.	45.97

HAINESVILLE SALT DOME - LONG TERM EVALUATION AFTER DESOLUTION TO -1700 FT. ELEV.

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
138	0.0000	34.00	139	0.0000	22.01	140	0.0000	10.00	141	0.0000	200.00
1138	-100.0	34.00	1139	-100.0	22.01	1140	-100.0	10.00	1141	-100.0	200.00
2138	-2100.	34.00	2139	-2100.	22.01	2140	-2100.	10.00	2141	-2100.	200.00
142	0.0000	192.37	143	0.0000	184.70	144	0.0000	176.89	145	0.0000	168.96
1142	-100.0	192.37	1143	-100.0	184.70	1144	-100.0	176.89	1145	-100.0	168.96
2142	-2100.	192.37	2143	-2100.	184.69	2144	-2100.	176.89	2145	-2100.	168.96
146	0.0000	160.75	147	0.0000	152.18	148	0.0000	143.32	149	0.0000	133.99
1146	-100.0	160.75	1147	-100.0	152.18	1148	-100.0	143.32	1149	-100.0	133.99
2146	-2100.	160.75	2147	-2100.	152.19	2148	-2100.	143.32	2149	-2100.	133.99
150	0.0000	124.19	151	0.0000	113.91	152	0.0000	103.22	153	0.0000	92.16
1150	-100.0	124.19	1151	-100.0	113.91	1152	-100.0	103.22	1153	-100.0	92.16
2150	-2100.	124.19	2151	-2100.	113.91	2152	-2100.	103.22	2153	-2100.	92.16
154	0.0000	80.83	155	0.0000	69.27	156	0.0000	57.57	157	0.0000	45.77
1154	-100.0	80.83	1155	-100.0	69.27	1156	-100.0	57.57	1157	-100.0	45.77
2154	-2100.	80.83	2155	-2100.	69.27	2156	-2100.	57.57	2157	-2100.	45.77
158	0.0000	33.88	159	0.0000	21.95	160	0.0000	10.00	161	0.0000	200.00
1158	-100.0	33.88	1159	-100.0	21.95	1160	-100.0	10.00	1161	-100.0	200.00
2158	-2100.	33.88	2159	-2100.	21.95	2160	-2100.	10.00	2161	-2100.	200.00
162	0.0000	192.26	163	0.0000	184.46	164	0.0000	176.61	165	0.0000	168.56
1162	-100.0	192.26	1163	-100.0	184.46	1164	-100.0	176.61	1165	-100.0	168.56
2162	-2100.	192.26	2163	-2100.	184.47	2164	-2100.	176.61	2165	-2100.	168.56
166	0.0000	160.26	167	0.0000	151.59	168	0.0000	142.68	169	0.0000	133.31
1166	-100.0	160.26	1167	-100.0	151.59	1168	-100.0	142.68	1169	-100.0	133.31
2166	-2100.	160.26	2167	-2100.	151.60	2168	-2100.	142.67	2169	-2100.	133.31
170	0.0000	123.51	171	0.0000	113.26	172	0.0000	102.66	173	0.0000	91.71
1170	-100.0	123.51	1171	-100.0	113.26	1172	-100.0	102.66	1173	-100.0	91.71
2170	-2100.	123.51	2171	-2100.	113.27	2172	-2100.	102.67	2173	-2100.	91.71
174	0.0000	80.48	175	0.0000	69.01	176	0.0000	57.38	177	0.0000	45.63
1174	-100.0	80.48	1175	-100.0	69.01	1176	-100.0	57.38	1177	-100.0	45.63
2174	-2100.	80.48	2175	-2100.	69.01	2176	-2100.	57.38	2177	-2100.	45.63
178	0.0000	33.88	179	0.0000	21.91	180	0.0000	10.00	181	0.0000	200.00
1178	-100.0	33.88	1179	-100.0	21.91	1180	-100.0	10.00	1181	-100.0	200.00
2178	-2100.	33.88	2179	-2100.	21.91	2180	-2100.	10.00	2181	-2100.	200.00
182	0.0000	192.23	183	0.0000	184.38	184	0.0000	176.51	185	0.0000	168.45
1182	-100.0	192.23	1183	-100.0	184.38	1184	-100.0	176.51	1185	-100.0	168.45
2182	-2100.	192.22	2183	-2100.	184.38	2184	-2100.	176.51	2185	-2100.	168.44
186	0.0000	160.09	187	0.0000	151.43	188	0.0000	142.46	189	0.0000	133.09
1186	-100.0	160.09	1187	-100.0	151.43	1188	-100.0	142.46	1189	-100.0	133.09
2186	-2100.	160.09	2187	-2100.	151.43	2188	-2100.	142.46	2189	-2100.	133.09
190	0.0000	123.30	191	0.0000	113.04	192	0.0000	102.49	193	0.0000	91.56
1190	-100.0	123.30	1191	-100.0	113.04	1192	-100.0	102.49	1193	-100.0	91.56
2190	-2100.	123.29	2191	-2100.	113.04	2192	-2100.	102.49	2193	-2100.	91.56
194	0.0000	80.36	195	0.0000	68.93	196	0.0000	57.32	197	0.0000	45.59
1194	-100.0	80.36	1195	-100.0	68.93	1196	-100.0	57.32	1197	-100.0	45.59
2194	-2100.	80.36	2195	-2100.	68.93	2196	-2100.	57.32	2197	-2100.	45.59
198	0.0000	33.77	199	0.0000	21.90	200	0.0000	10.00	201	0.0000	170.00
1198	-100.0	33.77	1199	-100.0	21.90	1200	-100.0	10.00	1201	-100.0	169.99
2198	-2100.	33.77	2199	-2100.	21.90	2200	-2100.	10.00	2201	-300.0	169.96
									3201	-500.0	169.94
									4201	-700.0	169.93
									5201	-1000.	169.92
									6201	-1300.	169.89
									7201	-1670.	169.88
									8201	-1700.	169.88

HAINESVILLE SALT DOME - LONG TERM EVALUATION AFTER DESOLUTION TO -1700 FT. ELEV.

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
202	0.0000	170.00	203	0.0000	170.00	204	0.0000	170.00	205	0.0000	169.73
1202	-100.0	169.97	1203	-100.0	169.91	1204	-100.0	169.79	1205	-100.0	169.72
2202	-300.0	169.91	2203	-300.0	169.76	2204	-300.0	169.68	2205	-1250.	169.17
3202	-500.0	169.83	3203	-500.0	169.64	3204	-500.0	169.58	3205	-1600.	169.02
4202	-700.0	169.79	4203	-700.0	169.54	4204	-700.0	169.49	4205	-1670.	168.99
5202	-1000.	169.72	5203	-1000.	169.42	5204	-1000.	169.35	5205	-1700.	168.98
6202	-1300.	169.68	6203	-1300.	169.31	6204	-1300.	169.23	6205	-1740.	168.97
7202	-1670.	169.66	7203	-1670.	169.24	7204	-1670.	169.18			
8202	-1700.	169.66	8203	-1700.	169.20	8204	-1700.	169.09			
206	0.0000	169.11	207	0.0000	167.79	208	0.0000	166.63	209	0.0000	165.78
1206	-100.0	169.11	1207	-100.0	167.79	1208	-100.0	166.63	1209	-100.0	165.78
2206	-1250.	168.79	2207	-1250.	167.75	2208	-1250.	166.63	2209	-2100.	165.77
3206	-1600.	168.69	3207	-1600.	167.74	3208	-2100.	166.65			
4206	-2100.	168.57	4207	-2100.	167.74						
210	0.0000	166.20	211	0.0000	170.00	212	0.0000	170.00	213	0.0000	170.00
1210	-100.0	166.20	1211	-100.0	169.99	1212	-100.0	169.97	1213	-100.0	169.90
2210	-2100.	166.21	2211	-300.0	169.96	2212	-300.0	169.90	2213	-300.0	169.73
			3211	-500.0	169.94	3212	-500.0	169.83	3213	-500.0	169.60
			4211	-700.0	169.92	4212	-700.0	169.77	4213	-700.0	169.49
			5211	-1000.	169.90	5212	-1000.	169.69	5213	-1000.	169.35
			6211	-1300.	169.88	6212	-1300.	169.64	6213	-1300.	169.24
			7211	-1670.	169.87	7212	-1670.	169.62	7213	-1670.	169.16
			8211	-1700.	169.87	8212	-1700.	169.62	8213	-1700.	169.16
214	0.0000	170.00	215	0.0000	169.70	216	0.0000	169.20	217	0.0000	167.52
1214	-100.0	169.76	1215	-100.0	169.60	1216	-100.0	169.08	1217	-100.0	167.52
2214	-300.0	169.64	2215	-1250.	169.07	2216	-1250.	168.65	2217	-1250.	167.47
3214	-500.0	169.53	3215	-1600.	168.91	3216	-1600.	168.54	3217	-1600.	167.46
4214	-700.0	169.43	4215	-1670.	168.88	4216	-2100.	168.41	4217	-2100.	167.46
5214	-1000.	169.28	5215	-1700.	168.87						
6214	-1300.	169.14	6215	-1740.	168.86						
7214	-1670.	169.00									
8214	-1700.	168.99									
218	0.0000	166.16	219	0.0000	164.97	220	0.0000	164.99	221	0.0000	170.00
1218	-100.0	166.16	1219	-100.0	164.97	1220	-100.0	164.99	1221	-100.0	169.98
2218	-1250.	166.18	2219	-2100.	164.98	2220	-2100.	165.00	2221	-300.0	169.96
3218	-2100.	166.18							3221	-500.0	169.93
									4221	-700.0	169.91
									5221	-1000.	169.88
									6221	-1300.	169.86
									7221	-1670.	169.85
									8221	-1700.	169.85
222	0.0000	170.00	223	0.0000	170.00	224	0.0000	170.00	225	0.0000	169.62
1222	-100.0	169.96	1223	-100.0	169.87	1224	-100.0	169.69	1225	-100.0	169.59
2222	-300.0	169.88	2223	-300.0	169.65	2224	-300.0	169.54	2225	-1250.	168.88
3222	-500.0	169.79	3223	-500.0	169.49	3224	-500.0	169.40	3225	-1600.	168.59
4222	-700.0	169.71	4223	-700.0	169.35	4224	-700.0	169.26	4225	-1670.	168.56
5222	-1000.	169.61	5223	-1000.	169.17	5224	-1000.	169.07	5225	-1700.	168.54
6222	-1300.	169.55	6223	-1300.	169.02	6224	-1300.	168.90	6225	-1740.	168.52
7222	-1670.	169.52	7223	-1670.	168.92	7224	-1670.	168.72			
8222	-1700.	169.52	8223	-1700.	168.92	8224	-1700.	168.70			
226	0.0000	168.70	227	0.0000	166.73	228	0.0000	164.88	229	0.0000	162.68
1226	-100.0	168.70	1227	-100.0	166.73	1228	-100.0	164.88	1229	-100.0	162.68
2226	-1250.	168.25	2227	-1250.	166.67	2228	-1250.	164.83	2229	-2100.	162.65
3226	-1600.	168.11	3227	-1600.	166.66	3228	-2100.	164.84			
4226	-2100.	167.94	4227	-2100.	166.66						
230	0.0000	161.54	231	0.0000	170.00	232	0.0000	170.00	233	0.0000	170.00
1230	-100.0	161.54	1231	-100.0	169.98	1232	-100.0	169.95	1233	-100.0	169.83
2230	-2100.	161.55	2231	-300.0	169.94	2232	-300.0	169.84	2233	-300.0	169.53
			3231	-500.0	169.91	3232	-500.0	169.72	3233	-500.0	169.31
			4231	-700.0	169.88	4232	-700.0	169.62	4233	-700.0	169.13
			5231	-1000.	169.85	5232	-1000.	169.49	5233	-1000.	168.89
			6231	-1300.	169.82	6232	-1300.	169.41	6233	-1300.	168.69
			7231	-1670.	169.80	7232	-1670.	169.30	7233	-1670.	168.56
			8231	-1700.	169.80	8232	-1700.	169.37	8233	-1700.	168.56

HAINSVILLE SALT DOME - LONG TERM EVALUATION AFTER DESOLUTION TO -1700 FT. ELEV.

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
234	0.0000	170.00	235	0.0000	169.48	236	0.0000	168.25	237	0.0000	165.56
1234	-100.0	169.59	1235	-100.0	169.45	1236	-100.0	168.25	1237	-100.0	165.56
2234	-300.0	169.38	2235	-1250.	168.48	2236	-1250.	167.65	2237	-1250.	165.47
3234	-500.0	169.19	3235	-1600.	168.12	3236	-1600.	167.46	3237	-1600.	165.43
4234	-700.0	169.01	4235	-1670.	168.07	4236	-2100.	167.23	4237	-2100.	165.46
5234	-1000.	168.76	5235	-1700.	168.03						
6234	-1300.	168.53	6235	-1740.	168.03						
7234	-1670.	168.29									
8234	-1700.	168.26									
238	0.0000	162.79	239	0.0000	159.23	240	0.0000	156.57	241	0.0000	170.00
1238	-100.0	162.79	1239	-100.0	159.23	1240	-100.0	156.57	1241	-100.0	169.98
2238	-1250.	162.82	2239	-2100.	159.21	2240	-2100.	156.57	2241	-300.0	169.93
3238	-2100.	162.82							3241	-500.0	169.89
									4241	-700.0	169.86
									5241	-1000.	169.82
									6241	-1300.	169.78
									7241	-1670.	169.77
									8241	-1700.	169.77
242	0.0000	170.00	243	0.0000	170.00	244	0.0000	170.00	245	0.0000	169.33
1242	-100.0	169.93	1243	-100.0	169.78	1244	-100.0	169.46	1245	-100.0	169.28
2242	-300.0	169.79	2243	-300.0	169.48	2244	-300.0	169.20	2245	-1250.	167.92
3242	-500.0	169.65	3243	-500.0	169.11	3244	-500.0	168.95	3245	-1600.	167.56
4242	-700.0	169.51	4243	-700.0	168.86	4244	-700.0	168.72	4245	-1670.	167.49
5242	-1000.	169.34	5243	-1000.	168.56	5244	-1000.	168.30	5245	-1700.	167.47
6242	-1300.	169.24	6243	-1300.	168.38	6244	-1300.	168.08	6245	-1740.	167.43
7242	-1670.	169.20	7243	-1670.	168.13	7244	-1670.	167.77			
8242	-1700.	169.20	8243	-1700.	168.10	8244	-1700.	167.74			
246	0.0000	167.71	247	0.0000	164.15	248	0.0000	168.38	249	0.0000	155.11
1246	-100.0	167.71	1247	-100.0	164.15	1248	-100.0	168.38	1249	-100.0	155.11
2246	-1250.	166.93	2247	-1250.	164.04	2248	-1250.	168.01	2249	-2100.	155.08
3246	-1600.	166.60	3247	-1600.	164.02	3248	-2100.	168.42			
4246	-2100.	166.30	4247	-2100.	164.03						
250	0.0000	150.51	251	0.0000	170.00	252	0.0000	170.00	253	0.0000	170.00
1250	-100.0	150.51	1251	-100.0	169.97	1252	-100.0	169.91	1253	-100.0	169.73
2250	-2100.	150.51	2251	-300.0	169.92	2252	-300.0	169.73	2253	-300.0	169.24
			3251	-500.0	169.87	3252	-500.0	169.55	3253	-500.0	168.87
			4251	-700.0	169.82	4252	-700.0	169.40	4253	-700.0	168.64
			5251	-1000.	169.77	5252	-1000.	169.20	5253	-1000.	168.23
			6251	-1300.	169.73	6252	-1300.	169.07	6253	-1300.	167.91
			7251	-1670.	169.70	7252	-1670.	169.01	7253	-1670.	167.69
			8251	-1700.	169.70	8252	-1700.	169.01	8253	-1700.	167.69
254	0.0000	170.00	255	0.0000	169.16	256	0.0000	167.16	257	0.0000	162.72
1254	-100.0	169.33	1255	-100.0	169.11	1256	-100.0	167.16	1257	-100.0	162.72
2254	-300.0	169.01	2255	-1250.	167.43	2256	-1250.	166.19	2257	-1250.	162.58
3254	-500.0	168.78	3255	-1600.	166.98	3256	-1600.	165.89	3257	-1600.	162.55
4254	-700.0	168.42	4255	-1670.	166.98	4256	-2100.	165.52	4257	-2100.	162.57
5254	-1000.	168.01	5255	-1700.	166.87						
6254	-1300.	167.63	6255	-1740.	166.83						
7254	-1670.	167.24									
8254	-1700.	167.21									
258	0.0000	157.91	259	0.0000	150.05	260	0.0000	144.15	261	0.0000	170.00
1258	-100.0	157.91	1259	-100.0	150.05	1260	-100.0	144.15	1261	-100.0	169.97
2258	-1250.	157.95	2259	-2100.	150.02	2260	-2100.	144.15	2261	-300.0	169.90
3258	-2100.	157.95							3261	-500.0	169.86
									4261	-700.0	169.82
									5261	-1000.	169.76
									6261	-1300.	169.71
									7261	-1670.	169.69
									8261	-1700.	169.69
262	0.0000	170.00	263	0.0000	170.00	264	0.0000	170.00	265	0.0000	169.03
1262	-100.0	169.92	1263	-100.0	169.69	1264	-100.0	169.22	1265	-100.0	168.96
2262	-300.0	169.74	2263	-300.0	169.15	2264	-300.0	168.83	2265	-1250.	166.94
3262	-500.0	169.56	3263	-500.0	168.70	3264	-500.0	168.45	3265	-1600.	166.41
4262	-700.0	169.27	4263	-700.0	168.20	4264	-700.0	168.11	4265	-1670.	166.31
5262	-1000.	169.02	5263	-1000.	167.85	5264	-1000.	167.62	5265	-1700.	166.28
6262	-1300.	168.88	6263	-1300.	167.49	6264	-1300.	167.17	6265	-1740.	166.23
7262	-1670.	168.82	7263	-1670.	167.25	7264	-1670.	166.72			
8262	-1700.	168.82	8263	-1700.	167.26	8264	-1700.	166.60			

HAINSVILLE SALT DOME - LONG TERM EVALUATION AFTER DESOLUTION TO -1700 FT. ELEV.

STEADY STATE SOLUTION WITH NO SURFACE FLUX

NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD	NODE	DEPTH	HEAD
266	0.0000	166.68	267	0.0000	161.48	268	0.0000	155.80	269	0.0000	147.15
1266	-100.0	166.68	1267	-100.0	161.48	1268	-100.0	155.80	1269	-100.0	147.15
2266	-1250.	165.53	2267	-1250.	161.32	2268	-1250.	155.84	2269	-2100.	147.14
3266	-1600.	165.17	3267	-1600.	161.29	3268	-2100.	155.86			
4266	-2100.	164.70	4267	-2100.	161.30						
270	0.0000	138.56	271	0.0000	170.00	272	0.0000	170.00	273	0.0000	170.00
1270	-100.0	138.54	1271	-100.0	169.96	1272	-100.0	169.91	1273	-100.0	169.66
2270	-2100.	138.56	2271	-300.0	169.88	2272	-300.0	169.72	2273	-300.0	169.07
			3271	-500.0	169.81	3272	-500.0	169.52	3273	-500.0	168.67
			4271	-700.0	169.80	4272	-700.0	169.20	4273	-700.0	168.02
			5271	-1000.	169.72	5272	-1000.	168.94	5273	-1000.	167.64
			6271	-1300.	169.67	6272	-1300.	168.78	6273	-1300.	167.26
			7271	-1670.	169.63	7272	-1670.	168.72	7273	-1670.	167.08
			8271	-1700.	169.63	8272	-1700.	168.72	8273	-1700.	167.09
274	0.0000	170.00	275	0.0000	168.93	276	0.0000	166.37	277	0.0000	168.67
1274	-100.0	169.15	1275	-100.0	168.86	1276	-100.0	166.37	1277	-100.0	168.67
2274	-300.0	168.72	2275	-1250.	166.65	2276	-1250.	165.11	2277	-1250.	168.49
3274	-500.0	168.31	3275	-1600.	166.07	3276	-1600.	164.72	3277	-1600.	168.45
4274	-700.0	167.93	4275	-1670.	165.97	4276	-2100.	164.25	4277	-2100.	168.47
5274	-1000.	167.39	5275	-1700.	165.93						
6274	-1300.	166.91	6275	-1740.	165.88						
7274	-1670.	166.42									
8274	-1700.	166.37									
278	0.0000	154.40	279	0.0000	144.76	280	0.0000	135.81	281	0.0000	170.00
1278	-100.0	154.40	1279	-100.0	144.76	1280	-100.0	135.81	1281	-100.0	169.97
2278	-1250.	154.40	2279	-2100.	144.72	2280	-2100.	135.83	2281	-300.0	169.91
3278	-2100.	154.40							3281	-500.0	169.85
									4281	-700.0	169.78
									5281	-1000.	169.72
									6281	-1300.	169.68
									7281	-1670.	169.65
									8281	-1700.	169.65
282	0.0000	170.00	283	0.0000	170.00	284	0.0000	170.00	285	0.0000	168.98
1282	-100.0	169.80	1283	-100.0	169.64	1284	-100.0	169.13	1285	-100.0	168.82
2282	-300.0	169.68	2283	-300.0	169.20	2284	-300.0	168.78	2285	-1250.	166.64
3282	-500.0	169.39	3283	-500.0	168.51	3284	-500.0	168.30	3285	-1600.	166.35
4282	-700.0	169.22	4283	-700.0	168.25	4284	-700.0	167.93	4285	-1670.	165.94
5282	-1000.	168.96	5283	-1000.	167.69	5284	-1000.	167.40	5285	-1700.	165.91
6282	-1300.	168.79	6283	-1300.	167.26	6284	-1300.	166.91	6285	-1740.	165.85
7282	-1670.	168.71	7283	-1670.	166.99	7284	-1670.	166.40			
8282	-1700.	168.71	8283	-1700.	166.99	8284	-1700.	166.35			
286	0.0000	166.26	287	0.0000	160.39	288	0.0000	153.91	289	0.0000	143.92
1286	-100.0	166.26	1287	-100.0	160.39	1288	-100.0	153.91	1289	-100.0	143.92
2286	-1250.	165.09	2287	-1250.	160.21	2288	-1250.	153.95	2289	-2100.	143.89
3286	-1600.	164.61	3287	-1600.	160.17	3288	-2100.	153.95			
4286	-2100.	164.11	4287	-2100.	160.19						
290	0.0000	133.81									
1290	-100.0	133.81									
2290	-2100.	133.82									

APPENDIX J

DOSE RESULTS

APPENDIX J

DOSE RESULTS

Listed in this appendix are the computer output from the PABLM dose model calculations. Dose burdens are reported by radionuclide, by organ, for times of intrusion 100 and 1000 yr after closure, and for differing time periods of ingestion. All doses presented are for total lifetimes, taken to be 70 yr.

The term "plant life" refers to the time of ingestion of salt. This is also included in the title information of 1/70, 10/70, 25/70, and 50/70, respectively, representing ingestions of 1, 10, 25, and 50 years for the 70-yr lifetime. The term "MI" stands for maximum individual, taken to be a person who consumes 1800 g of salt from the contaminated mine each year. The term "POP" stands for population doses, taken to be for 15 million such maximum individuals.

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082379
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 100 YEAR DECAY, 1710 MI
*** DOSE COMMITMENT SUMMARY FOR DOSE-YEAR 70 OF A 1. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE		TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
H	3	5.0E-06	0	.0	0	5.0E-06	0	5.0E-06	0
C	14	2.5E-03	0	1.3E-04	0	2.5E-03	0	2.5E-03	0
NI	59	1.6E-04	0	9.4E-04	0	.0	0	.0	0
NI	63	2.8E-02	0	8.3E-01	0	.0	0	.0	0
SE	79	5.0E-06	0	.0	0	.0	0	.0	0
PD	107	3.0E-08	0	.0	0	.0	0	.0	0
EU	154	4.8E-04	0	5.5E-05	0	.0	0	.0	0
U	234	2.3E-01	0	3.7E-02	0	.0	0	.0	0
U	236	3.6E-04	0	5.8E-03	0	.0	0	.0	0
SR	90	1.7E+02	85	7.2E+02	75	.0	0	.0	0
Y	90	4.0E-05	0	1.8E-03	0	.0	0	.0	0
ZR	93	9.8E-08	0	3.7E-06	0	.0	0	.0	0
NB	93M	1.8E-07	0	2.5E-06	0	.0	0	.0	0
TC	99	1.9E-05	0	8.7E-05	0	5.8E-06	0	.0	0
SN	126	5.1E-05	0	1.8E-03	0	.0	0	1.0E-08	0
SB	126M	.0	0	.0	0	.0	0	.0	0
SB	126	9.0E-08	0	1.2E-07	0	.0	0	2.8E-09	0
I	129	8.0E-06	0	2.8E-06	0	.0	0	6.3E-03	99
CS	135	8.6E-05	0	2.1E-04	0	2.2E-03	0	.0	0
CS	137	2.1E+01	9	2.3E+01	2	3.7E+00	99	.0	0
BA	137M	.0	0	.0	0	.0	0	.0	0
SM	151	1.4E-05	0	3.5E-04	0	.0	0	.0	0
TH	230	2.7E-06	0	8.7E-05	0	.0	0	.0	0
RA	226	1.8E-04	0	2.7E-04	0	.0	0	.0	0
RN	222	.0	0	.0	0	.0	0	.0	0
PB	210	2.2E-07	0	6.2E-06	0	.0	0	.0	0
BI	210	1.3E-10	0	1.8E-10	0	.0	0	.0	0
PO	210	.0	0	.0	0	.0	0	.0	0
NP	237	8.4E-04	0	1.9E-02	0	.0	0	.0	0
PA	233	1.0E-08	0	6.0E-05	0	.0	0	.0	0
U	233	.0	0	.0	0	.0	0	.0	0
TH	229	.0	0	.0	0	.0	0	.0	0
RA	225	.0	0	.0	0	.0	0	.0	0
AC	225	.0	0	.0	0	.0	0	.0	0
U	238	4.4E-04	0	7.8E-03	0	.0	0	.0	0
TH	234	.0	0	.0	0	.0	0	.0	0
PA	234M	.0	0	.0	0	.0	0	.0	0
PA	234	.0	0	.0	0	.0	0	.0	0
CM	242	9.1E-05	0	2.1E-03	0	.0	0	.0	0
PU	242	1.3E-03	0	2.5E-02	0	.0	0	.0	0
NP	238	.0	0	.0	0	.0	0	.0	0
PU	238	6.4E-01	0	1.3E+01	1	.0	0	.0	0
CM	244	2.7E-02	0	6.8E-01	0	.0	0	.0	0
PU	244	.0	0	.0	0	.0	0	.0	0
U	240	.0	0	.0	0	.0	0	.0	0
PU	240	3.0E-01	0	7.9E+00	0	.0	0	.0	0
AM	243	2.9E-02	0	7.9E-01	0	.0	0	.0	0
NP	239	2.0E-08	0	5.3E-07	0	.0	0	.0	0
PU	239	2.1E-01	0	4.8E+00	0	.0	0	.0	0
PU	241	1.0E-02	0	2.8E-01	0	.0	0	.0	0
AM	241	7.2E+00	3	1.9E+02	19	.0	0	.0	0
TOTALS		2.2E+02	100	9.6E+02	100	3.7E+00	100	6.3E-03	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION 082779
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 100 YEAR DECAY, 1/70 POP
*** DOSE COMMITMENT SUMMARY FOR DOSE-YEAR 70 OF A 1. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE		TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
H	3	7.5E+01	0	.0	0	7.5E+01	0	7.5E+01	0
C	14	3.8E+02	0	1.9E+03	0	3.8E+02	0	3.8E+02	0
NI	59	2.3E+03	0	1.4E+04	0	.0	0	.0	0
NI	63	4.2E+05	0	1.2E+07	0	.0	0	.0	0
SE	79	7.5E+01	0	.0	0	.0	0	.0	0
PD	107	4.5E-01	0	.0	0	.0	0	.0	0
EU	154	7.2E+01	0	6.2E+02	0	.0	0	.0	0
U	234	3.4E+04	0	5.5E+05	0	.0	0	.0	0
U	236	5.4E+03	0	6.7E+04	0	.0	0	.0	0
SR	90	2.9E+09	86	1.1E+10	75	.0	0	.0	0
Y	90	7.2E+02	0	2.7E+04	0	.0	0	.0	0
ZR	93	1.5E+00	0	5.6E+01	0	.0	0	.0	0
NB	93M	2.8E+00	0	3.4E+01	0	.0	0	.0	0
TC	99	2.8E+02	0	7.0E+02	0	6.8E+01	0	.0	0
SN	126	7.7E+02	0	2.7E+04	0	.0	0	1.6E+02	0
SB	126M	.0	0	.0	0	.0	0	.0	0
SB	126	7.6E-01	0	1.8E+00	0	.0	0	3.7E-02	0
I	129	1.2E+02	0	4.2E+01	0	.0	0	9.4E+04	99
CS	135	1.3E+03	0	3.2E+03	0	3.3E+02	0	.0	0
CS	137	3.1E+08	9	3.5E+08	2	5.5E+07	99	.0	0
BA	137M	.0	0	.0	0	.0	0	.0	0
SM	151	2.2E+02	0	5.2E+03	0	.0	0	.0	0
TH	230	4.0E+01	0	1.3E+03	0	.0	0	.0	0
RA	226	2.7E+03	0	4.0E+03	0	.0	0	.0	0
RN	222	.0	0	.0	0	.0	0	.0	0
PB	210	3.3E+00	0	9.2E+01	0	.0	0	.0	0
BI	210	1.0E-01	0	2.8E-03	0	.0	0	.0	0
PO	210	.0	0	.0	0	.0	0	.0	0
NP	237	1.3E+04	0	2.9E+05	0	.0	0	.0	0
PA	233	1.6E-01	0	9.0E-01	0	.0	0	.0	0
U	233	.0	0	.0	0	.0	0	.0	0
TH	229	.0	0	.0	0	.0	0	.0	0
RA	225	.0	0	.0	0	.0	0	.0	0
AC	225	.0	0	.0	0	.0	0	.0	0
U	238	6.5E+03	0	1.1E+05	0	.0	0	.0	0
TH	234	.0	0	.0	0	.0	0	.0	0
PA	234M	.0	0	.0	0	.0	0	.0	0
PA	234	.0	0	.0	0	.0	0	.0	0
CM	242	1.4E+03	0	3.1E+04	0	.0	0	.0	0
PU	242	1.9E+04	0	3.8E+05	0	.0	0	.0	0
NP	238	.0	0	.0	0	.0	0	.0	0
PU	238	9.5E+06	0	1.9E+08	1	.0	0	.0	0
CM	244	4.8E+05	0	9.6E+06	0	.0	0	.0	0
PU	244	.0	0	.0	0	.0	0	.0	0
U	240	.0	0	.0	0	.0	0	.0	0
PU	240	5.7E+06	0	1.2E+08	0	.0	0	.0	0
AM	243	4.4E+05	0	1.2E+07	0	.0	0	.0	0
NP	239	4.3E-01	0	7.9E+00	0	.0	0	.0	0
PU	239	3.5E+06	0	7.2E+07	0	.0	0	.0	0
PU	241	1.4E+05	0	4.1E+06	0	.0	0	.0	0
AM	241	1.1E+08	3	2.8E+09	19	.0	0	.0	0
TOTALS		3.3E+09	100	1.4E+10	100	5.5E+07	100	9.5E+04	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082378
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 100 YEAR DECAY, 10378 MI
*** DOSE COMMITMENT SUMMARY FOR DOSE-YEAR 70 OF A 10. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE		TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
H	3	5.0E-05	0	.0	0	5.0E-05	0	5.0E-05	0
C	14	2.3E-04	0	1.3E-03	0	2.3E-04	0	2.3E-04	0
NI	59	1.4E-03	0	9.4E-03	0	.0	0	.0	0
NI	63	2.2E-01	0	8.3E+00	0	.0	0	.0	0
SE	79	5.0E-05	0	.0	0	.0	0	.0	0
PD	107	3.0E-07	0	.0	0	.0	0	.0	0
EU	154	8.8E-05	0	5.5E-04	0	.0	0	.0	0
U	234	2.3E-02	0	3.7E-01	0	.0	0	.0	0
U	236	3.6E-03	0	5.8E-02	0	.0	0	.0	0
SR	90	1.9E+03	85	7.2E+03	75	.0	0	.0	0
Y	90	4.8E-04	0	1.8E-02	0	.0	0	.0	0
ZR	93	9.8E-07	0	3.7E-05	0	.0	0	.0	0
NB	93M	1.8E-06	0	2.3E-05	0	.0	0	.0	0
TC	99	1.9E-04	0	4.7E-04	0	5.3E-05	0	.0	0
SN	126	5.1E-04	0	1.3E-02	0	.0	0	1.0E-04	0
SB	126M	.0	0	.0	0	.0	0	.0	0
SB	126	5.8E-07	0	1.2E-06	0	.0	0	2.4E-08	0
I	129	8.0E-05	0	2.5E-05	0	.0	0	6.3E-02	99
CS	135	8.6E-04	0	2.1E-03	0	2.2E-04	0	.0	0
CS	137	2.1E+02	9	2.3E+02	2	3.7E+01	99	.0	0
BA	137M	.0	0	.0	0	.0	0	.0	0
SM	151	1.4E-08	0	3.3E-03	0	.0	0	.0	0
TH	230	2.5E-05	0	8.2E-04	0	.0	0	.0	0
RA	226	1.7E-03	0	2.6E-03	0	.0	0	.0	0
RN	222	.0	0	.0	0	.0	0	.0	0
PB	210	2.2E-06	0	6.2E-05	0	.0	0	.0	0
BI	210	1.1E-09	0	1.8E-09	0	.0	0	.0	0
PO	210	.0	0	.0	0	.0	0	.0	0
NP	237	8.0E-03	0	1.6E-01	0	.0	0	.0	0
PA	233	1.0E-07	0	6.0E-07	0	.0	0	.0	0
U	233	.0	0	.0	0	.0	0	.0	0
TH	229	.0	0	.0	0	.0	0	.0	0
RA	225	.0	0	.0	0	.0	0	.0	0
AC	225	.0	0	.0	0	.0	0	.0	0
U	238	4.4E-03	0	7.4E-02	0	.0	0	.0	0
TH	234	.0	0	.0	0	.0	0	.0	0
PA	234M	.0	0	.0	0	.0	0	.0	0
PA	234	.0	0	.0	0	.0	0	.0	0
CM	242	9.1E-04	0	2.1E-02	0	.0	0	.0	0
PU	242	1.2E-02	0	2.4E-01	0	.0	0	.0	0
NP	238	.0	0	.0	0	.0	0	.0	0
PU	238	6.1E+00	0	1.2E+02	1	.0	0	.0	0
CM	244	2.6E-01	0	6.5E+00	0	.0	0	.0	0
PU	244	.0	0	.0	0	.0	0	.0	0
U	240	.0	0	.0	0	.0	0	.0	0
PU	240	3.4E+00	0	7.4E+01	0	.0	0	.0	0
AM	243	2.8E-01	0	7.5E+00	0	.0	0	.0	0
NP	239	2.8E-07	0	5.3E-06	0	.0	0	.0	0
PU	239	2.2E+00	0	4.5E+01	0	.0	0	.0	0
PU	241	1.0E-01	0	2.7E+00	0	.0	0	.0	0
AM	241	6.9E+01	3	1.8E+03	18	.0	0	.0	0
TOTALS		2.2E+03	100	9.5E+03	100	3.7E+01	100	6.3E-02	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082379
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 100 YEAR DECAY, 10770 POP
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 10. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
H 3	7.5E+02	0	.0	0	7.5E+02	0	7.5E+02	0
C 14	3.8E+03	0	1.9E+04	0	3.8E+03	0	3.8E+03	0
NI 59	2.3E+04	0	1.4E+05	0	.0	0	.0	0
NI 63	4.2E+06	0	1.2E+08	0	.0	0	.0	0
SE 79	7.5E+02	0	.0	0	.0	0	.0	0
PD 107	4.5E+00	0	.0	0	.0	0	.0	0
EU 154	7.2E+02	0	8.2E+03	0	.0	0	.0	0
U 234	3.4E+05	0	5.5E+06	0	.0	0	.0	0
U 236	5.4E+04	0	8.7E+05	0	.0	0	.0	0
SR 90	2.9E+10	85	1.1E+11	79	.0	0	.0	0
Y 90	7.2E+03	0	2.7E+05	0	.0	0	.0	0
ZR 93	1.5E+01	0	5.6E+02	0	.0	0	.0	0
NB 93M	2.8E+01	0	3.8E+02	0	.0	0	.0	0
TC 99	2.8E+03	0	7.0E+03	0	6.8E+02	0	.0	0
SN 126	7.7E+03	0	2.7E+05	0	.0	0	1.6E+03	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	7.6E+00	0	1.8E+01	0	.0	0	3.7E-01	0
I 129	1.8E+03	0	4.2E+02	0	.0	0	9.8E+05	99
CS 135	1.3E+04	0	3.2E+04	0	3.3E+03	0	.0	0
CS 137	3.1E+09	9	3.5E+09	2	5.5E+08	99	.0	0
BA 137M	.0	0	.0	0	.0	0	.0	0
SM 151	2.8E+03	0	5.2E+04	0	.0	0	.0	0
TH 230	3.9E+02	0	1.2E+04	0	.0	0	.0	0
RA 226	2.0E+04	0	3.9E+04	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	3.3E+01	0	9.2E+02	0	.0	0	.0	0
BI 210	1.6E-02	0	2.8E-02	0	.0	0	.0	0
PU 210	.0	0	.0	0	.0	0	.0	0
NP 237	1.2E+05	0	2.7E+06	0	.0	0	.0	0
PA 233	1.6E+00	0	9.0E+00	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 238	6.9E+04	0	1.1E+06	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	1.4E+04	0	3.1E+05	0	.0	0	.0	0
PU 242	1.8E+05	0	3.6E+06	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	9.1E+07	0	1.9E+09	1	.0	0	.0	0
CM 244	4.9E+06	0	9.5E+07	0	.0	0	.0	0
PU 244	.0	0	.0	0	.0	0	.0	0
U 240	.0	0	.0	0	.0	0	.0	0
PU 240	5.3E+07	0	1.1E+09	0	.0	0	.0	0
AM 243	4.2E+06	0	1.1E+08	0	.0	0	.0	0
NP 239	4.3E+00	0	7.9E+01	0	.0	0	.0	0
PU 239	5.3E+07	0	6.8E+08	0	.0	0	.0	0
PU 241	1.5E+06	0	4.1E+07	0	.0	0	.0	0
AM 241	1.0E+09	3	2.7E+10	18	.0	0	.0	0
TOTALS	3.5E+10	100	1.4E+11	100	5.5E+08	100	9.9E+05	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082179
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR NISAP SOLUTION MINING, DIRECT INGESTION 100 YEAR DECAY, 29379 MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 25. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE		TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
H	3	1.2E-04	0	.0	0	1.2E-04	0	1.2E-04	0
C	14	6.5E-04	0	3.1E-03	0	6.3E-04	0	6.3E-04	0
NI	59	3.9E-03	0	2.3E-02	0	.0	0	.0	0
NI	63	7.0E-01	0	2.1E+01	0	.0	0	.0	0
SE	79	1.3E-04	0	.0	0	.0	0	.0	0
PD	107	7.3E-07	0	.0	0	.0	0	.0	0
EU	154	1.2E-04	0	1.4E-03	0	.0	0	.0	0
U	234	5.7E-02	0	9.2E-01	0	.0	0	.0	0
U	236	8.9E-03	0	1.4E-01	0	.0	0	.0	0
SR	90	4.8E+03	87	1.8E+04	77	.0	0	.0	0
Y	90	1.2E-03	0	4.5E-02	0	.0	0	.0	0
ZR	93	2.4E-06	0	9.3E-03	0	.0	0	.0	0
NB	93M	4.6E-06	0	5.7E-05	0	.0	0	.0	0
TC	99	4.7E-06	0	1.2E-03	0	1.5E-04	0	.0	0
SN	126	1.3E-03	0	4.5E-02	0	.0	0	2.6E-04	0
SB	126M	.0	0	.0	0	.0	0	.0	0
SB	126	1.3E-06	0	3.0E-06	0	.0	0	6.1E-08	0
I	129	2.0E-04	0	7.1E-05	0	.0	0	1.6E-01	99
CS	135	2.2E-03	0	5.3E-03	0	5.5E-04	0	.0	0
CS	137	5.2E+02	9	5.8E+02	2	9.2E+01	99	.0	0
BA	137M	.0	0	.0	0	.0	0	.0	0
SM	151	3.6E-08	0	8.7E-03	0	.0	0	.0	0
TH	230	5.6E-05	0	1.9E-03	0	.0	0	.0	0
RA	226	4.2E-03	0	6.0E-03	0	.0	0	.0	0
RN	222	.0	0	.0	0	.0	0	.0	0
PB	210	5.4E-06	0	1.3E-04	0	.0	0	.0	0
BI	210	2.6E-09	0	4.6E-09	0	.0	0	.0	0
PO	210	.0	0	.0	0	.0	0	.0	0
NP	237	1.8E-02	0	4.1E-01	0	.0	0	.0	0
PA	233	2.0E-07	0	1.5E-06	0	.0	0	.0	0
U	233	.0	0	.0	0	.0	0	.0	0
TH	229	.0	0	.0	0	.0	0	.0	0
RA	225	.0	0	.0	0	.0	0	.0	0
AC	225	.0	0	.0	0	.0	0	.0	0
U	238	1.3E-02	0	1.8E-01	0	.0	0	.0	0
TH	234	.0	0	.0	0	.0	0	.0	0
PA	234M	.0	0	.0	0	.0	0	.0	0
PA	234	.0	0	.0	0	.0	0	.0	0
CM	242	2.3E-03	0	5.1E-02	0	.0	0	.0	0
PU	242	2.7E-02	0	5.4E-01	0	.0	0	.0	0
NP	238	.0	0	.0	0	.0	0	.0	0
PU	238	1.9E+01	0	2.9E+02	1	.0	0	.0	0
CM	244	6.9E-01	0	1.5E+01	0	.0	0	.0	0
PU	244	.0	0	.0	0	.0	0	.0	0
U	240	.0	0	.0	0	.0	0	.0	0
PU	240	6.0E+00	0	1.7E+02	0	.0	0	.0	0
AM	243	6.4E-01	0	1.7E+01	0	.0	0	.0	0
NP	239	7.1E-07	0	1.3E-05	0	.0	0	.0	0
PU	239	4.9E+00	0	1.0E+02	0	.0	0	.0	0
PU	241	2.5E-01	0	6.7E+00	0	.0	0	.0	0
AM	241	1.6E+02	3	4.1E+03	17	.0	0	.0	0
TOTALS		5.3E+03	100	2.3E+04	100	9.2E+01	100	1.6E-01	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 082379
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 100 YEAR DECAY, 25/70 POP
*** DOSE COMMITMENT SUMMARY FOR DOSE-YEAR 70 OF A 25. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
H 3	1.9E+03	0	.0	0	1.9E+03	0	1.9E+03	0
C 14	9.4E+03	0	6.7E+04	0	9.4E+03	0	9.4E+03	0
NI 59	5.9E+04	0	3.5E+05	0	.0	0	.0	0
NI 63	1.6E+07	0	3.1E+08	0	.0	0	.0	0
SE 79	1.9E+03	0	.0	0	.0	0	.0	0
PD 107	1.1E+01	0	.0	0	.0	0	.0	0
EU 154	1.6E+03	0	2.1E+04	0	.0	0	.0	0
U 234	8.5E+05	0	1.4E+07	0	.0	0	.0	0
U 236	1.3E+05	0	2.2E+06	0	.0	0	.0	0
SR 90	7.2E+10	87	2.7E+11	77	.0	0	.0	0
Y 90	1.8E+04	0	6.7E+05	0	.0	0	.0	0
ZR 93	3.7E+01	0	1.4E+03	0	.0	0	.0	0
NB 93M	6.9E+01	0	6.6E+02	0	.0	0	.0	0
TC 99	7.8E+03	0	1.6E+04	0	2.2E+03	0	.0	0
SN 126	1.9E+04	0	6.8E+05	0	.0	0	3.9E+03	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	1.9E+01	0	4.5E+01	0	.0	0	9.2E-01	0
I 129	3.0E+03	0	1.1E+03	0	.0	0	2.3E+06	99
CS 135	3.2E+04	0	7.9E+04	0	8.3E+03	0	.0	0
CS 137	7.8E+09	9	8.8E+09	2	1.4E+09	99	.0	0
BA 137M	.0	0	.0	0	.0	0	.0	0
SM 151	5.4E+03	0	1.3E+05	0	.0	0	.0	0
TH 230	8.8E+02	0	2.8E+04	0	.0	0	.0	0
RA 226	6.3E+04	0	8.9E+04	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	8.2E+01	0	2.3E+03	0	.0	0	.0	0
BI 210	4.8E-02	0	6.9E-02	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	2.7E+05	0	6.1E+06	0	.0	0	.0	0
PA 233	3.9E+00	0	2.3E+01	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 238	1.6E+05	0	2.9E+06	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	1.4E+04	0	7.7E+05	0	.0	0	.0	0
PU 242	4.0E+05	0	8.1E+06	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	2.1E+08	0	4.3E+09	1	.0	0	.0	0
CM 244	9.7E+06	0	2.3E+08	0	.0	0	.0	0
PU 244	.0	0	.0	0	.0	0	.0	0
U 240	.0	0	.0	0	.0	0	.0	0
PU 240	1.2E+08	0	2.5E+09	0	.0	0	.0	0
AM 243	9.7E+06	0	2.5E+08	0	.0	0	.0	0
NP 239	1.1E+01	0	2.0E+02	0	.0	0	.0	0
PU 239	7.3E+07	0	1.5E+09	0	.0	0	.0	0
PU 241	1.4E+06	0	1.0E+08	0	.0	0	.0	0
AM 241	2.4E+09	2	6.1E+10	17	.0	0	.0	0
TOTALS	8.3E+10	100	3.5E+11	100	1.4E+09	100	2.4E+06	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   062394
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR NISAP SOLUTION MINING, DIRECT INGESTION 100 YEAR DECAY, 50/70 POP
*** DOSE COMMITMENT SUMMARY FOR DOSE-YEAR 70 OF A 50, YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE		TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
H	3	3.7E+03	0	.0	0	3.7E+03	0	3.7E+03	0
C	14	1.9E+09	0	9.8E+08	0	1.9E+08	0	1.9E+08	0
NI	59	1.2E+05	0	7.0E+05	0	.0	0	.0	0
NI	63	2.1E+07	0	6.2E+08	0	.0	0	.0	0
SE	79	3.6E+03	0	.0	0	.0	0	.0	0
PD	107	2.3E+01	0	.0	0	.0	0	.0	0
EU	154	3.6E+03	0	4.1E+04	0	.0	0	.0	0
U	234	1.7E+06	0	2.8E+07	0	.0	0	.0	0
U	236	2.7E+05	0	4.3E+06	0	.0	0	.0	0
SR	90	1.4E+11	87	5.2E+11	79	.0	0	.0	0
Y	90	3.6E+04	0	1.3E+06	0	.0	0	.0	0
ZR	93	7.3E+01	0	2.8E+03	0	.0	0	.0	0
NB	93M	1.9E+02	0	1.7E+03	0	.0	0	.0	0
TC	99	1.9E+04	0	3.5E+00	0	4.4E+03	0	.0	0
SN	126	3.8E+04	0	1.4E+06	0	.0	0	7.9E+03	0
SB	126M	.0	0	.0	0	.0	0	.0	0
SB	126	3.8E+01	0	9.0E+01	0	.0	0	1.8E+00	0
I	129	6.9E+03	0	2.1E+03	0	.0	0	4.7E+06	99
CS	135	6.5E+04	0	1.6E+05	0	1.7E+04	0	.0	0
CS	137	1.6E+10	9	1.8E+10	2	2.8E+09	99	.0	0
BA	137M	.0	0	.0	0	.0	0	.0	0
SM	151	1.1E+04	0	2.6E+05	0	.0	0	.0	0
TH	230	1.5E+03	0	4.5E+04	0	.0	0	.0	0
RA	226	1.1E+05	0	1.5E+05	0	.0	0	.0	0
RN	222	.0	0	.0	0	.0	0	.0	0
PB	210	1.6E+02	0	4.5E+03	0	.0	0	.0	0
BI	210	7.9E-02	0	1.4E-01	0	.0	0	.0	0
PO	210	.0	0	.0	0	.0	0	.0	0
NP	237	4.3E+05	0	9.9E+06	0	.0	0	.0	0
PA	233	7.8E+00	0	4.5E+01	0	.0	0	.0	0
U	233	.0	0	.0	0	.0	0	.0	0
TH	229	.0	0	.0	0	.0	0	.0	0
RA	225	.0	0	.0	0	.0	0	.0	0
AC	225	.0	0	.0	0	.0	0	.0	0
U	235	3.3E+05	0	5.5E+06	0	.0	0	.0	0
TH	231	.0	0	.0	0	.0	0	.0	0
PA	234M	.0	0	.0	0	.0	0	.0	0
PA	234	.0	0	.0	0	.0	0	.0	0
CM	242	6.8E+04	0	1.5E+06	0	.0	0	.0	0
PU	242	6.9E+05	0	1.3E+07	0	.0	0	.0	0
NP	239	.0	0	.0	0	.0	0	.0	0
PU	238	3.4E+08	0	7.1E+09	1	.0	0	.0	0
CM	244	1.5E+07	0	6.2E+08	0	.0	0	.0	0
PU	244	.0	0	.0	0	.0	0	.0	0
U	240	.0	0	.0	0	.0	0	.0	0
PU	240	1.9E+08	0	4.1E+09	0	.0	0	.0	0
AM	243	1.6E+07	0	4.1E+08	0	.0	0	.0	0
NP	239	2.1E+01	0	4.0E+02	0	.0	0	.0	0
PU	239	1.2E+08	0	2.5E+09	0	.0	0	.0	0
PU	241	7.0E+06	0	1.9E+08	0	.0	0	.0	0
AM	241	4.0E+09	2	9.9E+10	15	.0	0	.0	0
TOTALS		1.6E+11	100	6.5E+11	100	2.8E+09	100	4.7E+06	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082379
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 1000 YEAR DECAY, 1/70 MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 1. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	2.2E-05	0	1.1E-04	0	2.2E-05	44	2.2E-05	0
NI 59	1.6E-04	0	9.4E-04	0	.0	0	.0	0
NI 63	3.2E-05	0	9.5E-04	0	.0	0	.0	0
SE 79	5.0E-06	0	.0	0	.0	0	.0	0
PD 107	3.0E-08	0	.0	0	.0	0	.0	0
U 234	2.8E-03	0	4.6E-02	0	.0	0	.0	0
U 236	1.6E-04	0	5.9E-03	0	.0	0	.0	0
ZR 93	9.8E-08	0	3.7E-06	0	.0	0	.0	0
NB 93M	1.8E-07	0	2.3E-06	0	.0	0	.0	0
TC 99	1.9E-05	0	4.7E-05	0	5.8E-06	11	.0	0
SN 126	5.1E-05	0	1.8E-03	0	.0	0	1.0E-05	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	5.0E-08	0	1.2E-07	0	.0	0	2.4E-09	0
I 129	8.0E-06	0	2.8E-06	0	.0	0	6.3E-03	99
CS 135	8.6E-05	0	2.1E-04	0	2.2E-05	44	.0	0
SM 151	1.7E-08	0	4.2E-07	0	.0	0	.0	0
TH 230	3.4E-05	0	1.1E-03	0	.0	0	.0	0
RA 226	2.0E-02	0	3.0E-02	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	4.3E-05	0	1.2E-03	0	.0	0	.0	0
BI 210	2.1E-08	0	3.7E-08	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	2.1E-03	0	4.6E-02	0	.0	0	.0	0
PA 233	2.6E-08	0	1.5E-07	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 238	4.4E-04	0	7.4E-03	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	1.3E-06	0	3.5E-05	0	.0	0	.0	0
PU 242	1.3E-03	0	2.5E-02	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	6.4E-04	0	1.3E-02	0	.0	0	.0	0
PU 240	3.4E-01	14	7.1E+00	12	.0	0	.0	0
AM 243	2.7E-02	1	7.4E-01	1	.0	0	.0	0
NP 239	2.7E-08	0	5.0E-07	0	.0	0	.0	0
PU 239	2.3E-01	9	4.8E+00	8	.0	0	.0	0
PU 241	1.6E-07	0	4.8E-06	0	.0	0	.0	0
AM 241	1.7E+00	73	4.5E+01	77	.0	0	.0	0
TOTALS	2.3E+00	100	5.7E+01	100	5.0E-05	100	6.3E-03	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082779

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)

CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 1000 YEAR DECAY, 1/70 POP

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 1. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF

AIR DEPOSITION CROP PATH: OFF

AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	3.3E+02	0	1.7E+03	0	3.3E+02	44	3.1E+02	0
NI 59	2.3E+03	0	1.4E+04	0	.0	0	.0	0
NI 63	4.8E+02	0	1.4E+04	0	.0	0	.0	0
SE 79	7.5E+01	0	.0	0	.0	0	.0	0
PD 107	4.5E-01	0	.0	0	.0	0	.0	0
U 234	4.2E+04	0	6.9E+05	0	.0	0	.0	0
U 236	5.5E+03	0	8.8E+04	0	.0	0	.0	0
ZR 93	1.5E+00	0	5.6E+01	0	.0	0	.0	0
NB 93M	2.8E+00	0	3.4E+01	0	.0	0	.0	0
TC 99	2.8E+02	0	7.0E+02	0	8.8E+01	11	.0	0
SN 126	7.7E+02	0	2.7E+04	0	.0	0	1.6E+02	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	7.6E-01	0	1.8E+00	0	.0	0	3.7E-02	0
I 129	1.2E+02	0	4.2E+01	0	.0	0	9.4E+04	99
CS 135	1.3E+03	0	3.2E+03	0	3.3E+02	44	.0	0
SM 151	2.6E-01	0	6.3E+00	0	.0	0	.0	0
TH 230	5.1E+02	0	1.6E+04	0	.0	0	.0	0
RA 226	3.0E+05	0	4.5E+05	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	6.5E+02	0	1.8E+04	0	.0	0	.0	0
BI 210	3.2E-01	0	5.5E-01	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	3.1E+04	0	7.0E+05	0	.0	0	.0	0
PA 233	3.8E-01	0	2.2E+00	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 238	6.5E+03	0	1.1E+05	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	2.3E+01	0	5.2E+02	0	.0	0	.0	0
PU 242	1.9E+04	0	3.8E+05	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	9.5E+03	0	1.9E+05	0	.0	0	.0	0
PU 240	5.1E+06	14	1.1E+08	12	.0	0	.0	0
AM 243	4.1E+05	1	1.1E+07	1	.0	0	.0	0
NP 239	4.0E-01	0	7.4E+00	0	.0	0	.0	0
PU 239	3.5E+06	9	7.2E+07	5	.0	0	.0	0
PU 241	2.7E+00	0	7.2E+01	0	.0	0	.0	0
AM 241	2.6E+07	73	6.7E+08	77	.0	0	.0	0
TOTALS	3.5E+07	100	8.6E+08	100	7.5E+02	100	9.4E+04	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082379
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 1000 YEAR DECAY, 10/70 MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 10. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	2.2E-04	0	1.1E-03	0	2.2E-04	44	2.2E-04	0
NI 59	1.6E-03	0	9.4E-03	0	.0	0	.0	0
NI 63	3.2E-04	0	9.5E-03	0	.0	0	.0	0
SE 79	5.0E-05	0	.0	0	.0	0	.0	0
PD 107	3.0E-07	0	.0	0	.0	0	.0	0
U 234	2.8E-02	0	4.6E-01	0	.0	0	.0	0
U 236	3.6E-03	0	5.9E-02	0	.0	0	.0	0
ZR 93	9.8E-07	0	3.7E-05	0	.0	0	.0	0
NB 93M	1.8E-06	0	2.3E-05	0	.0	0	.0	0
TC 99	1.9E-04	0	4.7E-04	0	5.8E-05	11	.0	0
SN 126	5.1E-04	0	1.6E-02	0	.0	0	1.0E-04	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	5.0E-07	0	1.2E-06	0	.0	0	2.4E-08	0
I 129	8.0E-05	0	2.8E-05	0	.0	0	6.3E-02	99
CS 135	8.6E-04	0	2.1E-03	0	2.2E-04	44	.0	0
SM 151	1.7E-07	0	4.2E-06	0	.0	0	.0	0
TH 230	3.2E-04	0	1.0E-02	0	.0	0	.0	0
RA 226	1.9E-01	0	2.9E-01	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	4.3E-04	0	1.2E-02	0	.0	0	.0	0
BI 210	2.1E-07	0	3.7E-07	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	1.9E-02	0	4.4E-01	0	.0	0	.0	0
PA 233	2.6E-07	0	1.5E-06	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 238	4.4E-03	0	7.4E-02	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	1.5E-05	0	3.5E-04	0	.0	0	.0	0
PU 242	1.2E-02	0	2.4E-01	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	6.1E-03	0	1.2E-01	0	.0	0	.0	0
PU 240	3.2E+00	14	6.7E+01	12	.0	0	.0	0
AM 243	2.6E-01	1	7.0E+00	1	.0	0	.0	0
NP 239	2.7E-07	0	5.0E-06	0	.0	0	.0	0
PU 239	2.2E+00	9	4.5E+01	8	.0	0	.0	0
PU 241	1.3E-06	0	4.8E-05	0	.0	0	.0	0
AM 241	1.6E+01	73	4.3E+02	77	.0	0	.0	0
TOTALS	2.2E+01	100	5.5E+02	100	5.0E-04	100	6.3E-02	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082379

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)

CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 1000 YEAR DECAY, 10770 POP

*** DOSE COMMITMENT SUMMARY FOR DOSE-YEAR 70 OF A 10. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	3.3E+03	0	1.7E+04	0	3.3E+03	44	3.3E+03	0
NI 59	2.3E+04	0	1.4E+05	0	.0	0	.0	0
NI 63	4.9E+03	0	1.4E+05	0	.0	0	.0	0
SE 79	7.5E+02	0	.0	0	.0	0	.0	0
PD 107	4.5E+00	0	.0	0	.0	0	.0	0
U 234	4.2E+05	0	6.9E+06	0	.0	0	.0	0
U 236	5.5E+04	0	8.8E+05	0	.0	0	.0	0
ZR 93	1.5E+01	0	5.6E+02	0	.0	0	.0	0
NB 93M	2.8E+01	0	3.4E+02	0	.0	0	.0	0
TC 99	2.0E+03	0	7.0E+03	0	8.8E+02	11	.0	0
SN 126	7.7E+03	0	2.7E+05	0	.0	0	1.6E+03	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	7.6E+00	0	1.8E+01	0	.0	0	3.7E-01	0
I 129	1.2E+03	0	8.2E+02	0	.0	0	9.4E+05	99
CS 135	1.3E+04	0	3.2E+04	0	3.3E+03	44	.0	0
SM 151	2.6E+00	0	6.3E+01	0	.0	0	.0	0
TH 230	4.9E+03	0	1.6E+05	0	.0	0	.0	0
RA 226	2.9E+06	0	4.3E+06	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	6.5E+03	0	1.8E+05	0	.0	0	.0	0
BI 210	3.2E+00	0	5.5E+00	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	2.9E+05	0	6.6E+06	0	.0	0	.0	0
PA 233	3.8E+00	0	2.2E+01	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 235	6.5E+04	0	1.1E+06	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	2.3E+02	0	5.2E+03	0	.0	0	.0	0
PU 242	1.8E+05	0	3.6E+06	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	9.1E+04	0	1.9E+06	0	.0	0	.0	0
PU 240	4.8E+07	14	1.0E+09	12	.0	0	.0	0
AM 243	4.0E+06	1	1.0E+08	1	.0	0	.0	0
NP 239	3.0E+00	0	7.4E+01	0	.0	0	.0	0
PU 239	3.3E+07	9	6.8E+08	8	.0	0	.0	0
PU 241	2.7E+01	0	7.1E+02	0	.0	0	.0	0
AM 241	2.5E+08	73	6.4E+09	77	.0	0	.0	0
TOTALS	3.3E+08	100	8.2E+09	100	7.5E+03	100	9.4E+05	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082379
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 1000 YEAR DECAY, 25/70 MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 25. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	5.5E-04	0	2.8E-03	0	5.5E-04	44	5.5E-04	0
NI 59	3.9E-03	0	2.3E-02	0	.0	0	.0	0
NI 63	8.0E-04	0	2.4E-02	0	.0	0	.0	0
SE 79	1.3E-04	0	.0	0	.0	0	.0	0
PD 107	7.5E-07	0	.0	0	.0	0	.0	0
U 234	7.1E-02	0	1.1E+00	0	.0	0	.0	0
U 236	9.1E-03	0	1.5E-01	0	.0	0	.0	0
ZR 93	2.4E-06	0	9.3E-05	0	.0	0	.0	0
NB 93M	4.6E-06	0	5.7E-05	0	.0	0	.0	0
TC 99	4.7E-08	0	1.2E-03	0	1.5E-04	11	.0	0
SN 126	1.3E-03	0	4.5E-02	0	.0	0	2.6E-04	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	1.3E-06	0	3.0E-06	0	.0	0	6.1E-08	0
I 129	2.0E-04	0	7.1E-05	0	.0	0	1.6E-01	99
CS 135	2.2E-03	0	5.3E-03	0	5.5E-04	44	.0	0
SM 151	4.4E-07	0	1.1E-05	0	.0	0	.0	0
TH 230	7.1E-04	0	2.4E-02	0	.0	0	.0	0
RA 226	4.6E-01	0	6.6E-01	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.1E-03	0	3.1E-02	0	.0	0	.0	0
BI 210	5.3E-07	0	9.2E-07	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	4.4E-02	0	1.0E+00	0	.0	0	.0	0
PA 233	6.4E-07	0	3.7E-06	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 238	1.1E-02	0	1.8E-01	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	3.8E-05	0	9.6E-04	0	.0	0	.0	0
PU 242	2.7E-02	0	5.4E-01	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	1.4E-02	0	2.9E-01	0	.0	0	.0	0
PU 240	7.2E+00	14	1.5E+02	12	.0	0	.0	0
AM 243	6.1E-01	1	1.6E+01	1	.0	0	.0	0
NP 239	6.7E-07	0	1.2E-05	0	.0	0	.0	0
PU 239	4.9E+00	9	1.0E+02	8	.0	0	.0	0
PU 241	4.4E-06	0	1.2E-04	0	.0	0	.0	0
AM 241	3.8E+01	73	9.7E+02	77	.0	0	.0	0
TOTALS	5.1E+01	100	1.2E+03	100	1.2E-03	100	1.6E-01	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 082379

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)

CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 1000 YEAR DECAY, 25/70 POP

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 25. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	8.3E+03	0	4.1E+04	0	8.3E+03	44	8.3E+03	0
NI 59	5.9E+04	0	3.5E+05	0	.0	0	.0	0
NI 63	1.2E+04	0	3.6E+05	0	.0	0	.0	0
SE 79	1.9E+03	0	.0	0	.0	0	.0	0
PD 107	1.1E+01	0	.0	0	.0	0	.0	0
U 234	1.1E+06	0	1.7E+07	0	.0	0	.0	0
U 236	1.4E+05	0	2.2E+06	0	.0	0	.0	0
ZR 93	3.7E+01	0	1.4E+03	0	.0	0	.0	0
NB 93M	6.9E+01	0	8.6E+02	0	.0	0	.0	0
TC 99	7.0E+03	0	1.8E+04	0	2.2E+03	11	.0	0
SN 126	1.9E+04	0	6.8E+05	0	.0	0	3.9E+03	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	1.9E+01	0	4.5E+01	0	.0	0	9.2E-01	0
I 129	3.0E+03	0	1.1E+03	0	.0	0	2.3E+06	99
CS 135	3.2E+04	0	7.9E+04	0	8.3E+03	44	.0	0
SM 151	6.0E+00	0	1.6E+02	0	.0	0	.0	0
TH 230	1.1E+04	0	3.5E+05	0	.0	0	.0	0
RA 226	7.0E+06	0	9.9E+06	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.6E+04	0	4.6E+05	0	.0	0	.0	0
BI 210	7.9E+00	0	1.4E+01	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	6.6E+05	0	1.5E+07	0	.0	0	.0	0
PA 233	9.6E+00	0	5.5E+01	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 235	1.6E+05	0	2.8E+06	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	5.7E+02	0	1.3E+04	0	.0	0	.0	0
PU 242	4.0E+05	0	9.1E+06	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	2.1E+05	0	4.3E+06	0	.0	0	.0	0
PU 240	1.1E+08	14	2.3E+09	12	.0	0	.0	0
AM 243	9.1E+06	1	2.4E+08	1	.0	0	.0	0
NP 239	1.0E+01	0	1.9E+02	0	.0	0	.0	0
PU 239	7.3E+07	9	1.3E+09	8	.0	0	.0	0
PU 241	5.5E+01	0	1.5E+03	0	.0	0	.0	0
AM 241	5.7E+08	73	1.4E+10	77	.0	0	.0	0
TOTALS	7.7E+08	100	1.9E+10	100	1.9E+04	100	2.4E+06	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 082379
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 1000 YEAR DECAY, 50/70 MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	1.1E-03	0	5.5E-03	0	1.1E-03	44	1.1E-03	0
NI 59	7.8E-03	0	4.7E-02	0	.0	0	.0	0
NI 63	1.6E-03	0	4.8E-02	0	.0	0	.0	0
SE 79	2.5E-04	0	.0	0	.0	0	.0	0
PD 107	1.5E-06	0	.0	0	.0	0	.0	0
U 234	1.4E-01	0	2.3E+00	0	.0	0	.0	0
U 236	1.8E-02	0	2.9E-01	0	.0	0	.0	0
ZR 93	4.9E-06	0	1.9E-04	0	.0	0	.0	0
NB 93M	9.2E-06	0	1.1E-04	0	.0	0	.0	0
TC 99	9.4E-04	0	2.3E-03	0	2.9E-04	11	.0	0
SN 126	2.6E-03	0	9.0E-02	0	.0	0	5.2E-04	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	2.5E-06	0	6.0E-06	0	.0	0	1.2E-07	0
I 129	4.0E-04	0	1.4E-04	0	.0	0	3.1E-01	99
CS 135	4.3E-03	0	1.1E-02	0	1.1E-03	44	.0	0
SM 151	8.7E-07	0	2.1E-05	0	.0	0	.0	0
TH 230	1.1E-03	0	3.8E-02	0	.0	0	.0	0
RA 226	8.2E-01	0	1.1E+00	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	2.2E-03	0	6.0E-02	0	.0	0	.0	0
BI 210	1.1E-06	0	1.8E-06	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	7.1E-02	0	1.6E+00	0	.0	0	.0	0
PA 233	1.3E-06	0	7.4E-06	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 238	2.2E-02	0	3.7E-01	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	7.7E-05	0	1.7E-03	0	.0	0	.0	0
PU 242	4.2E-02	0	8.7E-01	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	2.3E-02	0	4.7E-01	0	.0	0	.0	0
PU 240	1.1E+01	13	2.4E+02	12	.0	0	.0	0
AM 243	1.0E+00	1	2.6E+01	1	.0	0	.0	0
NP 239	1.3E-06	0	2.5E-05	0	.0	0	.0	0
[illegible]	7.0E+00	[illegible]	1.7E+02	8	.0	0	.0	0
PU 241	8.1E-06	0	2.2E-04	0	.0	0	.0	0
AM 241	6.5E+01	78	1.6E+03	77	.0	0	.0	0
TOTALS	8.4E+01	100	2.0E+03	100	2.5E-03	100	3.1E-01	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   082379
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: RUN FOR WISAP SOLUTION MINING, DIRECT INGESTION 1000 YEAR DECAY, 50/70 POP
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	1.7E+04	0	8.3E+04	0	1.7E+04	44	1.7E+04	0
NI 59	1.2E+05	0	7.0E+05	0	.0	0	.0	0
NI 63	2.4E+04	0	7.2E+05	0	.0	0	.0	0
SE 79	3.8E+03	0	.0	0	.0	0	.0	0
PD 107	2.3E+01	0	.0	0	.0	0	.0	0
U 234	2.1E+06	0	3.4E+07	0	.0	0	.0	0
U 236	2.7E+05	0	4.4E+06	0	.0	0	.0	0
ZR 93	7.3E+01	0	2.8E+03	0	.0	0	.0	0
NB 93M	1.4E+02	0	1.7E+03	0	.0	0	.0	0
TC 99	1.4E+04	0	3.5E+04	0	4.4E+03	11	.0	0
SN 126	3.8E+04	0	1.4E+06	0	.0	0	7.9E+03	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	3.5E+01	0	9.0E+01	0	.0	0	1.5E+00	0
I 129	6.0E+03	0	2.1E+03	0	.0	0	4.7E+06	99
CS 135	6.5E+04	0	1.6E+05	0	1.7E+04	44	.0	0
SM 151	1.3E+01	0	3.2E+02	0	.0	0	.0	0
TH 230	1.7E+04	0	5.7E+05	0	.0	0	.0	0
RA 226	1.2E+07	0	1.7E+07	0	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	3.3E+04	0	9.0E+05	0	.0	0	.0	0
BI 210	1.6E+01	0	2.8E+01	0	.0	0	.0	0
PO 210	.0	0	.0	0	.0	0	.0	0
NP 237	1.1E+06	0	2.4E+07	0	.0	0	.0	0
PA 233	1.9E+01	0	1.1E+02	0	.0	0	.0	0
U 233	.0	0	.0	0	.0	0	.0	0
TH 229	.0	0	.0	0	.0	0	.0	0
RA 225	.0	0	.0	0	.0	0	.0	0
AC 225	.0	0	.0	0	.0	0	.0	0
U 238	3.3E+05	0	5.5E+06	0	.0	0	.0	0
TH 234	.0	0	.0	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
CM 242	1.1E+03	0	2.6E+04	0	.0	0	.0	0
PU 242	5.4E+05	0	1.3E+07	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	3.4E+05	0	7.1E+06	0	.0	0	.0	0
PU 240	1.7E+08	13	3.7E+09	12	.0	0	.0	0
AM 243	1.5E+07	1	3.8E+08	1	.0	0	.0	0
NP 239	2.0E+01	0	3.7E+02	0	.0	0	.0	0
PU 239	1.2E+08	9	2.5E+09	8	.0	0	.0	0
PU 241	1.2E+02	0	5.3E+05	0	.0	0	.0	0
AM 241	9.4E+08	74	2.4E+10	77	.0	0	.0	0
TOTALS	1.3E+09	100	3.0E+10	100	3.7E+04	100	4.7E+06	100

APPENDIX K

SITE CHARACTERIZATION

APPENDIX K

SITE CHARACTERIZATION

This section contains a summary of the important geological and hydrological characteristics of the Hainesville Salt Dome and the surrounding region. The following discussion provides the type of local and regional geological information that is necessary for evaluating the suitability of siting an underground nuclear waste repository within a Gulf Coast salt dome.

Unless otherwise noted, the material within this chapter has been taken from a report written and prepared by Law Engineering Testing Company LETCO--(1979b). Because this study is only a methodology exercise as applied to a reference salt dome, no detailed regional or local site investigations were performed. Rather, the geologic information was obtained from the existing literature and previous studies. For an actual site assessment, detailed geologic investigations would be conducted by ONWI to remove as much uncertainty as possible from
the resulting analyses.

REGIONAL GEOGRAPHY

This discussion of the regional geology is restricted to the region within a 200 mile radius of the Hainesville Salt Dome. The salt dome itself is located in the central part of Wood County in northeast Texas (Figure K.1). The regional surface generally slopes from northwest to southeast (Figure K.2). Elevations range from more than 2000 ft MSL in the Ouachita Mountains to below 100 ft MSL near the coast.

The region surrounding the Hainesville Salt Dome is composed of the four physiographic provinces shown in Figure K.3. Within this region lie the following major cities with populations exceeding 100,000: Dallas, Texas; Fort Worth, Texas; Waco, Texas; and Shreveport, Louisiana. The northeastern portion of the region drains easterly into the Mississippi River through the

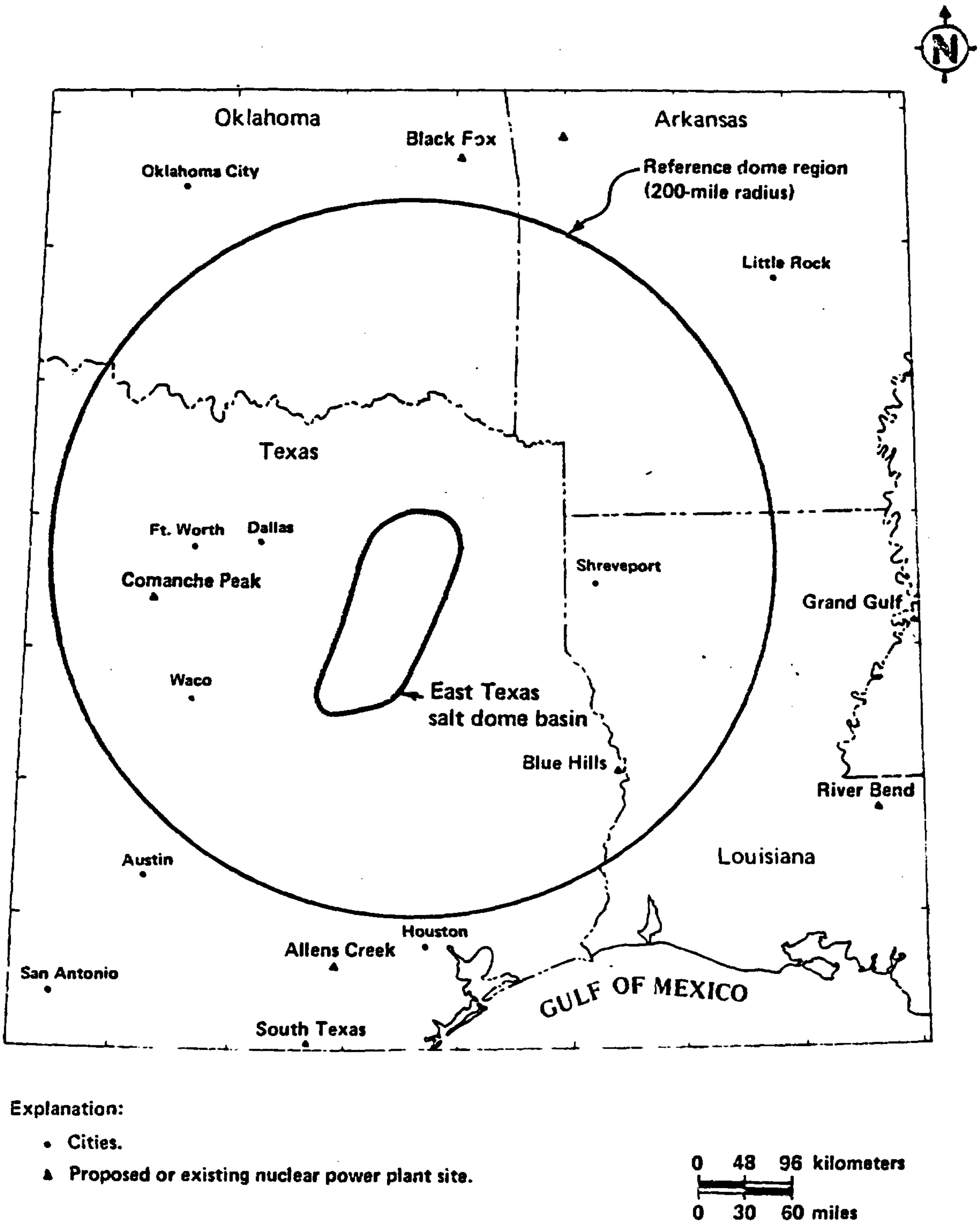
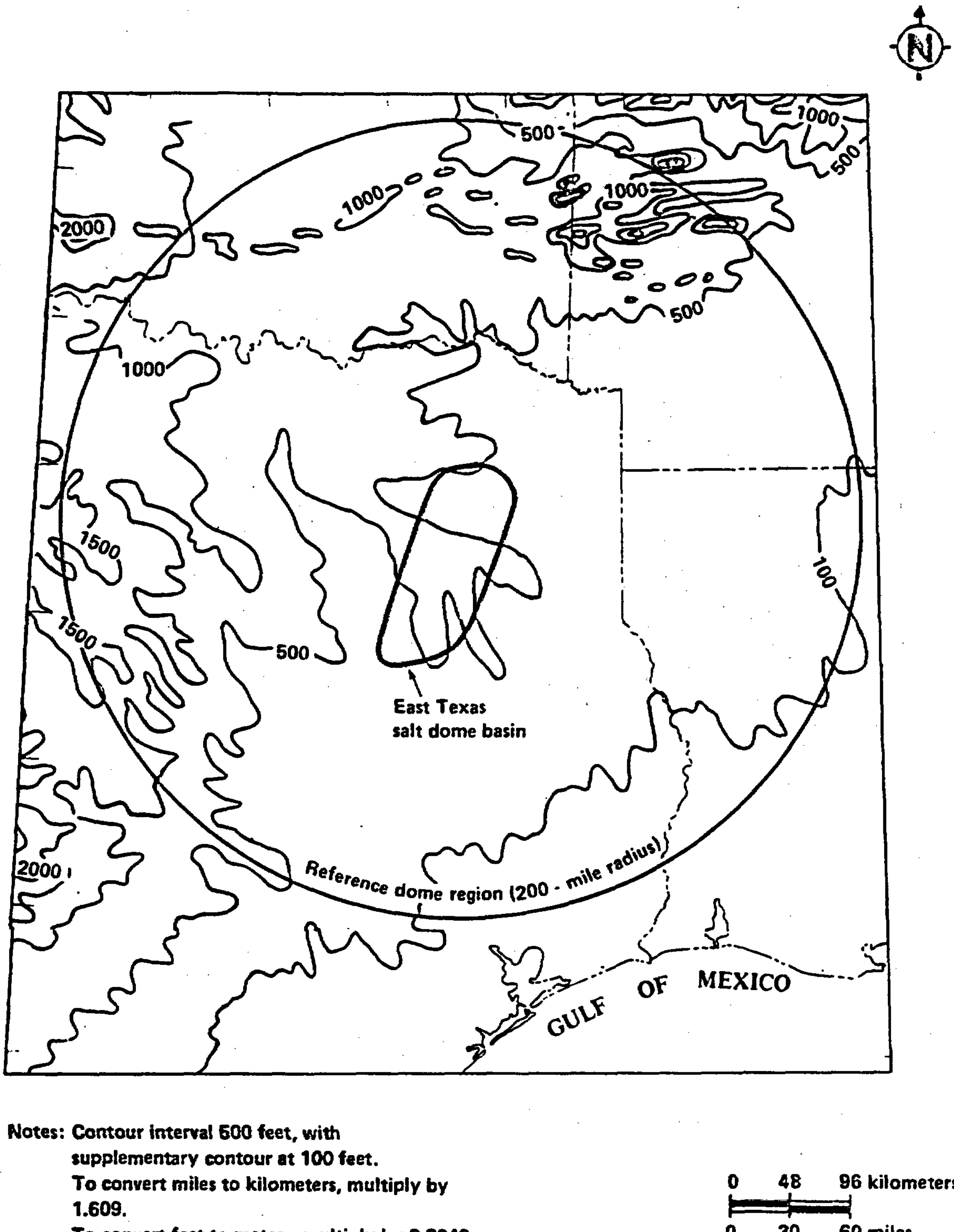


FIGURE K.1. Regional Location Map

Source: Law Engineering Testing Company 1979b



Notes: Contour interval 500 feet, with supplementary contour at 100 feet.
To convert miles to kilometers, multiply by 1.609.
To convert feet to meters, multiply by 0.3048.

FIGURE K.2. Regional Topographic Map
Source: Law Engineering Testing Company 1979b

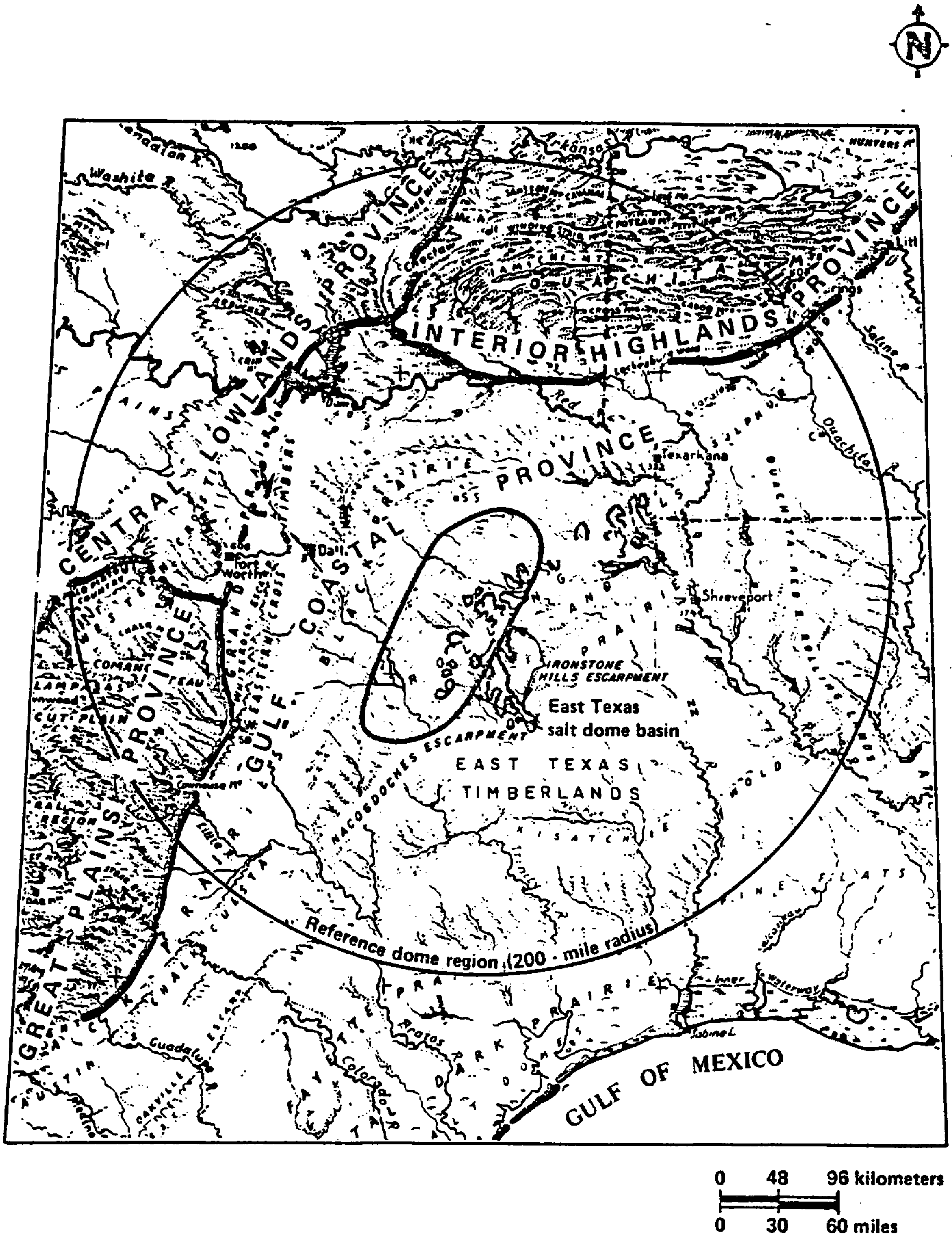


FIGURE K.3. Regional Physiographic Map

Source: Law Engineering Testing Company 1979b

Red, Ouachita, and Arkansas Rivers. The southwestern half of the region drains to the south toward the Gulf of Mexico, through the Sabine, Neches, Trinity, and Brazos Rivers.

REGIONAL GEOLOGIC SETTING

Pre-Mesozoic Geology

Precambrian outcrops occur only in the Arbuckle Mountains of Oklahoma and in the Llano uplift area of central Texas. The altered sedimentary rocks include metamorphosed sandstones, shales, and a limited amount of limestones. Intrusive igneous rocks, chiefly granite but also including diorite and more basic rocks, have intruded these Precambrian sediments.

During the Paleozoic, the Ouachita geosyncline formed along the southern margin of the North American Precambrian craton. Through most of the Paleozoic, sediments were eroded from the craton and were redeposited in the geosyncline. Sediments deposited in the interbasinal areas of the craton were mainly carbonates, with smaller interstratified beds of clastics. Sediments deposited into the geosyncline, however, were mostly clastics with small amounts of carbonates.

Geosynclinal sedimentation terminated with the Ouachita orogeny during Early Pennsylvanian. The Ouachita belt is a complexly deformed zone that developed as a result of northward oriented compressional forces. Most of the regional site area is south of the Ouachita orogenic belt. Knowledge of the Paleozoic history of this area is sketchy at best; however, deep wells have encountered unmetamorphosed Paleozoic sediments on the Sabine uplift. Other geophysical evidence shows that much of the area is attenuated continental crust bordering oceanic crust to the south.

Mesozoic and Post-Mesozoic Geology

The Gulf Coast geosyncline was initiated in Late Triassic by the combination of block faulting and rifting of the continental crust. The northern boundary of the basin was faulted along the southern flank of the Late Paleozoic Ouachita orogenic belt.

The Gulf Coastal Plain to the south of the Ouachita oroganic belt is an area of low relief that borders the Gulf of Mexico. It is underlain by sedimentary formations of Mesozoic and Cenozoic age (Figure K.4). Depositional patterns in the northern Gulf Coastal Plain consist of periods of inundation, characterized mainly by deposition of limestone, alternating with periods of delta progradation and deposition of clastics. A generalized geologic column of the stratigraphic units of the site region is shown in Table K.1.

Post-salt inundations began with the Smackover carbonates in the Jurassic and continued into the Cretaceous. A subsequent period of deltaic deposition culminated in the deposition of the Wilcox Group in Early Tertiary. Succeeding deposits were alternatively marine and non-marine. Late Cenozoic deposition consisted of terrace and valley-filling alluvial deposits in the interior salt basins. These deposits grade into marginal shoreline deposits, which parallel the present shoreline and grade into marine sediments offshore. The sediments generally have a regional dip of about one degree to the south; however, posiments and negaments interrupt this pattern and form the predominant structural elements in the Gulf Coast basin.

During the Mesozoic, subsidence initiated the development of a boundary fault system above pre-existing basement faults. Subsidence on a geosynclinal scale began in the Lower Gulf Coast basin during the Cenozoic. This period of subsidence initiated several new fault zones in the Gulf Coast basin.

The development of salt domes has caused localized structural features. Movement of salt (to form salt ridges) within the Louann Formation began during the later part of the Jurassic Smackover deposition, and continued as additional sedimentation occurred. Diapirism was initiated in places where salt was sufficiently thick. In the interior salt basin, diapirism climaxed during the Mesozoic. In the coastal salt basins, diapirism did not climax until the Late Tertiary.

Over the past 30 to 40 yr, surface level measurements in the Gulf Coastal Plain have shown recent vertical movements. These measurements are subject to variations of local, natural, or human-induced subsidence mechanisms. The cause and possible long-term effects of this movement are not yet conclusively

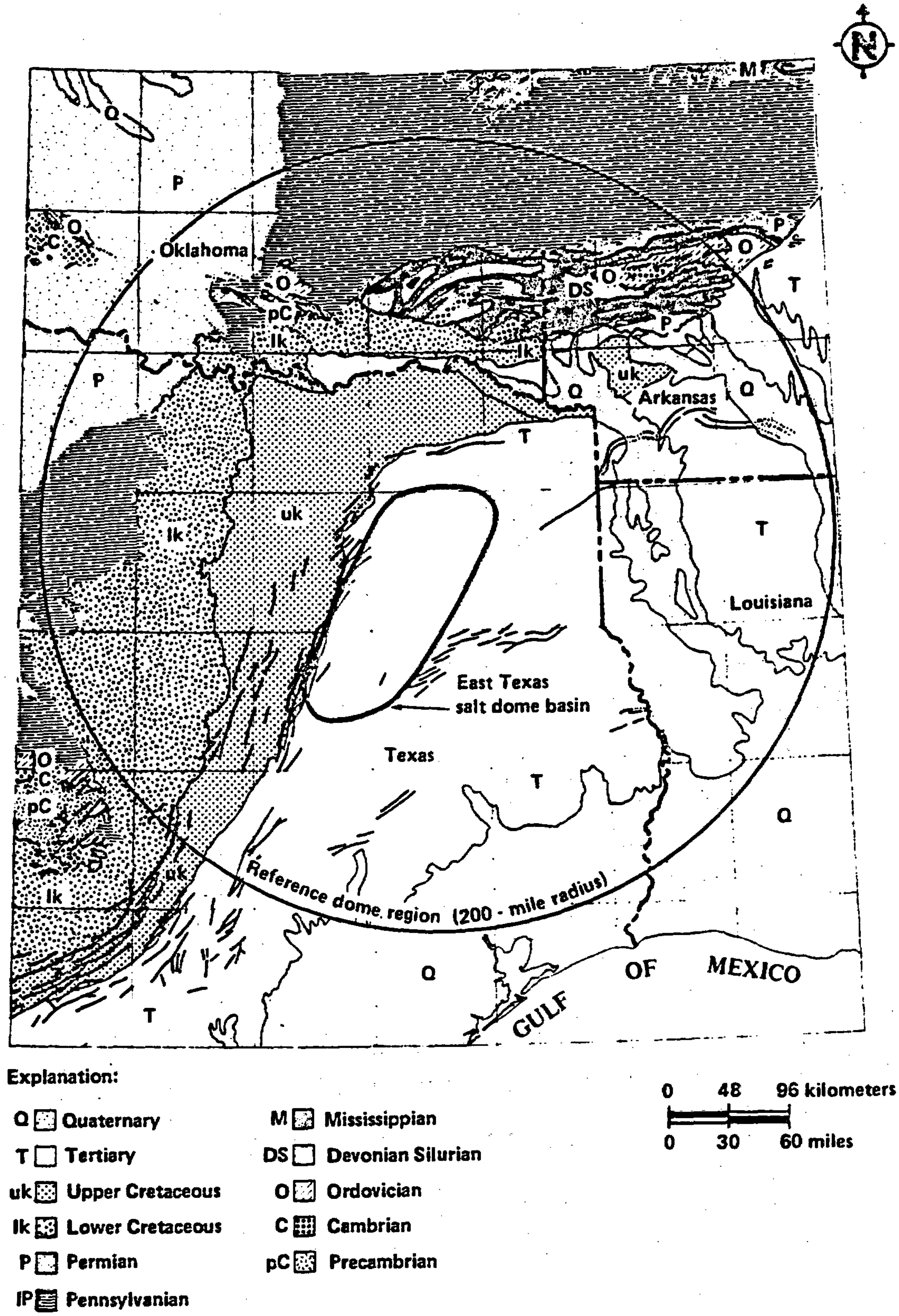


FIGURE K.4. Regional Surface Geology Map

Source: Law Engineering Testing Company 1979b

TABLE K.1. Stratigraphic Column East Texas Basin

Source: Law Engineering Testing Company 1979b

Era	System	Series	Stage	Group	Formation / Unit
MESOZOIC ERA	CRETACEOUS SYSTEM	COMANCHE SERIES	ALBIAN STAGE	FREDERICKSBURG GROUP	GOODLAND LS.-EDWARDS LS.
					KIAMICHI SHALE
				WASHITA GROUP (GEORGETOWN)	DUCK CREEK LIMESTONE
					FORT WORTH LIMESTONE
					DENTON SHALE
					WENO-PAW PAW LIMESTONE
					MAIN STREET LIMESTONE
			CENOMANIAN STAGE	WASHITA GROUP	GRAYSON SHALE
					BUDA LIMESTONE
					MANESS SHALE
		GULF SERIES		WOODBINE GROUP	DEXTER FM.
					LEWISVILLE FM.
			TURONIAN STAGE	EAGLE FORD GROUP (EAGLE FORD FORMATION)	LOWER
					MIDDLE
					U.
					SUBCLARKSVILLE SAND
			CONIACIAN SANTONIAN	AUSTIN GROUP	ECTOR CHALK FM.
					MIDDLE AUSTIN
			CAMPANIAN		GOBER CHALK
				TAYLOR GROUP	LOWER TAYLOR GP.
					WOLFE CITY SD.
					PECAN GAP CHALK
					UPPER TAYLOR GP.
			MAESTRICHT	NAVARRO GROUP	LOWER NAVARRO
					NACATOCH SAND
					UPPER NAVARRO
CENOZOIC ERA	TERTIARY SYSTEM	PALEOCENE SERIES	DANIAN THANETIAN	MIDWAY GROUP	LOWER
					UPPER
					KINCAID
					WILLS POINT
		EOCENE SERIES	SPARNACIAN CUISIAN	WILCOX GROUP	UNDIFF. IN NORTHEAST TEXAS
			LUTETIAN AUVERSIAN	CLAIBORNE GROUP	CARRIZO FM.
					REKLAW FM.
					QUEEN CITY FM.
					WECHES FM.
					SPARTA FM.
	QUATERNARY	PLEISTOCENE			
		RECENT			

Era	System	Series	Stages	Group	Formation / Unit
TRIASSIC AND/OR PERMIAN REDBEDS AND PALEOZOIC ROCKS. OUACHITA FACIES					
MESOZOIC ERA	JURASSIC SYSTEM	UPPER JURASSIC SERIES	OXFORD, KIMMERIDGIAN, TITHONIAN		EAGLE MILLS FM.
					WERNER FM.
					LOUANN SALT
					NORPHLET FM.
					SMACKOVER LIMESTONE
					BUCKNER FM.
				COTTON VALLEY GROUP	COTTON VALLEY LS.
					BOSSIER FM.
					SHULER FM.
	CRETACEOUS SYSTEM	COMANCHE SERIES	NEOCOMIAN STAGE → APTIAN STAGE → ALBIAN STAGE	TRINITY GROUP	TRAVIS PEAK FM.
				TRINITY GROUP, GLEN ROSE, LOWER GLEN ROSE FM.	PETTET LIMESTONE (TRANSITION ZONE)
					PINE ISLAND SHALE
					JAMES LIMESTONE
					RODESSA MEMBER
				TRINITY GROUP, GLEN ROSE	MASSIVE ANHYDRITE
					UPPER GLEN ROSE FM.
				TRINITY GROUP	PALUXY FM.

known. However, studies of Quaternary terraces have shown that there are no significant variations in level of the terraces, indicating that there has not been subsidence or uplift resulting from recent tectonism.

LOCAL GEOLOGY

East Texas Salt Dome Basin

The East Texas Salt Dome basin occupies the central portion of the East Texas embayment. The embayment is a coastal depression which occupies about 44,000 square miles of northeastern Texas. Embayment boundaries are defined by the Sabine uplift on the east and the Angelina-Caldwell flexure on the south. Sediments in the embayment range from Jurrasic to Mid-Tertiary and Quaternary in age. The East Texas embayment is thought to be controlled by down-faulted blocks on the southeast margin of the Ouachita foldbelt.

The limits of the East Texas Salt Dome basin are rather arbitrarily defined, but occupies about 4000 square miles (or about 10%) of the East Texas embayment. Elevations within the salt dome basin range from 200 ft above sea level in the south to between 400 to 500 ft toward the Sabine uplift to the east and the Mexia-Talco fault zone to the west.

The basin is characterized by a marked thickening of Mesozoic and Cenozoic strata toward its center. The strata generally dip toward the Gulf at angles slightly steeper than the regional slope of the land surface. Tertiary strata form concentric outcrop patterns in the basin, being younger in the center and progressively older toward the borders.

The sediments of the East Texas Salt Dome basin record a system of marine transgressions and regressions superimposed on a progradational depositional basin. A summary of stratigraphic units from Nichols (1964, 1968) is given in Table K.2.

As a result of subsidence, between 24,000 and 25,000 ft of sediment was deposited in the basin. From the Jurassic to the Late Mesozoic, sedimentation virtually kept pace with subsidence throughout the basin. Subsidence had essentially ceased by Mid-Tertiary.

Based on the average maximum sediment thickness over the basin, and assuming that subsidence is related to isostatic adjustment from the sediment loading that occurred since the Louann salt deposition, calculations indicate an average subsidence of 0.0358 mm/year. During the Tertiary, subsidence decreased significantly to an average rate of 0.0065 mm/year. This subsidence produced a gentle basin-wide warping of the sediments. As such, each successively younger bed is less warped than the older underlying beds.

The East Texas Salt Dome basin contains 14 shallow salt domes (within 2000 ft of the surface) and three intermediate salt domes (between 2000 and 6000 ft of the surface). There are nine deep salt domes (more than 6000 ft below the surface) that may or may not be diapiric structures. In addition, there are several salt ridges that trend parallel to the basin axis.

In general, there are five external features that are characteristic of most salt domes: the salt dome, central graben, growth faults, rim synclines, and unconformities. The salt dome or salt stock itself consists of a large column of salt extending from the source layer (Louann salt) to varying depths below the surface. The diameter of the stock is usually at least one mile and is often much greater.

Central graben faults tend to be radial and bound the salt domes. Localized faulting adjacent to the sides of a salt dome is common and is believed to result from shearing of the sediments because of the relative upward movement of the salt dome. Salt domes located within the East Texas Salt Dome basin are not necessarily independent structures, but are often associated with larger salt ridges and pillows. In some cases, several salt domes will develop from the same salt ridge.

Rim synclines are structural depressions that partially or completely encircle most domes. The depressions are thought to be formed by the sinking of overlying sediments into the space left by the lateral flow of salt into the salt dome. The ages of the sediments that thicken into the syncline indicate when the salt flow began. Unconformities, which are localized above the salt dome, also help to indicate when salt flow and dome growth began. Each unconformity marks an interval of relative uplift of the dome area with respect to adjacent sediments in the basin where deposition was continuous.

TABLE K.2. Summary of Basin Stratigraphy

Source: Law Engineering Testing Company 1979b

Era	System	Series	Group	Unit	Age MYBP	Thickness Feet
CENOZOIC ERA	QUATERNARY			RECENT AND PLEISTOCENE	< 1	LESS THAN 60
	TERTIARY SYSTEM	EOCENE SERIES	CLAIBORNE GROUP	SPARTA FM.	49	0 TO 250
				WECHES FM.		0 TO 75
				QUEEN CITY FM.		0 TO 400
				REKLAW FM.		0 TO 70
				CARRIZO FM.	54	0 TO 200
			WILCOX GROUP	UNDIFFERENTIATED	58.3	0 TO 3500+
		PALEOCENE SERIES	MIDWAY GROUP	UNDIFFERENTIATED	65	0 TO 1400
MESOZOIC ERA	CRETACEOUS SYSTEM	GULF SERIES	NAVARRO GROUP	UPPER NAVARRO	66	0 TO 1000+
				NACATOCH SAND		
				LOWER NAVARRO	71	
			TAYLOR GROUP	UPPER TAYLOR		0 TO 1500+
				PECAN GAP CHALK	76	
				WOLFE CITY SAND		
				LOWER TAYLOR	79	
			AUSTIN GROUP	GOBER CHALK		0 TO 1100
				MIDDLE AUSTIN		
				ECTOR CHALK		
			EAGLE FORD GROUP	SUB-CLARKSVILLE SAND		0 TO 600
				EAGLE FORD FM.	92	
			WOODBINE GROUP	UNDIFFERENTIATED	100	0 TO 1200
		COMANCHE SERIES	WASHITA GROUP	MANESS SH.		0 TO 110
				BUDA LS.		0 TO 200
				GRAYSON SH.		0 TO 70
			WASHITA GROUP – GEORGETOWN SUBGRP	MAIN STREET LS.		0 TO 1100+
				WENO-PAW PAW LS.		
				DENTON SH.		
				FORT WORTH LS.		
				DUCK CREEK LS.		
			FREDERICKSBURG GROUP	KIAMICHI SH.		25 TO 170
				GOODLAND LS.	104	25 TO 300
			TRINITY GROUP	PALUXY FM.	105	75 TO 750
			TRINITY GROUP – GLEN ROSE SUBGRP	UPPER GLEN ROSE FM.		0 TO 3500
				MASSIVE ANHYDRITE FM.	107	0 TO 540
			TRINITY GROUP – GLEN ROSE SUBGRP – LOWER GLEN ROSE FM.	RODESSA MEMBER		0 TO 630
				JAMES LS.	109	0 TO 250
				PINE ISLAND SH.		0 TO 230
				PETTET LS.	113	0 TO 900+
			TRINITY GROUP	TRAVIS PEAK FM.		500 TO 1500+
	JURASSIC SYSTEM	UPPER JURASSIC SERIES	COTTON VALLEY GROUP	SCHULER FM.		0 TO 2300+
				BOSSIER FM.		0 TO 1300
				BUCKNER FM.	139	0 TO 1200+
				SMACKOVER LS.	142	0 TO 800
				NORPHLET FM.		50 TO 150
				LOUANN SALT		TO 5000
				WERNER FM		0 TO 460
	?			EAGLE MILLS FM.		300 TO 4500
	TRIASSIC AND/OR PERMIAN REDBEDS					?
PALEOZOIC QUACHITA FACIES						

The rock salt in most salt domes usually consists of elongated halite crystals (NaCl) between 0.25-0.5 in. in diameter. Water insoluble residues, such as anhydrite ($CaSO_4$), generally constitute 1 to 10% by weight of the rock salt. The salt is generally deposited in layers. The layers may be pure white, gray, or sometimes black (containing high amounts of impurities such as anhydrite). Layers range in thickness from one inch to tens of feet, and generally have gradational contacts. Observations in salt mines indicate that salt generally flows first laterally and then vertically upward to form the salt dome.

Boundary shear zones have been identified in almost all coastal salt domes. However, shear zones have not been identified in most of the interior domes. This lack of identifiable shear zones in the interior salt domes by no means conclusively suggests that they are completely lacking. Boundary shear zones were not recognized for the first 60 years of mining in the coastal domes. The existence of such boundary shear zones in the interior salt dome is probably more a matter of their not being looked for. Research could continue on the effect that these zones would have on the long-term isolation of radioactive waste and should be addressed more carefully in any actual site analysis.

Caprock is the term applied to the varied mass of rocks, predominantly anhydrite, which covers the top salt layers of many salt domes. Gypsum ($CaSO_4$ H_2O), calcite ($CaCO_3$), and sulphur are often common constituents. Caprock is generally brecciated and sheared. It may cover the entire top surface of the salt dome and in some instances may extend down one or more flanks of the salt dome. In addition, the caprock may be mushroomed to form overhangs, and in some cases the caprock may even extend under the overhangs.

Currently, there are three theories that account for the formation of caprock. The theory of residual accumulation is based on the assumption that the caprock is formed at the top of the salt dome as salt is dissolved away by ground water, leaving less soluble materials such as anhydrite. The hypothesis of precipitation in place assumes that salt brine rises along the salt dome stock and precipitates the caprock on top of the salt dome when the dome top comes in contact with a fresh water aquifer. The modified precipitation in place hypothesis may suggest that some of the caprock material has been brought up along with the developing salt dome from beneath the mother salt bed.

Using a stratigraphic approach, it is possible to deduce the volume of salt that has moved per unit of time (Martinez et al. 1975, 1976, 1977; Loocke 1978). When this method was applied to the Vacherie salt dome in Louisiana, estimates indicated a vertical uplift rate of 0.2 mm/yr during Mid-Cretaceous, 0.02 mm/yr during Late Cretaceous, and cessation of movement about 30 million yr ago.

Netherland, Sewell and Associates (1976) studied rates of movement on six domes in the East Texas Salt Dome basin. They relied on structural data, measuring the amount of local uplift of a formation in the vicinity of each salt dome. Their results indicate that salt dome movement ceased in Late Paleocene-Early Eocene, and that rates were greatest in Late Jurassic and Early Cretaceous (0.153 mm/yr and 0.044 mm/yr), and then slowed with time.

Law Engineering Testing Company (1978a) performed a growth study on the Minden salt dome in the Louisiana Salt Dome basin and found maximum growth rates in the Middle Cretaceous with slower rates during the Mid-Tertiary.

While all three salt dome growth studies were carried out on different salt domes in different basins using different approaches, they all support the argument that dome growth ceased approxmately 30 million yr ago.

SITE GEOLOGY AND SUBSURFACE HYDROLOGY

Site Surface Geology

The Hainesville Salt Dome is the northernmost shallow piercement salt dome in the East Texas Salt Dome basin. The Hainsville Salt Dome has been excluded from consideration for a nuclear waste repository. The site area consists of rolling hills and prairies and encompasses approximately 542 square miles. The site area includes a structural feature known as the Mineola basin (Eaton 1952), which has been described as the area of influence or the rim synclinal area of the Hainesville Salt Dome.

Only Eocene, Pleistocene, and recent strata crop out in the site area. The Eocene strata consist of alternative marine and non-marine sediments representing cyclic deposition, while the Pleistocene and recent deposits consist of alluvial sediments (Figure K.5). Generally, the youngest units, exclusive of Quaternary deposits, are exposed in the center of the area with the older units exposed around the periphery of the site area. No surface faults are described in the literature and none are shown on geologic maps.

Site Subsurface Geology

External Structure

The Hainesville Salt Dome is a shallow piercement salt dome located approximately in the center of the site area. Data used to decipher the size and properties of the salt dome include 11 wells penetrating the salt, one seismic reflection line crossing the salt dome in a southwest to northeast direction, a basin gravity survey, and data from other wells in the vicinity of the salt dome.

The dome pierces 16,000 ft of strata ranging from Late Jurassic to Early Tertiary in age. An overhang exists from -10,000 ft MSL to near the dome top, with the largest diameter of the overhang occurring between -3000 ft to -5000 ft MSL. Below -10,000 ft MSL the salt dome develops a broad shoulder-like base down to -17,000 ft MSL, where the salt dome stock connects with the top of the Louann salt (Figures K.6 and K.7).

Subsurface mapping indicates a rim syncline adjacent to the Hainesville salt dome. Some peripheral faulting at the boundaries of the site area is also indicative of rim synclines in Late Lower Cretaceous to Early Upper Cretaceous rocks, as shown in Figure K.8. This subsurface mapping of the Woodbine and Austin Group indicates two peripheral, normal faults, which are related to rim syncline development during Lower Woodbine deposition. These faults have a displacement of 100-200 ft and are confined primarily to Upper Cretaceous rocks. Well data and published reports also show a fault offsetting Early Tertiary strata. This may be related to deeper Middle Cretaceous faulting (Dillard 1963). No central graben or radial faults have been mapped.

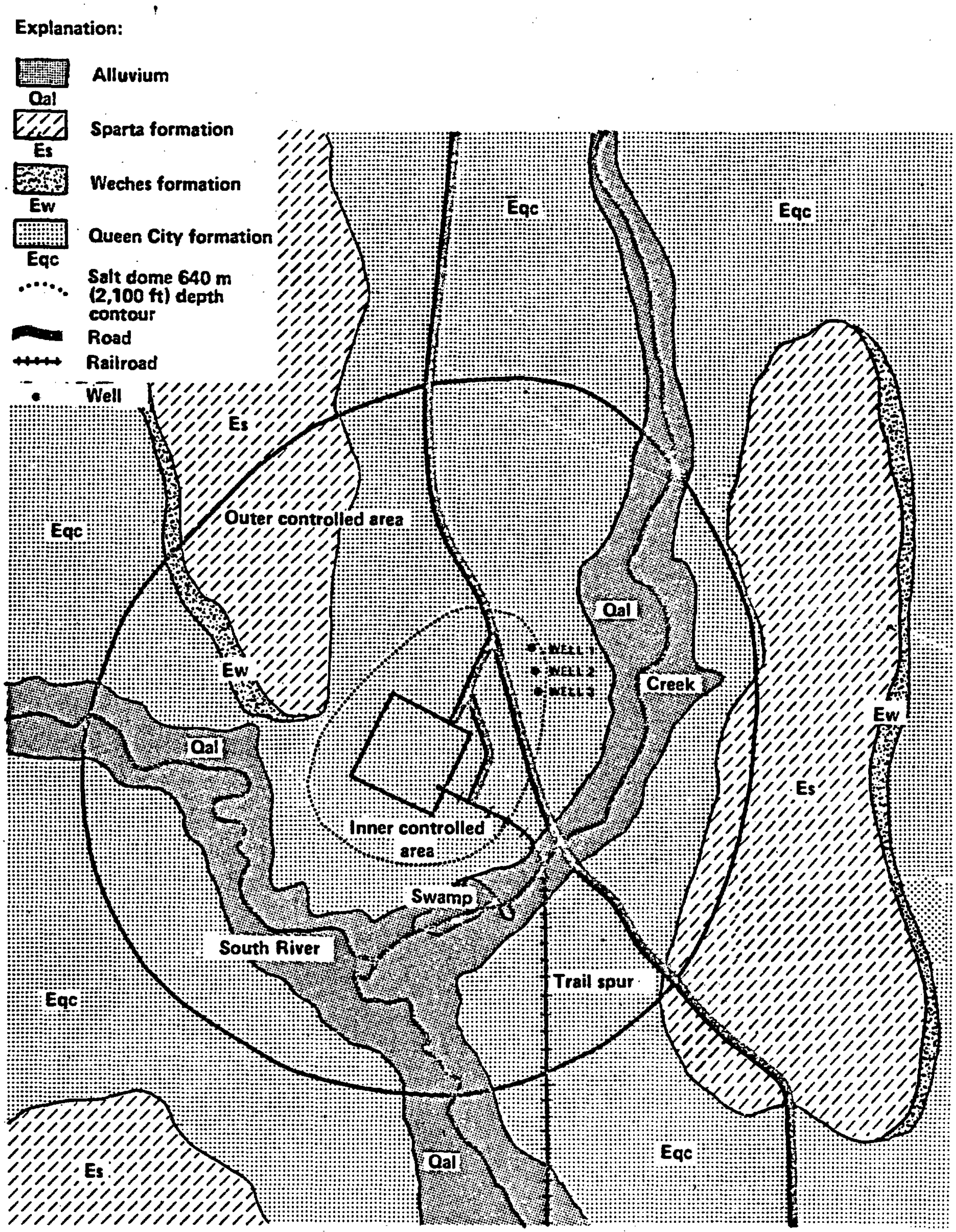
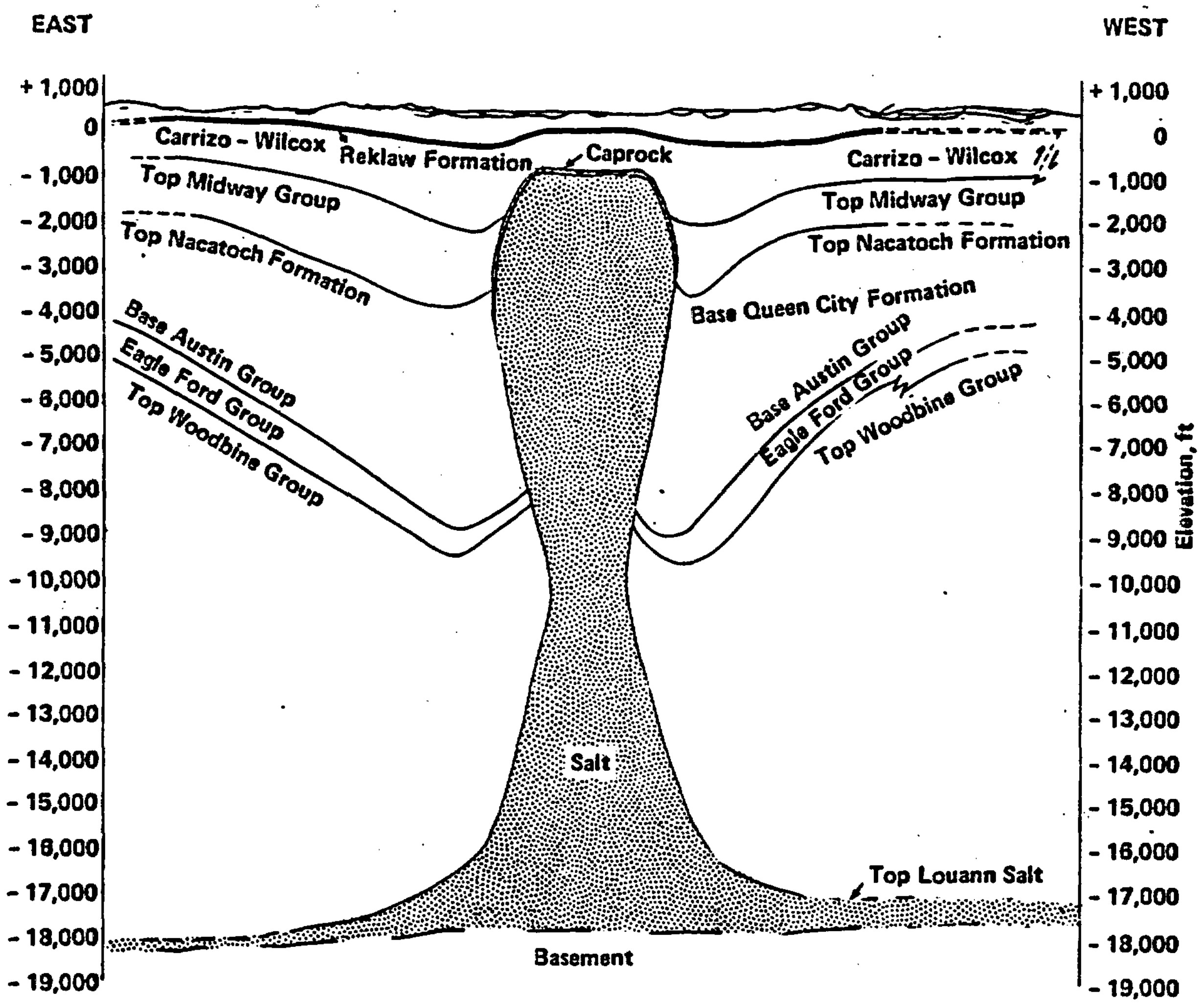
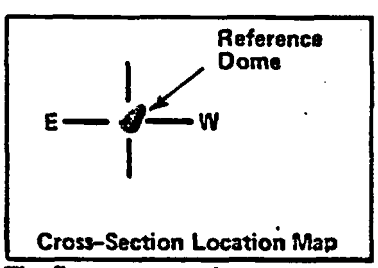
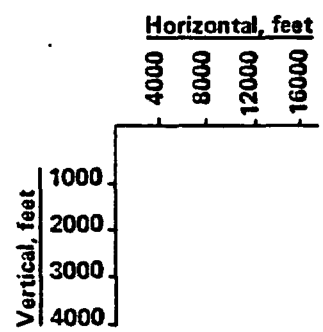


FIGURE K.5. Site Geologic Map

Source: Law Engineering Testing Company 1979b



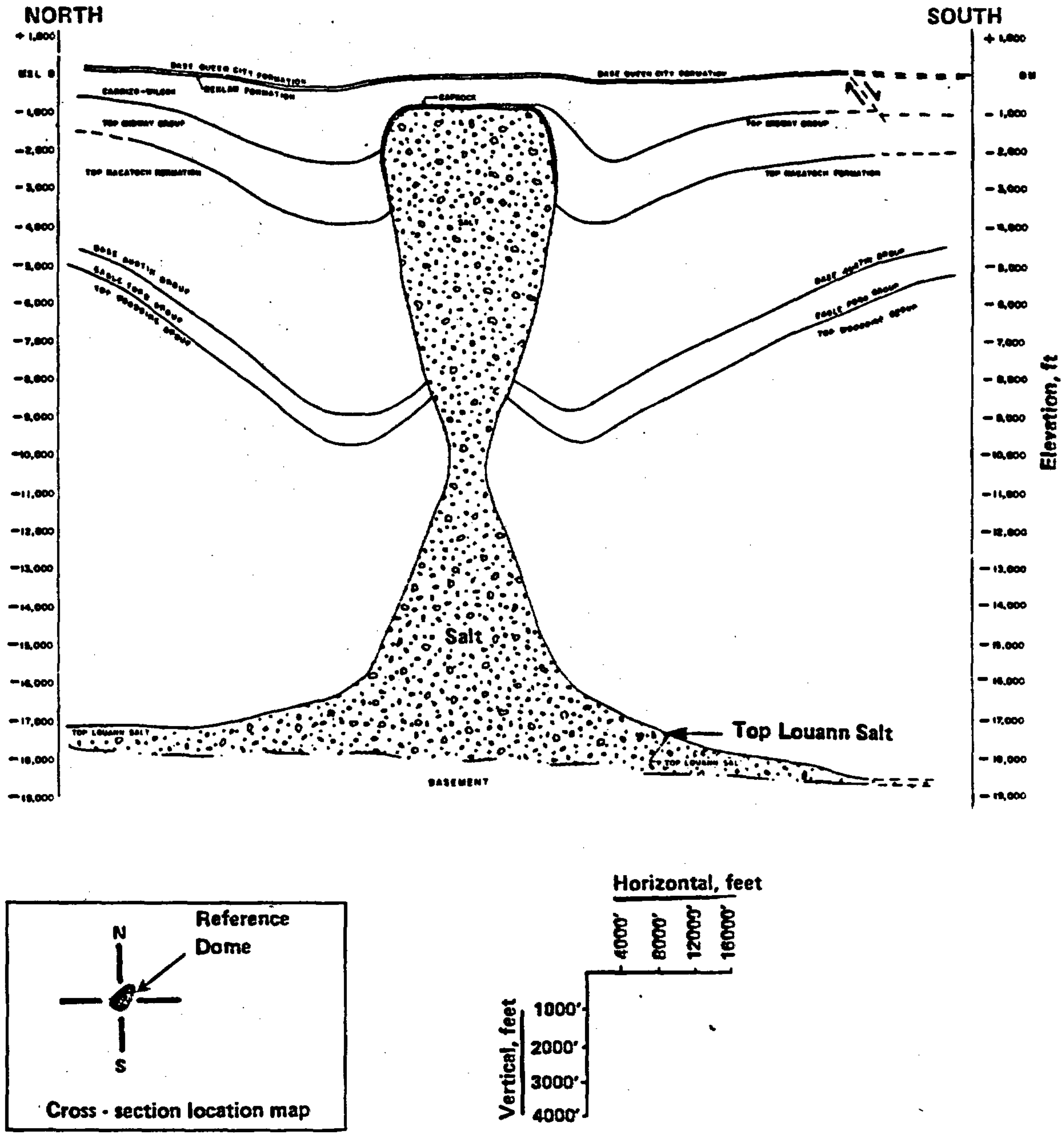




Notes: The figure presented represents an interpretation of subsurface conditions based on presently available data. Some variation from these conditions must be expected
Depths measured in feet.
To convert feet to meters, multiply by 0.3048.

FIGURE K.6. Site Cross Section East-West

Source: Law Engineering Testing Company 1979b



Notes: The figure presented represents an interpretation of subsurface conditions based on presently available data. Some variation from these conditions must be expected
Depths measured in feet.
To convert feet to meters, multiply by 0.3048.

FIGURE K.7. Site Cross Section North-South

Source: Law Engineering Testing Company 1979b

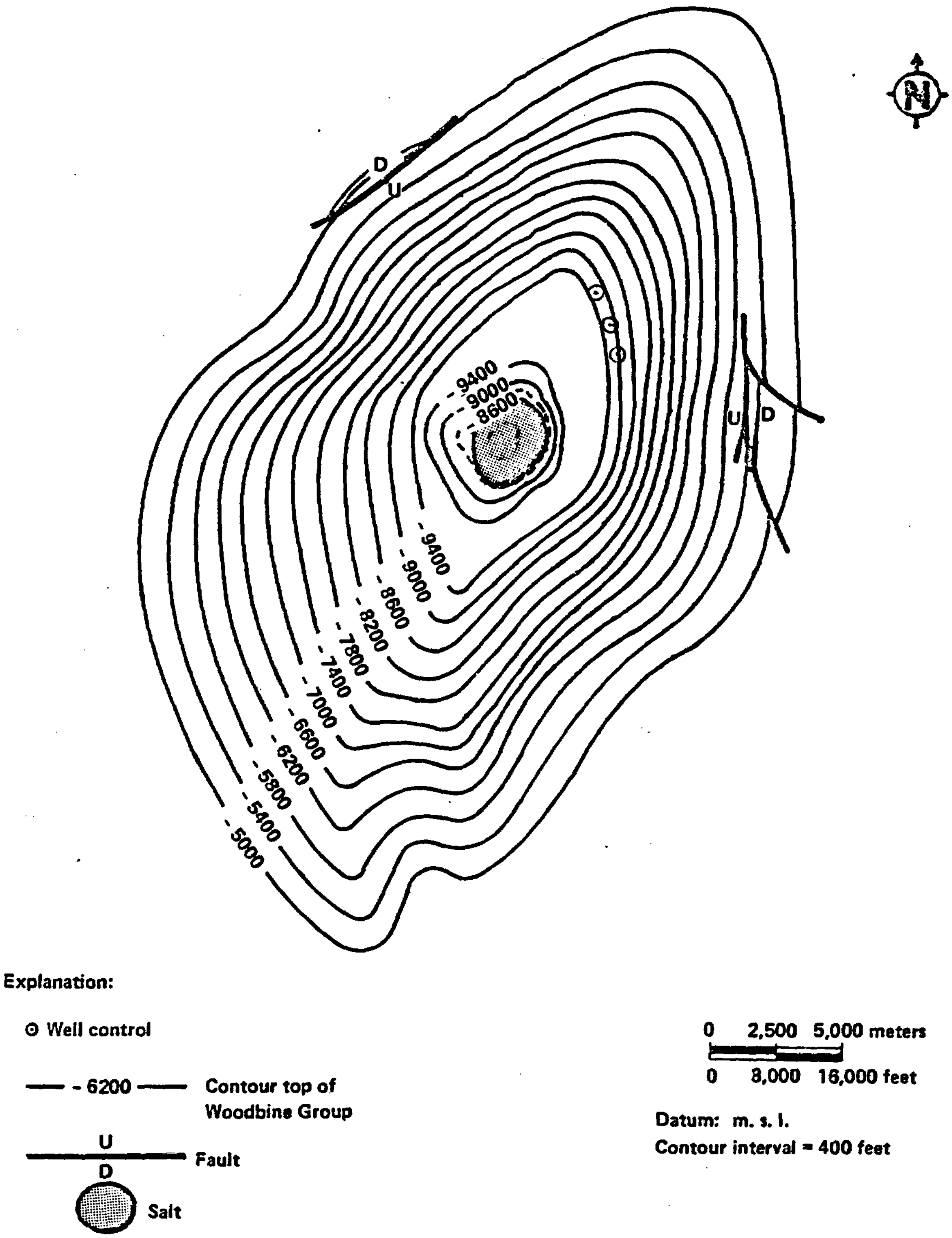


FIGURE K.8. Site Structure Contour Map, Top of Woodbine Group

Source: Law Engineering Testing Company 1979b

Internal Salt Structure

Internal salt dome structures are those that are related to the character of the caprock and dome salt. Well logs describe the dome salt principally as crystalline halite. However, wells on the south portion of the salt dome indicate the presence of some shale inclusions; wells closer to the center of the salt dome do not indicate a similar presence of shale inclusions.

Caprock is believed to drape over the entire top of the salt dome. The thickness of the caprock ranges from 49 to 265 ft, with the thickest portion of the caprock being in the northeast quadrant of the salt dome. The caprock can be divided into three zones. The upper zone is disseminated pyrite (FeS_2) in carbonate, the middle zone is gray shaley carbonate, and the lower zone is white, clear, very dense anhydrite ($CaSO_4$).

Host Sediments

The local stratigraphic section is made up of more than 18,000 ft of Mesozoic and Cenozoic sedimentary strata that overlie Paleozoic substrata. This discussion will concentrate on the Upper Cretaceous, Tertiary, and Quaternary rocks in the vicinity of the Hainesville Salt Dome. The stratigraphic groups within the following systems or series will be given in ascending order. All these groups are generally conformable and constitute a series of hydrologic aquifers and aquacludes. Because of their importance to the hydrologic analyses, the stratagraphic section which surrounds the Hainesville Salt Dome is presented below in additional detail.

- Upper Cretaceous Series
  - Woodbine Group: The Woodbine Group consists of sandstone interbedded with shales and mudstones. The thickness of the unit at the salt dome is about 70 ft. The Woodbine Group conformably underlies the Eagle Ford Group outside of the area of salt dome influence.
  - Eagle Ford Group: This group is recognized as a group only at the outcrop and is recognized as a formation in the subsurface of the basin. The thickness of the formation at the salt dome is 690 ft, and the formation primarily consists of a thick shale sequence with lenses of porous and non-porous sands.

- Austin Group: This group is about 1795 ft thick and can be divided into three units. The lower and upper units are chalk, and the middle unit is marl (calcareous clay).

- Taylor Group: The Taylor Group is about 2235 ft thick at the salt dome and is divided into three units. The Lower Taylor consists of shale with an upper sand unit. The Pecan Gap is composed of thick, dense chalk, and the Upper Taylor is thick, uniform calcareous shale.

- Navarro Group: The Navarro Group is about 1550 ft thick and is divided into three units. The Upper and Lower Navarro are both shale and are interbedded with marly, calcareous sandstone containing thin bentonite layers. The Nacatoch sand is a massive quartz sandstone. The contact with the overlying Tertiary Midway Group is unconformable.

- Tertiary System.

  - Midway Group (Paleocene Series): This group is about 1695 ft thick at the British American #B-1 Weisenhunt well, and it consists mainly of calcareous and non-calcareous shales. At the salt dome, the group is a thick shale with thin discontinuous beds of sand. The Midway shales have a very low hydraulic conductivity, and in the study area is considered to be an aquiclude. The top of the Midway represents the bottom confining surface for the overlying Wilcox Group.

  - Wilcox Group (Eocene Series): The Wilcox Group consists chiefly of silts and sands interbedded with clay and a few thin beds of lignite. The group is about 735 ft thick at the British American #B-1 Weisenhunt well. The sands and shales of the Wilcox group are unconformably overlain by the Claiborne Group. On the northeast and southeast flanks of the basin, the Wilcox dips to the southeast.

  - Claiborne Group (Eocene Series): The Claiborne Group consists of five different formations and is generally composed of alternating sands, silts, and clays with occasional indurated layers. The five formations of the Claiborne Group are described below.

The Carrizo Formation is about 150 ft thick at the Hainesville Salt Dome and is the only formation that does not crop out in the site area. The formation is composed of interbedded sands, silts, and clays.

The combined Carrizo-Wilcox aquifer represents the most significant aquifer in the study area. Though in some places a shale layer separates the two aquifers, they are hydraulically connected and are generally considered to be one aquifer.

The Reklaw Formation has a total thickness of about 70-100 ft and often contains highly fossiliferous layers and some lignite in the upper portions of the formation. The Reklaw generally consists of slightly glauconitic clay with smaller portions of sand. Regionally, the Reklaw is assumed to be an aquitard, but this assumption has not yet been proven. The Reklaw is significant hydrologically as a semiconfining layer overlying the Carrizo-Wilcox aquifer.

The Queen City Formation is 200 to 500 ft thick, becoming thicker towards the salt dome. This formation sometimes contains petrified wood and some plant fossils, and is generally composed of interbedded sand, silt, and clay with some lignite. The Queen City aquifer is extensively used as a municipal water supply because of its thickness and areal extent. Coefficients of transmissivity range between 3000 and 12,000 gal/day/ft, and the hydraulic conductivity ranges between 10 and 130 gal/day/ft^2. A hydraulic conductivity of 50 gal/day/ft^2 is probably representative of the aquifer as a whole. Many of the wells giving these data were not screened through the entire sand thickness. (The percent of thickness screened for the pump test has an effect on the calculated coefficients.)

The Weches Formation contains highly fossiliferous strata and has a thickness of about 70-75 ft. The formation basically consists of glauconitic sand and clay with occasional layers of glauconite. The Weches Formation is not considered important to the hydrogeology of the area. It has a very low hydraulic conductivity and is considered to be an aquiclude or aquitard, depending upon its location. The formation is generally an ineffective separator between the Sparta and Queen City Formations.

The Sparta Formation is composed chiefly of layered, unconsolidated sands, silt, and clay. This formation occasionally contains petrified wood and leaf fossils. The Sparta is only 50 ft thick at the site area. This aquifer is not very important, even though it has reasonably good hydraulic properties, because of its limited areal extent.

Quarternary System

A small, isolated, Pleistocene alluvial terrace deposit exists along the Sabine River, southwest of the salt dome. The deposit is about 60 ft thick and consists of sand, silt, clay and some gravel. Recent alluvium is also present along portions of most of the creeks in the area and consists of sands, silts, and clays.

SALT DOME DEVELOPMENT

The following geologic history concerning the development of the Hainesville Salt Dome is primarily taken from Loocke (1978).

- Upper Jurassic. The Louann salt was deposited on a relatively flat area of a restricted marine environment in the East Texas Salt Dome basin. Flow of salt within the Louann formation resulted in a thicker salt bed in the site area. Salt pillow formation began as a response both to continued salt flow and to irregularities that existed in the pre-salt surface during this time.
- Lower Cretaceous (Comanchean Series). Deltaic progradation characterized the beginning of the Lower Cretaceous with deposition of the Travis Peak Formation. This major transgressive sequence marked the end of the Lower Cretaceous Comanchean Series and resulted in continued salt dome growth.

As the salt dome growth continued, the structure developed from an initial thick area of salt deposition into a low, broad salt pillow into a better defined and centralized salt structure. By the end of Lower Cretaceous deposition, the salt pillow had evolved into a salt ridge.

- Upper Cretaceous (Gulf Series). The Upper Cretaceous is marked by deposition of the Woodbine Group during a regressive interval and by deposition of the Eagle Ford Group during a minor transgressive interval. During deposition of the Woodbine, salt dome growth reached its maximum rate of 800 ft/million years.

  Erosion of the salt dome occurred in Late Woodbine time, when the top of the salt dome was several hundred feet to 1000 ft above sea level. Near the end of the Upper Cretaceous, salt extruded from an eroded hole in the underlying salt structure (Loocke 1978). The volume of salt lost during the extrusion stage resulted in collapse of the underlying salt structure (the original salt pillow). The collapse of the salt pillow created a space below the units undergoing contemporaneous deposition and resulted in the development of an inner rim syncline adjacent to the salt stock. Loocke suggests that this extrusion continued during the Tertiary. The growth rate slowed to 150 ft/million years by the close of the Cretaceous.

- Tertiary. Regression marked the beginning of the Tertiary and resulted in deposition of alluvial deltaic sediments. A permanent salt overhang developed during the Tertiary. This overhang was caused by lateral salt movement induced by collapse of the salt dome flanks during extrusion when vertical loads above the salt dome exceeded the lateral confining pressure.

- Quaternary. Sediments of Recent age overlying portions of the salt dome are unaffected by the salt dome, suggesting that the Hainesville Salt Dome has been stable throughout Recent time and possibly as far back as the Middle to Late Tertiary.

MINERAL RESOURCES

On a regional scale, mineral resources include oil, gas, lignite, clay, salt, asphaltic sands, peat, iron ore, rock aggregate, sand, and gravel.

Oil and gas are by far the most important resources in the East Texas Salt Dome basin (Figure K.9). However, hydrocarbon accumulations are noticeably absent around shallow piercement salt domes. Commercial hydrocarbon occurrences within the immediate vicinity of salt domes have been sporadic and scattered (Netherland, Sewell, and Associates 1975). Sufficient drilling has been performed to prove that most of the interior salt domes are predominantly free of significant hydrocarbon accumulations. However, additional hydrocarbon resources may be concentrated on the sides of salt domes that have not yet been fully explored.

In the site area, exploration at the Hainesville Salt Dome has continued since the salt dome was first discovered in 1927. Oil was first produced in 1956 from the British American #1 Weisenhunt well in the southwest quadrant of the salt dome. A second producing well (British American #1 Amos) has been drilled northwest of the first producing well. As of 1977, these two wells have recovered 3,897 billion ft^3 of gas, 191,301 barrels of condensate and 19,067 barrels of oil.

Production to date has been limited to the Lower Cretaceous Travis Peak, Lower Glen Rose, and Paluxy Formations, as well as the Upper Cretaceous, Woodbine, and Sub-Clarksville Formations. In 1978, three new producing wells were completed on the east flank of the salt dome. Five new wells are currently being completed in the area.

Lignite is a low-grade coal that is becoming a major energy resource in Texas. On the regional extent, near-surface deposits (less than 200 ft deep) occur in a bank following the outcrop pattern of the Wilcox Group, which essentially parallels the basin's western boundary. Geophysical evidence indicates that deep basin lignite deposits (greater than 200 ft deep) exist in the Wilcox Group throughout the basin. Regional development of these deep lignites would probably require some means of underground gasification, because of the limitations of present subsurface mining practices.

Sands comprising the Queen City Formation are abundant at the site, and do represent a resource. Development of these sand deposits could affect both the hydrologic characteristics of near-surface aquifers and the present

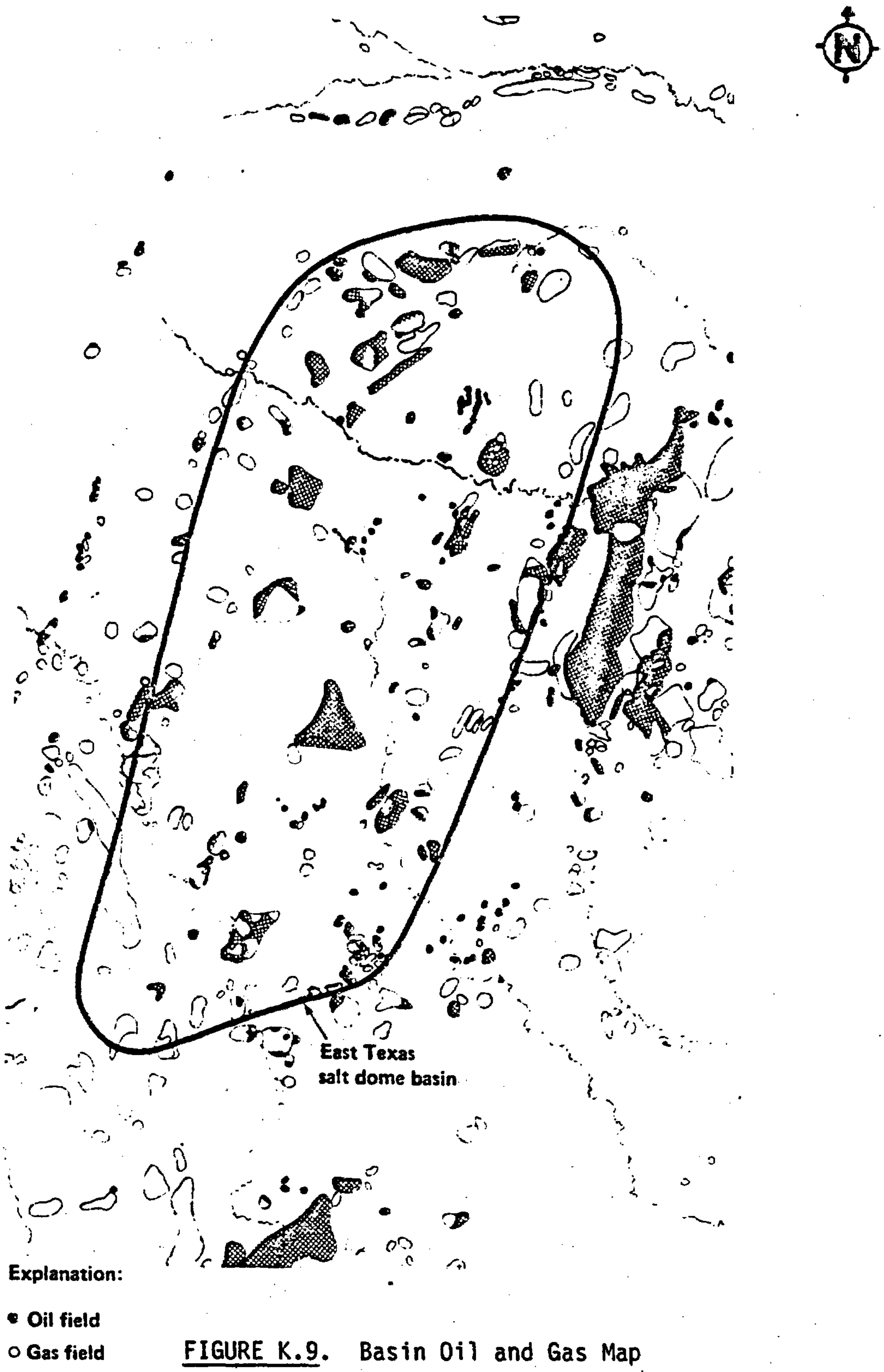


FIGURE K.9. Basin Oil and Gas Map
Source: Law Engineering Testing Company 1979b

drainage system. However, because sand deposits are extensive elsewhere in the area, resource development at the site should not be necessary.

No commerical salt mining occurs in the Hainesville salt dome. However, the salt dome has been the site of gas storage since 1950. Caverns for the gas storage were created in the salt dome by solution mining.

FAULTING AND SEISMIC CONSIDERATIONS

Several fault systems are present in the site region; however, none of them are considered to be capable. Capable faults are those which have the potential for generating significant ground motion at the site relative to the Integrity Basic Earthquake. Earthquakes that have occurred in the site region have been few in number and small in intensity. These minor seismic events have not been directly correlated with known faults.

Boundary Fault Systems

Boundary fault systems are those fault zones which tend to define the limits of the basin. They include the Mexia-Talco fault zone, the Balcones fault zone, the Mt. Enterprise fault zone and the Rodessa fault zone (Figure K.10).

Mexia-Talco Fault Zone

This fault zone extends through east Texas. The zone, located 43 miles northwest of the site, extends from north of the Sabine uplift west towards Dallas, and then south into southern Texas. The zone forms a nearly continuous series of en echelon normal faults and grabens and is considered to represent a zone of major fracturing and graben formation associated with the upper portion of the Gulf Coast basin (Murray 1961). Displacements along the faults range from none at the strike termination of individual fault segments to 2500 ft at various places along the fault. Surface displacements are usually contained to Upper Cretaceous or Eocene beds and rarely exceed 300 ft. Movement on some faults may have occurred as late as mid-Tertiary. The amount of movement on the faults has generally decreased with time. Pleistocene terraces extend across the fault system without interruption, indicating that movement probably ceased about Eocene time.

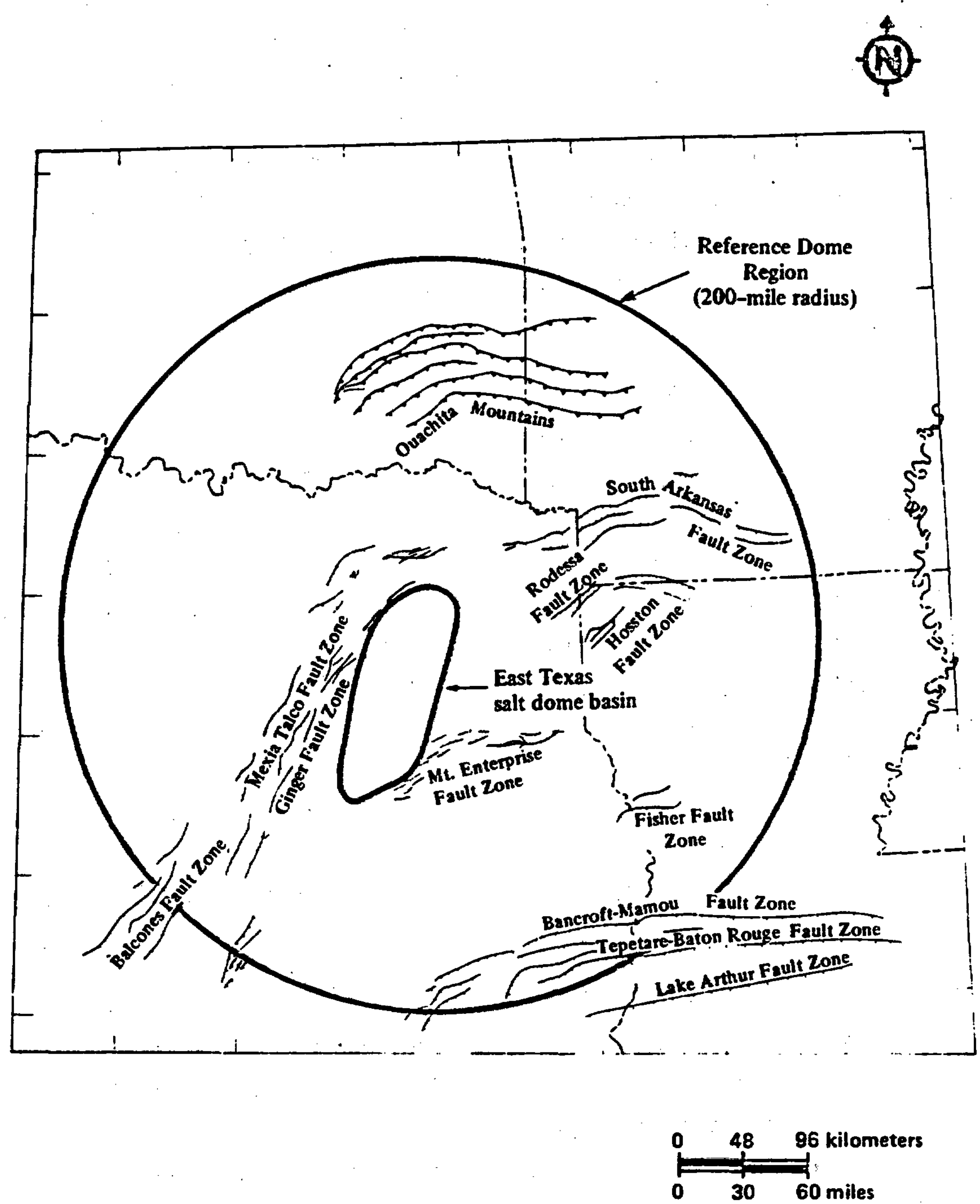


FIGURE K.10. Regional Fault Map

Source: Law Engineering Testing Company 1979b

Balcones Fault Zone

The Balcones zone is situated east of the Ouachita frontal zone and overlies the Ouachita foldbelt, forming a great convex arc gulfward through central Texas and paralleling the outcrop of Upper Cretaceous strata. The individual faults are normal and generally dip down toward the coast. Maximum displacement of up to 1700 ft occurred across the fault zone in central Texas. Pliocene terrace deposits indicate that movement along individual faults probably ceased during Late Tertiary. It has been postulated that movement on the fault zone may be a result of uplift and tilting of the crust west of the Gulf region (Kehle 1978).[a]

Mount Enterprise Fault Zone

The Mount Enterprise system of faults is an en echelon series of displacements roughly parallel to the present coastline. The zone extends from the southwestern portion of the Sabine uplift westward along the southern edge of the East Texas Salt Dome basin. The faults generally have displacements ranging from about 35 to 60 ft. Movement began in Early Cretaceous. The Mount Enterprise system is probably closely related to the hinge line or transitional zone between the attentuated continental crust and the oceanic crust. The differential subsidence along this hinge line resulted in tensional stresses and the faulting that began in Early Cretaceous time. Possible recent faulting has been identified on the Elkhardt fault (part of the Mt. Enterprise system). Little information is available at this time and, as such, is not addressed in this report. Any additional studies in the area should focus on this faulting so that it can be considered in detail in future studies.

Rodessa Fault Zone

The Rodessa zone is a series of en echelon down-to-the-basin faults comprising a zone on the north flank of the Sabine uplift. It extends partly into the East Texas Salt Dome basin. Faulting in the Rodessa zone is believed to have been initiated in the Early Cretaceous and to have ceased in the Middle Tertiary.

(a) Kehle, R. O. 1978. "Tectonic Framework and History, Gulf of Mexico Region." Unpublished report prepared for Law Engineering Testing Company, Marietta, Georgia.

Faulting Related to Basin Salt

Faulting that resulted from movement of salt is common in the East Texas Salt Dome basin. The faults may be related to movement of salt at depth or in piercement salt domes near the surface. Both types of faulting exist in the site area. Because this type of faulting is related to the mobility of salt, these faults are considered non-tectonic in origin.

Ginger Fault Zone

The Ginger fault zone extends from the southern edge of the salt dome basin northward and eastward, terminating east of the Hainesville Salt Dome. This zone is related to the movement of salt along a deep salt ridge. The faults do not have surface expression and die out in Cretaceous age rocks, indicating that movement ceased during the Mid-Cretaceous.

Site Area Faults

Peripheral faulting associated with salt dome growth at the boundaries of the site area has been reported by Loocke (1978) and Eaton (1952). At the Hainesville Salt Dome, these peripheral faults are normal faults, upthrown toward the salt dome, with displacements of between 100 to 200 ft. The faulting occurs in Upper Cretaceous and Lower Tertiary rocks.

The central graben and radial fault patterns that are characteristic of many east Texas salt domes have not been mapped at the Hainesville Salt Dome. Fisher et al. (1965), however, describe a central graben overlying the salt dome. According to Fisher, the graben affects Tertiary age Claiborne rocks at the surface.

Nearly all of the fault systems in the region surrounding the site, with the exception of coastal growth faults, have not been active since before Late Tertiary (approximately 1.5 million yr ago). As the coastal growth faults are considered to be aseismic, there are no known capable faults within the region of study, with the possible exception of the recent movement on the Elkhardt fault, which is currently being investigated.

Faulting Related to Sedimentation and Subsidence

Two other fault zones are also present in the site region but lie outside of the East Texas embayment. These two fault zones are associated with sedimentation and subsidence in the lower Gulf basin and are described below.

Fisher Fault Zone

This fault zone has a length of 30 to 40 miles and trends west-southwest from Sabine Parish, Louisiana, across the Sabine River and into Sabine County, Texas. The fault zone is about 5 to 10 miles wide, and the maximum length of any fault segment is about 10 miles. The individual faults are shallow, normal faults that produce a series of horsts and grabens, and step faults that parallel the Angelina-Caldwell flexure (Durham and White 1960). Displacements vary from more than 250 ft in Louisiana to displacements on the order of tens of feet in Texas.

Initiation of movement is believed to be post-Cretaceous, because most of the faults die out above the Cretaceous. According to geological maps, faulting does not extend into Pleistocene terrace deposits, indicating that movement ceased in Late Tertiary. Movement appears to be related to extension of sediments, resulting from Tertiary sedimentation and subsidence in the lower Gulf basin.

Growth Faults

The movement on growth faults produced by and occurring simultaneously with periods of sedimentation is rather slow, unlike the rapid movements that are generally associated with earthquake-generating faults. As sedimentation ends, so does the faulting. Major growth activity on these faults ceased in the Miocene, as sediment depocenters moved further gulfward. Recent movement of some of these faults has occurred, resulting in measurable fault scarps and movement rates. The recent fault movement has disrupted human-made structures over short time intervals. This recent fault movement is believed to be the result of subsidence associated with the withdrawal of ground water and hydrocarbons.

Seismic Considerations

Investigations of the regional seismicity of the Hainesville site area have resulted in the following conclusions:

- The region is tectonically stable and subject to only occasional earthquakes of low intensity.
- There are no seismically active tectonic structures and/or capable faults within 200 miles of the site.
- An Integrity Basic Earthquake (IBE) equaling 0.10 g was conservatively selected for the site.
- The Operating Basis Earthquake (OBE) was estimated to be 0.05 g, with a return period of 470 yr.
- Acceleration and displacement time histories and design spectra were derived for the site's surface and subsurface structures.

Historic Seismicity

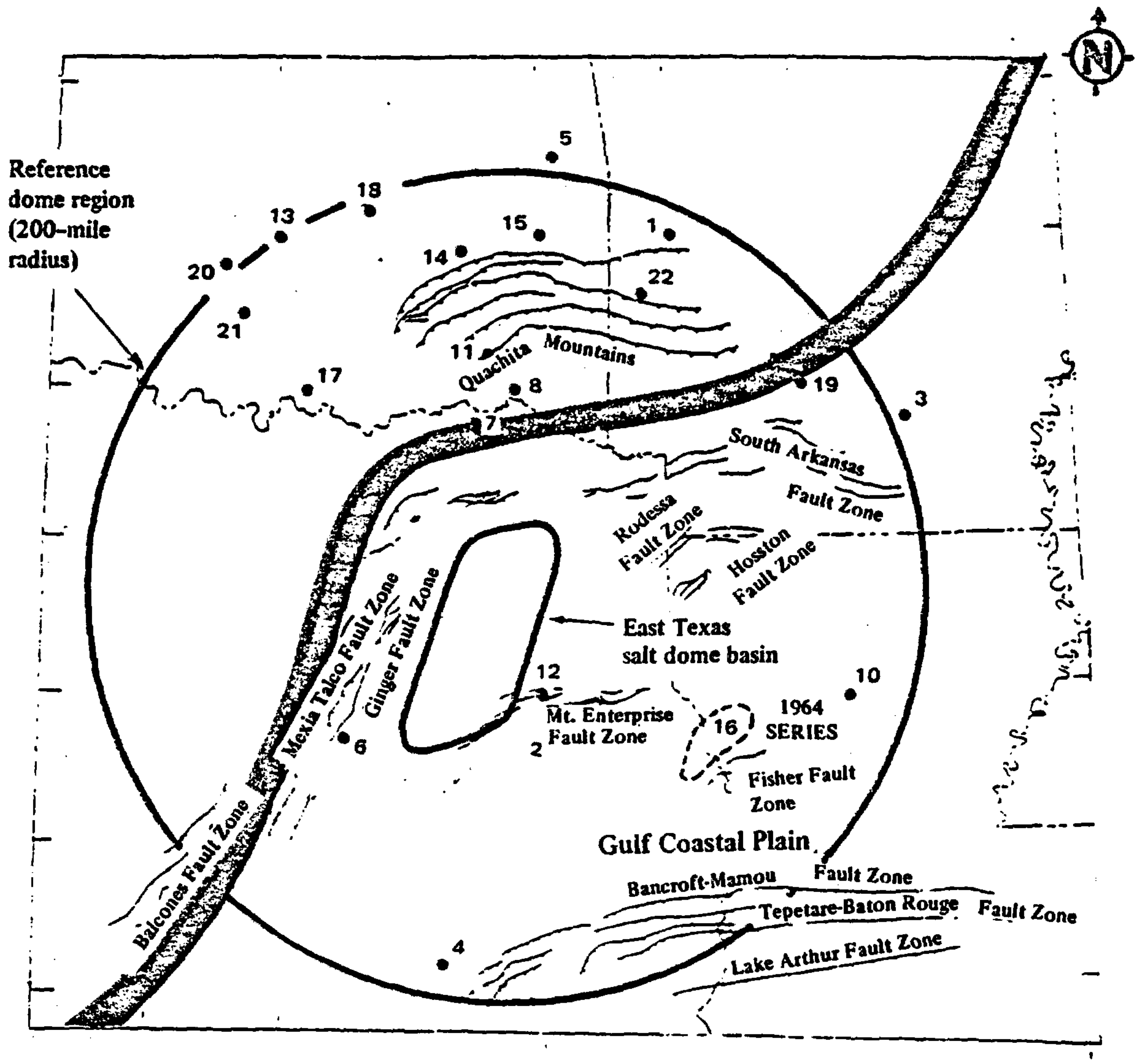
Locations for epicenters of all recorded earthquakes that have occurred in the Hainesville site area with an intensity greater than IV-V on the Modified Mercalli scale (MM) are plotted on Figure K.11. As the figure illustrates, there have been 22 historical earthquakes within a 200 mile radius of the Hainesville Salt Dome.

The Gulf Coastal Plain has experienced only a few earthquakes during the historical period. The region has numerous surface and subsurface faults, but the faults are not directly correlative to earthquakes. The mechanisms underlying earthquakes in this region are not well understood. Therefore, all folded areas in the region are generally given an equal earthquake potential.

Historical evidence suggests that an intensity IV MM earthquake can probably be defined as the maximum earthquake for the Hainesville site.

Integrity Basis Earthquake (IBE)

A conservative IBE having a surface acceleration of 0.10 (Intensity VI MM) was selected for the site. The IBE selection was based on a conservative evaluation of the amount of ground motion that is remotely possible, considering



Explanation:

- Earthquake epicenters
  Index numbers 1-22: see Table 2.2-7.
- Boundary between Gulf Coastal Plain and interior continental regions.

FIGURE K.11. Regional Seismicity
Source: Law Engineering Testing Company 1979

seismic history and geological structure. This level of acceleration would not be exceeded during a size VI MM intensity earthquake (the intensity of the largest provincial event).

Operating Basis Earthquake (OBE)

The Operating Basis Earthquake for the Hainesville site is postulated to have a peak horizontal acceleration of 0.05 g. This acceleration is equal to 1/2 the IBE.

SURFACE HYDROLOGY

The Hainesville Salt Dome is located in the Sabine River drainage basin. It is bounded by the Neches and Trinity River drainage basins to the west, the Red River basin on the northeast, and the Calcasieu River basin on the east (Figure K.12). The Sabine River drainage basin drains an area of 9700 square miles. The Red River flows into the Mississippi River, whereas the Trinity, Neches, Sabine and Calcasieu Rivers discharge directly into the Gulf of Mexico (Figure K.12).

The Sabine River flows southeastward from its headwaters in Hunt and Collin Counties, Texas. Its course changes to southerly as it nears the Louisiana border to its mouth on an estuary of the Gulf of Mexico. The river meanders through its floodplain with numerous sloughs, overflow channels, and marshes.

The climate of the Sabine River basin is sub-humid to humid. Annual precipitation averages about 48 in. About 25% of the precipitation fills streams as surface runoff. The distribution of precipitation is often uneven, making the construction of reservoirs useful for flood control and water supplies. Lake Tawakoni Reservoir is located on the Sabine River. The total length of the dam is 5.6 miles. The Carl L. Estes Reservoir has been authorized for construction but has not yet been built. It will be located downstream of Lake Tawakoni.

The Lake Fork Creek is the largest tributary of the Sabine River and flows over the southwest rim of the Hainesville Salt Dome site. The Lake Fork Creek drainage basin has a watershed area of 685 square miles. Mean annual

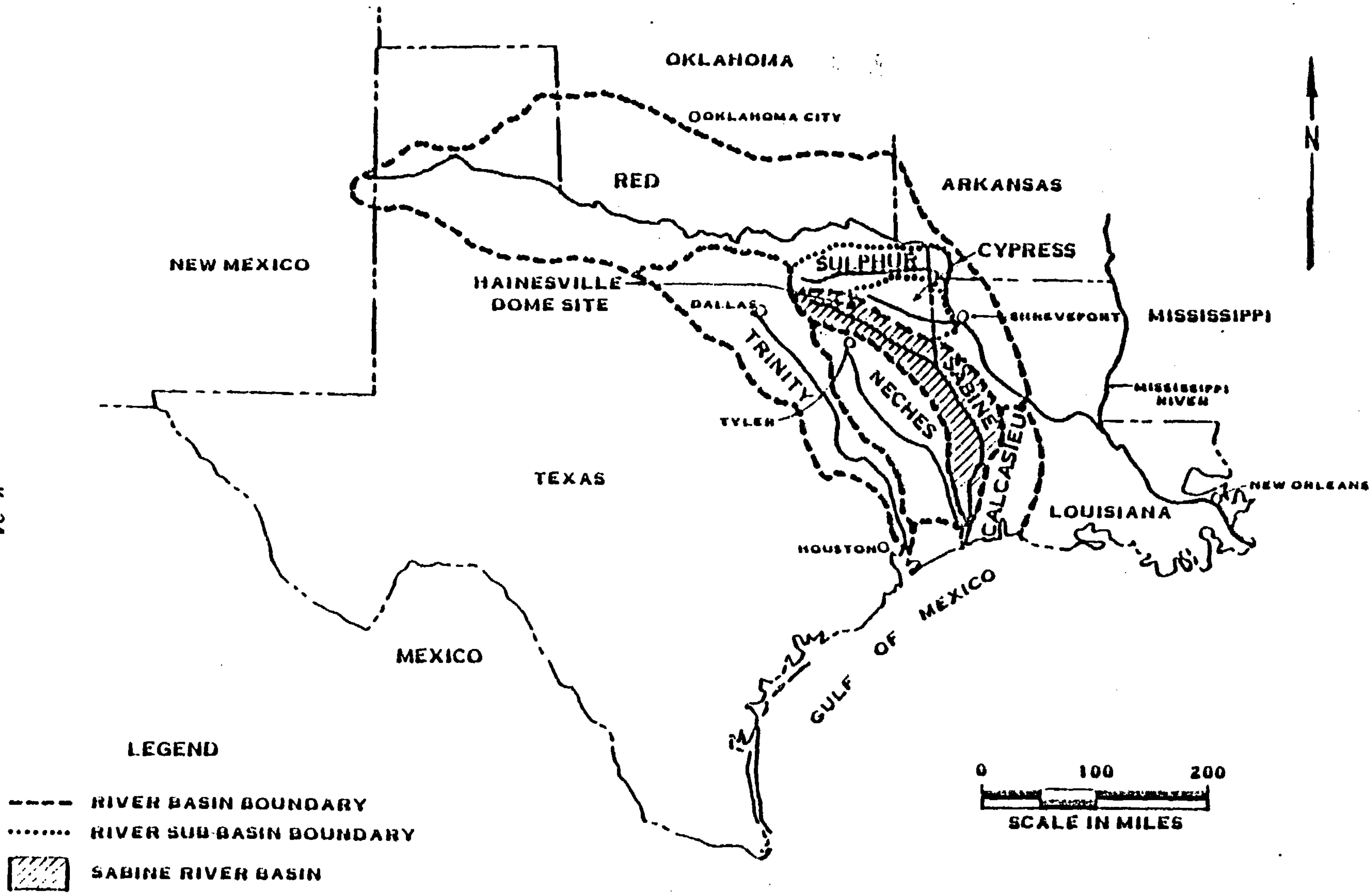


FIGURE K.12. Index Map Showing Sabine River Drainage Basin
Source: Law Engineering Testing Company 1979b

precipitation is about 43 in., and surface runoff is about 25% of the precipitation. Construction has already begun on the Lake Fork Dam. This will be an earthen dam with a reservoir capacity of 675,800 acre-ft.

Haines Creek is a very short creek, which, in addition to Lake Fork Creek, lies within the area above the Hainesville salt dome. The entire Haines Creek drainage basin lies within Wood County and covers an area of 24 square miles.

SUBSURFACE HYDROLOGY

Regional Characteristics

Of interest are all waters that conceivably could come within proximity of the repository site. The repository is assumed to be 2000 ft below land surface (-1600 ft MSL). Therefore, all water movements in geologic formations are above -3000 ft MSL were investigated. A sectional view through the Hainesville Salt Dome (Figure K.6) shows that the following formations and groups are important in this analysis:

	Geologic Unit	
1.	Sparta Formation	Aquifer
2.	Weches Formation	Aquitard/Aquiclude
3.	Queen City Formation	Aquifer
4.	Reklaw Formation	Aquitard/Aquiclude
5.	Carrizo Formation	Aquifer
6.	Wilcox Group	Aquifer
7.	Midway Group	Aquiclude

All aquifers below the Midway Group are quite saline and therefore are not used to supply water.

The Carrizo-Wilcox aquifer is the most important aquifer in the study area. Most of the larger municipalities and industries in the region obtain their water from this aquifer. Some ground water is used for irrigation when rainfall is insufficient to meet area needs.

In the study area, the portion of the Wilcox group that contains water of usable quality ranges from 0 to 2400 ft. Coefficients of transmissivity are dependent upon the aquifer thickness as well as upon the permeability. Because of its great thickness, the Wilcox portion of the aquifer exhibits large coefficients of transmissivity at some places within the study area, despite the relatively low permeability of its sands.

In the site area, the Carrizo-Wilcox aquifer crops out in the northwestern half of Wood County (Figure K.13). The water in the outcrop area is generally unconfined. However, artesian pressures may exist locally in places where water is confined beneath lenticular bodies of clay that have a limited areal extent. The water table is generally shallow (about 50 ft) and commonly is near the base of streams that cross the outcrop.

Pumping tests made on eight wells in Wood County produced the following aquifer characteristics:

Coefficient of transmissivity = 600 to 19,000 gal/day/ft

Discharge rates = 50 to 490 gal/min

Specific capacities = .8 to 9.7 gal/min/ft of drawdown

Hydraulic conductivity = 4 to 700 gal/day/ft^2 (However, an average value of 50 gal/day/ft^2 is considered more realistic--Broom 1968).

The variations in transmissivity result not only from changes in hydraulic conductivity but also variations in sand thickness. None of the wells fully penetrated the aquifer, so the measured values are less than the true values.

Water levels in the Carrizo-Wilcox aquifer range from land surface to 300 ft below the land surface. In areas of heavy pumping, water levels have declined as pumpage has increased. This decline does not necessarily mean that the water will eventually be depleted nor that pumpage is exceeding recharge. Water moves through an aquifer at a rate that is proportional to the hydraulic gradient; therefore, if pumpage is increased, the water level must decline to a point where the gradient is sufficient to move water at a given pumping rate.

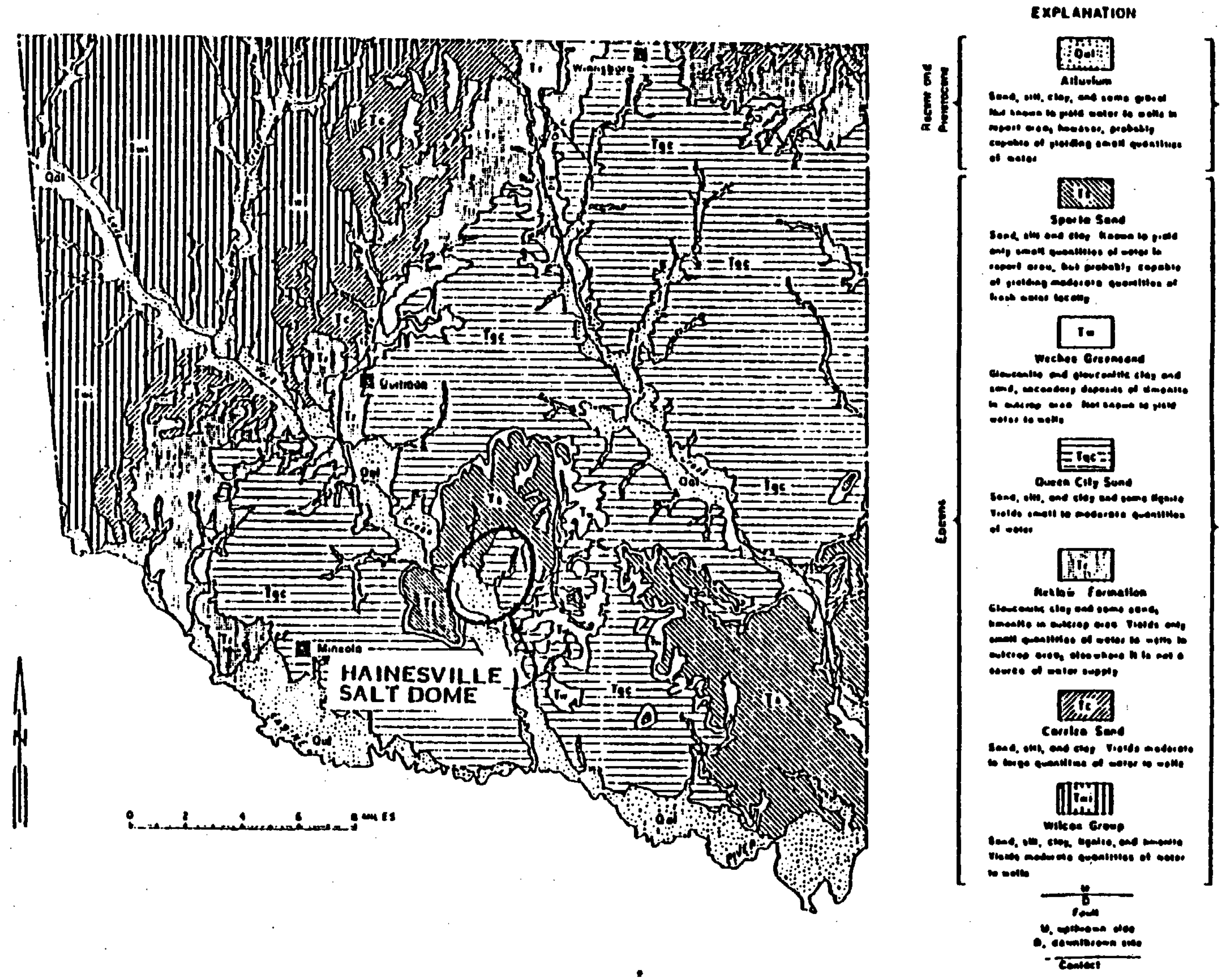


FIGURE K.13. Geologic Map of Wood County

Source: Law Engineering Testing Company 1979b

Water levels in the Sparta-Queen City aquifers range from the land surface to approximately 150 ft below the land surface. Water level fluctuations result from variations in precipitation, evapotranspiration, and changes in pumping rate on the outcrop area. No apparent downward trend in water level exists in either the Carrizo-Wilcox or the Sparta-Queen City aquifers. This is an indication that neither aquifer is developed to its potential.

Ground-Water Flow

The Physical Control Volume (PCV), through which ground water flows through the region, consists of a complicated layered system. The bottom layer is the Midway Group, an aquiclude which represents the bottom flow boundary. Above the Midway is the Carrizo-Wilcox aquifer, which is the primary aquifer in the PCV.

The remaining layers do not exist over the entire areal extent of the PCV. The next succeeding layer is the Reklaw Formation, which is an aquitard on a regional scale, but may locally be an aquiclude. The Reklaw separates the Carrizo-Wilcox aquifer from the Queen City sands. The Queen City aquifer is extensively tapped; however, its limited thickness and areal extent eliminate it as a primary aquifer. Above the Queen City is the Weches aquitard, which ineffectively separates it from the Sparta sands.

The Carrizo-Wilcox is an unconfined aquifer throughout its outcrop area but it is assumed to be leaky elsewhere in the PCV. The Queen City is also generally unconfined, but there are numerous local exceptions. The Weches Formation is an aquitard, and thus the Queen City is locally semi-confined. The Weches, however, is considered to be an ineffective separator between the Queen City and Sparta sands. The Sparta is an unconfined aquifer throughout its entire areal extent.

Potentiometric Surfaces and Flow Directions

The overall flow pattern for the Physical Control Volume described above is so complex that more than one potentiometric surface can be measured; that is, waters flowing within the Carrizo-Wilcox aquifer have an identifiable potentiometric surface, while the waters flowing within the Queen City aquifer most likely have a different potentiometric surface.

In most of the region the Carrizo-Wilcox aquifer is under artesian conditions. The storage coefficient typically ranges between 0.00007 and 0.00027. The typical flow direction is toward a stream or pumped well. The flow in the southern portion of the study area appears to be controlled by the structural dip of the Wilcox Group which is toward the southeast.

Within the site area, the most important aquifer is the Carrizo-Wilcox aquifer. It can be seen from Figure K.6 that the Wilcox Group is in contact with the Hainesville Salt Dome caprock.

On a regional basis, the Queen City aquifer occurs under various water table conditions. Confined, semiconfined, and perched water tables exist locally, where layers of clay and shale hinder vertical movement of water. In other areas, where the water is not confined by impermeable layers, the movement of water is mainly controlled by the elevation of the land surface. In semi-confinement, the water usually moves in the direction of dip of the aquifer.

The Sparta aquifer is unconfined within the study region. Flow within the aquifer tends to be topographically controlled and is thus towards streams in the immediate area. In the site area, the Sparta-Queen City aquifer is unconfined throughout its areal extent. Because of hydrological difficulties and inaccuracies in the data, no potentiometric surfaces are available for either the Sparta or the Queen City aquifer. However, some of the waters in the Sparta-Queen City aquifer are discharging into nearby streams.

APPENDIX L

ORIGEN OUTPUT FOR LONG-TERM SPENT FUEL INVENTORIES

TABLE L.1. Curies of Light-Element Isotopes in a BWR Assembly

	INITIAL	1. Y	3. Y	10. Y	30. Y	100. Y	300. Y	1000. Y
H 3	4.73+001	4.47+001	4.00+001	2.69+001	8.73+000	1.69-001	2.16-006	1.61-023
C 14	2.65-001	2.65-001	2.65-001	2.65-001	2.62-001	2.60-001	2.54-001	2.33-001
CL 36	1.96-003	1.96-003	1.96-003	1.96-003	1.96-003	1.96-003	1.96-003	1.96-003
MN 54	2.46+001	1.07+001	2.01+000	5.80-003	3.22-010	.00	.00	.00
FE 55	2.15+002	1.64+002	9.65+001	1.49+001	7.23-002	5.70-010	.00	.00
CO 58	1.57+002	4.51+000	3.72-003	6.01-014	.00	.00	.00	.00
CO 60	4.17+002	3.66+002	2.81+002	1.12+002	8.02+000	7.92-004	2.85-015	.00
NI 59	1.51+000	1.51+000	1.51+000	1.51+000	1.51+000	1.51+000	1.50+000	1.49+000
NI 63	2.29+001	2.28+001	2.24+001	2.13+001	1.85+001	1.08+001	2.39+000	1.23-002
ZN 65	2.00+001	7.12+000	9.01-001	6.52-004	6.93-013	.00	.00	.00
ZR 93	9.28-002	9.28-002	9.28-002	9.28-002	9.28-002	9.27-002	9.27-002	9.27-002
ZR 95	1.50+004	3.06+002	1.27-001	1.84-013	.00	.00	.00	.00
NB 93M	7.02-005	1.13-002	1.92-002	4.14-002	7.45-002	9.27-002	9.32-002	9.31-002
NB 94	5.88-002	5.88-002	5.88-002	5.88-002	5.88-002	5.86-002	5.82-002	5.68-002
NB 95	.00	6.50+002	2.70-001	3.91-013	.00	.00	.00	.00
MO 93	5.56-004	5.56-004	5.56-004	5.56-004	5.55-004	5.52-004	5.44-004	5.15-004
SN119M	2.22+003	8.05+002	1.00+002	8.88-002	1.43-010	.00	.00	.00
SN121M	1.14+003	1.13+003	1.11+003	1.09+003	8.70+002	4.59+002	7.42+001	1.25-001
SN123	1.06+002	1.39+001	2.43-001	1.70-007	4.38-025	.00	.00	.00
SB125	6.31+002	4.89+002	2.92+002	4.84+001	2.86-001	4.50-009	.00	.00
TE125M	1.36+002	2.01+002	1.21+002	2.01+001	1.18-001	1.66-009	.00	.00
SUBTOT	2.02+004	4.22+003	2.08+003	1.29+003	9.07+002	4.72+002	7.86+001	2.11+000
TOTAL	2.02+004	4.22+003	2.08+003	1.29+003	9.07+002	4.72+002	7.86+001	2.11+000

TABLE L.1. (Contd)

	INITIAL	3000. Y	10000. Y	30000. Y	50000. Y	100000. Y	500000. Y	1,000,000 Y
C 14	2.33-001	1.83-001	7.85-002	6.99-003	6.22-004	1.47-006	.00	.00
CL 36	1.96-003	1.95-003	1.92-003	1.83-003	1.75-003	1.57-003	6.41-004	2.10-004
NI 59	1.49+000	1.47+000	1.38+000	1.16+000	9.77-001	6.34-001	1.98-002	2.61-004
NI 63	1.23-002	3.52-009	.00	.00	.00	.00	.00	.00
ZR 93	9.27-002	9.26-002	9.23-002	9.15-002	9.06-002	8.80-002	7.36-002	5.84-002
NB 93M	9.31-002	9.30-002	9.25-002	9.15-002	9.06-002	8.80-002	7.36-002	5.84-002
NB 94	5.68-002	5.30-002	4.10-002	2.06-002	1.04-002	1.84-003	1.76-009	5.27-017
MO 93	5.15-004	4.42-004	2.58-004	5.52-005	1.18-005	2.52-007	1.06-020	.00
SN121M	1.25-001	1.51-009	.00	.00	.00	.00	.00	.00
SUBTOT	2.11+000	1.89+000	1.69+000	1.37+000	1.17+000	8.14-001	1.68-001	1.17-001
TOTAL	2.11+000	1.89+000	1.69+000	1.37+000	1.17+000	8.14-001	1.68-001	1.17-001

TABLE L.2. Curies of Fission-Product Isotopes in a BWR Assembly

	INITIAL	1. Y	3. Y	10. Y	30. Y	100. Y	300. Y	1000. Y
H 3	8.29+001	7.83+001	7.00+001	4.72+001	1.53+001	2.96-001	3.78-006	2.82-023
SE 79	6.05-002	6.05-002	6.05-002	6.05-002	6.05-002	6.05-002	6.03-002	5.99-002
KR 85	1.82+003	1.54+003	1.17+003	7.50+002	2.06+002	2.33+000	6.21-006	1.93-025
SR 89	9.80+004	7.54+002	4.46-002	7.11-017	.00	.00	.00	.00
SR 90	1.14+004	1.12+004	1.06+004	8.93+003	5.45+003	9.70+002	7.00+000	2.23-007
Y 90	.00	1.12+004	1.06+004	8.93+003	5.46+003	9.71+002	7.00+000	2.23-007
Y 91	1.29+005	1.70+003	3.17-001	2.60-014	.00	.00	.00	.00
ZR 93	4.43-001	4.43-001	4.43-001	4.43-001	4.43-001	4.43-001	4.43-001	4.43-001
NB 93M	3.71-002	5.73-002	9.47-002	1.99-001	3.55-001	4.41-001	4.43-001	4.43-001
ZR 95	1.87+005	3.81+003	1.58+000	2.29-012	.00	.00	.00	.00
NB 95M	.00	8.08+001	3.35-002	4.86-014	.00	.00	.00	.00
NB 95	1.90+005	8.30+003	3.42+000	4.97-012	.00	.00	.00	.00
TC 99	2.04+000	2.04+000	2.04+000	2.04+000	2.04+000	2.04+000	2.04+000	2.03+000
RU103	1.88+005	3.15+002	8.85-004	3.28-023	.00	.00	.00	.00
RH103M	1.85+005	3.15+002	8.85-004	3.28-023	.00	.00	.00	.00
RU106	7.80+004	3.91+004	9.85+003	7.88+001	8.06-005	8.70-026	.00	.00
RH106	8.39+004	3.91+004	9.85+003	7.88+001	8.06-005	8.70-026	.00	.00
PD107	1.74-002	1.74-002	1.74-002	1.74-002	1.74-002	1.74-002	1.74-002	1.74-002
SB125	2.07+004	1.60+004	9.57+003	1.59+003	9.36+000	1.47-007	.00	.00
TE125M	4.44+002	6.52+003	3.97+003	6.58+002	3.88+000	6.11-008	.00	.00
SN126	1.16-001	1.16-001	1.16-001	1.16-001	1.16-001	1.16-001	1.16-001	1.15-001
SB126M	6.29+001	1.16-001	1.16-001	1.16-001	1.16-001	1.16-001	1.16-001	1.15-001
SB126	1.26+002	1.15-001	1.15-001	1.15-001	1.15-001	1.15-001	1.14-001	1.14-001
I129	4.73-003	4.73-003	4.73-003	4.73-003	4.73-003	4.73-003	4.73-003	4.73-003
CS134	2.03+004	1.45+004	7.40+003	7.04+002	8.49-001	5.15-011	.00	.00
CS135	8.51-002	8.51-002	8.51-002	8.51-002	8.51-002	8.51-002	8.51-002	8.50-002
CS137	1.59+004	1.55+004	1.48+004	1.26+004	7.93+003	1.57+003	1.55+001	1.47-006
BA137M	1.49+004	1.45+004	1.38+004	1.18+004	7.41+003	1.47+003	1.45+001	1.38-006
CE144	1.59+005	6.51+004	1.09+004	2.14+001	3.88-007	.00	.00	.00
PR144	1.59+004	6.51+004	1.09+004	2.14+001	3.88-007	.00	.00	.00
PM147	1.97+004	1.51+004	8.89+003	1.40+003	7.04+000	6.40-006	.00	.00
SM151	6.17+001	6.12+001	6.02+001	5.69+001	4.86+001	2.78+001	5.65+000	2.14-002
EU154	1.50+003	1.43+003	1.32+003	9.71+002	4.08+002	1.97+001	3.41-003	2.32-016
EU155	9.60+002	6.59+002	3.06+002	2.10+001	4.93-003	2.28-014	.00	.00
SUBTOT	1.42+006	3.32+005	1.24+005	4.86+004	2.70+004	5.04+003	5.31+001	3.45+000
TOTAL	1.42+006	3.32+005	1.24+005	4.86+004	2.70+004	5.04+003	5.31+001	3.45+000

TABLE L.2. (Contd)

	INITIAL	3000. Y	10000. Y	30000. Y	50000. Y	100000. Y	500000. Y	1,000,000 Y
SE 79	5.99-002	5.86-002	5.44-002	4.40-002	3.55-002	2.08-002	2.93-004	1.42-006
ZR 93	4.43-001	4.43-001	4.41-001	4.37-001	4.33-001	4.23-001	3.52-001	2.79-001
NB 93M	4.43-001	4.43-001	4.41-001	4.37-001	4.33-001	4.23-001	3.52-001	2.79-001
TC 99	2.03+000	2.02+000	1.98+000	1.85+000	1.73+000	1.47+000	3.98-001	7.77-002
PD107	1.74-002	1.74-002	1.74-002	1.73-002	1.73-002	1.72-002	1.65-002	1.57-002
SN126	1.15-001	1.13-001	1.08-001	9.41-002	8.19-002	5.79-002	3.62-003	1.13-004
SB126M	1.15-001	1.13-001	1.08-001	9.41-002	8.19-002	5.79-002	3.62-003	1.13-004
SB126	1.14-001	1.12-001	1.07-001	9.32-002	8.11-002	5.74-002	3.59-003	1.12-004
I129	4.73-003	4.73-003	4.73-003	4.73-003	4.72-003	4.71-003	4.64-003	4.54-003
CS135	8.50-002	8.50-002	8.48-002	8.45-002	8.38-002	8.25-002	7.32-002	6.29-002
SM151	2.14-002	2.58-009	.00	.00	.00	.00	.00	.00
SUBTOT	3.45+000	3.41+000	3.34+000	3.16+000	2.99+000	2.62+000	1.21+000	7.20-001
TOTAL	3.45+000	3.41+000	3.34+000	3.16+000	2.99+000	2.62+000	1.21+000	7.20-001

TABLE L.3. Curies of Heavy-Element Isotopes in a BWR Assembly

	INITIAL	1. Y	3. Y	10. Y	30. Y	100. Y	300. Y	1000. Y
PB210	2.42-010	3.64-010	8.55-010	7.10-009	1.03-007	2.24-006	3.10-005	4.39-004
PB214	2.98-009	5.13-009	1.14-008	5.49-008	3.70-007	3.93-006	3.82-005	4.39-004
BI210	5.29-002	3.64-010	8.50-010	7.10-009	1.03-007	2.24-006	3.10-005	4.39-004
BI214	2.98-009	5.13-009	1.14-008	5.49-008	3.70-007	3.93-006	3.82-005	4.39-004
PO210	1.47-010	3.19-004	8.13-005	7.12-009	1.03-007	2.24-006	3.10-005	4.39-004
PO214	6.20-009	5.13-009	1.14-008	5.49-008	3.70-007	3.93-006	3.82-005	4.39-004
PO218	2.98-009	5.13-009	1.14-006	5.49-008	3.70-007	3.93-006	3.82-005	4.39-004
RN222	2.99-009	5.13-009	1.14-008	5.49-008	3.70-007	3.93-006	3.82-005	4.39-004
RA226	3.00-009	5.13-009	1.14-008	5.49-008	3.70-007	3.93-006	3.82-005	4.39-004
TH230	4.16-006	5.71-006	8.82-006	2.00-005	5.37-005	1.89-004	6.50-004	2.41-003
TH231	.00	5.29-008	1.59-007	5.29-007	1.59-006	5.28-006	1.58-005	5.22-005
TH234	5.80-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002
PA233	4.17-002	4.36-002	4.37-002	4.41-002	4.69-002	6.09-002	9.60-002	1.59-001
PA234M	5.85-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002
PA234	.00	5.81-005	5.81-005	5.81-005	5.81-005	5.81-005	5.81-005	5.81-005
U233	.00	2.06-007	6.00-007	1.91-006	5.80-006	2.19-005	8.98-005	4.88-004
U234	1.78-001	1.79-001	1.81-001	1.87-001	2.02-001	2.40-001	2.82-001	2.93-001
U235	.00	5.29-008	1.59-007	5.29-007	1.59-006	5.28-006	1.58-005	5.22-005
U236	3.85-002	3.85-002	3.85-002	3.85-002	3.85-002	3.87-002	3.92-002	4.07-002
U237	.00	4.57-001	4.45-001	3.19-001	1.25-001	4.72-003	4.04-007	2.36-021
U238	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002
NP237	4.36-002	4.36-002	4.37-002	4.41-002	4.69-002	6.09-002	9.60-002	1.59-001
NP239	2.61+000	2.15+000	2.15+000	2.15+000	2.14+000	2.13+000	2.09+000	1.96+000
PU238	2.89+002	3.11+002	3.13+002	2.96+002	2.54+002	1.47+002	3.10+001	1.33-001
PU239	5.35+001	5.42+001	5.42+001	5.42+001	5.41+001	5.40+001	5.37+001	5.27+001
PU240	8.25+001	8.25+001	8.26+001	8.26+001	8.26+001	8.22+001	8.05+001	7.49+001
PU241	2.04+004	1.94+004	1.77+004	1.28+004	5.00+003	1.89+002	1.62-002	9.41-017
PU242	2.70-001	2.70-001	2.70-001	2.70-001	2.70-001	2.70-001	2.70-001	2.69-001
AM241	2.26+001	5.44+001	1.14+002	2.80+002	5.32+002	6.27+002	4.60+002	1.50+002
AM243	2.15+000	2.15+000	2.15+000	2.15+000	2.14+000	2.13+000	2.09+000	1.96+000
CM242	6.10+003	1.31+003	5.80+001	1.11-003	3.62-017	.00	.00	.00
CM244	1.84+002	1.77+002	1.64+002	1.26+002	5.84+001	4.00+000	1.89-003	4.34-015
SUBTOT	2.64+006	2.14+004	1.85+004	1.36+004	5.99+003	1.11+003	6.30+002	2.83+002
TOTAL	2.64+006	2.14+004	1.85+004	1.36+004	5.99+003	1.11+003	6.30+002	2.83+002

TABLE L.3. (Contd)

	INITIAL	3000. Y	10000. Y	30000. Y	50000. Y	100000. Y	500000. Y	1,000,000 Y
TL207	5.55-007	4.82-006	4.79-005	3.15-004	6.49-004	1.31-003	1.86-003	1.88-003
TL208	7.01-010	2.21-009	8.30-009	2.90-008	5.07-008	1.05-007	5.40-007	1.08-006
TL209	4.13-007	5.13-006	5.70-005	3.31-004	6.33-004	1.29-003	3.31-003	3.21-003
PB209	1.88-005	2.33-004	2.59-003	1.50-002	2.88-002	5.88-002	1.50-001	1.46-001
PB210	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
PB211	5.55-007	4.84-006	4.80-005	3.16-004	6.51-004	1.32-003	1.88-003	1.88-003
PB212	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
PB214	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
BI210	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
BI211	5.55-007	4.84-006	4.80-005	3.16-004	6.51-004	1.32-003	1.88-003	1.88-003
BI212	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
BI213	1.88-005	2.33-004	2.59-003	1.50-002	2.88-002	5.88-002	1.50-001	1.46-001
BI214	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
PO210	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
PO211	1.66-009	1.45-008	1.44-007	9.48-007	1.95-006	3.96-006	5.65-006	5.65-006
PO212	1.25-009	3.94-009	1.49-008	5.16-008	9.02-008	1.87-007	9.60-007	1.91-006
PO213	1.83-005	2.28-004	2.53-003	1.47-002	2.81-002	5.75-002	1.47-001	1.43-001
PO214	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
PO215	5.55-007	4.84-006	4.80-005	3.16-004	6.51-004	1.32-003	1.88-003	1.88-003
PO216	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
PO218	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
AT217	1.88-005	2.33-004	2.59-003	1.50-002	2.88-002	5.88-002	1.50-001	1.46-001
RN219	5.55-007	4.84-006	4.80-005	3.16-004	6.51-004	1.32-003	1.88-003	1.88-003
RN220	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
RN222	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
FR221	1.88-005	2.33-004	2.59-003	1.50-002	2.88-002	5.88-002	1.50-001	1.46-001
FR223	7.77-009	6.77-008	6.72-007	4.43-006	9.12-006	1.85-005	2.64-005	2.64-005
RA223	5.55-007	4.84-006	4.80-005	3.16-004	6.51-004	1.32-003	1.88-003	1.88-003
RA224	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
RA225	1.88-005	2.33-004	2.59-003	1.50-002	2.88-002	5.88-002	1.50-001	1.46-001
RA226	4.39-004	3.23-003	1.87-002	6.52-002	9.83-002	1.52-001	1.38-001	7.91-002
RA228	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
AC225	1.88-005	2.33-004	2.59-003	1.50-002	2.88-002	5.88-002	1.50-001	1.46-001
AC227	5.55-007	4.84-006	4.80-005	3.16-004	6.51-004	1.32-003	1.88-003	1.88-003
AC228	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
TH227	5.47-007	4.77-006	4.73-005	3.12-004	6.42-004	1.30-003	1.86-003	1.86-003
TH228	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
TH229	1.88-005	2.33-004	2.59-003	1.50-002	2.88-002	5.88-002	1.50-001	1.46-001
TH230	2.41-003	7.38-003	2.40-002	6.48-002	9.72-002	1.50-001	1.38-001	7.91-002
TH231	5.22-005	1.52-004	4.62-004	1.08-003	1.43-003	1.77-003	1.88-003	1.88-003
TH232	1.95-009	6.15-009	2.32-008	8.06-008	1.41-007	2.93-007	1.50-006	2.99-006
TH234	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002

TABLE L.3. (Contd)

	INITIAL	3000. Y	10000. Y	30000. Y	50000. Y	100000. Y	500000. Y	1,000,000 Y
PA231	5.55-007	4.83-006	4.80-005	3.16-004	6.51-004	1.32-003	1.66-003	1.88-003
PA233	1.59-001	1.88-001	1.89-001	1.87-001	1.86-001	1.83-001	1.61-001	1.37-001
PA234M	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002
PA234	5.81-005	5.81-005	5.81-005	5.81-005	5.81-005	5.81-005	5.81-005	5.81-005
U233	4.88-004	2.02-003	7.53-003	2.23-002	3.58-002	6.44-002	1.50-001	1.45-001
U234	2.93-001	2.92-001	2.87-001	2.75-001	2.63-001	2.36-001	1.16-001	7.23-002
U235	5.22-005	1.52-004	4.62-004	1.08-003	1.43-003	1.77-003	1.88-003	1.88-003
U236	4.07-002	4.47-002	5.35-002	6.08-002	6.17-002	6.16-002	6.11-002	6.02-002
U238	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002	5.81-002
NP237	1.59-001	1.88-001	1.89-001	1.87-001	1.86-001	1.83-001	1.61-001	1.37-001
NP239	1.96+000	1.64+000	8.69-001	1.42-001	2.32-002	2.50-004	4.59-020	.00
PU238	1.33-001	2.30-008	.00	.00	.00	.00	.00	.00
PU239	5.27+001	4.99+001	4.11+001	2.35+001	1.33+001	3.22+000	3.75-005	2.55-011
PU240	7.49+001	6.10+001	2.98+001	3.83+000	4.93-001	2.93-003	4.56-021	.00
PU242	2.69-001	2.68-001	2.65-001	2.55-001	2.46-001	2.25-001	1.08-001	4.34-002
AM241	1.50+002	6.11+000	8.35-005	1.05-018	.00	.00	.00	.00
AM243	1.96+000	1.64+000	8.69-001	1.42-001	2.32-002	2.50-004	4.59-020	.00
SUBTOT	2.83+002	1.22+002	7.40+001	2.95+001	1.62+001	6.35+000	3.54+000	2.75+000
TOTAL	2.83+002	1.22+002	7.40+001	2.95+001	1.62+001	6.35+000	3.54+000	2.75+000

TABLE L.4. Curies of Light-Element Isotopes in a PWR Assembly

	INITIAL	1. Y	3. Y	10. Y	30. Y	100. Y	300. Y	1000. Y
H 3	1.21+002	1.14+002	1.02+002	6.88+001	2.23+001	4.32-001	5.52-006	4.11-023
C 14	6.87-001	6.87-001	6.86-001	6.86-001	6.84-001	6.78-001	6.62-001	6.08-001
CL 36	5.12-003	5.12-003	5.12-003	5.12-003	5.12-003	5.12-003	5.12-003	5.11-003
MN 54	4.53+001	1.96+001	3.69+000	1.07-002	5.92-010	.00	.00	.00
FE 55	2.48+003	1.90+003	1.11+003	1.72+002	8.34-001	6.58-009	.00	.00
CO 58	3.11+003	8.45+001	7.38-002	1.19-012	.00	.00	.00	.00
CO 60	3.60+003	3.16+003	2.43+003	9.65+002	6.92+001	6.84-003	2.46-014	.00
NI 59	2.20+000	2.20+000	2.20+000	2.20+000	2.20+000	2.20+000	2.20+000	2.19+000
NI 63	3.03+002	3.01+002	2.96+002	2.81+002	2.42+002	1.43+002	3.16+001	1.62-001
ZN 65	6.29+001	2.24+001	2.84+000	2.05-003	2.18-012	.00	.00	.00
ZR 93	1.05-001	1.05-001	1.05-001	1.05-001	1.05-001	1.05-001	1.05-001	1.05-001
ZR 95	2.21+004	4.50+002	1.87-001	2.71-013	.00	.00	.00	.00
NB 93M	6.57-003	1.17-002	2.11-002	4.70-002	8.70-002	1.09-001	1.09-001	1.09-001
NB 94	6.24-001	6.24-001	6.24-001	6.23-001	6.23-001	6.21-001	6.17-001	6.02-001
NB 95	2.19+004	9.72+002	3.96-001	5.75-013	.00	.00	.00	.00
MO 93	5.40-003	5.40-003	5.40-003	5.40-003	5.39-003	5.36-003	5.28-003	5.00-003
TC 99	2.59-003	2.59-003	2.59-003	2.59-003	2.59-003	2.59-003	2.59-003	2.58-003
SN119M	3.07+003	1.12+003	1.47+002	1.23-001	1.98-010	.00	.00	.00
SN123	1.46+002	1.96+001	3.41-001	2.38-007	6.10-025	.00	.00	.00
SB125	7.67+002	6.09+002	3.64+002	6.04+001	3.56-001	5.61-009	.00	.00
TE125M	1.67+002	2.50+002	1.51+002	2.50+001	1.48-001	2.33-009	.00	.00
SUBTOT	5.60+004	9.02+003	4.01+003	1.58+003	3.38+002	1.47+002	3.54+001	3.78+000
TOTAL	5.60+004	9.02+003	4.01+003	1.58+003	3.38+002	1.47+002	3.54+001	3.78+000

TABLE L.4. (Contd)

	INITIAL	3000. Y	10000. Y	30000. Y	50000. Y	100000. Y	500000. Y	1,000,000 Y
C 14	6.08-001	4.78-001	2.05-001	1.82-002	1.62-003	3.84-006	.00	.00
CL 36	5.11-003	5.09-003	5.01-003	4.79-003	4.58-003	4.10-003	1.68-003	5.48-004
NI 59	2.19+000	2.15+000	2.02+000	1.70+000	1.43+000	9.27-001	2.90-002	3.81-004
NI 63	1.62-001	4.55-008	.00	.00	.00	.00	.00	.00
ZR 93	1.05-001	1.05-001	1.04-001	1.03-001	1.02-001	9.99-002	8.31-002	6.59-002
NB 93M	1.09-001	1.08-001	1.06-001	1.04-001	1.02-001	1.00-001	8.31-002	6.59-002
NB 94	6.02-001	5.62-001	4.41-001	2.21-001	1.10-001	1.95-002	1.87-008	5.58-016
MO 93	5.00-003	4.29-003	2.50-003	5.36-004	1.15-004	2.45-006	1.03-019	.00
TC 99	2.58-003	2.56-003	2.50-003	2.34-003	2.19-003	1.86-003	4.97-004	9.55-005
SUBTOT	3.78+000	3.41+000	2.89+000	2.15+000	1.75+000	1.15+000	1.97-001	1.33-001
TOTAL	3.74+000	3.41+000	2.89+000	2.15+000	1.75+000	1.15+000	1.97-001	1.33-001

TABLE L.5. Curies of Fission Product Isotopes in a PWR Assembly

	INITIAL	1. Y	3. Y	10. Y	30. Y	100. Y	300. Y	1000. Y
H 3	2.55+002	2.41+002	2.15+002	1.45+002	4.70+001	9.10-001	1.16-005	8.66-023
SE 79	1.87-001	1.87-001	1.87-001	1.87-001	1.87-001	1.87-001	1.86-001	1.85-001
KR 85	4.34+003	4.07+003	3.58+003	2.28+003	6.33+002	7.09+000	1.89-005	5.89-025
SR 89	3.64+005	2.80+003	1.00-001	2.64-016	.00	.00	.00	.00
SR 90	3.49+004	3.40+004	3.24+004	2.73+004	1.67+004	2.96+003	2.14+001	6.80-007
Y 90	3.64+004	3.41+004	3.24+004	2.73+004	1.67+004	2.96+003	2.14+001	6.80-007
Y 91	4.78+005	6.45+003	1.10+000	9.64-014	.00	.00	.00	.00
ZR 93	1.34+000	1.34+000	1.34+000	1.34+000	1.34+000	1.34+000	1.34+000	1.34+000
NB 93M	9.41-002	1.56-001	2.71-001	5.92-001	1.07+000	1.33+000	1.34+000	1.34+000
ZR 95	6.87+005	1.40+004	5.80+000	8.42-012	.00	.00	.00	.00
NB 95M	.00	2.97+002	1.23-001	1.79-013	.00	.00	.00	.00
NB 95	7.02+005	3.05+004	1.20+001	1.83-011	.00	.00	.00	.00
TC 99	6.09+000	6.09+000	6.09+000	6.09+000	6.09+000	6.09+000	6.08+000	6.07+000
RU103	6.83+005	1.14+003	3.21-003	1.19-022	.00	.00	.00	.00
RH103M	6.73+005	1.15+003	3.22-003	1.19-022	.00	.00	.00	.00
RU106	2.59+005	1.30+005	3.27+004	2.62+002	2.68-004	2.89-025	.00	.00
RH106	2.86+005	1.30+005	3.27+004	2.62+002	2.68-004	2.89-025	.00	.00
PD107	5.16-002	5.16-002	5.16-002	5.16-002	5.16-002	5.16-002	5.16-002	5.16-002
SB125	6.70+003	5.23+003	3.13+003	5.19+002	3.06+000	4.82-008	.00	.00
TE125M	1.43+003	2.15+003	1.30+003	2.15+002	1.27+000	2.00-008	.00	.00
SN126	3.57-001	3.57-001	3.57-001	3.57-001	3.57-001	3.57-001	3.57-001	3.55-001
SB126M	2.28+002	3.57-001	3.57-001	3.57-001	3.57-001	3.57-001	3.57-001	3.55-001
SB126	5.05+002	3.54-001	3.54-001	3.54-001	3.54-001	3.53-001	3.53-001	3.51-001
I129	1.42-002	1.42-002	1.42-002	1.42-002	1.42-002	1.42-002	1.42-002	1.42-002
CS134	7.08+004	5.06+004	2.56+004	2.46+003	2.90+000	1.80-010	.00	.00
CS135	2.22-001	2.22-001	2.22-001	2.22-001	2.22-001	2.22-001	2.22-001	2.22-001
CS137	4.82+004	4.71+004	4.49+004	3.82+004	2.41+004	4.78+003	4.71+001	4.07-006
BA137M	4.52+004	4.40+004	4.20+004	3.57+004	2.25+004	4.47+003	4.40+001	4.16-006
CE144	5.57+005	2.28+005	3.84+004	7.50+001	1.30-006	.00	.00	.00
PR144	5.60+005	2.28+005	3.84+004	7.50+001	1.30-006	.00	.00	.00
PM147	5.71+004	4.38+004	2.58+004	4.05+003	2.04+001	1.86-007	.00	.00
SM151	1.85+002	1.84+002	1.81+002	1.71+002	1.46+002	8.34+001	1.70+001	6.42-002
EU154	4.90+003	4.69+003	4.30+003	3.17+003	1.34+003	6.44+001	1.11-002	7.58-016
EU155	3.10+003	2.16+003	1.00+003	6.87+001	3.25-002	7.45-014	.00	.00
SUBTOT	5.56+006	1.05+006	3.59+005	1.42+005	8.21+004	1.53+004	1.61+002	1.03+001
TOTAL	5.56+006	1.05+006	3.59+005	1.42+005	8.21+004	1.53+004	1.61+002	1.03+001

TABLE L.5. (Contd)

	INITIAL	3000. Y	10000. Y	30000. Y	50000. Y	100000. Y	500000. Y	1,000,000Y
SE 79	1.65-001	1.81-001	1.68-001	1.36-001	1.10-001	6.44-002	9.05-004	4.38-006
ZR 93	1.34+000	1.34+000	1.33+000	1.32+000	1.31+000	1.28+000	1.06+000	8.44-001
NB 93M	1.34+000	1.34+000	1.33+000	1.32+000	1.31+000	1.28+000	1.06+000	8.44-001
TC 99	6.07+000	6.03+000	5.89+000	5.52+000	5.17+000	4.39+000	1.19+000	2.32-001
PD107	5.16-002	5.16-002	5.16-002	5.15-002	5.13-002	5.11-002	4.91-002	4.67-002
SN126	3.55-001	3.50-001	3.33-001	2.90-001	2.53-001	1.79-001	1.12-002	3.49-004
SN126M	3.55-001	3.50-001	3.33-001	2.90-001	2.53-001	1.79-001	1.12-002	3.49-004
SB126	3.51-001	3.46-001	3.30-001	2.87-001	2.50-001	1.77-001	1.11-002	3.46-004
I129	1.42-002	1.42-002	1.42-002	1.42-002	1.42-002	1.41-002	1.39-002	1.36-002
CS135	2.22-001	2.22-001	2.22-001	2.20-001	2.19-001	2.16-001	1.91-001	1.65-001
SM151	6.42-002	7.75-009	.00	.00	.00	.00	.00	.00
SUBTOT	1.03+001	1.02+001	1.00+001	9.45+000	8.94+000	7.83+000	3.60+000	2.15+000
TOTAL	1.03+001	1.02+001	1.00+001	9.45+000	8.94+000	7.83+000	3.60+000	2.15+000

TABLE L.6. Curies of Heavy-Element Isotopes in a PWR Assembly

	INITIAL	1. Y	3. Y	10. Y	30. Y	100. Y	300. Y	1000. Y
PB210	2.20-010	4.80-010	1.63-009	1.79-008	2.85-007	6.48-006	9.23-005	1.33-003
PB214	5.85-009	1.10-008	2.71-008	1.40-007	1.04-006	1.14-005	1.14-004	1.33-003
BI210	4.85-002	4.81-010	1.63-009	1.79-008	2.85-007	6.48-006	9.23-005	1.33-003
BI214	5.85-009	1.10-008	2.71-008	1.40-007	1.04-006	1.14-005	1.14-004	1.33-003
PO210	1.23-010	2.92-004	7.45-006	1.79-008	2.65-007	6.48-006	9.23-005	1.33-003
PO214	6.77-009	1.10-008	2.71-008	1.40-007	1.04-006	1.14-005	1.14-004	1.33-003
PO218	5.80-009	1.10-008	2.71-008	1.40-007	1.04-006	1.14-005	1.14-004	1.33-003
RN222	5.85-009	1.10-008	2.71-008	1.40-007	1.04-006	1.14-005	1.14-004	1.33-003
RA226	5.80-009	1.10-008	2.71-008	1.40-007	1.04-006	1.14-005	1.14-004	1.33-003
TH230	9.70-006	1.42-005	2.31-005	5.54-005	1.54-004	5.55-004	1.95-003	7.32-003
TH231	.00	1.39-007	4.17-007	1.39-006	4.16-006	1.39-005	4.15-005	1.37-004
TH234	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001
PA233	1.33-001	1.40-001	1.40-001	1.42-001	1.49-001	1.89-001	2.87-001	4.62-001
PA234M	1.47-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001
PA234	.00	1.45-004	1.45-004	1.45-004	1.45-004	1.45-004	1.45-004	1.45-004
U233	.00	6.01-007	1.93-006	6.15-006	1.86-005	6.90-005	2.74-004	1.44-003
U234	5.13-001	5.15-001	5.21-001	5.41-001	5.93-001	7.21-001	8.60-001	8.96-001
U235	.00	1.39-007	4.17-007	1.39-006	4.16-006	1.39-005	4.15-005	1.37-004
U236	1.16-001	1.16-001	1.16-001	1.16-001	1.16-001	1.16-001	1.18-001	1.22-001
U237	.00	1.37+000	1.25+000	8.96-001	3.52-001	1.33-002	1.14-006	6.63-021
U238	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001
NP237	1.40-001	1.40-001	1.40-001	1.42-001	1.49-001	1.89-001	2.87-001	4.62-001
NP239	9.21+006	7.34+000	7.34+000	7.33+000	7.32+000	7.27+000	7.14+000	6.70+000
PU238	9.81+002	1.04+003	1.04+003	9.89+002	8.47+002	4.91+002	1.03+002	4.44-001
PU239	1.40+002	1.42+002	1.42+002	1.42+002	1.42+002	1.42+002	1.41+002	1.38+002
PU240	2.29+002	2.29+002	2.29+002	2.29+002	2.30+002	2.29+002	2.24+002	2.08+002
PU241	5.73+004	5.47+004	4.98+004	3.59+004	1.41+004	5.30+002	4.54-002	2.65-016
PU242	8.29-001	8.29-001	8.29-001	8.29-001	8.29-001	8.28-001	8.28-001	8.27-001
AM241	5.01+001	1.40+002	3.00+002	7.75+002	1.48+003	1.75+003	1.29+003	4.19+002
AM243	7.34+000	7.34+000	7.34+000	7.33+000	7.32+000	7.27+000	7.14+000	6.70+000
CM242	1.70+004	3.73+003	1.67+002	3.18-003	1.03-016	.00	.00	.00
CM244	6.92+002	6.86+002	6.17+002	4.72+002	2.19+002	1.50+001	7.10-003	1.63-014
SUBTOT	9.29+006	6.06+004	5.23+004	3.85+004	1.70+004	3.18+003	1.77+003	7.83+002
TOTAL	9.29+006	6.06+004	5.23+004	3.85+004	1.70+004	3.18+003	1.77+003	7.83+002

TABLE L.6. (Contd)

	INITIAL	3000. Y	10000. Y	30000. Y	50000. Y	100000. Y	500000. Y	1,000,000 Y
TL207	1.45-006	1.27-005	1.26-004	8.29-004	1.71-003	3.46-003	4.95-003	4.95-003
TL208	2.11-009	6.63-009	2.48-008	8.54-008	1.49-007	3.09-007	1.58-006	3.15-006
TL209	1.23-006	1.30-005	1.65-004	9.56-004	1.85-003	3.74-003	9.57-003	9.29-003
PB209	5.60-005	6.82-004	7.51-003	4.35-002	8.32-002	1.70-001	4.35-001	4.22-001
PB210	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
PB211	1.46-006	1.27-005	1.25-004	8.32-004	1.71-003	3.47-003	4.97-003	4.96-003
PB212	5.85-009	1.84-008	6.89-008	2.37-007	4.14-007	8.58-007	4.39-006	8.74-006
PB214	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
BI210	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
BI211	1.46-006	1.27-005	1.26-004	8.32-004	1.71-003	3.47-003	4.97-003	4.96-003
BI212	5.85-009	1.84-008	6.89-008	2.37-007	4.14-007	8.58-007	4.39-006	8.74-006
BI213	5.60-005	6.82-004	7.51-003	4.35-002	8.32-002	1.70-001	4.35-001	4.22-001
BI214	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
PU210	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
PU211	4.37-009	3.81-008	3.79-007	2.49-006	5.14-006	1.04-005	1.49-005	1.49-005
PU212	3.75-009	1.18-008	4.41-008	1.52-007	2.65-007	5.49-007	2.81-006	5.60-006
PU213	5.48-005	6.67-004	7.35-003	4.26-002	8.13-002	1.66-001	4.25-001	4.13-001
PU214	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
PU215	1.46-006	1.27-005	1.26-004	8.32-004	1.71-003	3.47-003	4.97-003	4.96-003
PU216	5.85-009	1.84-008	6.87-008	2.37-007	4.14-007	8.58-007	4.39-006	8.74-006
PU218	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
AT217	5.60-005	6.82-004	7.51-003	4.35-002	8.32-002	1.70-001	4.35-001	4.22-001
RN219	1.46-006	1.27-005	1.26-004	8.32-004	1.71-003	3.47-003	4.97-003	4.96-003
RN220	5.85-009	1.84-008	6.89-008	2.37-007	4.14-007	8.58-007	4.39-006	8.74-006
RN222	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
FR221	5.60-005	6.82-004	7.51-003	4.35-002	8.32-002	1.70-001	4.35-001	4.22-001
FR223	2.04-008	1.78-007	1.77-006	1.16-005	2.40-005	4.86-005	6.95-005	6.95-005
RA223	1.46-006	1.27-005	1.26-004	8.32-004	1.71-003	3.47-003	4.97-003	4.96-003
RA224	5.85-009	1.84-008	6.89-008	2.37-007	4.14-007	8.58-007	4.39-006	8.74-006
RA225	5.60-005	6.82-004	7.51-003	4.35-002	8.32-002	1.70-001	4.35-001	4.22-001
RA226	1.33-003	9.86-003	5.70-002	1.99-001	3.00-001	4.61-001	4.03-001	2.12-001
RA228	5.85-009	1.84-008	6.89-008	2.37-007	4.14-007	8.55-007	4.39-006	8.74-006
AC225	5.60-005	6.82-004	7.51-003	4.35-002	8.32-002	1.70-001	4.35-001	4.22-001
AC227	1.46-006	1.27-005	1.26-004	8.32-004	1.71-003	3.47-003	4.97-003	4.96-003
AC228	5.85-009	1.84-008	6.89-008	2.37-007	4.14-007	8.58-007	4.39-006	8.74-006
TH227	1.44-006	1.25-005	1.24-004	8.20-004	1.69-003	3.43-003	4.90-003	4.89-003
TH228	5.85-009	1.84-008	6.89-008	2.37-007	4.14-007	8.58-007	4.39-006	8.74-006
TH229	5.60-005	6.82-004	7.51-003	4.35-002	8.32-002	1.70-001	4.35-001	4.22-001
TH230	7.32-003	2.25-002	7.32-002	1.98-001	2.96-001	4.57-001	4.02-001	2.12-001
TH231	1.37-004	4.00-004	1.22-003	2.84-003	3.76-003	4.68-003	4.97-003	4.96-003
TH232	5.85-009	1.84-008	6.89-008	2.37-007	4.14-007	8.58-007	4.39-006	8.74-006
TH234	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001

TABLE L.6. (Contd)

	INITIAL	3000. Y	10000. Y	30000. Y	50000. Y	100000. Y	500000. Y	1,000,000 Y
PA231	1.40-006	1.27-005	1.20-004	8.32-004	1.71-003	3.47-003	4.97-003	4.96-003
PA233	4.62-001	5.43-001	5.45-001	5.42-001	5.38-001	5.29-001	4.65-001	3.96-001
PA234M	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001
PA234	1.45-004	1.45-004	1.45-004	1.45-004	1.45-004	1.45-004	1.45-004	1.45-004
U233	1.44-003	5.87-003	2.18-002	6.40-002	1.04-001	1.86-001	4.33-001	4.20-001
U234	8.90-001	8.92-001	8.77-001	6.37-001	7.99-001	7.14-001	3.30-001	1.91-001
U235	1.37-004	4.00-004	1.22-003	2.84-003	3.76-003	4.68-003	4.97-003	4.96-003
U236	1.22-001	1.33-001	1.56-001	1.78-001	1.81-001	1.81-001	1.79-001	1.76-001
U238	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001	1.45-001
NP237	4.62-001	5.43-001	5.45-001	5.42-001	5.38-001	5.29-001	4.65-001	3.96-001
NP239	6.70+000	5.59+000	2.97+000	4.85-001	7.92-002	8.54-004	1.57-019	.00
PU238	4.44-001	7.06-008	.00	.00	.00	.00	.00	.00
PU239	1.38+002	1.31+002	1.08+002	6.19+001	3.52+001	8.51+000	9.91-005	6.74-011
PU240	2.08+002	1.70+002	8.29+001	1.07+001	1.37+000	8.15-003	1.27-020	.00
PU242	8.27-001	8.24-001	8.14-001	7.84-001	7.56-001	6.90-001	3.32-001	1.33-001
AM241	4.19+002	1.71+001	2.33-004	2.92-018	.00	.00	.00	.00
AM243	6.70+000	5.59+000	2.97+000	4.85-001	7.92-002	8.54-004	1.57-019	.00
SUBTOT	7.83+002	3.33+002	2.01+002	7.93+001	4.37+001	1.78+001	1.02+001	7.70+000
TOTAL	7.83+002	3.33+002	2.01+002	7.93+001	4.37+001	1.78+001	1.02+001	7.70+000

APPENDIX M

LONG-TERM DOSE CALCULATIONS FOR SOLUTION MINING SCENARIOS

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 10,000 YR, SALT INGESTION, MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR   1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	7.1E-06	0	3.6E-05	0	7.1E-06	17	7.1E-06	0
NI 59	2.7E-04	0	1.6E-03	0	.0	0	.0	0
SE 79	4.4E-06	0	.0	0	.0	0	.0	0
MO 93	2.4E-08	0	.0	0	.0	0	.0	0
PD 107	3.0E-08	0	.0	0	.0	0	.0	0
U 234	2.7E-03	0	4.4E-02	0	.0	0	.0	0
U 236	4.8E-04	0	7.8E-03	0	.0	0	.0	0
ZR 93	9.9E-08	0	3.8E-06	0	.0	0	.0	0
NB 93M	1.9E-07	0	2.4E-06	0	.0	0	.0	0
TC 99	1.8E-05	0	4.5E-05	0	5.6E-06	13	.0	0
SN 126	4.8E-05	0	1.7E-03	0	.0	0	9.9E-06	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	3.3E-07	0	7.8E-07	0	.0	0	1.6E-08	0
I 129	8.0E-06	0	2.8E-06	0	.0	0	6.3E-03	99
CS 135	1.1E-04	0	2.8E-04	0	2.9E-05	69	.0	0
TH 230	3.4E-04	0	1.1E-02	0	.0	0	.0	0
RA 226	8.6E-01	71	1.3E+00	15	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.9E-03	0	5.3E-02	0	.0	0	.0	0
BI 210	9.2E-07	0	1.6E-06	0	.0	0	.0	0
PO 210	3.0E-04	0	1.2E-03	0	.0	0	.0	0
U 235	3.9E-06	0	6.4E-05	0	.0	0	.0	0
TH 231	1.6E-12	0	3.5E-11	0	.0	0	.0	0
PA 231	1.7E-06	0	4.0E-05	0	.0	0	.0	0
AC 227	9.6E-07	0	1.5E-05	0	.0	0	.0	0
TH 227	3.2E-09	0	1.1E-07	0	.0	0	.0	0
RA 223	7.9E-06	0	4.0E-05	0	.0	0	.0	0
NP 237	2.5E-03	0	5.6E-02	0	.0	0	.0	0
PA 233	3.1E-08	0	1.8E-07	0	.0	0	.0	0
U 233	7.0E-05	0	1.2E-03	0	.0	0	.0	0
TH 229	2.4E-04	0	4.9E-03	0	.0	0	.0	0
RA 225	5.9E-04	0	3.0E-03	0	.0	0	.0	0
AC 225	1.3E-07	0	2.0E-06	0	.0	0	.0	0
U 238	4.3E-04	0	7.3E-03	0	.0	0	.0	0
TH 234	2.2E-08	0	7.6E-07	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	1.2E-03	0	2.4E-02	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	1.3E-01	11	2.8E+00	33	.0	0	.0	0
AM 243	1.2E-02	0	3.1E-01	3	.0	0	.0	0
NP 239	1.1E-08	0	2.1E-07	0	.0	0	.0	0
PU 239	1.[illegible]E-01	14	3.7E+00	44	.0	0	.0	0
TOTALS	1.2E+00	100	8.3E+00	100	4.2E-05	100	6.3E-03	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)

CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 10,000 YR, SALT INGESTION, MI

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	3.6E-04	0	1.8E-03	0	3.6E-04	17	3.6E-04	0
NI 59	1.3E-02	0	8.0E-02	0	.0	0	.0	0
SE 79	2.2E-04	0	.0	0	.0	0	.0	0
MO 93	1.2E-06	0	.0	0	.0	0	.0	0
PD 107	1.5E-06	0	.0	0	.0	0	.0	0
U 234	1.4E-01	0	2.2E+00	0	.0	0	.0	0
U 236	2.4E-02	0	3.9E-01	0	.0	0	.0	0
ZR 93	4.9E-06	0	1.9E-04	0	.0	0	.0	0
NB 93M	9.4E-06	0	1.2E-04	0	.0	0	.0	0
TC 99	9.0E-04	0	2.3E-03	0	2.8E-04	13	.0	0
SN 126	2.4E-03	0	8.5E-02	0	.0	0	4.9E-04	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	1.7E-05	0	3.9E-05	0	.0	0	8.0E-07	0
I 129	4.0E-04	0	1.4E-04	0	.0	0	3.1E-01	99
CS 135	5.6E-03	0	1.4E-02	0	1.4E-03	69	.0	0
TH 230	1.1E-02	0	3.8E-01	0	.0	0	.0	0
RA 226	3.5E+01	75	4.8E+01	16	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	9.4E-02	0	2.6E+00	0	.0	0	.0	0
BI 210	4.6E-05	0	8.0E-05	0	.0	0	.0	0
PO 210	1.5E-02	0	6.2E-02	0	.0	0	.0	0
U 235	1.9E-04	0	3.2E-03	0	.0	0	.0	0
TH 231	8.1E-11	0	1.8E-09	0	.0	0	.0	0
PA 231	5.8E-05	0	1.4E-03	0	.0	0	.0	0
AC 227	4.1E-05	0	6.6E-04	0	.0	0	.0	0
TH 227	1.6E-07	0	5.5E-06	0	.0	0	.0	0
RA 223	4.0E-04	0	2.0E-03	0	.0	0	.0	0
NP 237	8.5E-02	0	1.9E+00	0	.0	0	.0	0
PA 233	1.5E-06	0	8.8E-06	0	.0	0	.0	0
U 233	3.5E-03	0	5.8E-02	0	.0	0	.0	0
TH 229	8.1E-03	0	1.6E-01	0	.0	0	.0	0
RA 225	3.0E-02	0	1.5E-01	0	.0	0	.0	0
AC 225	6.7E-06	0	1.0E-04	0	.0	0	.0	0
U 238	2.1E-02	0	3.6E-01	0	.0	0	.0	0
TH 234	1.1E-06	0	3.8E-05	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	4.1E-02	0	8.5E-01	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	4.5E+00	9	9.6E+01	32	.0	0	.0	0
AM 243	4.2E-01	0	1.1E+01	3	.0	0	.0	0
NP 239	5.6E-07	0	1.0E-05	0	.0	0	.0	0
PU 239	6.0E+00	12	1.3E+02	43	.0	0	.0	0
TOTALS	4.7E+01	100	2.9E+02	100	2.1E-03	100	3.1E-01	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)

CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 10,000 YR, SALT INGESTION, POP

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF

AIR DEPOSITION CROP PATH: OFF

AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	1.1E+02	0	5.3E+02	0	1.1E+02	17	1.1E+02	0
NI 59	4.0E+03	0	2.4E+04	0	.0	0	.0	0
SE 79	6.7E+01	0	.0	0	.0	0	.0	0
MO 93	3.6E-01	0	.0	0	.0	0	.0	0
PD 107	4.5E-01	0	.0	0	.0	0	.0	0
U 234	4.1E+04	0	6.7E+05	0	.0	0	.0	0
U 236	7.2E+03	0	1.2E+05	0	.0	0	.0	0
ZR 93	1.5E+00	0	5.7E+01	0	.0	0	.0	0
NB 93M	2.8E+00	0	3.5E+01	0	.0	0	.0	0
TC 99	2.7E+02	0	6.8E+02	0	8.4E+01	13	.0	0
SN 126	7.2E+02	0	2.5E+04	0	.0	0	1.5E+02	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	5.0E+00	0	1.2E+01	0	.0	0	2.4E-01	0
I 129	1.2E+02	0	4.2E+01	0	.0	0	9.4E+04	99
CS 135	1.7E+03	0	4.1E+03	0	4.3E+02	69	.0	0
TH 230	5.1E+03	0	1.7E+05	0	.0	0	.0	0
RA 226	1.3E+07	71	1.9E+07	15	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	2.8E+04	0	8.0E+05	0	.0	0	.0	0
BI 210	1.4E+01	0	2.4E+01	0	.0	0	.0	0
PO 210	4.5E+03	0	1.9E+04	0	.0	0	.0	0
U 235	5.8E+01	0	9.6E+02	0	.0	0	.0	0
TH 231	2.4E-05	0	5.3E-04	0	.0	0	.0	0
PA 231	2.5E+01	0	6.0E+02	0	.0	0	.0	0
AC 227	1.4E+01	0	2.3E+02	0	.0	0	.0	0
TH 227	4.7E-02	0	1.6E+00	0	.0	0	.0	0
RA 223	1.2E+02	0	6.0E+02	0	.0	0	.0	0
NP 237	3.7E+04	0	8.4E+05	0	.0	0	.0	0
PA 233	4.6E-01	0	2.6E+01	0	.0	0	.0	0
U 233	1.1E+03	0	1.7E+04	0	.0	0	.0	0
TH 229	3.6E+03	0	7.4E+04	0	.0	0	.0	0
RA 225	8.9E+03	0	4.5E+04	0	.0	0	.0	0
AC 225	2.0E+00	0	3.0E+01	0	.0	0	.0	0
U 238	6.4E+03	0	1.1E+05	0	.0	0	.0	0
TH 234	3.3E-01	0	1.1E+01	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	1.8E+04	0	3.7E+05	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	2.0E+06	11	4.2E+07	33	.0	0	.0	0
AM 243	1.7E+05	0	4.7E+06	3	.0	0	.0	0
NP 239	1.7E-01	0	3.1E+00	0	.0	0	.0	0
PU 239	2.7E+06	14	5.5E+07	44	.0	0	.0	0
TOTALS	1.8E+07	100	1.2E+08	100	6.3E+02	100	9.4E+04	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 10,000 YR, SALT INGESTION, POP
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	5.3E+03	0	2.7E+04	0	5.3E+03	17	5.3E+03	0
NI 59	2.0E+05	0	1.2E+06	0	.0	0	.0	0
SE 79	3.3E+03	0	.0	0	.0	0	.0	0
MO 93	1.8E+01	0	.0	0	.0	0	.0	0
PD 107	2.2E+01	0	.0	0	.0	0	.0	0
U 234	2.1E+06	0	3.3E+07	0	.0	0	.0	0
U 236	3.6E+05	0	5.8E+06	0	.0	0	.0	0
ZR 93	7.4E+01	0	2.8E+03	0	.0	0	.0	0
NB 93M	1.4E+02	0	1.8E+03	0	.0	0	.0	0
TC 99	1.4E+04	0	3.4E+04	0	4.2E+03	13	.0	0
SN 126	3.6E+04	0	1.3E+06	0	.0	0	7.4E+03	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	2.5E+02	0	5.9E+02	0	.0	0	1.2E+01	0
I 129	6.0E+03	0	2.1E+03	0	.0	0	4.7E+06	99
CS 135	8.5E+04	0	2.1E+05	0	2.2E+04	69	.0	0
TH 230	1.7E+05	0	5.7E+06	0	.0	0	.0	0
RA 226	5.3E+08	75	7.2E+08	16	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.4E+06	0	3.9E+07	0	.0	0	.0	0
BI 210	6.9E+02	0	1.2E+03	0	.0	0	.0	0
PO 210	2.2E+05	0	9.3E+05	0	.0	0	.0	0
U 235	2.9E+03	0	4.8E+04	0	.0	0	.0	0
TH 231	1.2E-03	0	2.6E-02	0	.0	0	.0	0
PA 231	8.7E+02	0	2.1E+04	0	.0	0	.0	0
AC 227	6.2E+02	0	9.9E+03	0	.0	0	.0	0
TH 227	2.4E+00	0	8.2E+01	0	.0	0	.0	0
RA 223	5.9E+03	0	3.0E+04	0	.0	0	.0	0
NP 237	1.3E+06	0	2.9E+07	0	.0	0	.0	0
PA 233	2.3E+01	0	1.3E+02	0	.0	0	.0	0
U 233	5.3E+04	0	8.7E+05	0	.0	0	.0	0
TH 229	1.2E+05	0	2.5E+06	0	.0	0	.0	0
RA 225	4.5E+05	0	2.2E+06	0	.0	0	.0	0
AC 225	1.0E+02	0	1.5E+03	0	.0	0	.0	0
U 238	3.2E+05	0	5.4E+06	0	.0	0	.0	0
TH 234	1.6E+01	0	5.7E+02	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	6.2E+05	0	1.3E+07	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	6.7E+07	9	1.4E+09	32	.0	0	.0	0
AM 243	6.3E+06	0	1.6E+08	3	.0	0	.0	0
NP 239	8.4E+00	0	1.6E+02	0	.0	0	.0	0
PU 239	9.[illegible]E+07	12	1.9E+09	43	.0	0	.0	0
TOTALS	7.0E+08	100	4.4E+09	100	3.1E+04	100	4.7E+06	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 50,000 YR, SALT INGESTION, MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR   1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	7.4E-08	0	3.7E-07	0	7.4E-08	0	7.4E-08	0
NI 59	1.9E-04	0	1.1E-03	0	.0	0	.0	0
SE 79	2.9E-06	0	.0	0	.0	0	.0	0
MO 93	1.1E-09	0	.0	0	.0	0	.0	0
PD 107	2.9E-08	0	.0	0	.0	0	.0	0
U 234	2.5E-03	0	4.1E-02	0	.0	0	.0	0
U 236	5.5E-04	0	8.9E-03	0	.0	0	.0	0
ZR 93	9.7E-08	0	3.7E-06	0	.0	0	.0	0
NB 93M	1.9E-07	0	2.3E-06	0	.0	0	.0	0
TC 99	1.6E-05	0	4.0E-05	0	4.9E-06	14	.0	0
SN 126	3.7E-05	0	1.3E-03	0	.0	0	7.5E-06	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	2.5E-07	0	6.0E-07	0	.0	0	1.2E-08	0
I 129	8.0E-06	0	2.8E-06	0	.0	0	6.3E-03	99
CS 135	1.1E-04	0	2.7E-04	0	2.9E-05	85	.0	0
TH 230	1.4E-03	0	4.5E-02	0	.0	0	.0	0
RA 226	4.5E+00	98	6.7E+00	78	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	9.9E-03	0	2.8E-01	3	.0	0	.0	0
BI 210	4.8E-06	0	8.4E-06	0	.0	0	.0	0
PO 210	1.6E-03	0	6.5E-03	0	.0	0	.0	0
U 235	1.2E-05	0	2.0E-04	0	.0	0	.0	0
TH 231	4.8E-12	0	1.1E-10	0	.0	0	.0	0
PA 231	2.3E-05	0	5.4E-04	0	.0	0	.0	0
AC 227	1.3E-05	0	2.1E-04	0	.0	0	.0	0
TH 227	4.3E-08	0	1.5E-06	0	.0	0	.0	0
RA 223	1.1E-04	0	5.4E-04	0	.0	0	.0	0
NP 237	2.4E-03	0	5.5E-02	0	.0	0	.0	0
PA 233	3.0E-08	0	1.7E-07	0	.0	0	.0	0
U 233	3.4E-04	0	5.6E-03	0	.0	0	.0	0
TH 229	2.7E-03	0	5.6E-02	0	.0	0	.0	0
RA 225	6.7E-03	0	3.4E-02	0	.0	0	.0	0
AC 225	1.5E-06	0	2.3E-05	0	.0	0	.0	0
U 238	4.3E-04	0	7.3E-03	0	.0	0	.0	0
TH 234	2.2E-08	0	7.6E-07	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	1.1E-03	0	2.3E-02	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	2.2E-03	0	4.6E-02	0	.0	0	.0	0
AM 243	3.1E-04	0	8.3E-03	0	.0	0	.0	0
NP 239	3.7E-10	0	5.6E-09	0	.0	0	.0	0
PU 239	5.8E-02	1	1.2E+00	14	.0	0	.0	0
TOTALS	4.6E+00	100	8.5E+00	100	3.4E-05	100	6.3E-03	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 50,000 YR, SALT INGESTION, MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE		TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C	14	3.7E-06	0	1.9E-05	0	3.7E-06	0	3.7E-06	0
NI	59	9.5E-03	0	5.7E-02	0	.0	0	.0	0
SE	79	1.5E-04	0	.0	0	.0	0	.0	0
MO	93	5.5E-08	0	.0	0	.0	0	.0	0
PD	107	1.5E-06	0	.0	0	.0	0	.0	0
U	234	1.3E-01	0	2.0E+00	0	.0	0	.0	0
U	236	2.7E-02	0	4.4E-01	0	.0	0	.0	0
ZR	93	4.9E-06	0	1.9E-04	0	.0	0	.0	0
NB	93M	9.3E-06	0	1.2E-04	0	.0	0	.0	0
TC	99	7.9E-04	0	2.0E-03	0	2.5E-04	14	.0	0
SN	126	1.8E-03	0	6.4E-02	0	.0	0	3.7E-04	0
SB	126M	.0	0	.0	0	.0	0	.0	0
SB	126	1.3E-05	0	3.0E-05	0	.0	0	6.1E-07	0
I	129	4.0E-04	0	1.4E-04	0	.0	0	3.1E-01	99
CS	135	5.6E-03	0	1.4E-02	0	1.4E-03	85	.0	0
TH	230	4.7E-02	0	1.6E+00	0	.0	0	.0	0
RA	226	1.9E+02	98	2.5E+02	78	.0	0	.0	0
RN	222	.0	0	.0	0	.0	0	.0	0
PB	210	4.9E-01	0	1.4E+01	4	.0	0	.0	0
BI	210	2.4E-04	0	4.2E-04	0	.0	0	.0	0
PO	210	7.8E-02	0	3.2E-01	0	.0	0	.0	0
U	235	6.2E-04	0	1.0E-02	0	.0	0	.0	0
TH	231	2.4E-10	0	5.3E-09	0	.0	0	.0	0
PA	231	7.9E-04	0	1.9E-02	0	.0	0	.0	0
AC	227	5.7E-04	0	9.0E-03	0	.0	0	.0	0
TH	227	2.2E-06	0	7.5E-05	0	.0	0	.0	0
RA	223	5.4E-03	0	2.7E-02	0	.0	0	.0	0
NP	237	8.4E-02	0	1.9E+00	0	.0	0	.0	0
PA	233	1.5E-06	0	8.7E-06	0	.0	0	.0	0
U	233	1.7E-02	0	2.8E-01	0	.0	0	.0	0
TH	229	9.1E-02	0	1.9E+00	0	.0	0	.0	0
RA	225	3.4E-01	0	1.7E+00	0	.0	0	.0	0
AC	225	7.6E-05	0	1.1E-03	0	.0	0	.0	0
U	238	2.1E-02	0	3.6E-01	0	.0	0	.0	0
TH	234	1.1E-06	0	3.8E-05	0	.0	0	.0	0
PA	234M	.0	0	.0	0	.0	0	.0	0
PA	234	.0	0	.0	0	.0	0	.0	0
PU	242	3.8E-02	0	7.8E-01	0	.0	0	.0	0
NP	238	.0	0	.0	0	.0	0	.0	0
PU	238	.0	0	.0	0	.0	0	.0	0
PU	240	7.4E-02	0	1.6E+00	0	.0	0	.0	0
AM	243	1.1E-02	0	2.9E-01	0	.0	0	.0	0
NP	239	1.5E-08	0	2.8E-07	0	.0	0	.0	0
PU	239	1.9E+00	1	4.1E+01	13	.0	0	.0	0
TOTALS		1.9E+02	100	3.2E+02	100	1.7E-03	100	3.1E-01	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)

CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 50,000 YR, SALT INGESTION, POP

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE		TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C	14	1.1E+00	0	5.6E+00	0	1.1E+00	0	1.1E+00	0
NI	59	2.8E+03	0	1.7E+04	0	.0	0	.0	0
SE	79	4.4E+01	0	.0	0	.0	0	.0	0
MO	93	1.7E-02	0	.0	0	.0	0	.0	0
PD	107	4.4E-01	0	.0	0	.0	0	.0	0
U	234	3.8E+04	0	6.1E+05	0	.0	0	.0	0
U	236	8.2E+03	0	1.3E+05	0	.0	0	.0	0
ZR	93	1.5E+00	0	5.6E+01	0	.0	0	.0	0
NB	93M	2.8E+00	0	3.5E+01	0	.0	0	.0	0
TC	99	2.4E+02	0	5.9E+02	0	7.4E+01	14	.0	0
SN	126	5.5E+02	0	1.9E+04	0	.0	0	1.1E+02	0
SB	126M	.0	0	.0	0	.0	0	.0	0
SB	126	3.8E+00	0	8.9E+00	0	.0	0	1.8E-01	0
I	129	1.2E+02	0	4.2E+01	0	.0	0	9.4E+04	99
CS	135	1.7E+03	0	4.1E+03	0	4.3E+02	85	.0	0
TH	230	2.1E+04	0	6.7E+05	0	.0	0	.0	0
RA	226	6.7E+07	98	1.0E+08	78	.0	0	.0	0
RN	222	.0	0	.0	0	.0	0	.0	0
PB	210	1.5E+05	0	4.2E+06	3	.0	0	.0	0
BI	210	7.2E+01	0	1.3E+02	0	.0	0	.0	0
PO	210	2.3E+04	0	9.7E+04	0	.0	0	.0	0
U	235	1.8E+02	0	3.0E+03	0	.0	0	.0	0
TH	231	7.3E-05	0	1.6E-03	0	.0	0	.0	0
PA	231	3.5E+02	0	8.2E+03	0	.0	0	.0	0
AC	227	2.0E+02	0	3.2E+03	0	.0	0	.0	0
TH	227	6.5E-01	0	2.2E+01	0	.0	0	.0	0
RA	223	1.6E+03	0	8.1E+03	0	.0	0	.0	0
NP	237	3.6E+04	0	8.3E+05	0	.0	0	.0	0
PA	233	4.5E-01	0	2.6E+00	0	.0	0	.0	0
U	233	5.1E+03	0	8.4E+04	0	.0	0	.0	0
TH	229	4.0E+04	0	8.3E+05	0	.0	0	.0	0
RA	225	1.0E+05	0	5.0E+05	0	.0	0	.0	0
AC	225	2.3E+01	0	3.4E+02	0	.0	0	.0	0
U	238	6.4E+03	0	1.1E+05	0	.0	0	.0	0
TH	234	3.3E-01	0	1.1E+01	0	.0	0	.0	0
PA	234M	.0	0	.0	0	.0	0	.0	0
PA	234	.0	0	.0	0	.0	0	.0	0
PU	242	1.7E+04	0	3.4E+05	0	.0	0	.0	0
NP	238	.0	0	.0	0	.0	0	.0	0
PU	238	.0	0	.0	0	.0	0	.0	0
PU	240	3.3E+04	0	6.9E+05	0	.0	0	.0	0
AM	243	4.7E+03	0	1.2E+05	0	.0	0	.0	0
NP	239	4.5E-03	0	8.4E-02	0	.0	0	.0	0
PU	239	8.7E+05	1	1.8E+07	14	.0	0	.0	0
TOTALS		6.9E+07	100	1.3E+08	100	5.0E+02	100	9.4E+04	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 50,000 YR, SALT INGESTION, POP
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	5.6E+01	0	2.8E+02	0	5.6E+01	0	5.6E+01	0
NI 59	1.4E+05	0	8.5E+05	0	.0	0	.0	0
SE 79	2.2E+03	0	.0	0	.0	0	.0	0
MO 93	8.3E-01	0	.0	0	.0	0	.0	0
PD 107	2.2E+01	0	.0	0	.0	0	.0	0
U 234	1.9E+06	0	3.0E+07	0	.0	0	.0	0
U 236	4.1E+05	0	6.6E+06	0	.0	0	.0	0
ZR 93	7.3E+01	0	2.8E+03	0	.0	0	.0	0
NB 93M	1.4E+02	0	1.7E+03	0	.0	0	.0	0
TC 99	1.2E+04	0	3.0E+04	0	3.7E+03	14	.0	0
SN 126	2.7E+04	0	9.7E+05	0	.0	0	5.6E+03	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	1.9E+02	0	4.5E+02	0	.0	0	9.1E+00	0
I 129	6.0E+03	0	2.1E+03	0	.0	0	4.7E+06	99
CS 135	8.4E+04	0	2.0E+05	0	2.1E+04	85	.0	0
TH 230	7.0E+05	0	2.3E+07	0	.0	0	.0	0
RA 226	2.8E+09	98	3.8E+09	78	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	7.4E+06	0	2.0E+08	4	.0	0	.0	0
BI 210	3.6E+03	0	6.3E+03	0	.0	0	.0	0
PO 210	1.2E+06	0	4.8E+06	0	.0	0	.0	0
U 235	9.2E+03	0	1.5E+05	0	.0	0	.0	0
TH 231	3.6E-03	0	7.9E-02	0	.0	0	.0	0
PA 231	1.2E+04	0	2.8E+05	0	.0	0	.0	0
AC 227	8.5E+03	0	1.4E+05	0	.0	0	.0	0
TH 227	3.2E+01	0	1.1E+03	0	.0	0	.0	0
RA 223	8.1E+04	0	4.1E+05	0	.0	0	.0	0
NP 237	1.3E+06	0	2.9E+07	0	.0	0	.0	0
PA 233	2.3E+01	0	1.3E+02	0	.0	0	.0	0
U 233	2.5E+05	0	4.2E+06	0	.0	0	.0	0
TH 229	1.4E+06	0	2.8E+07	0	.0	0	.0	0
RA 225	5.0E+06	0	2.5E+07	0	.0	0	.0	0
AC 225	1.1E+03	0	1.7E+04	0	.0	0	.0	0
U 238	3.2E+05	0	5.4E+06	0	.0	0	.0	0
TH 234	1.6E+01	0	5.7E+02	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	5.7E+05	0	1.2E+07	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	1.1E+06	0	2.4E+07	0	.0	0	.0	0
AM 243	1.7E+05	0	4.3E+06	0	.0	0	.0	0
NP 239	2.3E-01	0	4.2E+00	0	.0	0	.0	0
PU 239	2.9E+07	1	6.2E+08	13	.0	0	.0	0
TOTALS	2.8E+09	100	4.8E+09	100	2.5E+04	100	4.7E+06	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   120580

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)

CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 100,000 YR, SALT INGESTION, MI

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF

AIR DEPOSITION CROP PATH: OFF

AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	1.7E-10	0	8.7E-10	0	1.7E-10	0	1.7E-10	0
NI 59	1.2E-04	0	7.4E-04	0	.0	0	.0	0
SE 79	1.7E-06	0	.0	0	.0	0	.0	0
MO 93	2.4E-11	0	.0	0	.0	0	.0	0
PD 107	2.9E-08	0	.0	0	.0	0	.0	0
U 234	2.2E-03	0	3.6E-02	0	.0	0	.0	0
U 236	5.5E-04	0	8.9E-03	0	.0	0	.0	0
ZR 93	9.5E-08	0	3.6E-06	0	.0	0	.0	0
NB 93M	1.8E-07	0	2.3E-06	0	.0	0	.0	0
TC 99	1.3E-05	0	3.4E-05	0	4.2E-06	12	.0	0
SN 126	2.6E-05	0	9.1E-04	0	.0	0	5.3E-06	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	1.8E-07	0	4.2E-07	0	.0	0	8.6E-09	0
I 129	8.0E-06	0	2.8E-06	0	.0	0	6.3E-03	99
CS 135	1.1E-04	0	2.7E-04	0	2.8E-05	87	.0	0
TH 230	2.1E-03	0	6.9E-02	0	.0	0	.0	0
RA 226	6.9E+00	99	1.0E+01	90	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.5E-02	0	4.3E-01	3	.0	0	.0	0
BI 210	7.4E-06	0	1.3E-05	0	.0	0	.0	0
PO 210	2.4E-03	0	1.0E-02	0	.0	0	.0	0
U 235	1.5E-05	0	2.5E-04	0	.0	0	.0	0
TH 231	6.2E-12	0	1.3E-10	0	.0	0	.0	0
PA 231	4.8E-05	0	1.1E-03	0	.0	0	.0	0
AC 227	2.7E-05	0	4.4E-04	0	.0	0	.0	0
TH 227	8.9E-08	0	3.1E-06	0	.0	0	.0	0
RA 223	2.2E-04	0	1.1E-03	0	.0	0	.0	0
NP 237	2.4E-03	0	5.4E-02	0	.0	0	.0	0
PA 233	3.0E-08	0	1.7E-07	0	.0	0	.0	0
U 233	6.1E-04	0	1.0E-02	0	.0	0	.0	0
TH 229	5.5E-03	0	1.1E-01	0	.0	0	.0	0
RA 225	1.6E-12	0	6.9E-02	0	.0	0	.0	0
AC 225	3.1E-06	0	4.6E-05	0	.0	0	.0	0
U 238	4.2E-04	0	7.3E-03	0	.0	0	.0	0
TH 234	2.2E-08	0	7.6E-07	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	1.[illegible]E-03	0	2.0E-07	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	1.7E-05	0	2.7E-04	0	.0	0	.0	0
AM 243	3.5E-06	0	9.5E-05	0	.0	0	.0	0
NP 239	3.5E-12	0	6.4E-11	0	.0	0	.0	0
PU 239	1.4E-02	0	2.9E-01	2	.0	0	.0	0
TOTALS	7.0E+00	100	1.2E+01	100	3.2E-05	100	6.3E-03	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 100,000 YR, SALT INGESTION, NI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	8.7E-09	0	4.4E-08	0	8.7E-09	0	8.7E-09	0
NI 59	6.1E-03	0	3.7E-02	0	.0	0	.0	0
SE 79	8.5E-05	0	.0	0	.0	0	.0	0
MO 93	1.2E-09	0	.0	0	.0	0	.0	0
PD 107	1.5E-06	0	.0	0	.0	0	.0	0
U 234	1.1E-01	0	1.8E+00	0	.0	0	.0	0
U 236	2.7E-02	0	4.4E-01	0	.0	0	.0	0
ZR 93	4.8E-06	0	1.8E-04	0	.0	0	.0	0
NB 93M	9.1E-06	0	1.1E-04	0	.0	0	.0	0
TC 99	6.7E-04	0	1.7E-03	0	2.1E-04	12	.0	0
SN 126	1.3E-03	0	4.6E-02	0	.0	0	2.7E-04	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	8.9E-06	0	2.1E-05	0	.0	0	4.3E-07	0
I 129	4.0E-04	0	1.4E-04	0	.0	0	3.1E-01	99
CS 135	5.5E-03	0	1.3E-02	0	1.4E-03	87	.0	0
TH 230	7.2E-02	0	2.4E+00	0	.0	0	.0	0
RA 226	2.9E+02	99	3.9E+02	89	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	7.6E-01	0	2.1E+01	4	.0	0	.0	0
BI 210	3.7E-04	0	6.5E-04	0	.0	0	.0	0
PO 210	1.2E-01	0	5.0E-01	0	.0	0	.0	0
U 235	7.4E-04	0	1.2E-02	0	.0	0	.0	0
TH 231	3.1E-10	0	6.7E-09	0	.0	0	.0	0
PA 231	1.6E-03	0	3.9E-02	0	.0	0	.0	0
AC 227	1.2E-03	0	1.9E-02	0	.0	0	.0	0
TH 227	4.5E-06	0	1.5E-04	0	.0	0	.0	0
RA 223	1.1E-02	0	5.6E-02	0	.0	0	.0	0
NP 237	8.2E-02	0	1.9E+00	0	.0	0	.0	0
PA 233	1.5E-06	0	8.6E-06	0	.0	0	.0	0
U 233	3.0E-02	0	5.0E-01	0	.0	0	.0	0
TH 229	1.9E-01	0	3.8E+00	0	.0	0	.0	0
RA 225	6.9E-01	0	3.4E+00	0	.0	0	.0	0
AC 225	1.5E-04	0	2.3E-03	0	.0	0	.0	0
U 238	2.1E-02	0	3.6E-01	0	.0	0	.0	0
TH 234	1.1E-06	0	3.8E-05	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	3.4E-02	0	6.9E-01	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	4.4E-04	0	9.4E-03	0	.0	0	.0	0
AM 243	1.3E-04	0	3.3E-03	0	.0	0	.0	0
NP 239	1.7E-10	0	3.2E-09	0	.0	0	.0	0
PU 239	4.7E-01	0	1.[illegible]E+01	2	.0	0	.0	0
TOTALS	2.9E+02	100	4.3E+02	100	1.6E-03	100	3.1E-01	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 100,000 YR, SALT INGESTION, POP
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	2.6E-03	0	1.3E-02	0	2.6E-03	0	2.6E-03	0
NI 59	1.8E+03	0	1.1E+04	0	.0	0	.0	0
SE 79	2.6E+01	0	.0	0	.0	0	.0	0
MO 93	3.5E-04	0	.0	0	.0	0	.0	0
PD 107	4.4E-01	0	.0	0	.0	0	.0	0
U 234	3.4E+04	0	5.4E+05	0	.0	0	.0	0
U 236	8.2E+03	0	1.3E+05	0	.0	0	.0	0
ZR 93	1.4E+00	0	5.5E+01	0	.0	0	.0	0
NB 93M	2.7E+00	0	3.4E+01	0	.0	0	.0	0
TC 99	2.0E+02	0	5.0E+02	0	6.3E+01	12	.0	0
SN 126	3.9E+02	0	1.4E+04	0	.0	0	8.0E+01	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	2.7E+00	0	6.3E+00	0	.0	0	1.3E-01	0
I 129	1.2E+02	0	4.2E+01	0	.0	0	9.4E+04	99
CS 135	1.7E+03	0	4.0E+03	0	4.2E+02	87	.0	0
TH 230	3.2E+04	0	1.0E+06	0	.0	0	.0	0
RA 226	1.0E+08	99	1.6E+08	90	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	2.3E+05	0	6.5E+06	3	.0	0	.0	0
BI 210	1.1E+02	0	1.9E+02	0	.0	0	.0	0
PO 210	3.6E+04	0	1.5E+05	0	.0	0	.0	0
U 235	2.2E+02	0	3.7E+03	0	.0	0	.0	0
TH 231	9.3E-05	0	2.0E-03	0	.0	0	.0	0
PA 231	7.2E+02	0	1.7E+04	0	.0	0	.0	0
AC 227	4.1E+02	0	6.6E+03	0	.0	0	.0	0
TH 227	1.3E+00	0	4.6E+01	0	.0	0	.0	0
RA 223	3.4E+03	0	1.7E+04	0	.0	0	.0	0
NP 237	3.6E+04	0	8.1E+05	0	.0	0	.0	0
PA 233	4.5E-01	0	2.6E+00	0	.0	0	.0	0
U 233	9.1E+03	0	1.5E+05	0	.0	0	.0	0
TH 229	8.3E+04	0	1.7E+06	0	.0	0	.0	0
RA 225	2.1E+05	0	1.0E+06	0	.0	0	.0	0
AC 225	4.6E+01	0	6.9E+02	0	.0	0	.0	0
U 238	6.4E+03	0	1.1E+05	0	.0	0	.0	0
TH 234	3.3E-01	0	1.1E+01	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	1.5E+04	0	3.0E+05	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	2.0E+02	0	4.1E+03	0	.0	0	.0	0
AM 243	5.7E+01	0	1.4E+03	0	.0	0	.0	0
NP 239	5.2E-05	0	9.6E-04	0	.0	0	.0	0
PU 239	2.1E+05	0	4.4E+06	2	.0	0	.0	0
TOTALS	1.0E+08	100	1.7E+08	100	4.9E+02	100	9.4E+04	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   120580

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)

CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 100,000 YR, SALT INGESTION, POP

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF

AIR DEPOSITION CROP PATH: OFF

AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
C 14	1.7E-01	0	6.6E-01	0	1.3E-01	0	1.3E-01	0
NI 59	9.2E+04	0	5.5E+05	0	.0	0	.0	0
SE 79	1.3E+03	0	.0	0	.0	0	.0	0
MO 93	1.8E-02	0	.0	0	.0	0	.0	0
PD 107	2.2E+01	0	.0	0	.0	0	.0	0
U 234	1.7E+06	0	2.7E+07	0	.0	0	.0	0
U 236	4.1E+05	0	6.6E+06	0	.0	0	.0	0
ZR 93	7.1E+01	0	2.7E+03	0	.0	0	.0	0
NB 93M	1.4E+02	0	1.7E+03	0	.0	0	.0	0
TC 99	1.0E+04	0	2.5E+04	0	3.1E+03	12	.0	0
SN 126	1.9E+04	0	6.8E+05	0	.0	0	4.0E+03	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	1.3E+02	0	3.2E+02	0	.0	0	6.5E+00	0
I 129	6.0E+03	0	2.1E+03	0	.0	0	4.7E+06	99
CS 135	8.3E+04	0	2.0E+05	0	2.1E+04	87	.0	0
TH 230	1.1E+06	0	3.6E+07	0	.0	0	.0	0
RA 226	4.3E+09	99	5.8E+09	89	.0	0	.0	0
RH 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.1E+07	0	3.2E+08	4	.0	0	.0	0
BI 210	5.5E+03	0	9.7E+03	0	.0	0	.0	0
PO 210	1.8E+06	0	7.5E+06	0	.0	0	.0	0
U 235	1.1E+04	0	1.8E+05	0	.0	0	.0	0
TH 231	4.6E-03	0	1.0E-01	0	.0	0	.0	0
PA 231	2.5E+04	0	5.8E+05	0	.0	0	.0	0
AC 227	1.8E+04	0	2.8E+05	0	.0	0	.0	0
TH 227	6.7E+01	0	2.3E+03	0	.0	0	.0	0
RA 223	1.7E+05	0	8.4E+05	0	.0	0	.0	0
NP 237	1.2E+06	0	2.8E+07	0	.0	0	.0	0
PA 233	2.2E+01	0	1.3E+02	0	.0	0	.0	0
U 233	4.5E+05	0	7.5E+06	0	.0	0	.0	0
TH 229	2.8E+06	0	5.7E+07	0	.0	0	.0	0
RA 225	1.0E+07	0	5.2E+07	0	.0	0	.0	0
AC 225	2.3E+03	0	3.5E+04	0	.0	0	.0	0
U 238	3.2E+05	0	5.4E+06	0	.0	0	.0	0
TH 234	1.6E+01	0	5.7E+02	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	5.1E+05	0	1.0E+07	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 240	6.6E+03	0	1.4E+05	0	.0	0	.0	0
AM 243	1.9E+03	0	4.9E+04	0	.0	0	.0	0
NP 239	2.6E-03	0	4.8E-02	0	.0	0	.0	0
PU 239	7.0E+06	0	1.5E+08	2	.0	0	.0	0
TOTALS	4.3E+09	100	6.5E+09	100	2.4E+04	100	4.7E+06	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 500,000 YR, SALT INGESTION, MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
NI 59	3.8E-06	0	2.3E-05	0	.0	0	.0	0
SE 79	2.4E-08	0	.0	0	.0	0	.0	0
PD 107	2.8E-08	0	.0	0	.0	0	.0	0
U 234	1.1E-03	0	1.7E-02	0	.0	0	.0	0
U 236	5.4E-04	0	8.8E-03	0	.0	0	.0	0
ZR 93	7.9E-08	0	3.0E-06	0	.0	0	.0	0
NB 93M	1.5E-07	0	1.9E-06	0	.0	0	.0	0
TC 99	3.6E-06	0	9.1E-06	0	1.1E-06	4	.0	0
SN 126	1.6E-06	0	5.7E-05	0	.0	0	3.3E-07	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	.0	0	.0	0	.0	0	.0	0
I 129	7.7E-06	0	2.7E-06	0	.0	0	6.1E-03	99
CS 135	9.7E-05	0	2.4E-04	0	2.5E-05	95	.0	0
TH 230	1.9E-03	0	6.2E-02	0	.0	0	.0	0
RA 226	6.1E+00	98	9.2E+00	89	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.3E-02	0	3.8E-01	3	.0	0	.0	0
BI 210	6.6E-06	0	1.1E-05	0	.0	0	.0	0
PO 210	2.1E-03	0	8.8E-03	0	.0	0	.0	0
U 235	1.5E-05	0	2.5E-04	0	.0	0	.0	0
TH 231	6.2E-12	0	1.3E-10	0	.0	0	.0	0
PA 231	6.5E-05	0	1.5E-03	0	.0	0	.0	0
AC 227	3.7E-05	0	5.9E-04	0	.0	0	.0	0
TH 227	1.2E-07	0	4.2E-06	0	.0	0	.0	0
RA 223	3.0E-04	0	1.5E-03	0	.0	0	.0	0
NP 237	2.1E-03	0	4.8E-02	0	.0	0	.0	0
PA 233	2.6E-08	0	1.5E-07	0	.0	0	.0	0
U 233	1.4E-03	0	2.3E-02	0	.0	0	.0	0
TH 229	1.4E-02	0	2.9E-01	2	.0	0	.0	0
RA 225	3.5E-02	0	1.8E-01	1	.0	0	.0	0
AC 225	7.9E-06	0	1.2E-04	0	.0	0	.0	0
U 238	4.3E-04	0	7.3E-03	0	.0	0	.0	0
TH 234	2.2E-08	0	7.6E-07	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	5.0E-04	0	9.9E-03	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 239	1.7E-07	0	3.4E-06	0	.0	0	.0	0
TOTALS	6.2E+00	100	1.0E+01	100	2.6E-05	100	6.1E-03	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 500,000 YR, SALT INGESTION, HI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
NI 59	1.9E-04	0	1.2E-03	0	.0	0	.0	0
SE 79	1.2E-06	0	.0	0	.0	0	.0	0
PD 107	1.4E-06	0	.0	0	.0	0	.0	0
U 234	5.3E-02	0	8.5E-01	0	.0	0	.0	0
U 236	2.7E-02	0	4.4E-01	0	.0	0	.0	0
ZR 93	3.9E-06	0	1.5E-04	0	.0	0	.0	0
NB 93M	7.5E-06	0	9.4E-05	0	.0	0	.0	0
TC 99	1.8E-04	0	4.5E-04	0	5.7E-05	4	.0	0
SN 126	8.2E-05	0	2.9E-03	0	.0	0	1.7E-05	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	.0	0	.0	0	.0	0	.0	0
I 129	3.9E-04	0	1.4E-04	0	.0	0	3.0E-01	99
CS 135	4.9E-03	0	1.2E-02	0	1.2E-03	95	.0	0
TH 230	6.4E-02	0	2.1E+00	0	.0	0	.0	0
RA 226	2.5E+02	98	3.4E+02	88	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	6.7E-01	0	1.9E+01	4	.0	0	.0	0
BI 210	3.3E-04	0	5.7E-04	0	.0	0	.0	0
PO 210	1.1E-01	0	4.4E-01	0	.0	0	.0	0
U 235	7.4E-04	0	1.2E-02	0	.0	0	.0	0
TH 231	3.1E-10	0	6.7E-09	0	.0	0	.0	0
PA 231	2.2E-03	0	5.3E-02	0	.0	0	.0	0
AC 227	1.6E-03	0	2.5E-02	0	.0	0	.0	0
TH 227	6.1E-06	0	2.1E-04	0	.0	0	.0	0
RA 223	1.5E-02	0	7.6E-02	0	.0	0	.0	0
NP 237	7.2E-02	0	1.6E+00	0	.0	0	.0	0
PA 233	1.3E-06	0	7.5E-06	0	.0	0	.0	0
U 233	7.0E-02	0	1.2E+00	0	.0	0	.0	0
TH 229	4.8E-01	0	9.7E+00	2	.0	0	.0	0
RA 225	1.8E+00	0	8.8E+00	2	.0	0	.0	0
AC 225	4.0E-04	0	5.9E-03	0	.0	0	.0	0
U 238	2.1E-02	0	3.6E-01	0	.0	0	.0	0
TH 234	1.1E-06	0	3.8E-05	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	1.7E-02	0	3.4E-01	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 239	5.6E-06	0	1.2E-04	0	.0	0	.0	0
TOTALS	2.6E+02	100	3.9E+02	100	1.3E-03	100	3.0E-01	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 500,000 YR, SALT INGESTION, POP
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR   1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
NI 59	5.8E+01	0	3.5E+02	0	.0	0	.0	0
SE 79	3.6E-01	0	.0	0	.0	0	.0	0
PD 107	4.2E-01	0	.0	0	.0	0	.0	0
U 234	1.6E+04	0	2.6E+05	0	.0	0	.0	0
U 236	8.1E+03	0	1.3E+05	0	.0	0	.0	0
ZR 93	1.2E+00	0	4.5E+01	0	.0	0	.0	0
NB 93M	2.3E+00	0	2.8E+01	0	.0	0	.0	0
TC 99	5.5E+01	0	1.4E+02	0	1.7E+01	4	.0	0
SN 126	2.4E+01	0	8.6E+02	0	.0	0	5.0E+00	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	.0	0	.0	0	.0	0	.0	0
I 129	1.2E+02	0	4.1E+01	0	.0	0	9.1E+04	99
CS 135	1.5E+03	0	3.6E+03	0	3.7E+02	95	.0	0
TH 230	2.9E+04	0	9.3E+05	0	.0	0	.0	0
RA 226	9.2E+07	98	1.4E+08	89	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	2.[illegible]E+05	0	5.7E+06	3	.0	0	.0	0
BI 210	9.8E+01	0	1.7E+02	0	.0	0	.0	0
PO 210	3.2E+04	0	1.3E+05	0	.0	0	.0	0
U 235	2.2E+02	0	3.7E+03	0	.0	0	.0	0
TH 231	9.3E-05	0	2.0E-03	0	.0	0	.0	0
PA 231	9.7E+02	0	2.3E+04	0	.0	0	.0	0
AC 227	5.5E+02	0	8.9E+03	0	.0	0	.0	0
TH 227	1.8E+00	0	6.3E+01	0	.0	0	.0	0
RA 223	4.6E+03	0	2.3E+04	0	.0	0	.0	0
NP 237	3.1E+04	0	7.1E+05	0	.0	0	.0	0
PA 233	3.9E-01	0	2.3E+0[illegible]	0	.0	0	.0	0
U 233	2.1E+04	0	3.5E+05	0	.0	0	.0	0
TH 229	2.1E+05	0	4.4E+06	2	.0	0	.0	0
RA 225	5.3E+05	0	2.6E+06	1	.0	0	.0	0
AC 225	1.2E+02	0	1.8E+03	0	.0	0	.0	0
U 238	6.4E+03	0	1.1E+05	0	.0	0	.0	0
TH 234	3.3E-01	0	1.1E+01	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	7.5E+03	0	1.5E+05	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 239	2.5E+00	0	5.2E+01	0	.0	0	.0	0
TOTALS	9.3E+07	100	1.5E+08	100	3.9E+02	100	9.1E+04	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)

CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 500,000 YR, SALT INGESTION, POP

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
NI 59	2.9E+03	0	1.7E+04	0	.0	0	.0	0
SE 79	1.8E+01	0	.0	0	.0	0	.0	0
PD 107	2.1E+01	0	.0	0	.0	0	.0	0
U 234	7.9E+05	0	1.3E+07	0	.0	0	.0	0
U 236	4.1E+05	0	6.3E+06	0	.0	0	.0	0
ZR 93	5.9E+01	0	2.3E+03	0	.0	0	.0	0
NB 93M	1.1E+02	0	1.4E+03	0	.0	0	.0	0
TC 99	2.7E+03	0	6.8E+03	0	8.5E+02	4	.0	0
SN 126	1.2E+03	0	4.3E+04	0	.0	0	2.5E+02	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	.0	0	.0	0	.0	0	.0	0
I 129	5.8E+03	0	2.1E+03	0	.0	0	4.6E+06	99
CS 135	7.3E+04	0	1.8E+05	0	1.9E+04	95	.0	0
TH 230	9.6E+05	0	3.2E+07	0	.0	0	.0	0
RA 226	3.8E+09	98	5.1E+09	88	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.0E+07	0	2.3E+08	4	.0	0	.0	0
BI 210	4.9E+03	0	8.6E+03	0	.0	0	.0	0
PO 210	1.6E+06	0	6.6E+06	0	.0	0	.0	0
U 235	1.1E+04	0	1.8E+05	0	.0	0	.0	0
TH 231	4.6E-03	0	1.0E-01	0	.0	0	.0	0
PA 231	3.3E+04	0	7.9E+05	0	.0	0	.0	0
AC 227	2.4E+04	0	3.8E+05	0	.0	0	.0	0
TH 227	9.1E+01	0	3.1E+03	0	.0	0	.0	0
RA 223	2.3E+05	0	1.1E+06	0	.0	0	.0	0
NP 237	1.1E+06	0	2.5E+07	0	.0	0	.0	0
PA 233	2.0E+01	0	1.1E+02	0	.0	0	.0	0
U 233	1.1E+06	0	1.7E+07	0	.0	0	.0	0
TH 229	7.1E+06	0	1.5E+08	2	.0	0	.0	0
RA 225	2.6E+07	0	1.3E+08	2	.0	0	.0	0
AC 225	5.9E+03	0	8.8E+04	0	.0	0	.0	0
U 238	3.2E+05	0	5.4E+06	0	.0	0	.0	0
TH 234	1.6E+01	0	5.7E+02	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	2.5E+05	0	5.2E+06	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
PU 239	8.3E+01	0	1.8E+03	0	.0	0	.0	0
TOTALS	3.8E+09	100	5.8E+09	100	2.0E+04	100	4.6E+06	100

COMBINED PATHWAY SUMMARY TOTALS   PABLM VERSION2   120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS   (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 1,000,000 YR, SALT INGESTION, MI
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
NI 59	5.0E-08	0	3.0E-07	0	.0	0	.0	0
SE 79	1.2E-10	0	.0	0	.0	0	.0	0
PD 107	2.7E-08	0	.0	0	.0	0	.0	0
U 234	6.3E-04	0	1.0E-02	0	.0	0	.0	0
U 236	5.4E-04	0	8.7E-03	0	.0	0	.0	0
ZR 93	6.3E-08	0	2.4E-06	0	.0	0	.0	0
NB 93M	1.2E-07	0	1.5E-06	0	.0	0	.0	0
TC 99	7.1E-07	0	1.8E-06	0	2.2E-07	1	.0	0
SN 126	5.1E-08	0	1.8E-06	0	.0	0	1.0E-08	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	3.5E-10	0	8.3E-10	0	.0	0	1.7E-11	0
I 129	7.6E-06	0	2.7E-06	0	.0	0	6.0E-03	99
CS 135	8.4E-05	0	2.0E-04	0	2.2E-05	98	.0	0
TH 230	1.0E-03	0	3.4E-07	0	.0	0	.0	0
RA 226	3.3E+00	98	5.0E+00	86	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	7.3E-03	0	2.1E-01	3	.0	0	.0	0
BI 210	3.6E-06	0	6.2E-06	0	.0	0	.0	0
PO 210	1.2E-03	0	4.8E-03	0	.0	0	.0	0
U 235	1.5E-05	0	2.5E-04	0	.0	0	.0	0
TH 231	6.2E-12	0	1.3E-10	0	.0	0	.0	0
PA 231	6.5E-05	0	1.5E-03	0	.0	0	.0	0
AC 227	3.7E-05	0	5.9E-04	0	.0	0	.0	0
TH 227	1.2E-07	0	4.2E-06	0	.0	0	.0	0
RA 223	3.0E-04	0	1.5E-03	0	.0	0	.0	0
NP 237	1.8E-03	0	4.0E-02	0	.0	0	.0	0
PA 233	2.2E-08	0	1.3E-07	0	.0	0	.0	0
U 233	1.4E-03	0	2.3E-02	0	.0	0	.0	0
TH 229	1.4E-02	0	2.8E-01	4	.0	0	.0	0
RA 225	3.4E-02	1	1.7E-01	2	.0	0	.0	0
AC 225	7.7E-06	0	1.1E-04	0	.0	0	.0	0
U 238	4.3E-04	0	7.3E-03	0	.0	0	.0	0
TH 234	2.2E-08	0	7.6E-07	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	2.0E-04	0	4.0E-03	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
TOTALS	3.4E+00	100	5.8E+00	100	2.2E-05	100	6.0E-03	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580

TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)

CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 1,000,000 YR, SALT INGESTION, NI

*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 10 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF

AIR DEPOSITION CROP PATH: OFF

AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
NI 59	2.5E-06	0	1.5E-05	0	.0	0	.0	0
SE 79	5.9E-09	0	.0	0	.0	0	.0	0
PD 107	1.3E-06	0	.0	0	.0	0	.0	0
U 234	3.1E-02	0	5.1E-01	0	.0	0	.0	0
U 236	2.7E-02	0	4.3E-01	0	.0	0	.0	0
ZR 93	3.1E-06	0	1.2E-04	0	.0	0	.0	0
NB 93M	6.0E-06	0	7.5E-05	0	.0	0	.0	0
TC 99	3.5E-05	0	8.9E-05	0	1.1E-05	1	.0	0
SN 126	2.6E-06	0	9.0E-05	0	.0	0	5.2E-07	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	1.8E-08	0	4.2E-08	0	.0	0	8.5E-10	0
I 129	3.8E-04	0	1.4E-04	0	.0	0	3.0E-01	99
CS 135	4.2E-03	0	1.0E-02	0	1.1E-03	98	.0	0
TH 230	3.5E-02	0	1.2E+00	0	.0	0	.0	0
RA 226	1.4E+02	97	1.9E+02	84	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	3.7E-01	0	1.0E+01	4	.0	0	.0	0
BI 210	1.8E-04	0	3.1E-04	0	.0	0	.0	0
PO 210	5.8E-02	0	2.4E-01	0	.0	0	.0	0
U 235	7.4E-04	0	1.2E-02	0	.0	0	.0	0
TH 231	3.1E-10	0	6.7E-09	0	.0	0	.0	0
PA 231	2.2E-03	0	5.3E-02	0	.0	0	.0	0
AC 227	1.6E-03	0	2.5E-02	0	.0	0	.0	0
TH 227	6.1E-06	0	2.1E-04	0	.0	0	.0	0
RA 223	1.5E-02	0	7.6E-02	0	.0	0	.0	0
NP 237	6.2E-02	0	1.4E+00	0	.0	0	.0	0
PA 233	1.1E-06	0	6.4E-06	0	.0	0	.0	0
U 233	6.8E-02	0	1.1E+00	0	.0	0	.0	0
TH 229	4.6E-01	0	9.4E+00	4	.0	0	.0	0
RA 225	1.7E+00	1	8.5E+00	3	.0	0	.0	0
AC 225	3.8E-04	0	5.7E-03	0	.0	0	.0	0
U 238	2.1E-02	0	3.6E-01	0	.0	0	.0	0
TH 234	1.1E-06	0	3.8E-05	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	6.7E-03	0	1.4E-01	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
TOTALS	1.4E+02	100	2.2E+02	100	1.1E-03	100	5.0E-01	100

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 1,000,000 YR, SALT INGESTION, POP
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 1 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE	TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
NI 59	7.5E-01	0	4.5E+00	0	.0	0	.0	0
SE 79	1.8E-03	0	.0	0	.0	0	.0	0
PD 107	4.0E-01	0	.0	0	.0	0	.0	0
U 234	9.4E+03	0	1.5E+05	0	.0	0	.0	0
U 236	8.0E+03	0	1.3E+05	0	.0	0	.0	0
ZR 93	9.4E-01	0	3.6E+01	0	.0	0	.0	0
NB 93M	1.8E+00	0	2.2E+01	0	.0	0	.0	0
TC 99	1.1E+01	0	2.7E+01	0	3.3E+00	1	.0	0
SN 126	7.7E-01	0	2.7E+01	0	.0	0	1.6E-01	0
SB 126M	.0	0	.0	0	.0	0	.0	0
SB 126	5.3E-03	0	1.2E-02	0	.0	0	2.6E-04	0
I 129	1.1E+02	0	4.1E+01	0	.0	0	9.0E+04	99
CS 135	1.3E+03	0	3.1E+03	0	3.2E+02	98	.0	0
TH 230	1.5E+04	0	5.0E+05	0	.0	0	.0	0
RA 226	5.0E+07	98	7.5E+07	86	.0	0	.0	0
RN 222	.0	0	.0	0	.0	0	.0	0
PB 210	1.1E+05	0	3.1E+06	3	.0	0	.0	0
BI 210	5.3E+01	0	9.3E+01	0	.0	0	.0	0
PO 210	1.7E+04	0	7.2E+04	0	.0	0	.0	0
U 235	2.2E+02	0	3.7E+03	0	.0	0	.0	0
TH 231	9.3E-05	0	2.0E-03	0	.0	0	.0	0
PA 231	9.7E+02	0	2.3E+04	0	.0	0	.0	0
AC 227	5.5E+02	0	8.9E+03	0	.0	0	.0	0
TH 227	1.8E+00	0	6.3E+01	0	.0	0	.0	0
RA 223	4.6E+03	0	2.3E+04	0	.0	0	.0	0
NP 237	2.7E+04	0	6.1E+05	0	.0	0	.0	0
PA 233	3.3E-01	0	1.9E+00	0	.0	0	.0	0
U 233	2.0E+04	0	3.4E+05	0	.0	0	.0	0
TH 229	2.0E+05	0	4.2E+06	4	.0	0	.0	0
RA 225	5.1E+05	1	2.6E+06	2	.0	0	.0	0
AC 225	1.2E+02	0	1.7E+03	0	.0	0	.0	0
U 238	6.4E+03	0	1.1E+05	0	.0	0	.0	0
TH 234	3.3E-01	0	1.1E+01	0	.0	0	.0	0
PA 234M	.0	0	.0	0	.0	0	.0	0
PA 234	.0	0	.0	0	.0	0	.0	0
PU 242	3.0E+03	0	6.0E+04	0	.0	0	.0	0
NP 238	.0	0	.0	0	.0	0	.0	0
PU 238	.0	0	.0	0	.0	0	.0	0
TOTALS	5.1E+07	100	8.7E+07	100	3.3E+02	100	9.0E+04	100

M.19

COMBINED PATHWAY SUMMARY TOTALS PABLM VERSION2 120580
TOTALS BY NUCLIDE FOR SPECIFIED ORGANS (INTERNAL DOSES ONLY)
CASE TITLE: AEGIS SOLUTION MINING SCENARIO, SPENT FUEL @ 1,000,000 YR, SALT INGESTION, POP
*** DOSE COMMITMET SUMMARY FOR DOSE-YEAR 70 OF A 50. YEAR PLANT LIFE ***

IRRIGATION CROP PATHWAY: OFF
AIR DEPOSITION CROP PATH: OFF
AQUATIC FOODS PATHWAY: ON

DOSES AND TOTALS REPORTED IN MAN-REM

RADIONUCLIDE		TOTAL BODY	%	BONE	%	LUNGS	%	THYROID	%
NI	59	3.7E+01	0	2.2E+02	0	.0	0	.0	0
SE	79	8.8E-02	0	.0	0	.0	0	.0	0
PD	107	2.0E+01	0	.0	0	.0	0	.0	0
U	234	4.7E+05	0	7.6E+06	0	.0	0	.0	0
U	236	4.0E+05	0	6.5E+06	0	.0	0	.0	0
ZR	93	4.7E+01	0	1.8E+03	0	.0	0	.0	0
NB	93M	9.0E+01	0	1.1E+03	0	.0	0	.0	0
TC	99	5.3E+02	0	1.3E+03	0	1.7E+02	1	.0	0
SN	126	3.8E+01	0	1.4E+03	0	.0	0	7.9E+00	0
SB	126M	.0	0	.0	0	.0	0	.0	0
SB	126	2.6E-01	0	6.2E-01	0	.0	0	1.3E-02	0
I	129	5.7E+03	0	2.0E+03	0	.0	0	4.5E+06	99
CS	135	6.3E+04	0	1.5E+05	0	1.6E+04	98	.0	0
TH	230	5.2E+05	0	1.7E+07	0	.0	0	.0	0
RA	226	2.1E+09	97	2.8E+09	84	.0	0	.0	0
RN	222	.0	0	.0	0	.0	0	.0	0
PB	210	5.5E+06	0	1.5E+08	4	.0	0	.0	0
BI	210	2.7E+03	0	4.7E+03	0	.0	0	.0	0
PO	210	8.7E+05	0	3.6E+06	0	.0	0	.0	0
U	235	1.1E+04	0	1.8E+05	0	.0	0	.0	0
TH	231	4.6E-03	0	1.0E-01	0	.0	0	.0	0
PA	231	3.3E+04	0	7.9E+05	0	.0	0	.0	0
AC	227	2.4E+04	0	3.8E+05	0	.0	0	.0	0
TH	227	9.1E+01	0	3.1E+03	0	.0	0	.0	0
RA	223	2.3E+05	0	1.1E+06	0	.0	0	.0	0
NP	237	9.2E+05	0	2.1E+07	0	.0	0	.0	0
PA	233	1.7E+01	0	9.6E+01	0	.0	0	.0	0
U	233	1.0E+06	0	1.7E+07	0	.0	0	.0	0
TH	229	6.9E+06	0	1.4E+08	4	.0	0	.0	0
RA	225	2.6E+07	1	1.3E+08	3	.0	0	.0	0
AC	225	5.8E+03	0	8.6E+04	0	.0	0	.0	0
U	238	3.2E+05	0	5.4E+06	0	.0	0	.0	0
TH	234	1.6E+01	0	5.7E+02	0	.0	0	.0	0
PA	234M	.0	0	.0	0	.0	0	.0	0
PA	234	.0	0	.0	0	.0	0	.0	0
PU	242	1.7E+05	0	2.1E+06	0	.0	0	.0	0
NP	238	.0	0	.0	0	.0	0	.0	0
PU	238	.0	0	.0	0	.0	0	.0	0
TOTALS		2.1E+09	100	3.3E+09	100	1.6E+04	100	4.5E+06	100

APPENDIX REFERENCES

Ahlstrom, S. W., et al. 1977. Multicomponent Mass Transport Model: Theory and Numerical Implementation (Discrete-Parcel-Random-Walk Version). BNWL-2127. Pacific Northwest Laboratory, Richland, Washington.

Baker, D. A., G. R. Hoenes and J. K. Soldat. 1976. FOOD - An Interactive Code to Calculate Internal Radiation Doses from Contaminated Food Products. BNWL-SA-5532, Pacific Northwest Laboratory, Richland, Washington.

Bear, J., 1972. Dynamics of Fluids in Porous Media. American Elsevier Publishing Co., New York.

Boersma, L., F. T. Lindstrom and S. K. Saxena. 1973. "Limitations of Darcy's Law in Glass Bead Porous Media." SSSAP 37:333-336.

Boussinessq, J. J. 1904. "Recherches Theoriques sur l'ecoulement des Nappes d'Eau Infiltrees dans le Sol et sur Debit des Sources." Journ. de Mathematiques Pures et Appliquees. Series 5(10):5-78.

Bredehoeft, J. D. and G. F. Pinder. 1973. "Mass Transport in Flowing Ground Water." Water Resour. Res. 9(1):194-210.

Broom, M. E. 1968. "Ground-Water Resources of Wood County, Texas." Rept. No. 79, Texas Water Devel. Board.

Bull, C. 1978. Glaciological Parameters of Disruptive Event Analysis. PNL-2863, Pacific Northwest Laboratory, Richland, Washington.

Cavendish, J. E., H. S. Price and R. S. Varga. 1968. "Variational Methods for Numerical Solution of Boundary Value Problems." Paper presented at Symposium on Numerical Simulation of Reservoir Performance, Soc. Petrol. Eng. April 22-23, Dallas, Texas.

Culham, W. E. and R. S. Varga. 1970. "Numerical Methods for Time Dependent Nonlinear Boundary Value Problems." Paper presented at 2nd Symposium on Numerical Simulation of Reservoir Performance, Soc. Petrol. Eng., April 22, 23, Dallas, Texas.

Dillard, J. W. 1963. "Availability and Quality of Groundwater in Smith County, Texas." Texas Water Comm. Bull. 6302.

Durham, C. O. and W. S. White, Jr. 1960. "Guided Geological Tour Through North and Central Louisiana." In: Interior Salt Domes and Tertiary Stratigraphy of North Louisiana. Shreveport Geol. Soc. Guidebook, Shreveport, Louisiana.

Eaton, R. W. 1952. "Preliminary Notes on the Geology of the Mineola Basin, Smith and Wood Counties, Texas." Gulf Coast Assoc. Geol. Socs. Trans., v. 2, p. 16-180.

Eliason, J. R. and H. P. Foote. 1972. Long Beach Generating Station Thermal Transport Modeling Study. Prepared for the Southern California Edison Company, 2120133F, Battelle, Pacific Northwest Laboratories, Richland, Washington.

Fisher, W. L., et al. 1965. "Rock and Mineral Resources of East Texas." Rep. Inv., No. 54, Bur. Econ. Geology, Univ. Texas, Austin, Texas.

Fletcher, J. F. and W. L. Dotson (compilers). 1971. "HERMES - Digital Computer Code for Estimating Regional Radiological Effects from the Nuclear Power Industry." USAEC Report HEDL-TME-71-168, Hanford Engineering Development Laboratory, Richland, Washington.

Gray, W. G. 1975. "A Derivation of the Equations of Multiphase Transport." Chem. Eng. Sci. 30:229-233.

Griswold, G. B. 1981. Solution Mining in Salt Domes of the Gulf Coast Embayment. PNL-3190, Pacific Northwest Laboratory, Richland, Washington.

Gupta, S. K., K. K. Tanji and J. N. Luthin. 1975. "A Three-dimensional Finite Element Ground Water Model." California Water Resource Center, Univ. of California, Davis, Contribution #152.

Gupta, S. K. and K. K. Tanji. 1977. "Computer Program for Solution of Large, Sparse Unsymmetric Systems of Linear Equations." Int. J. Num. Meth. in Eng., Vol. 11.

Gupta, S. K., and G. F. Pinder. 1978. "Three-Dimensional Finite Element Model for Multilayered Ground-Water Reservoir of Long-Island, New York." Dept. of Civil Engineering, Princeton University, Princeton, New Jersey.

Harleman, D. R. F., P. F. Melhorn and R. R. Rumer. 1963. "Dispersion-Permeability Correlation in Porous Media." Journal of the Hydraulics Division, ASCE, Vol. 89, No. H-12, Proc. Paper 3459.

International Commission on Radiological Protection (ICRP). 1959. Report of Committee II on Permissible Dose for Internal Radiation, International Commission on Radiological Protection. ICRP Publication 2, Pergamon Press, New York.

Jacob, C. E. 1950. Chapter 5. In: Engineering Hydraulics. ed. H. Rouse, p. 321-386, John Wiley and Sons, New York.

Kellogg, O. D. 1954. Foundations of Potential Theory. Dover, New York.

Konikow, L. F., and J. D. Bredehoeft. 1974. "Modeling Flow and Chemical Quality Changes in an Irrigated Stream-Aquifer System." Water Resour. Res. 10(3):546-562.

Law Engineering Testing Company. 1978a. Geology and Growth History of Minden Salt Dome, Webster Parish, Louisiana. Marietta, Georgia.

Law Engineering Testing Company. 1978b. Geologic Evaluation of Gulf Coast Salt Domes. Marietta, Georgia.

Law Engineering Testing Company. 1979a. Gulf Coast Salt Dome Geothermal Study. Marietta, Georgia.

Law Engineering Testing Company. 1979b. Preliminary Report on the Geology and Hydrology of the Hainesville Dome, Wood County, Texas. Marietta, Georgia.

Loocke, J. E. 1978. "Growth History of the Hainesville Salt Dome, Wood County, Texas." Masters Thesis, Univ. Texas, Austin, Texas.

Martinez, J. D., et al. 1975. An Investigation of the Utility of Gulf Coast Salt Domes for the Storage or Disposal of Radioactive Waste. Inst. Env. Studies, Baton Rouge, Louisiana.

Martinez, J. D., et al. 1976. An Investigation of the Utility of Gulf Coast Salt Domes for the Storage or Disposal of Radioactive Waste. Inst. Env. Studies, Baton Rouge, Louisiana.

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Murray, G. E., Jr. 1961. Geology of the Atlantic and Gulf Coastal Province of North America. Harper and Brothers, Publishers, New York.

Narasimhan, T, N. and P. A. Witherspoon. 1976. "An Integrated Finite Difference Method for Analyzing Fluid Flow in Porous Media." Water Resour. Res. 12(1):57-64.

Netherland, Sewell, and Associates, Inc. 1975. Preliminary Study of the Present and Possible Future Oil and Gas Development of Areas Immediately Surrounding the Interior Salt Domes, Upper Gulf Coast Salt Dome Basins of East Texas, North Louisiana, and Mississippi, as of December 1975. Prep. for Union Carbide Corp., Nuclear Division, Oak Ridge National Laboratory, ORNL/SUB-75/87988.

Netherland, Sewell, and Associates, Inc. 1976. Geologic Study of the Interior Salt Domes of Northeast Texas Salt Dome Basin to Investigate Their Suitability for Possible Storage of Radioactive Waste Material as of May, 1976. Prep. for Office of Waste Isolation, Union Carbide Corp., Nuclear Div., Energy Res. Devel. Admin.

Nichols, P. H. 1964. "The Remaining Frontiers for Exploration in Northeast Texas." Gulf Coast Assoc., Geol. Socs., Trans., v. 14, p. 7-22.

Nichols, P. H. 1968. "Summary of Subsurface Geology of Northeast Texas." In Natural Gases of North America. pp. 928-1004. Am. Assoc. Petroleum Geologists, Mem., no. 9, v. 2.

Peltier, W. R. and J. T. Andrews. 1976. "Glacial-Isostatic Adjustment - The Forward Problem." Geophysical Journal of Royal Astronomical Society, 46:605.

Pinder, G. F. and E. O. Frind. 1972. "Application of Galerkin's Procedure To Aquifer Analysis." Water Resour. Res. 8(1):108-120.

Pinder, G. F. and H. H. Cooper. 1970. "A Numerical Technique for Calculating the Transient Position of the Saltwater Front." Water Resour. Res. 6(3):875-882.

Price, H. S., J. C. Cavendish and R. S. Varga. 1968. "Numerical Methods of Higher Order Accuracy for Diffusion-Convection Equations." Soc. Petrol. Eng. J. 8(3):293-303.

Rand, J. R. and R. G. Gerber. 1976. "Sears Island Fault Investigation. Report to Maine Nuclear Power Station." Central Maine Power Company, Augusta, Maine.

Raymond, J. R. (chairman). 1977. Workshop on Transport Modeling for Nuclear Waste Repositories. PNL-SA-7468. Pacific Northwest Laboratory, Richland, Washington.

Routson, R. C. and R. J. Serne. 1972. One-Dimensional Model of the Movement of Trace Radioactive Solute Through Soil Columns. BNWL-1718, Pacific Northwest Laboratory, Richland, Washington.

Schwartz, F. W. 1977. "Macroscopic Dispersion in Porous Media: The Controlling Factors." Water Resour. Res. pp. 743-752.

Schwartz, M. L. 1978. "Sea Level Report: Long-Term Meteorite Hazards to Buried Nuclear Waste, Report 2." In Summary of FY-1978 Consultant Input for Scenario Methodology Development. PNL-2851, Pacific Northwest Laboratory, Richland, Washington.

Soldat, J. K., et al. 1974. Models and Computer Codes for Evaluating Environmental Radiation Doses, USAEC Report. BNWL-1754, Pacific Northwest Laboratory, Richland, Washington.

Trent, D. S. 1975. Mathematical Modeling of Transport Processes in Aquatic Systems. BNWL-SA-5379, Pacific Northwest Laboratory, Richland, Washington.

Tubbs, D. W. 1979. "Pacific Northwest Geomorphology and Hydrology: Rates and Probabilities of Selected Processes and Events." In Summary of FY-1978 Consultant Input for Scenario Methodology Development. PNL-2851, Pacific Northwest Laboratory, Richland, Washington.

Zienkiewicz, O. C., and Y. K. Cheung. 1965. "Finite Elements in the Solutions of Field Problems." The Engineer. pp. 507-510, September 1965.

Zienkiewicz, O. C. 1971. The Finite Element Method in Engineering Science. p. 129-153, McGraw-Hill, London.

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COPY OF SWEC PROCEDURE FOR UPGRADING DATA CLASSIFICATION

SWEC RESPONSE:

SWEC does not have a project specific written procedure for upgrading data classification. The Project has established a methodology for using data obtained by others in an unknown control manner (shelf data). This includes use of Project Technical Procedures and/or approved calculations as deemed warranted. The process used in a particular study is indicated in the Technical Report and the reviews employed include Independent Technical Review.

An example is drill stem test data obtained from thousands of wells in the Texas Panhandle and surrounding areas. A report entitled Hydrogeologic Investigations Based on Drill-Stem Test Data, Palo Duro Basin Area, Texas and New Mexico (copy enclosed) was issued based upon this data. The report presents the screening process and classification system devised and used to evaluate the quality of DST data obtained. This resulted in approximately only twenty percent of the data obtained being considered usable for the purposes of this hydrogeologic investigation. Sections 2 and 3 of the report primarily present the methodology used (as indicated in the attached copy) and the other sections present the results from same.

The Project is presently formulating a written procedure(s) that will entail the following:

- Classification of procured data as to the level of confidence of same based upon Project participation in the controls used in obtaining data.
- Guidelines and requirements for use of data for the various classification types.
- Classification of deliverables to indicate authors prescribed limitation(s) for the use of information (including data) contained in same.