BOOK 1

TELEDYNE ISOTOPES

AN EVALUATION OF THE PLUM BROOK REACTOR FACILITY AND DOCUMENTATION OF EXISTING CONDITIONS

STUDY ORGANIZATION

Prepared For

The National Aeronautics and Space Administration
Lewis Research Center
21000 Brookpark Road
Cleveland, OH 44135

Under Modification 3 to
Contract NAS3-24359PB

December, 1987

by:

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Teledyne Isotopes, Inc.
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Westwood, NJ 07675

Exhibit (1)

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This is a synopsis of a 6 volume Report Of An Evaluation Of The Plum Brook Reactor Facility For The Purpose Of Documenting Existing Conditions At The PBRF. Section 0.1 presents pertinent background information prior to this Study. Sections 0.2 and 0.3 describe the type of work performed under each task assignment. A Summary of Observations appears in Section 0.4. These are categorized as follows:

1) Outdoor Areas
2) Structures
3) Radioactive Systems
4) Other Environmental Considerations

Section 0.5 presents a discussion of future dismantling options and the factors which influence the timing.

0.1 BACKGROUND

The Plum Brook Reactor Facility contained a 60 megawatt (thermal) Materials Testing and Research Reactor owned by the National Aeronautics and Space Administration. It was planned in 1957, and built in 1960. Criticality was first achieved in 1962. After the approach to power tests were completed in April, 1963, the reactor operated with full on-line capability (in excess of 85%) until January, 1973. At that time NASA no longer had a requirement for continued materials testing for space applications and the reactor was shutdown and secured. This shutdown and securing involved the de-fueling and partial disassembly of key components so that the facility could not be operated. Residual accessible contamination was cleaned up and the facility was put in a safe secure storage mode and mothballed by July, 1973. The end condition was to possess the reactor but not operate it; however, it was to be maintained for re-start if needed. The NASA license with the AEC (now NRC) was amended to permit that "possess but do not operate" mode.

In 1977, NASA made the decision that they would no longer have a requirement for future operation of the Plum Brook Reactor Facility. In 1978, NASA had Teledyne Isotopes perform a preliminary study on the further options for disposition of that facility.

Three modes were chosen by Teledyne Isotopes for consideration. The first mode was Continued Safe Storage With Delayed Dismantling (approximately 100 years into the future). Total cost for surveillance and ultimate dismantling was approximately $30M in 1978 dollars. The second mode considered was Immediate Prompt Dismantling of some structures and radioactive systems and construction of an entombment structure around the areas of highest radioactivity. This mode was estimated to cost approximately $18M; however, this was considered not to be a viable mode because it would not permit termination of the NRC license and would require continuing surveillance. A third option considered was the Prompt Dismantling of the reactor facility at a cost of nearly $7M. This third option (Prompt Dismantling), was the most economical and was the recommendation of Teledyne Isotopes in 1978. NASA concurred in that recommendation and entered into preparation of an environmental impact plan and dismantling plan. They also escalated the $7M Teledyne Isotopes cost estimate up to $15M to permit additional costs which NASA would incur and to allow for inflation. The NRC license was then amended to permit the decommissioning and NASA proceeded towards that end. It was soon discovered, however, that the funds would not be available to perform Prompt Dismantling so NASA was required to continue Safe Storage of the facility with future dismantling at some distant point in time.

In 1984, the Facilities Engineering Division of Lewis Research Center funded this current study to document the present condition of the PBRF. This study was begun in August, 1984, planning was completed by November, 1984, and field studies started in December, 1984, and proceeded thru December, 1985. The report writing proceeded into 1986 and was terminated in early 1987 with the preparation of this 6 volume written report.

During the course of this study, the NRC advised NASA that if they were not going to proceed with decommissioning they should take action to re-apply for their Possession Only license. NASA did re-apply for their Possession Only license and it was received in 1987.

0.2 TASK ASSIGNMENTS

Teledyne Isotopes performed their evaluation of the Plum Brook Reactor Facility for the purpose of documenting existing conditions of the PBRF under Modification 3 to Contract NAS3-24359PB. The supplemental statement of work identified seven specific tasks listed in order of priority that were to be performed:

(1) Review existing PBRF data and pertinent regulatory changes enacted since the 1978 Study which would affect the documentation of present conditions at PBRF.

(2) Develop a list of items of radiological significance addressed in the 1978 PBRF Options Study for which additional information is needed.

(3) Determine the exact physical characterization of radioactive contaminated areas by conducting radiological surveys and materials sampling and analyses.

(4) Update the 1978 Cost Estimate for PBRF dismantling projects

based upon the new and updated information obtained from this study.

(5) Develop and document cost estimates and maintenance and repair schedules to maintain the integrity of barriers to keep the facility in a dry safe protective storage mode for the next 30 years.

(6) Prepare recommended systems equipment disposition lists based on radiological inventory and radiological characterization.

(7) Recycle useable equipment and perform minor decontamination to support this effort.

Teledyne Isotopes has performed the Health Physics and radiological surveillance function continuously at the Plum Brook Reactor Facility since November, 1960. Teledyne's in-depth knowledge of the Plum Brook Reactor Facility provided an excellent data base upon which to develop the activities surrounding the various task assignments. To assist them in this matter, Teledyne subcontracted to Burns & Roe, Inc. of Oradell, New Jersey, to perform certain pricing techniques and other functions within the framework of the task assignments. Burns & Roe, Inc. was selected because they had just recently completed in 1983 the engineering planning for the Shippingport Nuclear Power Station Decommissioning Project. This was a U.S. Department of Energy contract and enabled them to participate in all the latest pricing techniques. The combination of Burns & Roe's engineering planning and pricing experience on the most recent decommissioning project plus Teledyne Isotopes' indepth knowledge of the PBRF helps to assure the highest degree of precision attached to all data generated from this study.

Five other specialty firms were used as subcontractors to support various portions of the activities as necessary.

0.3 SYNOPSIS OF ACTIVITIES PERFORMED UNDER EACH TASK ASSIGNMENT

0.3.1 Task Priority #1 - Review Existing PBRF Data And Pertinent Regulatory Changes Enacted Since The 1978 Study Which Would Affect The Documentation Of Present Conditions At PBRF

A review of PBRF data and conditions was performed and this included:

(1) An updating of the radioactive materials inventory to allow for radioactive decay from 1978 to 1985.

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(2) A review of the routine radiological monitoring results and comparison of recent results with those obtained routinely since 1978.

(3) A review of the PBRF facility changes, the two most significant ones being, (a) the radiological clearance of the Reactor Office Building #1142 and the Assembly and Test Structure Building #1121 and water tank #1156, plus 2.7 acres of land from the PBRF in 1980, and (b) the demolition of the reactor cooling tower in 1983, thereby resulting in the elimination of a major fire problem.

(4) An inspection and review of the condition of the buildings and grounds at the Plum Brook Reactor Facility.

Volume 1 presents the results of these reviews of the Plum Brook Reactor Facility data and conditions. However, it is sufficient to say for purposes of summarization that preliminary planning indicated nearly all contidions were as expected and would be duly noted so as to determine what affect they would have on documentation of the present conditions at PBRF.

A review of current regulations relating to the safe storage and dismantliing of the PBRF was also performed This included both State and Federal regulations. None of the regulations passed since 1978 have a major effect on the continued safe storage of the PBRF. There are two regulations which have been enacted since 1978 which do affect the dismantling of the PBRF. One of these is the deregulation of the interstate trucking industry in the early 1980s. The second was the passage of the Low-Level Radioactive Waste Policy Act of 1980. The combined effect of these two changes in Federal legislation resulted in the escalation of packaging, transportation, and burial costs of radioactive waste. The transportation costs have increased creased by a factor of 5, in part due to increased freight rates, in part due to longer shipping distances required by the lack of available burial space in the eastern burial sites. Burial costs have increased by a factor of 8.2 for solid materials. In the future it is likely that waste transporation and packaging costs will follow inflation. However, it is increasingly likely that burial costs will substantially increase faster than the rate of inflation.

A more detailed evaluation of the effects of these regulations as well as other Federal and State regulations is presented in Volume 1.

0.3.2 Task Priority #2 - Develop A List Of Items Of Radiological Significance Addressed In The 1978 Options Study For Which Additional Information Is Needed

The Task Study Team identified six items of radiological significance for which additional information was needed as part of this current evaluation:

(1) It was necessary to institute a system-by-system review and comprehensive monitoring to insure that all questions are identified and answered.

(2) It was necessary to comprehensively monitor all structures and grounds to properly identify all areas of radiological significance.

(3) It was necessary to identify and list all loose and fixed equipment within the facility by system and/or location.

(4) It was necessary to identify the major factors which influence the decisions whether or not to commit to rad waste disposal or to decontaminate a particular item.

(5) It was necessary to develop and evaluate techniques for in-place decontamination and compare the pros and cons of in-place decontamination with the advantages and disadvantages of removal and disposal (as radioactive waste) of the major embedded piping systems. In other words, decon versus removal and the most cost effective options.

(6) It was necessary to expand and update the preliminary procedure developed in 1978 for removing the reactor core and in-tank components and develop that into a much more detailed comprehensive procedure so as to accurately identify labor and other cost factors related to that important task.

The result and significance of all six of the above items is discussed in more detail in Volume 2. Volume 2 also includes two important appendices. The first, developed by Burns & Roe, involves the detailed evaluation of in-place decontamination versus dismantling and disposal by burial for facility piping - both large and small - particularly the primary cooling water system and the quadrant and canal recirculate and pump out systems. In the case of the primary cooling water system, in-place decontamination would cost approximately $1,074,000 and would require an effort of ten weeks and result in the occupational exposure of 3.7 person-Rems. Removal by engineering explosives and concrete break up would cost an estimated $360,000 over a period of 6-1/2 weeks and would result in an exposure of approximately 6 person - Rems. The cost advantage and time advantage is clearly in favor of removal and burial of the primary cooling water piping. In the case of the quadrant and canal embedded piping, decontamination is not a viable option because these drains are cast or black iron and are not stainless steel. They are highly corroded and use of harsh chemicals is not recommended under such conditions. Leakage of these drains could result in high level massive contamination of large quantities of concrete. Clearly in the case of the quadrant and canal embedded piping the removal is the only viable option. That price is estimated to be $372,500 requiring a period of ten weeks at an estimated occupational exposure of 22.6 man-Rems.

0.3.3 <u>Task Priority #3</u> - <u>Physical Characterization Of Radioactive/Contaminated Areas Of The PBRF</u>

Work performed under this task involved seven major areas of investigation.

The first involved general background preparatory evaluation including a pathway analysis of all of the potential mechanisms for transfer of radiological contamination to man This was done in order to assure that the sampling plan was comprehensive to identify all potential pathways. Also included in this first general task was the background interpretation and systems and procedures for monitoring radioactive backgrounds in soil, silts, water, air, etc. Review was also performed for release limits, instrumentation was selected, and procedures were written to insure a comprehensive monitoring plan as well as a plan for proper Isotope identification in the samples.

The second major task performed under this category was development of a comprehensive outdoor radiological classification scheme. The actual sampling plan included collection of a substantial number of surface soil samples, deep soil samples by means of core boring and split spoon sampling, drainage system sampling including catch basins, effluent station, emergency retention basin, and effluent ditches. Also as part of the outdoor radiological classification there was a series of roof top samples and monitoring to assure that no contamination on roof tops existed that could be washed off into run-off water. Surface water sampling was performed as well as groundwater sampling and two series of biospecimens were collected to determine the degree to which contamination may have been carried to biosystems. The eastern groundhog was sampled because they are predominantly surface vegetation feeders. Secondly, the eastern mole was selected because they feed predominantly on grubs which attach to or feed from the roots of surface plants.

The third area of work involved the development and collection and analysis of a large number of reactor systems radiological samples. These were comprehensively collected and included reactor tank, reactor core, and bioshield sampling, air sampling from within the reactor tank for Tritium, primary cooling system sampling, quadrant and canal pump out and recirc systems sampling, hot drains, sumps, pumps, valves, hot retention area, cold retention basins, exhaust air system, hot-dry storage, hot lab, mock-up reactor, and deep core sampling indoors but adjacent to canals at the PBRF to assure that no contaminated water leached into subsurface fill areas.

A fourth area of investigation included the indoor surface contamination classification of buildings and structures. In addition to all of the systems previously described each building was comprehensively monitored to determine the structure contamination, if any, in the various buildings.

The fifth area of investigation was an evaluation of asbestos present in the facility.

The sixth area included was an evaluation of radon and the significance of radon buildup in a shutdown facility with ventilation systems secured.

Finally, the seventh category of investigation under the Task Priority #3 involved comprehensive evaluation of the various radioisotopes present in order to identify the most predominant isotopes that would affect future NASA related activities.

Volume 3 of this report series includes the results of all of these findings and comprehensive listing and cataloging of all of the data related to this sampling program. Each item is summarized by category.

0.3.4 Task Priority #4 - Update The 1978 Cost Estimate For The PBRF Dismantling Project Based Upon The New And Updated Information Obtained From This Study

Work performed under this task involved a detailed evaluation of the methodology, pricing, organization, structure, etc., for prompt dismantling of the PBRF. A second phase also involved the similar considerations of comparing costs with a delayed dismantling at some length in the future. A third mode evaluated was the extended time early dismantling where dismantling would occur over a period of about 12 years. In addition, alternate uses of the PBRF as a Spent Fuel Storage Facility and a Radiological Waste Repository or Storage Facility were also considered.

The work performed in this task involved a data base and values generated by Teledyne Isotopes and detailed pricing by Burns & Roe, Inc. of Oradell, New Jersey.

Volume 4 presents both a summary and indepth evaluation and comparison of these costs including a cost sensitivity analyses for prompt dismantling as well as an evaluation of the contingencies utilized and the pricing structures utilized.

Detailed tasks and pricing work books were developed and although not included in the report were generated for the Vital Records so that at any point in time the details relating to the pricing can be reviewed, updated, and re-priced if needed. This is an extremely valuable outgrowth from this Task and will be of substantial value during the formation of a detailed dismantling procedure in the future.

0.3.5 Task Priority #5 - Develop And Document Cost Estimates And Maintenance And Repair Schedules To Maintain The Integrity Of Barriers To Keep The Facility In A Dry Safe Protective Storage Mode For The Next 30 Years

Work performed under this task consisted of a thorough inspection of the structural conditions of various PBRF buildings and facilities. Every single area of the facility was entered including areas that had been seal-welded closed as part of the mothballing. Each of the seven hot cells, the hot pipe tunnel, the Cold Retention Area structures, the Hot Retention Area structure, the Subpile Room, and each of the six sealed rooms in the Primary Pump House all were entered and evaluated for their current conditions and integrity of enclosure.

Structural specialists were utilized as subcontractors to assist in this work. The condition of all facilities was assessed and a maintenance schedule was developed. This schedule consisted of priority maintenance to be performed over the next three years in order to get the facility upgraded to a contition where routine maintenance would preserve it. A routine maintenance schedule was also developed out to the year 2073 showing the scheduling and timing of major maintenance functions that should be performed. The costs of all of these maintenance activities as well as the extended costs of utilities and surveillance services are also presented in Volume 5 for the purposes of determining the cost of surveillance during the "possess but do not operate" period.

0.3.6 Task Priority #6 - Prepare Recommended System Equipment Disposition Lists Based On A Radiological Inventory And Radiological Characterization

Work performed under this task was in accordance with the systems procedures developed in Volume 2. Basically, all items of loose and fixed equipment, as well as individual pieces in the systems such as valves, piping, regulators, pressure indicators, etc., are identified in a comprehensive computerized data listing. Items are organized as to systems which are radiologically clean, systems which are radiologically contaminated, items of fixed and loose equipment which are not part of a system, and a master list of all PBRF items indexed by building and location. Volume 6 presents this information in detail and it will be a valuable listing to have at any point in the future when partial or full dismantling occurs. This listing also includes the various sizes, weights, volumes, radiological activity, and units necessary for compiling radiological waste data in the future. It's also useful in the sense that it can permit sizing of radiological waste containers to the individual pieces as necessary.

0.3.7 Recyle Useable Equipment And Perform Minor Decontamination To Support This Effort

Work performed under this task consisted of numerous instances of minor decontamination to bring special test equipment, monitoring equipment, and contractor equipment in and out of contaminated control zones. There was no decontamination performed towards ultimate future dismantling. Also, the effort involved in performing the first six tasks identified previously was substantial and it was not possible to recyle any useable equipment at this time as part of this study. For this reason there was no written report given of Task Priority #7 and so there is no documentation by way of a report of decon activities performed in conjunction with this study. However, as indicated earlier there was substantial minor decontamination performed along with the general effort of this study.

0.4 SUMMARY OF OBSERVED RADIOLOGICAL CONDITIONS

0.4.1 Outdoor Areas

There was little or no evidence of outdoor radiological contamination within the 27 acre PBRF fence line except for the 2 acre Emergency Retention Basin. The Emergency Retention Basin has low level contamination consisting of predominantly Co 60, Cs 137, and Sr 90. This contamination was concentrated in the upper 2 inches of the

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soil in the floor of the basin. In a few areas the contamination extended to a depth of 6 inches. The contamination is well fixed to both the upper layer of clay with which the basin was rolled and in the decaying organic matter associated with the upper strata of that surface clay. There is no evidence that it has been translocated to other areas.

As part of this study it was recommended that the best long range method for removing the contamination in the Emergency Retention Basin is to cultivate the basin as an area of fine turf grass over a period of several years and then utilize commercial sod harvesting equipment as a means of removing the upper contaminated 2 inches of soil and decaying organic matter.

Outside of the Emergency Retention Basin there were 3 minor areas of surface contamination. Two of these were very localized and will involve but minimal efforts to correct. The third one involved a spill of a radioactive waste drum during past operations at the PBRF. The penetration of the soil contamination extended to a depth of 5 ft. in a very localized area due to the fact that there was fine gravel and sand fill adjacent to the concrete pad where the spill occurred. Core sampling indicated that the contamination extended to a depth of almost 6 ft. at which point it hit a clay layer and the clay retained the contamination.

It was also found as part of the study that the Pentolite Ditch, which is the effluent ditch receiving all the PBRF discharge waters, is contaminated to a very low level. Although this presents no immediate health problems it is contaminated to a level that will require correction before the NRC will permit license free operations. Approximately 1/3 to 1/2 of the length of Pentolite Ditch will require reme dial action by closing off the flow to the ditch and ultimately removing several inches of silt from the base of the ditch.

In the course of the outdoor sampling it was discovered that Plum Brook Station sits atop an area of gray shale that is referred to in geological circles as Huron and Mentor shale. This shale layer contains high natural levels of Radium 226, which occurred from the long term decay of natural Uranium. This Radium 226 in shale has been found as close to the surface as 3 ft. in parts of Plum Brook Station and in other areas as deep as 16-18 ft. Pentolite Ditch is one area where this shale shows within 3 ft. of the surface. In fact, the cut bank of Pentolite Ditch permits direct monitoring of this shale layer which is approximately 12-18 inches thick. This is mentioned only from the standpoint that presence of this high natural background (up to a factor of 10 in excess of natural background) can cause an erroneous assumption that there would be man-made isotope contamination (requiring decontamination), when in reality, the higher levels are due to a naturally occurring decay of Radium. It is important to recognize this fact when future dismantling of PBRF occurs because shale layers found in Pentolite Ditch were within several hundred yards of the PBRF, and it is quite likely the shale layer extends under PBRF as well.

0.4.2 Structures

As a result of this evaluation it was found that the integrity of the barriers to the high radiation areas remains high and is effective in preventing the spread of radiological contamination. It was also found that the protective custody procedures were effective in minimizing spread of radioactivity from other areas as well. The buildings are radiologically clean except for low level contamination in the hot lab and quadrants and canals and a few other spot areas of contamination which can be decontaminated with straightforward techniques.

This evaluation also revealed, however, that the condition of dry safe protective custody was not assured by sealed systems. It was noticed that water had infiltrated a number of systems once considered to be in a dry safe protective condition. The Primary Pump House resin pits, the pump pit and the Room #8 sump of the Primary Pump House were infiltrated with precipitation and surface water run-off. The Fan House resin pits were also infiltrated with precipitation and surface run-off.

The ROLB cold/hot sump had been contaminated with groundwater infiltration into a contaminated sump. Quadrant and Canal drains had small quantities of water in them resulting from the condensation off of the metal structure of the containment dome, and this condensation on the floor of the quadrants and canals eventually flowed thru failed sealed drains and did get into contaminated drain lines.

The Hot Retention Area structure also had substantial groundwater infiltration. There was approximately 30 inches of groundwater infiltrated into this 46' x 96' structure. Hot Retention Area tanks 2, 5, and 7 also had precipitation infiltration through cracks in the concrete roof of the Hot Retention Area structure.

The PBRF stack had collected and held precipitation to the depth of 12-15 inches in the base of the stack.

The Hot Pipe Tunnel has had a groundwater infiltration problem from time to time which has since been corrected.

All of these conditions have been corrected during the course of the evaluation or shortly thereafter and the dry safe inaccessible protective custody has been supplemented in certain areas by accessible, verifiable, dry safe custody.

It was also found that because of the high humidity present in some sealed concrete structures there was substantial corrosion of pipe hangers and other building internals (electrical conduits, switches, hangers, etc.). Also, many of these concrete structures showed cracks, probably from structural stressing over a period of time and improper construction. None of these cracks were deemed to be immediately hazardous or a structural integrity problem, however, it was necessary to seal some of these cracks since they were the source of some of the precipitation and other water infiltration.

0.4.3 Radioactive Systems

The inventory of radioactivity present in the PBRF reactor tank and Hot Dry Storage was verified to be as expected with respect to the activity resulting from stainless steel and aluminum activation products. There were several surprises, however. Europium 152, 154, and 155 were found to be present in the corrosion film in the reactor primary piping and systems. Also, Cesium 137 and Strontium 90 were found to be present in most liquid and gaseous drain systems and vent systems other than the primary system. The Europium isotopes are thought to have occurred from several accidental injections of gadolinium nitrate into the primary system during operation. Cs 137 and Sr 90 are fission products resulting from the fissioning of Uranium.

The presence of all of these isotopes, particularly the Eu 152, Eu 154, Cs 137, and Sr 90, with their relatively long half-lives ranging from 12 to 30 years means that the decay of the facilities to extremely low levels, or license free levels, is not apt to occur for several hundred years as indicated by Table 0.1. The implications are that even after a substantial period of decay, essentially everything that would have to be done for prompt dismantling of the facility at this time would still have to be done a century from now. The only difference is the radioactivity levels, the dose rates, and the occupational exposures resulting from Co 60 would be substantially lower. Nevertheless, the facility will not have decayed to the point where license free handling of the materials is permitted. This essentially negates any cost advantage to long term continued storage of the PBRF in the hopes that it would be cheaper to dismantle it in the future. Such is not likely to occur within the next several centuries.

TABLE 0.1

Time Interval For Various PBRF Isotopes To Decay To Exempt Quantities

ISOTOPE	T-1/2	PRESENT QTY (Ci)	LICENSE EXEMPT QTY (Ci)	YEARS TO ACHIEVE LICENSE EXEMPT LIMITS
H3	12.3 YR	91000	1 E-3	325 YR
CO 60	5.2 YR	713	1 E-6	153 YR
EU 152	12.8 YR	1	1 E-6	255 YR
EU 154	16.0 YR	1	1 E-6	320 YR
NI 59	8 E4 YR	0.5	1 E-4	1 MEGA YR
NI 63	92 YR	42	1 E-5	2014 YR
AL 26	7.4 E5 YR	1.4	1 E-7	10 MEGA YR
CS 137	30 YR	1	1 E-5	296 YR
SR 90	28 YR	1	1 E-7	651 YR

0.4.4 Other Environmental Considerations

One environmental consideration discovered during the course of this PBRF evaluation was the presence of the elevated concentrations of Radon 222 (a radioactive daughter product from the decay of Radium 226). Radon 222, therefore, is a naturally occuring isotope which persists as a radioactive emitting gas with a half-life of 3.8 days. This isotope was found to be present in elevated concentrations throughout the containment vessel, particularly noticeable at the lower elevations. Since the containment vessel is sealed off from the subterranean structures by means of the steel shell and massive concrete, the source of the Radium is not likely to be from the earth itself. Instead it's thought to be emanating from large amounts of local stone present in the concrete aggregate within the massive concrete structures of the containment vessel. Most of this stone was quarried locally and it is thought that the higher levels of Radium 226 mentioned earlier in this report also are present in some of the stone aggregate which was used in pouring the various concrete structures.

Normal air turnover in a facility will purge the Radon 222 from the facility, however, the ventilation system has been off essentially for 13 years since shutdown in 1973. As a result, the Radon gas has accumulated and even though the Radon itself only persists for 3-4 days, the daughter products in the decay chain, particularly Lead 210 with a half-life of 21 years, and Plutonium 210 with a half-life of a 138 days are generated. They will eventually reach equilibrium but in the meantime the radioactive daughters will continue to increase and build up within the containment structure.

Another interesting part of this study was the fact that other areas of Plum Brook Station were also sampled for Radon and several of these areas of Plum Brook Station tion were found to have these elevated Radon concentrations. Two types of monitoring systems were used to detect Radon 222, a chemical etch plate system and a charcoal absorbing system. The results of the survey data and decay sequence appear in Table 0.2.

The presence of Radon indicates that, as time goes on, there should be an increasing build up of the Radon to the point where it will be easier and easier to detect. It could give some instrument survey interferences and may build up to a level which makes delayed dismantling many years into the future increasingly difficult. A suggested way of minimizing this effect is to periodically purge the containment vessel or any area where massive concrete structures exist within the structure itself. This purging, or normal air turnover, then will keep the Radon concentrations to more normal levels.

For Radon concentrations in the range of 4 to 20 pCi/l, the EPA requires temporary and/or permanent remedial action be taken to reduce levels below the 4 pCi/l control point. Higher exposure levels require the action to be taken in a shorter period of time. The action time ranges from 4 to 15 months.

It should be recognized that Radon buildup in closed unventilated facilities has been commonly observed. It is a naturally occurring phenomenon and not peculiar only to nuclear facilities. Its presence interferes with the ability to measure low levels of man made contaminants, and may cause a slightly elevated risk of lung cancer if occupancy is continuous over an extended period of time.

During the course of this evaluation specific sampling for Tritium was conducted in the reactor tank vent line, from the reactor tank directly itself, and from the Hot Dry Storage area. This was done because of the large inventory of Tritium present within the metal matrixes of the Beryllium pieces in storage. Tritium was found to be offgassing from these Beryllium pieces at a very low rate. The dry nitrogen purge in the reactor tank actually served a beneficial effect by carrying out at a

TABLE 0.2 - RADON 222 CONCENTRATIONS IN SELECTED PLUM BROOK FACILITIES

LOCATION	TERRADEX TYPE SF - 1985 EXPOSURE PERIOD	TERRADEX TYPE SF - 1985 pCi/l	TERRADEX TYPE SF - 1986 EXPOSURE PERIOD	TERRADEX TYPE SF - 1986 pCi/l	TELEDYNE CHARCOAL 1986 EXPOSURE PERIOD	TELEDYNE CHARCOAL 1986 pCi/l
Bldg. #1111 - 0' CV Canal E Railing	7/2-9/5	4.64	3/14-5/19	4.58	3/14-3/19	7.0 ± 1.4
Bldg. #1111 - -25' CV Center Dry Annulus	7/2-9/5	8.14	3/14-5/19	10.81	3/14-3/19	10.9 ± 1.7
Bldg. #1111 - 25' Door of PPP Room	7/2-9/5	4.75	3/14-5/19	1.7	3/14-3/19	2.6 + 1.4
Bldg. #1111 - 15' Entrance to CPT	7/2-9/5	4.05	3/14-5/19	1.93	-	-
Bldg. #1112 - Hot Handling Room 80-T Door	7/2-9/5	3.24	3/14-5/19	2.74	3/14-3/19	3.4 + 1.0
Bldg. #1132 - 15' Entrance to HPT	7/2-9/5	4.40	3/14-5/19	2.89	3/14-3/19	LT 4
Warehouse #9199	7/2-9/5	9.66	3/20-5/19	3.66	3/20-3/24	8.4 ± 0.8
Bldg. #7141 - Room 105	7/2-9/5	5.22	3/14-5/19	7.12	3/14-3/19	5.1 ± 1.0
Bldg. #7141 - Room 114	-	-	3/14-5/19	5.74	-	-
Bldg. #3211 - 60' (B-2)	7/2-9/5	2.18	3/17-5/19	0.94	-	-
Bldg. #3411 - 15' (HTF)	-	-	3/17-5/19	1.11	-	-
Bldg. #7233, Mail Desk (Background)	7/2-9/5	1.02	3/14-5/19	0.32	3/14-3/19	LT 2

Uranium 238 (4.5 E9 years) → x → x → x → Uranium 234 (2.5 E5 years)

Uranium 234 (2.5 E5 years) → Thorium 230 (8 E4 years) → $\boxed{\text{Alpha Radium 226 (1602 years)}}$ → $\boxed{\text{Alpha Radon 222 (3.8 days)}}$

Radon 222 → Polonium 218 (3 minutes) → Lead 214 (27 minutes) → Bismuth 214 (20 minutes) → Polonium 214 (LT 1 second)

Polonium 214 → $\boxed{\text{Beta Lead 210 (21 years)}}$ → Bismuth 210 (5 days) → $\boxed{\text{Alpha Polonium 210 (138 days)}}$ → Lead 206 (Stable) very low rate, the Tritium that was offgassing from the Beryllium pieces. Experiments were run during the course of this study by discontinuing this purge for a period of 10 days. By discontinuing this purge for a period of 10 days the Tritium levels in the tank increased by a factor of 3. This indicates that the dry nitrogen purge should be continued, and along with this, a quarterly monitoring program for Tritium will be conducted to assure that the rate of emission for the Tritium (approx. 2 x E-8 uCi/ml) remains below the maximum permissible concentration permitted under 10 CFR 20, Appendix B, Table II (5 x E-6 uCi/ml occupational and 2 x E-7 uCi/ml non-occupational).

One major question exists, however. The Beryllium pieces which contain the Tritium (produced as a result of the irradiation of the Beryllium by neutrons during the course of reactor operations) have been exposed to a dose approaching 1E11 - 1E12 rads of combined neutron and gamma exposure. As a result of this, the Beryllium pieces may well become embrittled and prone to crack or crumble. If that should happen, the rate of release of Tritium is apt to increase substantially. If that should be observed in the future, it would be necessary to discontinue the reactor tank purge with the dry nitrogen. Subsequent handling of the Tritium would involve a very difficult procedure during the course of later reactor decommissioning. Tritium is extremely difficult to contain and handle because of the fact that the Tritium atoms exchange freely with the Hydrogen atoms present in the water vapor in the air and in all hydrocarbon and other materials with an abundance of Hydrogen atoms. This is a strong environmental/technical reason for considering early dismantling as opposed to long delayed dismantling in the future.

0.5 DISCUSSION OF FUTURE DISMANTLING OPTIONS

In 1978, Teledyne Isotopes prepared a report titled, "An Evaluation of the Options for Further Decommissioning of the Plum Brook Reactor Facility." That report was based on a preliminary study performed after the PBRF had been in a mothballed condition for five years following shutdown in 1973. As a result of that study Teledyne Isotopes presented preliminary cost estimates for five options. Prompt dismantling costs, continuing cost of surveillance and maintenance, and delayed dismantling costs were considered. Table 0.3 presents these options evaluated in 1978 with the estimated cost of each.

TELEDYNE ISOTOPES

TABLE 0.3

Estimated Costs Of Various Options
For The Further Dismantling Of The Plum Brook Reactor Facility
Based On 1978 Study

		ALL STRUCTURES DEMOLISHED	RADIOACTIVELY CLEAN STRUCTURES REMAIN
1.	Mothballed/Delayed Dismantling (100 years)	$30,807,000	$23,016,000
2.	Mothballed/Reduced Acreage From 30 To 7/Delayed Dismantling (100 years)	$31,254,000	$24,463,000
3.	Temporary Entombment/Delayed Dismantling (100 years)	$26,768,000	$18,960,000
4.	Prompt Dismantling/Structures Removed	$14,108,000	NA
5.	Prompt Dismantling/Structures Remain	NA	$ 6,317,000 ($15,000,000 in 1981)

Mode 2 Delayed Dismantling with Reduced Acreage was not a viable option. The early cost of gaining the release of about 23 acres was $450,000. In addition to the fact that this was not a cost effective action, it was subsequently determined that the larger acreage would be needed for staging areas, property lay down and clearance procedures, property control and inventory and a number of other activities when the time came to commence decommissioning.

Mode 3 Temporary Entombment was subsequently determined not to be a viable alternative. Substantial prompt costs would be required to release most of the facility outside of entombment and to build an approved entombment structure. Once achieved the NRC rules still would require some type of surveillance and continuation of a possession license. Although some facilities would be released, the main objective of NRC license termination would not be met.

Mode 4 Prompt Dismantling (with structures removed to 4 feet below grade and backfilled) also was not a truly viable option at that time. The structures themselves were not significantly contaminated and were not a complicating factor in license termination. Most were in excellent condition and could be renovated for alternate use, if needed, once NRC license termination was obtained.

This essentially left only Modes 1 and 5 as the clear choice for

NASA management. Either continue the safe, protective storage status and have a delayed decommissioning or enter into prompt decommissioning. Mode 5 was the most cost effective choice in the long run and NASA attempted to proceed towards that end in the 1979-81 period. The $6.3M estimate of decommissioning operations by Teledyne was escalated to $15M to allow for NASA planning, engineering, project management, and inflation. Funding could not be achieved and Mode 1 was selected (Mothballing with Delayed Decommissioning) for an indefinite extended period.

For purposes of this Study, Task 4 - Update of the 1978 Study, was limited to updating Modes 1 and 5. In addition, an extended Mode 5 (Prompt Dismantling) was considered in order to utilize lower annual rates of funding over a longer time span. A preliminary review and evaluation was also made to consider two alternate nuclear uses of the facility. One as a Spent Fuel Storage Facility and the other as a Monitored Retrievable Waste Storage Facility.

Burns and Roe, Inc. of Oradell, New Jersey, was selected as a subcontractor to develop cost estimates for Prompt Dismantling, Decontamination Methods Report (see Appendix 2.1 of Volume 2), changes in radiation regulations (presented as part of Volume 1 of this series), and the feasibility of utilizing PBRF for alternate nuclear uses. Burns and Roe was selected because they had just recently completed the engineering plan for the Prompt Decommissioning of the Shippingport Reactor under contract to the U.S. Department of Energy. Shippingport is a power reactor, moderately larger than the Plum Brook Reactor, with many similar features and some similar problems to be addressed in dismantling. It was found that Burns and Roe's recent experience in developing the Shippingport Plan was extremely useful in the update of the PBRF dismantling costs.

0.5.1 Prompt Decommissioning

Burns and Roe's evaluation of Prompt PBRF Dismantling costs identified tasks, approaches, cost and pricing elements, organization, staffing, scheduling and sequencing, task efficiencies, and contingencies. A cost sensitivity analysis was also performed as well as a comparison with the Shippingport Decommissioning Plan Cost Estimate. Teledyne Isotopes personnel provided considerable base data because of their knowledge of the facility. They also reviewed and concurred in Burns and Roe's methodology. The Burns and Roe report on Prompt Dismantling of the PBRF appears in its entirety as Appendix 4.1 of Volume 4. The detailed pages of job costing/estimating sheets have not been included because of their volume. They have been separately secured in the PBRF Vital Records File because of their extreme value to future PBRF activities. Burns and Roe has retained one copy for contract purposes, as has Teledyne

Isotopes.

The results of the Burns and Roe evaluation indicates that Prompt Dismantling would require an expenditure of $32,143,178 including a contingency of approximately 16.5%. A total time span of approximately 4.3 years would be required. One year would be required for decommissioning planning and selection of contractors. A half year would be required for NASA plan review and approval, submission of Decommissioning Request to the NRC, and receipt of NRC approval. Approximately 3 years would be required for actual decommissioning operations. Burns and Roe developed a work breakdown structure identifying various project tasks and then developed their costs and schedules in accordance with those work breakdown structures. Burns and Roe's complete report is included in Appendix 4.1 of Volume 4. Table 0.4 compares the PBRF Dismantling Project with others of comparable scope. Figures 0.1 through 0.4 present simplified work packages, organization, and scheduling of a PBRF Dismantling Project.

TABLE 0.4

COMPARISON OF PBRF DECOMMISSIONING ESTIMATES
WITH COMPARABLE PROJECTS

	ELK RIVER	ENRICO FERMI-1	ALRR	SHIPPINGPORT-1	PBRF 1981	PBRF 1985-6
REFERENCE	NUREG/CR-2985	NUREG/CR-3116	NUREG/CR-3370	NUREG/CR-4090	NUREG/CR-1756 NUREG/CR-3336	TELEDYNE/BRI
DATE	1973	1974	1981	1984-1988	1981	1985
TYPE OF DECOM.	DECON/ACTUAL	SAFSTOR/ACTUAL	DECON/ACTUAL	DECON/ESTIMATE	DECON/ESTIMATE	DECON/ESTIMATE
MEGAWATTS (THERMAL)	58.2	430	5	355 (LWBR ONLY)	60	60
MEGAWATT-DAYS (THERMAL)	53,000	5,941	15,200	275,000	98,000	98,000
COST-ORIG. ($)	$ 6,155,775	$ 7,164,988	$ 4,816,000	$73,666,000	$15,600,000	$28,400,000
COST-ADJ. FACTOR	1.964	1.854	1.211	0	1.211	0
COST-1985 ($)	$12,089,442	$13,283,887	$ 5,832,176	$73,666,000	$18,891,600	$28,400,000
ACTIVITY (Ci)	9,955	5,000	6,672	8,876	369,000 (W. H-3)	118,000 (6,824 W.O. H-3)
$/Ci	$1,214	$2,657	$874	$8,300	$51	$4,162 (W.O. H-3)
$/MW	$207,730	$30,893	$1,166,435	$207,510	$314,860	$473,333
$/MWD	$228	$2,236	$384	$268	$193	$290
DISP. VOL. FT.	91,550	DNA	40,830	66,703	174,200	63,378
$/CU. FT.	$132	DNA	$143	$1,104	$108	$448
OCCUP. EXP. (MAN-REM)	75	28	69.4	1004.6	322	340
$/MAN-REM	$161,199	$473,747	$84,043	$73,329	$58,673	$83,529
MAN-REM/MW	1.29	6.5 E-2	13.9	2.83	5.37	5.7
MAN-REM/MWD	1.4 E-3	4.7 E-3	4.6 E-3	3.7 E-3	3.3 E-3	3.5 E-3
MAN-REM/Ci	7.6 E-3	5.6 E-3	1 E-2	1.13 E-1	8.7 E-4	4.9 E-2 (W.O. H-3)

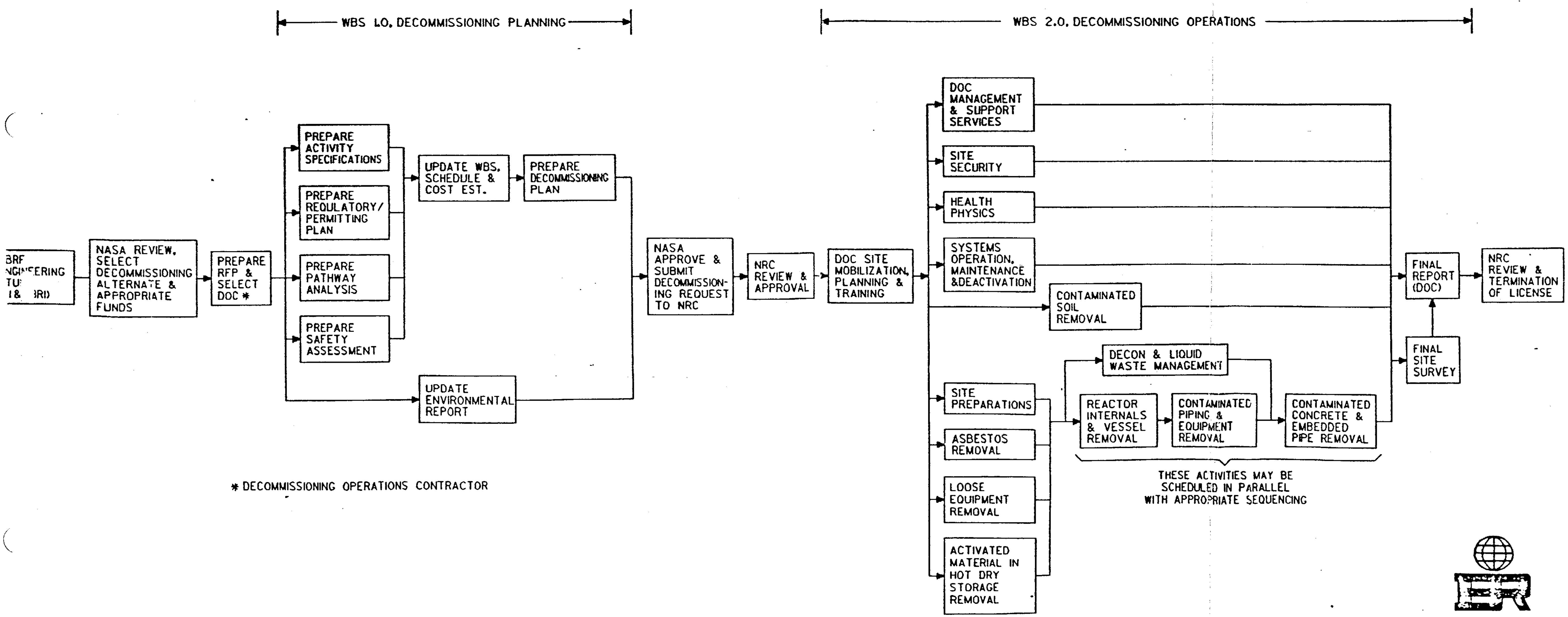
WORK BREAKDOWN STRUCTURE (WBS)
PLUM BROOK REACTOR FACILITY DECOMMISSIONING PROJECT

LEVEL 0 · LEVEL 1 · LEVEL 2 · LEVEL 3 · LEVEL 4

- **0.0 PLUM BROOK REACTOR DECOMMISSIONING PROJECT** (Level 0)
  - **1.0 DECOMMISSIONING PLANNING** (Level 1)
    - **1.1 PLANNING DIRECTION & SUPPORT** (Level 2)
      - 1.1.1 PLANNING DIRECTION (Level 3)
      - 1.1.2 PLANNING SITE SUPPORT (Level 3)
    - **1.2 ENGINEERING & PLANNING** (Level 2)
      - 1.2.1 ENGINEERING & PLANNING MANAGEMENT (Level 3)
        - 1.2.1.1 MANAGEMENT & ADMINISTRATION
        - 1.2.1.2 QUALITY ASSURANCE
        - 1.2.1.3 TECHNICAL & SAFETY REVIEW COMMITTEE
      - 1.2.2 ENGINEERING (Level 3)
        - 1.2.2.1 DECOMMISSIONING OPERATIONS CONTRACTOR (DOC) ACTIVITIES
        - 1.2.2.2 SITE SECURITY
        - 1.2.2.3 HEALTH PHYSICS
        - 1.2.2.4 SYSTEM OPERATION, MAINTENANCE & DEACTIVATION
        - 1.2.2.5 CONTAMINATED SOIL REMOVAL
        - 1.2.2.6 SITE PREPARATION
        - 1.2.2.7 ASBESTOS REMOVAL
        - 1.2.2.8 LOOSE EQUIPMENT REMOVAL
        - 1.2.2.9 ACTIVATED MATERIAL IN HOT DRY STORAGE REMOVAL
        - 1.2.2.10 DECONTAMINATION & LIQUID WASTE MANAGEMENT
        - 1.2.2.11 REACTOR INTERNALS & VESSEL REMOVAL
        - 1.2.2.12 CONTAMINATED PIPING & EQUIPMENT REMOVAL
        - 1.2.2.13 CONTAMINATED CONCRETE & EMBEDDED PIPE REMOVAL
        - 1.2.2.14 FINAL SITE SURVEY
        - 1.2.2.15 REGULATORY REQUIREMENTS & PERMITTING PLAN
        - 1.2.2.16 RADIOLOGICAL RELEA[illegible] LIMITS & PATHWAY ANALYSIS
        - 1.2.2.17 SAFETY ASSESSMENT & RADIA[illegible] EXPOSURE ESTIM[illegible] SUMMARY
        - 1.2.2.18 DECOMMISSIONING PLAN
        - 1.2.2.19 ENVIRONMENTAL REPORT
        - 1.2.2.20 GENERAL ENGINEERING SUPPORT
      - 1.2.3 SCHEDULING & COST ESTIMATING (Level 3)
        - 1.2.3.1 WBS UPDATE
        - 1.2.3.2 SCHEDULING
        - 1.2.3.3 COST ESTIMATING
        - 1.2.3.4 GENERAL SCHEDUL[illegible] & COST ESTIMATING SUPPORT
  - **2.0 DECOMMISSIONING OPERATIONS** (Level 1)
    - **2.1 OPERATIONS DIRECTION & SUPPORT** (Level 2)
      - 2.1.1 OPERATIONS DIRECTION (Level 3)
      - 2.1.2 OPERATIONS SITE SUPPORT (Level 3)
    - **2.2 OPERATIONS MANAGEMENT & DECOMMISSIONING ACTIVITIES** (Level 2)
      - 2.2.1 OPERATIONS MANAGEMENT & SUPPORT (Level 3)
        - 2.2.1.1 DOC SITE MANAGEMENT & ADMINISTRATION
        - 2.2.1.2 DOC SITE STAFF
        - 2.2.1.3 DOC HOME OFFICE MANAGEMENT & ENGINEERING SUPPORT
        - 2.2.1.4 DOC PROCUREMENT
        - 2.2.1.5 UTILITIES
      - 2.2.2 DECOMMISSIONING ACTIVITIES (Level 3)
        - 2.2.2.1 (NOT USED)
        - 2.2.2.2 SITE SECURITY
        - 2.2.2.3 HEALTH PHYSICS
        - 2.2.2.4 SYSTEMS OPERATION, MAINTENANCE & DEACTIVATION
        - 2.2.2.5 CONTAMINATED SOIL REMOVAL
        - 2.2.2.6 SITE PREPARATION
        - 2.2.2.7 ASBESTOS REMOVAL
        - 2.2.2.8 LOOSE EQUIPMENT REMOVAL
        - 2.2.2.9 ACTIVATED MATERIAL IN HOT DRY STORAGE REMOVAL
        - 2.2.2.10 DECONTAMINATION & LIQUID WASTE MANAGEMENT
        - 2.2.2.11 REACTOR INTERNALS & VESSEL REMOVAL
        - 2.2.2.12 CONTAMINATED PIPING & EQUIPMENT REMOVAL
        - 2.2.2.13 CONTAMINATED CONCRETE & EMBEDDED PIPE REMOVAL
        - 2.2.2.14 FINAL SITE SURVEY
    - **2.3 RADIOACTIVE WASTE BURIAL** (Level 2)

FIGURE 0.2

DECOMMISSIONING LOGIC
PLUM BROOK REACTOR FACILITY



* DECOMMISSIONING OPERATIONS CONTRACTOR

FIGURE 0.3

DOC ORGANIZATION CHART

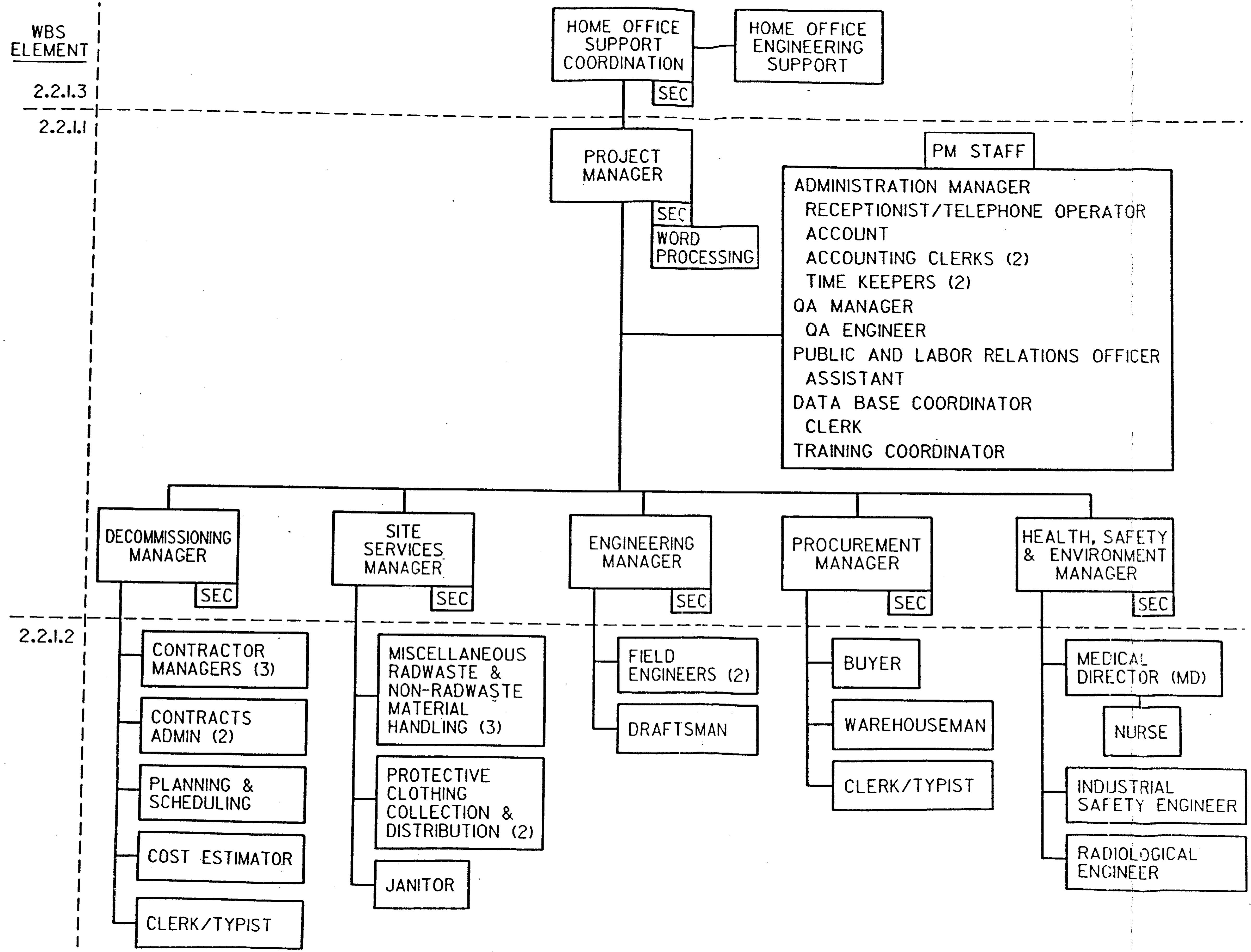
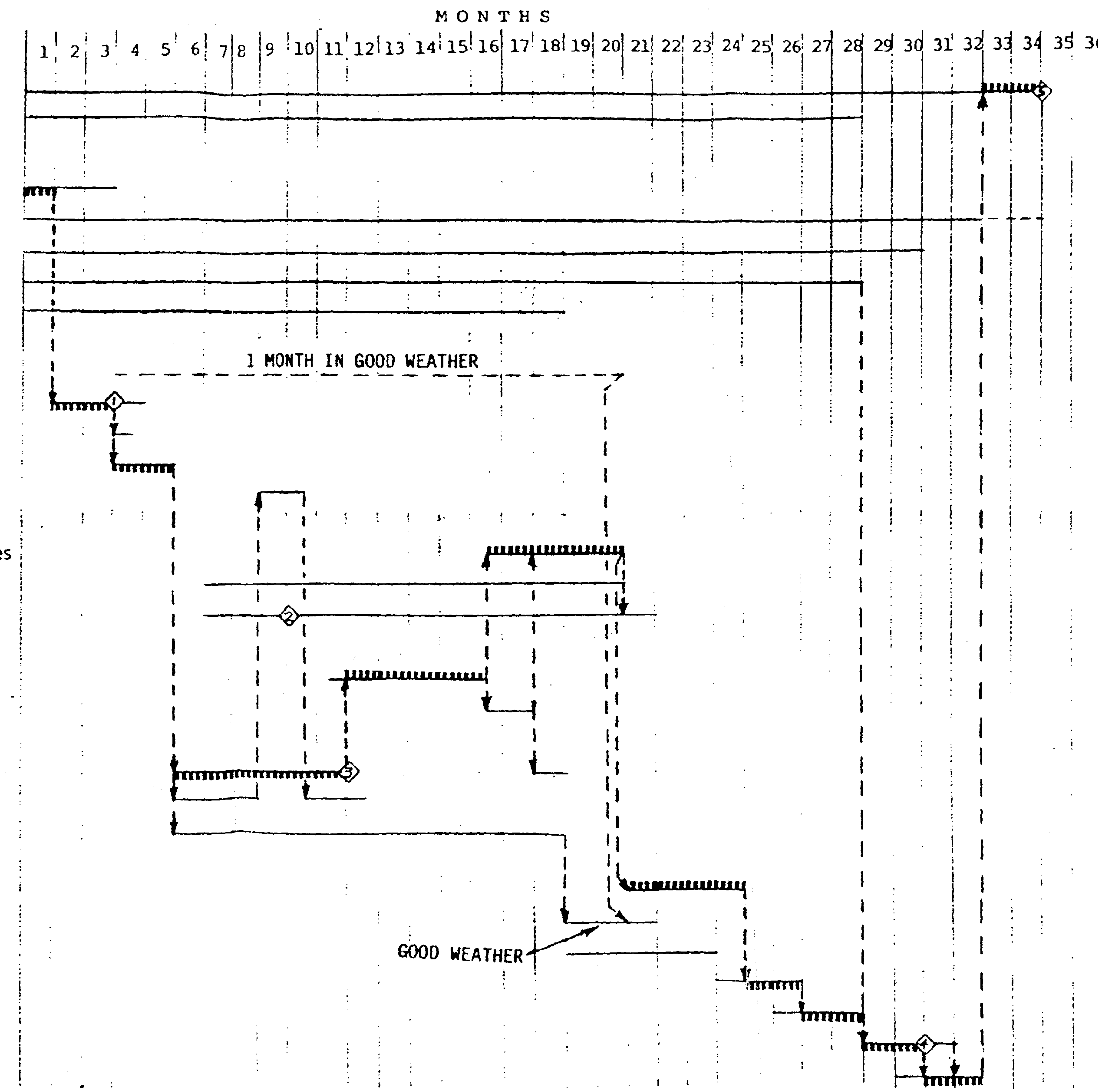


FIGURE 0.4

PBRF PROMPT DECOMMISSIONING SCHEDULE FOR DECOMMISSIONING OPERATIONS
(WBS Element 2.0)

1. COMPLETE SITE ACCESS MODS. & CRANE CERTIFICATI
2. START PROCESSING LIQUID WASTES
3. COMPLETE CONTAINMENT EXCEPT SUPPORT SYSTEMS
4. COMPLETE SURVEY
5. LICENSE TERMINATION

WBS	ACTIVITY
2.1.1	Operations Direction (NASA Staff)
2.1.2	Operations Site Support
2.2.1	Operations Management & Support
	DOC Mobilization & Training
	DOC Management & Services
2.2.2.2	Site Security
2.2.2.3	Health Physics
2.2.2.4	Systems Operation, Maintenance, and Deactivation
2.2.2.5	Contaminated Soil Removal
2.2.2.6	Site Preparation
2.2.2.7	Asbestos Removal
2.2.2.8	Loose Equipment Removal
2.2.2.9	Activated Mat'l in HDS Removal
2.2.2.10	Decontamination & Liquid Waste Management
	Decon Containment Structure & Bioshield Thru Pipes
	Decon Other Areas & Decon Support
	Liquid Waste Management
2.2.2.11	Reactor Internals & Vessel Removal
	Internals
	Vessel
2.2.2.12	Contaminated Piping & Equipment Removal
	Containment
	Hot Cells & Hot Lab Hot Side
	Other Areas
2.2.2.13	Contaminated Concrete & Embedded Pipe Removal
	Contaminated Concrete Removal from Containment
	Remove CRA's
	Cont. Concrete Removal from Other Areas
	Embedded Pipe Removal - Q&C, PCWS, HD
	Embedded Pipe Removal - PCW
2.2.2.14	Final Site Survey and Report
2.1.1 & 2.2.1	Final Report to NRC



0.5.2 Delayed Dismantling

Teledyne Isotopes evaluated the comprehensive radiological data reported in Volume 3 in order to determine the time interval necessary to permit natural decay of the various isotopes present in the PBRF and its systems to license exempt quantities. Table 0.1 on Page 0-13 summarizes this review.

When reviewing Table 0.1, it should be remembered that Tritium is contained in the reactor Beryllium components only and when those items are removed the Tritium will go. Cobalt 60 and the Nickel isotopes 59 and 63 are present in the stainless steel portions of the reactor core plus the corrosion film on the reactor primary piping, heat exchanger, pumps, valves, etc. The Europium isotopes 152 and 154 are also present in the primary system corrosion film. Small quantities of all of the above isotopes (except Tritium) plus Sr 90 and Cs 137 are also widely distributed throughout the remaining facility systems.

The major point evident from Table 0.1 is that the isotopes still present at PBRF are going to be there for a long time and are not going away in the foreseeable future.

With this thought in mind a review and updating of the Mode 1, Continued Safe Storage with Delayed Dismantling, was conducted. The time period for the end of safe storage and beginning of delayed dismantling was chosen to be the year 2073. The reasons were threefold. First, the buildings and facilities will be approximately 113 years old at that time, and it is not likely their life will extend beyond that time even with a good planned maintenance program. Second, at that time radiation levels from penetrating gamma radiation will have diminished to a level which will permit more ordinary approaches to removal of the reactor core box. Third, the likelihood of environmental complications beyond that date escalate rapidly.

All tasks necessary for prompt dismantling will still need to be performed for delayed dismantling due to the presence of the long half-life isotopes. There will be a savings estimated to be approximately $1M because of:

1. More straightforward handling of in-tank items after a 100 year decay.

2. Use of lower cost LSA shipping containers for handling in-tank items under delayed decommissioning, vs the use of higher cost, leased, Type A, Type B, and large quantity shielded containers necessary if

prompt dismantling were performed.

The delayed dismantling procedures, sequencing, and costs are otherwise the same in unescalated dollars as the costs for prompt dismantling. The net cost of delayed dismantling is therefore $31,143,178. To this sum it is necessary to add the continuing maintenance costs for the facility until 2073. This amount is estimated to be $22,937,899 as developed in Volume 5 of this series. The total cost of delaying dismantling is therefore $54,081,077.

The major advantage of delayed dismantling is the reduced occupational radiation exposure resulting from the reduced radiation levels. Cobalt 60 is the main contributor to occupational exposures. Since it will have decayed to less than 1 Curie by 2073, the estimated occupational exposure will be approximately 10% of the 342 man-Rem total exposures resulting from prompt dismantling. At an additional cost of $23M, to maintain the facility until delayed dismantling, the $75,000 cost per man-Rem saved does not appear to be cost effective considering the miniscule risks associated with the higher exposures.

A second evaluation was performed using an earlier date for delayed dismantling. The year 2015 was selected because:

1. The quantity of 60 Cobalt will have decayed from its present level of nearly 1000 Curies to 22 Curies.

2. All of the 55 Iron and other isotopes with 2-3 year half lives will have decayed.

3. The facility will be approximately 55 years old at that time and facility equipment obsolence will be settling in by then.

4. There is no practical advantage to delaying dismantling beyond that time considering cost and occupational exposures.

All tasks necessary for prompt dismantling will still need to be performed for delayed dismantling in 2015 due to the presence of the long half-life isotopes. The total costs are $32,143,178 for dismantling plus continuing surveillance costs until 2015 estimated to be $7,920,292. Total costs for delayed dismantling beginning in 2015 are therefore $40,063,470.

The occupational radiation exposures are estimated to be approximately 68 man-Rem or 20% of the 342 man-Rem of exposure estimated for prompt dismantling.

0.5.3 Summary Cost Comparison For Prompt Dismantling vs Delayed

Table 0.5 summarizes the costs and occupational exposure estimates for prompt dismantling of the PBRF and the two delayed dismantling periods. It also includes the preliminary estimates from the 1978 Study for comparison, as well as the 1981 NRC Study as published in NUREG CR/1756.

TABLE 0.5

Comparison of PBRF Dismantling Costs
Prompt vs Delayed

PROMPT DISMANTLING

	TELEDYNE 1978	NASA 1980	NUREG CR/1756 1981	TELEDYNE/BURNS & ROE 1985	
Cost ($000)	$6,317	$15,000	$15,600	$32,143	
Occupational Exposure (Man-Rem)	134		322	342	
Continuing Costs ($000)		$20,358	$11,051	$22,938	$ 7,920
Delayed Costs ($000)		$ 5,360	$ 8,523	$31,143	$32,143
Total ($000)		$25,718	$19,574	$54,081	$40,063
Occupational Exposure (Man-Rem)		13	LT 1	34	68

0.5.4 Extended Time Early Dismantling

It is clearly evident from Section 0.5.3 that prompt dismantling of the PBRF is substantially less expensive than delayed dismantling. Even though prompt dismantling is less expensive, a C of F project costing $32M over a period of 4.3 years is not likely to be approved under the present Federal budget deficit. An alternative approach is to extend the time period of a prompt dismantling project from 4.3 years to approximately 12 years.

Annual funding would range from a low of $0.61M in each of the first two years to a high of $5.2M in the fourth year. The overall costs could be controlled to be about the same in unescalated dollars, as those for the prompt decommissioning described in the Burns and Roe evaluation in Appendix 4.1 of Volume 4. The dedicated staff of management and support personnel would be reduced from 51 to 14, but would be utilized for 12 years vs 4.3 years. Also a smaller task force of approximately 10 skilled, knowledgeable employees would perform most of the decommissioning operations over the extended 12 year mode. Subcontract labor would be utilized for specialized tasks. The same sequencing called for by the Burns and Roe approach would be used except that the time scale would be expanded. Discreet tasks would be approached so that the end point of each task would leave the facility in a safe configuration in the event funding was temporarily reduced or suspended.

It is recognized that NASA has made the decision to continue PBRF Safe Storage and to dismantle in the distant future. Periodic re-evaluation or review of this decision is necessary to determine present conditions of the facility, and optimum times for going forward with dismantling. With renewed interest in other facilities at Plum Brook, there is a possibility that a skilled labor group will be involved in operating various research and test facilities. This labor group could be cross trained in the nuclear aspects of PBRF dismantling and utilized intermittently (during lulls in testing) for PBRF dismantling tasks. Substantial overall efficiencies could be realized.

The use of other test site personnel intermittently could be scheduled so as to provide assistance during peak labor demand periods, and can also provide emergency back up if needed. Table 0.6 shows the annual funding schedule and Figure 0.5 presents a prospective schedule of the activities for a 12 year configuration.

TABLE 0.6

Annual Funding Rate for Extended Rate
Early Dismantling of the PBRF

YEAR	ANNUAL FUNDING
1	$ 609,157
2	$ 609,157
3	$ 3,257,715
4	$ 5,178,765
5	$ 4,569,420
6	$ 3,966,985
7	$ 3,783,644
8	$ 2,662,407
9	$ 2,362,316
10	$ 2,380,296
11	$ 2,036,448
12	$ 727,038
TOTAL	$32,143,336

The overall cost of extending prompt dismantling tasks over a longer period will result in somewhat higher costs if rad waste burial costs continue to escalate faster than inflation. Also, some continuing facility maintenance costs will be required during the 12 year extended mode. In addition, cost sensitivity studies for prompt dismantling are not likely to be accurate if extended over a 12 year period. Regulations, policies, practices, etc., could change drastically. For this reason Teledyne Isotopes' approach to an extended rate (12 year) early dismantling should not be viewed as precise as the Burns and Roe evaluation of prompt dismantling over a 4.3 year period. Instead, it should be viewed as a conceptual approach recognizing that some changes could occur during a 12 year project due to external factors.

If major external changes do not occur, then the following comparison of prompt dismantling costs with extended time early dismantling costs may be appropriate.

	Prompt Dismantling	Extended Time Early Dismantling
Project Period	4.3 Years	12 Years
Estimate Cost (1985 Unescalated)	$32,143,000	$34,228,264*
Precision of Estimate	High	Moderate

*Includes 8 years of additional maintenance costs of $2,085,264.

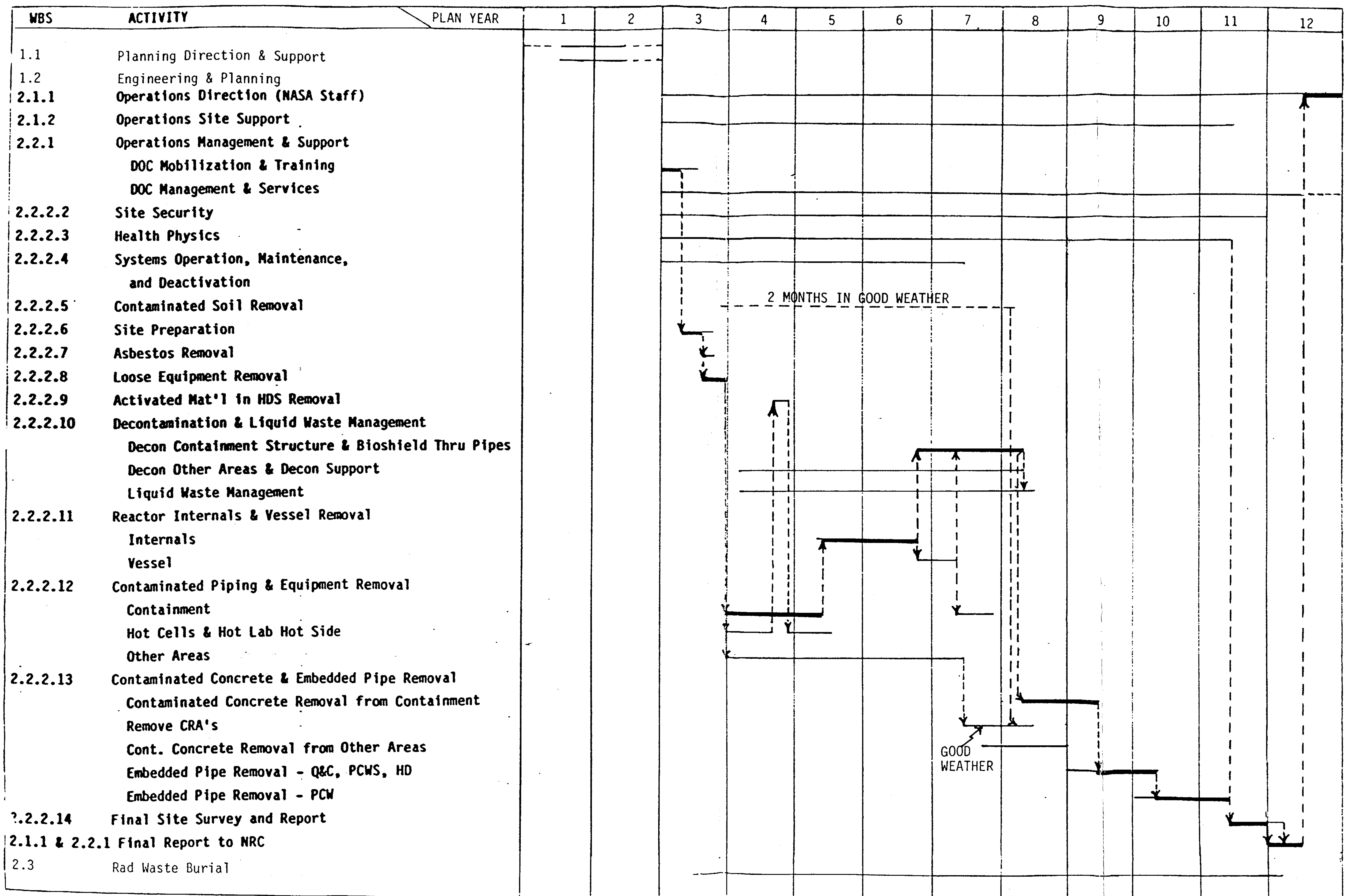
0.5.5 Review Of Alternate Uses Of The PBRF

Since 1978 there have been two major changes in United States Nuclear Policies. One involved termination of reprocessing of spent commercial nuclear fuels in the late 1970s. As an outgrowth of that policy, commercial nuclear power plants are now forced to store their spent fuel assemblies on-site. As time goes on and storage space on-site becomes limited there may be a need for special spent fuel storage facilities.

A second change in nuclear policy occurred as a result of the "Low Level Radioactive Waste Policy Act" of 1980. This act requires each state to provide for the disposal of the low level radioactive wastes generated in the state or by forming compacts with other nearby states to form regional disposal sites.

The above indicated Nuclear Policy changes led the review team to consider if the PBRF could be utilized as either

FIGURE 0.5 - PROSPECTIVE SCHEDULE FOR PBRF DISMANTLING - USING A TWELVE YEAR EXTENDED RATE EARLY PLAN



a spent fuel storage facility or as a monitored retrievable low level waste storage site. These potential alternate uses of the PBRF might permit partial dismantling and re-licensing for the general benefit of the nation, at a cost reduction to NASA with possible future income revenues.

Burns and Roe, Inc. was asked to perform a preliminary evaluation of these possibilities. The results of their review indicated that alternate use as a spent fuel storage facility is not likely, and that alternate use as a low level radioactive waste storage site is possible but not likely at this time.

0.5.5.1 Conclusions Regarding Alternate Use Of the PBRF For Interim Spent Fuel Storage

Conversion of the PBRF to an Interim Spent Fuel Storage Facility on a commercial basis is not considered practical due to the configuration and age of the PBRF structures and systems and the extensive and significant requirements for spent fuel storage facilities.

NASA could, however, determine if the DOE would consider using the PBRF to support a monitored retrievable storage (MRS) facility that could be constructed adjacent to or near the PBRF. DOE appears to be committed to the construction of several MRS facilities, and integrating portions of the PBRF, after decommissioning, into a MRS facility could result in a significant cost savings.

0.5.5.2 Conclusions Regarding Alternate Use Of The PBRF For Low-Level Radioactive Waste Storage

Although the PBRF could be adapted to store low-level radioactive waste with relative ease, the need for such a facility will not develop if the U.S. Congress passes legislation allowing continued use of existing disposal sites while the regional compacts develop new disposal sites. Therefore, this alternate use of the PBRF will become viable only if the legislative process now in motion should fail to extend the date for operating regional disposal sites or if the Midwest compact should fail to expeditiously establish a disposal site.

TELEDYNE ISOTOPES

AN EVALUATION OF THE PLUM BROOK REACTOR FACILITY AND DOCUMENTATION OF EXISTING CONDITIONS

VOLUME 1 - REVIEW OF EXISTING PBRF DATA AND PERTINENT REGULATORY CHANGES 1978 WHICH WOULD AFFECT DOCUMENTATION OF PRESENT CONDITIONS AT THE PBRF

VOLUME 1 OF A 6 VOLUME SERIES

Prepared For

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TELEDYNE ISOTOPES

This is Volume 1 of a series titled, "An Evaluation of the Plum Brook Reactor Facility and Documentation of Existing Conditions."

Following is a list of sub titles in the series:

Study Organization

Volume 1 - Review of Existing PBRF Data and Pertinent Regulatory Changes Since 1978 Which Would Affect Documentation of Present Conditions at the Plum Brook Reactor Facility

Volume 2 - Items of Radiological Significance Addressed in the 1978 PBRF Options Study for Which Additional Information is Needed

Volume 3 - Part 1 -Physical Characteriaztion of Radioactive/ Contaminated Areas at the PBRF
Part 2 - Appendices

Volume 4 - Update of the 1978 Cost Estimate for the Plum Brook Reactor Facility Dismantling Project

Volume 5 - Cost Estimates and Schedules to Maintain the Integrity of Barriers at the PBRF to Ensure Dry Safe Protective Storage for the Next 30 Years

Volume 6 - Plum Brook Reactor Facility Systems/Equipment Disposition Lists

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NOTICE

This report was prepared for the National Aeronautics and Space Administration for the purpose of documenting an evaluation of the existing conditions at the Plum Brook Reactor Facility. Neither NASA, Teledyne Isotopes, or its subcontractors assumes liability for the use or accuracy of information contained herein for other than the above expressed purpose.

Requests for copies of this report must be submitted to:

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PREFACE

The National Aeronautics and Space Administration (NASA) owns the Plum Brook Reactor Facility (PBRF). This facility includes a 60 megawatt test reactor and a zero power pool type research reactor. The PBRF was mothballed in 1973 and placed in a dry safe configuration. NASA has made the decision to keep the PBRF in this safe storage configuration for an indefinite period. As a result of this decision it is important that NRC decommissioning regulations, methodology, technology, and activities be periodically tracked by NASA in order to optimize decision making and timing in the future. This report addresses further PBRF decommissioning in order to provide external feedback to NASA. The fact that PBRF decommissioning is discussed should in no way be interpreted to mean that such project plans are underway.

TELEDYNE ISOTOPES

VOLUME 1
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1.0 TASK PRIORITY #1: REVIEW EXISTING PBRF DATA AND PERTINENT REGULATORY CHANGES ENACTED SINCE THE 1978 STUDY WHICH WOULD AFFECT DOCUMENTATION OF PRESENT CONDITIONS AT PBRF.

This task involved several avenues of review and investigation. The first was to update the PBRF inventory of radioactive materials to current quantities. The second involved a review of recent monitoring results to ascertain the significance of changes. The third was to evaluate facility changes and the structural integrity of enclosures and compare them to 1978 conditions. The fourth area involved review of regulatory changes since 1978 as well as notices of intended changes. Burns and Roe, Inc. of Oradell, New Jersey, was subcontracted to assist by researching regulations appearing in Sections 1.2.1 through 1.2.7, herein.

1.1 REVIEW OF PBRF DATA AND CONDITIONS

1.1.1 PBRF Inventory of Radioactive Materials

The inventory of radioactive materials at PBRF was updated and calculated for the year 1988, or fifteen years after shutdown of the PBRF. 1988 was used because this was the earliest date at which any further decommissioning activities could take place even if planning began in 1986. Since this date and inventory was the most meaningful for completion of Task Priority #4 (Update the 1978 Study), it was decided to use the same data for Task Priority #1. Following is a summary table showing inventories of In-Tank and Hot Dry Storage items compared to past dates and significant future dates.

INVENTORY OF PBRF RADIONUCLIDES
(Quantity in Curies)

REACTOR TANK

Nuclide	6/1/73	6/1/78	6/1/88	2003	2015	2073
3H (12.3y)	206,300	156,800	90,944	37,632	18,980	681
60 Co (5.2y)	5,077	2,640	713	103	22	<1
55 Fe (2.4y)	26,214	7,340	558	13	<1	<1
63 Ni (92y)	47	45	41	35	33	22
59 Ni (8xE4y)	0.5	0.5	0.5	0.5	0.5	0.5
65 Zn (0.7y)	14,720	115	<1	-	-	-
26 Al (7.4xE5y)	1.4	1.4	1.4	1.4	1.4	1.4
113m Cd (14y)	1	0.8	0.5	0.2	0.1	-

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INVENTORY OF PBRF RADIONUCLIDES
(Quantity in Curies)

HOT DRY STORAGE

Nuclide	6/1/73	6/1/78	6/1/88	2003	2015	2073
3H (12.3y)	46,133	34,600	20,068	8,304	4,244	152
60 Co (5.2y)	30,962	16,100	4,347	628	133	<1
55 Fe (2.4y)	52,143	14,600	1,110	25	1	<1
63 Ni (92y)	Not Calc	Not Calc	-	-	-	-
59 Ni (8xE4y)	Not Calc	Not Calc	-	-	-	-
65 Zn (0.7y)	128	1	<1	-	-	-
26 Al (7.4xE5y)	Not Calc	Not Calc	-	-	-	-
113m Cd (14y)	Not Calc	Not Calc	-	-	-	-

Before interpreting the significance of this inventory it is important to note that items listed in Hot Dry Storage represent no major problems to retrieve, package and dispose of. They were placed in storage at shutdown and the facility design permits them to be taken out remotely and packaged for disposal. Their presence is not a complicating factor in the ultimate destiny of PBRF. On the other hand, items in the Reactor Tank will require some remote disassembly, cutting, etc. under a water shield. Although this work is similar to numerous tasks performed in-tank during operations and represents no major technical problems, it is nevertheless more extensive than simply retrieving items. For these reasons the Reactor Tank Inventory is considered when attempting to optimize timing for future PBRF activities.

Cobalt 60, and to a lesser extent, Aluminum 26 are the major isotopes which contribute to external exposures. For these reasons the amount of shielding and remote handling required for PBRF activities will be proportionate to the inventory of 60 Co. The remaining isotopes contribute very little to external dose, however, do represent potential internal exposure and environmental transport. For this reason their presence in significant quantities along with their longer physical half-lives make it improbable that PBRF will ever qualify for NRC license termination due to physical decay alone (at least within several centuries). Decontamination and dismantling will have to be performed at some time to permit license termination. ation. In the meantime, PBRF will have to be kept in a safe, secure mode to prevent the release of contamination to surrounding structures, soil, water, and air.

It should also be recognized that essentially all associated systems, structures, and equipment are contaminated with lesser quantities of many of these same isotopes in the microcurie range. These levels of contamination however are in excess of release limits and will likely remain that way until decontamination and dismantling take place. Accordingly, these systems and structures must also be kept in a safe, secure mode. Radiological classification performed in Task Priority #3 reviews each such system in detail and verifies the presence of Cesium 137 and Strontium 90 with longer half-lives of approximately 30 years and 28 years, respectively. Their significance is addressed elsewhere in this report.

1.1.2 Review of Current Monitoring Results

Various accessible systems were monitored in late 1984 and early 1985 and compared with comparable monitoring results obtained in 1973 and 1978. Several items of significant activity which were compared included: (1) the evaporator in the waste handling building; (2) the ceiling penetration in the Sub-Pile Room; and (3) the Hot Cell Drain Line in the Hot Pipe Tunnel. Comparison of this data indicates that the reduction in dose rates approximates the decay of 60 Co for the Reactor Tank, Hot Lab facilities and Hot Drain systems after the decay of shorter lived isotopes during the first few years following shutdown in 1973.

	Surface Dose Rate (mRem/hr)		
Location	1973	1978	1985
WHB Evaporator	200	75	60
Sub-Pile Room Ceiling	>5000	1000	500
Hot Pipe Tunnel Cell Drains	5000	3000	1500

Environmental sample data was also compared. In general differences were much more subtle due to the low levels of radioactivity at near background values. Two parameters did afford some degree of comparison...facility environmental thermoluminescent dosimeters (TLDs) and Pentolite Ditch silt samples.

FACILITY ENVIRONMENTAL DOSIMETER DATA

Location	Cumulative Dose Rate (mRem) for 1st Three Quarters 1978	1985
Reactor Bldg. Wall - West	55.7	33.7
Reactor Bldg. Wall - North	71.6	32.7
Reactor Bldg. Wall - East	54.8	15.1
Reactor Bldg. Wall - South	69.9	22.5
Hot Lab Front Control	28.5	18.5
Hot Lab Manipulator Room	37.7	27.9
Hot Lab Rear Work Area	212.5	105.4

PENTOLITE DITCH SILT SAMPLES

Location	pCi/gm 1978	1985
South of WEMS - Alpha	11.6	8.1
South of WEMS - Beta Gamma	315.0	35.0
Culvert - Alpha	8.9	2.5
Culvert - Beta Gamma	24.0	19.0
Deer Crossing - Alpha	6.7	7.3
Deer Crossing - Beta Gamma	18.0	23.0
At Plum Brook - Alpha	4.8	6.1
At Plum Brook - Beta Gamma	22.0	20.0

1.1.3 PBRF Facility Changes

Since the 1978 study was performed, PBRF has undergone several facility changes. The first of these involved removal of Buildings #1142 (Reactor Office Building), #1121 (Assembly-Test Storage Building), structure #1156 water tank, and approximately 2.7 acres of land from the PBRF license. These buildings were radiologically clean and uncontaminated. The effort involved monitoring and documenting their radiological status, performing necessary isolation of systems, requesting and obtaining license amendments, and relocating the PBRF fence line. This effort made these facilities available for alternate use. This action had no significant impact on future PBRF activities. At the present time they are still available as a lay down and classification area for processing radiologically clean items from the PBRF. Such space will be at a premium when future decommissioning activites begin.

Another facility change involved the removal of the redwood/steel cooling tower. This was necessary for safety reasons due to the deteriorating condition of the tower and its flammability in conjunction with its close proximity to other structures.

A third facility change involved altering the PBRF electrical substation in line with the reduced power requirements of the present safe storage mode. This reduces electrical costs substantially yet power can be upgraded or restored to its original capacity with minimal effort. The present power system will be adequate during safe storage. Any major activities at PBRF will require somewhat more power, however, probably not the full original capacity. Major motors, compressors, fans, etc. are not likely to be used even in future decommissioning.

A fourth facility change involves the shutdown of the central facility steam heating system and installation of unit heaters to maintain minimal temperatures in certain areas. Any future activities requiring ambient temperatures of 60-70 degrees fahrenheit will necessitate the reactivation of the central steam system. This is particularly true in the office and lab areas which do not lend themselves to effective use of unit heaters.

A fifth change involved the removal of the Chem Lab roof fans and capping of the duct work. This was done when the roof was recoated on Building #1141. This is not likely to have any impact on future PBRF activities since these facilities are not likely to be used again.

1.1.4 Conditions of Buildings and Grounds

In 1978 the general condition of the PBRF buildings, structures, and grounds was good. Only 5 years had elapsed at that time from normal operations. Since then, NASA has maintained the facilities in a reasonable manner consistent with their unoccupied status. They have had a planned program for recoating or resealing roofs and the CV dome and have promptly addressed the few problem areas which occasionally come to light. Despite these responsible actions, it is evident that time and lack of usage are impacting general conditions of buildings and grounds.

Woody vegetation growth around buildings was contributing to harboring groundhogs which burrowed under buildings. Vegetation has also contributed to corrosion of the lower edges of metal siding. During the past year all woody vegetation around the buildings was removed when this condition was noted. Culverts, drainage basins, and fences are in good condition.

Buildings are water tight, with a few minor roof leaks, but some minor internal corrosion of the CV was noted as well as some roof support beams. This is due to a combination of high humidity due to minimal winter heating and the accumulation of sulfurous gases emanating from deep sumps and deep wells in unventilated buildings. This has also affected crane controls and power pick up shoes. All cranes which might be needed for emergency repairs were inspected and renovated during the past year.

Externally, the metal window frames are in need of maintenance. Old putty should be scraped, frames sanded, cleaned and painted, and reglazed. The upper portion of the CV dome is showing evidence of corrosion where insulation has been damaged by weather. The PBRF stack showed signs of corrosion as well as some building siding.

None of the conditions noted on general observation precluded our documenting the current conditions of the PBRF. They did indicate that Task Priority #5 should address the conditions of buildings and grounds in-depth, and these should be the basis of future funding commitments and efforts to maintain the facility in Safe Protective Custody. Task Priority #5 (Section 5.0) addresses priority maintenance and continuing maintenance in detail.

1.2 REGULATIONS RELATING TO SAFESTORAGE AND DECOMMISSIONING

The Plum Brook Reactor Facility (PBRF) is owned by NASA, an agency of the United States Government, and is located on property owned by the Federal Government with exclusive federal jurisdiction. As such, local and state laws are not applicable to activities conducted within the confines of the Plum Brook Station. NASA, however, has maintained the policy throughout the years of attempting to comply with the spirit of state and local laws whenever possible including, but not limited to, such items as construction standards, elevator and crane inspection, health and safety standards and effluent control limitations. The majority of regulations pertaining to PBRF decommissioning activities, therefore, are predominantly those controlled by the Nuclear Regulatory Commission, the Department of Transportation, the Labor Department, the Occupational Safety and Health Administration, and the Environmental Protection Agency. The most significant of these regulations to future PBRF activities are discussed in the following sections.

The 1978 evaluation of PBRF decommissioning alternatives (Ref. 1) included a comprehensive discussion of the regulations applicable to decommissioning at that time. It covered all the regulations that would be applicable to the PBRF as later documented in NUREG/CR-0671, "Decommissioning Commercial Nuclear Facilities: A Review and Analysis of Current Regulations," (Ref. 2), published in 1979 (Appendix A of NUREG/CR-0671 provides a listing of decommissioning criteria by subject area). Since 1978/1979, there have been changes to the regulations and additional changes have been proposed and are pending.

A proposed rule on decommissioning criteria for nuclear facilities was published in the Federal Register on February 11, 1985 (Ref. 3). It would change the NRC's regulations in 10CFR Parts 30, 40, 50, 51, 70 and 72. The general topics include: decommissioning alternatives, timing, planning, financial assurance, residual radioactivity, and environmental review requirements. Decommissioning alternatives in which unrestricted release is postponed for a significant period of time following cessation of operations would be acceptable in cases where sufficient benefits would result such as reduced occupational exposure or waste volume. Regulatory Guide 1.86 (Ref. 4) would be revised to include the factors affecting the acceptability of the various decommissioning alternatives.

Timing refers to the length of time from cessation of operations to license termination. The proposed rules require that decommissioning begin shortly after cessation of operations and significant delays in completion of decommissioning would be acceptable if there is an adequate compensating benefit on a case-by-case basis. Since the radiation fields at the PBRF have already decayed by more than two half-lives of 60 Co, it may be difficult to justify a compensating benefit adequate to further postpone the completion of decommissioning if this proposed rule becomes effective.

The proposed rule for planning includes preliminary planning, record keeping, and final planning. Because of the present status of the PBRF, no time limit would apply for application for license termination and no additional planning would be specifically required until such application is made. However, to obtain approval for futher decommissioning, it appears that a decommissioning plan will have to be submitted to the NRC covering decommissioning alternatives, waste disposal plans, technical and environmental plans, terminal radiation survey, and cost estimate. It is recommended that NASA periodically consult with the NRC to determine the procedure to be followed for the unique status of the PBRF during the evolution of the proposed rule changes.

Financial assurance requirements in the proposed rule do not appear to be applicable to the PBRF. The proposed rule does not quantitatively define permissible levels of residual radioactivity, leaving this for a separate rule making. The proposed rule would require the NRC to prepare an environmental assessment based on the applicant's detailed decommissioning plan. Since an environmental assessment is a supplement to a previously prepared and approved environmental impact statement, it is not clear how this would apply to the PBRF. However, an update of the Environmental Report, Plum Brook Reactor Dismantling (Ref. 5) should satisfy this requirement.

In summary, the main effect of this proposed decommissioning rule would be the possible need to expedite the final decommissioning and the probable requirement to submit a detailed decommissioning plan prior to further decommissioning operations. Currently, comments on the proposed rule making are being categorized, and the final rule is expected to be issued in October, 1987 (Ref. 6). Until then, decommissioning licensing will continue to be on a case-by-case basis.

1.2.1 Personnel Radiation Protection

Since the 1978 study (Ref. 1), the personnel radiation protection standards embodied in 10CFR20 have not changed significantly. However, a complete revision to 10CFR20 has been proposed (Ref. 7) which would establish a clear health protection basis for limits and other regulatory actions; reflect current information on health risk, dosimetry, and radiation protection practices and experiences; provide better assurance of protection; and apply to all licenses in a consistent manner. At this time, it is understood that the proposed rulemaking is tentatively satisfactory to four of the NRC commissioners, but the NRC staff is preparing responses to questions from the fifth commissioner (Ref. 8). Also, the lower limits for embryo and fetus proposed by the EPA have been incorporated into the proposed changes to 10CFR20. Although the final form and timing of the final rulemaking remains in doubt,it appears likely 10CFR20 will be eventually revised essentially as proposed.

Present 10CFR20 requirements are compared to the proposed revision in the attached Table 1 from Reference 7 (see Appendix 1.1, Page 1-24). It appears that the proposed revision would not change the amount of time decommissioning workers could spend on the job. On the other hand it appears that more record keeping would be required as well as more bioassays to obtain real doses to personnel.

The proposed changes to 10CFR20 would also require licensees to incorporate ALARA (As Low As Reasonably Achievable) considerations into their radiation protection programs and require the ALARA effort to be periodically reviewed by management. Applicable portions of U. S. Regulatory Guides 8.8 (Ref. 9), covering ALARA program elements and radiation protection programs, facilities, instrumentation and equipment, and 8.10 (Ref. 10), covering management commitment and health physics vigilance, should be incorporated into the plans and procedures for the PBRF decommissioning.

1.2.2 Radioactive Liquid and Gaseous Effluents

Limits on releases of radioactive liquid and gases are given in 10CFR20, Paragraph 20.106, "Radioactivity in Effluents to Unrestricted Areas." The specific yearly average effluent concentration limits are given in 10CFR20, Appendix B, Table II. The releases should also meet the ALARA release criteria as defined in 10CFR50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion, 'As Low As Is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." During decommissioning, control of gaseous releases and processing of liquid wastes before discharge will assure that these limits and criteria are met.

The proposed changes to 10CFR20 would lower the limiting concentrations for release. For example, the limiting annual average release concentration for 60 Co in water would be reduced by a factor of 10 to 3E-6 uCi/ml. The proposed concentrations are based on a reference dose level of 0.1 rem/year to individual members of the public rather than the 0.5 rem/year which may be inferred from the present concentration limits. The proposed changes would explicitly set the whole-body limit at 0.5 rem/year to an individual member of the public, considering <u>all</u> sources of both external and internal dose other than natural background, medical diagnosis and therapy, and radioactive material disposed into sanitary sewerage. The proposed annual average concentration limits were based on 0.1 rem/year to account for exposure of individuals from all other applicable sources. Since release concentrations are generally at a small fraction of the present annual average concentration limits, meeting the lower proposed annual average concentration limits should not be a problem during decommissioning.

1.2.3 Uncontrolled Release of Materials for Off-Site Use

In general, prompt decommissioning does not include the removal of materials from the site for unrestricted use. Generally materials will be left on-site in accordance with the criteria discussed in 1.2.4 below. However, there will be a need to release contractors' tools and equipment for uncontrolled use off-site.

ANSI draft standard N13.12 (Ref. 11) provides limits on radioactivity deposited on surfaces of materials, equipment and facilities to be released for uncontrolled use. However, this standard has not been issued as a final standard and has not been endorsed by the NRC. For 60 Co and 137 Cs, the main radionuclides of concern for power reactors, the limits in ANSI N13.12 are the same as those given in Regulatory Guide 1.86 (Ref. 4), and the NRC, on a case-by-case basis, uses the limits of Regulatory Guide 1.86 as a basis for off-site release of materials (Ref. 6). Therefore, it is likely that Regulatory Guide 1.86 could be used as a basis for off-site release of contractors' tools and equipment from the PBRF. However, the whole issue of release of materials for uncontrolled use as described in Reference 12 remains unresolved (Ref. 6). This decommissioning alternative, however, approaches the ideal of either leaving materials on-site as discussed in 1.2.4 below, or disposal as radioactive waste.

It should be recognized that during decommissioning activities, NASA may wish to use their present control zone limits for transporting items within the facility or for release off-site for unrestricted use. The following shows these contamination limits currently being utilized, which are more restrictive values than those of Regulatory Guide 1.86.

	FIXED CONTAMINATION	
Zone	Alpha	Beta-Gamma
White*	<50 dpm/59 sq. cm. PAC-4S	<150 cpm GS-3W**
Magenta-Yellow	50 dpm to <8000 dpm/59 sq. cm. (This equals approx. 4000 cpm on a PAC-4S in contact with smooth flat surface.)	150 cpm to <8000 cpm GS-3W**
Magenta	>8000 dpm/59 sq. cm. PAC-4S	>8000 cpm GS-3W**

	TRANSFERABLE CONTAMINATION	
Zone	Alpha	Beta-Gamma
White*	<4 dpm/100 sq. cm. smear, PCC-11A	<600 dpm/100 sq. cm., EW-GM plus scaler
Magenta-Yellow	4 dpm/100 sq. cm to <1000 dpm/100 sq. cm. smear, PCC-11A or equivalent	600 dpm/100 sq. cm. to <10000 dpm/100 sq cm., EW-GM plus scaler
Magenta	>1000 dpm/100 sq. cm. smear, PCC-11A	>10000 dpm/100 sq. dm., EW-GM plus scaler

* These numbers are approximately two times the normal background in a white zone.

** Probe face is held approximately one inch from the surface being monitored.

1.2.4 Unrestricted Release of Materials On-Site

Although the NRC plans to issue new regulatory guides covering the relationship between dose rates and contamination levels and radioactivity survey methods, Regulatory Guide 1.86 remains the only guidance available for the on-site release of the structures, systems, and components (Ref. 6). Since Regulatory Guide 1.86 covers only surface contamination levels (external and internal), activated material and contaminated soil and concrete must be considered on a case-by-case basis. ANSI/ANS-15.10-1981 (Ref. 13) includes the same surface contamination limits as Regulatory Guide 1.86 and provides no further guidance for activated materials or porous material contamination. NUREG-0590 (Ref. 14) includes a general discussion of radioactive residues but establishes no firm guidance.

In addition to the limits specified in Table 1 of Regulatory Guide 1.86, the NRC has previously established the following release limits for the PBRF:

Direct Radiation:	<5 uR/hr above natural background at one meter from all surfaces
Silt and Soil:	<two times natural background
Emergency Retention Basin:	<5 pCi of 90 Sr/gm of soil

Since no new criteria for residual radioactivity is expected for several years, it is assumed that the on-site release limits for further decommissioning would be approximately the same as those established previously by the NRC for the PBRF.

1.2.5 Nuclear Facility License Termination

Regulatory Guide 1.86 gives the current requirements for license termination including: (1) Application for a License to Possess But Not Operate (Possession Only License); (2) Alternates for Reactor Retirement; (3) Surveillance and Security for the Retirement Alternatives Whose Final Status Requires a Possession Only License; (4) Decontamination for Release for Unrestricted Use; and (5) Reactor Retirement Procedures. A revision is planned to cover the restrictions on the various acceptable decommissioning alternatives, but Table 1, Acceptable Surface Contamination Levels, probably will not be changed

(Ref. 6). This revision may not be issued until about October, 1987.

1.2.6 Radioactive Waste Transportation

Since the 1978 study (Ref. 1), the NRC and DOT radioactive waste transportation regulations have been revised. Effective September 6, 1983, 10CFR Part 71, Packaging and Transport of Radioactive Material, exempts licensees of most of the requirements of 10CFR71 for non-fissile materials with no more than Type A quantity of radioactive material and instead imposes the applicable DOT transport regulations. The DOT regulation revisions, which became effective on July 1, 1983, also cover Type B shipments. The applicable DOT regulations include:

Packaging:	49CFR Part 173, Subparts A,B, & I
Marking and Labeling:	49CFR Part 172, Subpart D and Paragraphs 172.400 to .407 and 172.436 to .440
Placarding:	49CFR Part 172.500 to .519, 172.556, and Appendices A and B
Monitoring:	49CFR Part 172, Subpart C
Accident Reporting:	49CFR Part 171.15 and 171.16
Shipping Papers:	49CFR Part 172, Subpart C
Public Highway Shipping:	49CFR Part 177

Activated portions of the reactor internals and some activated items in hot dry storage will be Type A and Type B. Nearly everything else within the PBRF will qualify as low specific activity (LSA). 60 Co (or Tritium [3-H] for some activated items) will generally be the predominant radionuclide, and the following radwaste shipping categories will generally result:

LSA:	<0.3 mCi 60 Co/gm
Limited Quantity:	<7 mCi 60 Co/package
Type A:	<7 Ci 60 Co/package
Type B:	>7 Ci 60 Co/package
	>1000 Ci 3-H/package

LSA materials transported in exclusive use vehicles are exempt from most packaging, marking and labeling requirements. The container need only be a strong, tight package to prevent leakage during transport and meet the standard external contamination and radiation limits summarized below.

Limited quantity packages are exempt from packaging, shipping paper and certification, marking and labeling requirements if strong, tight packages are used, external package dose rate does not exceed 0.5 mR/hr and the standard external contamination limits are met.

The standard external contamination limits are:

	uCi/sq. cm.	dpm/sq. cm.
Beta-Gamma Activity	10E-5	22.0
Alpha Activity	10E-6	2.2

For a closed exclusive use transport vehicle, these limits may be increased by a factor of 10 if certain other minor restrictions are met.

The external radiation levels for all exclusive use shipments are:

200 mR/hr	on package surface, or
1000 mR/hr	on package surface for closed vehicle shipment with packages secured for entire trip duration,
200 mR/hr	at vehicle surface,
10 mR/hr	at 2 meters from vehicle surface,
2 mR/hr	at occupied positions of the vehicle.

1.2.7 Radioactive Waste Disposal Requirements

Radioactive waste disposal sites must meet the requirements of 10CFR Part 61, Licensing Requirements for Land Disposal of Radioactive Wastes. Most, if not all, the PBRF radioactive wastes will be Class A waste which must meet the minimum requirements of Paragraph 61.56(a). There should be no problem in meeting these requirements since metal containers are to be used for all waste packaging.

For the Barnwell Low-Level Radioactive Waste Disposal Facility, all radioactive material shall also be packaged in accordance with the NRC and South Carolina Radioactive Material Licenses with Chem-Nuclear Systems.

It is important to understand the impact which recent legislation has had on low level radioactive waste characterization, packaging, transportation, and disposal.

In the seven years since Teledyne Isotopes concluded its study, An Evaluation of the Options for Further Decommissioning of the Plum Brook Reactor Facility, a number of developments have taken place which influence current disposal practice and may have an important impact on such practices in the future.

The principal developments which will affect the disposal of low level radioactive materials are as follows:

1. Rapid escalation of packaging, transportation, and burial costs.

2. Passage of the Low Level Radioactive Waste Policy Act of 1980.

3. Issuance of final rulemaking on land disposal of low level radioactive waste (10CFR Part 61) February 11, 1983.

4. Promulgation of 10CFR Part 71.5 Notification of States.

Awareness of these developments is essential for planning and executing the future work at the Plum Brook Reactor and disposing of radioactive wastes generated. A more detailed examination of each of these factors is presented below.

a. Escalation of packaging, transportation, and burial costs.

   The costs of packaging materials have increased about 50%, essentially in line with general inflation of wages and materials. However, transportation costs have increased by a factor of 5 in part due to increased freight rates and in part due to the longer shipping distances required by the lack of available burial space at eastern burial sites. Burial costs have increased by a factor of 8.2 for solid materials.

b. Impact of the Low Level Radioactive Waste Policy Act of 1980.

The Low Level Radioactive Waste Policy Act of 1980 states that after January 1, 1986 it will be possible for regional multistate compacts to refuse to accept waste from states outside the compact region. The wastes generated at Plum Brook after that date will have to be disposed of at a midwest regional site which does not now exist or special arrangements will have to be made for disposal at existing sites. This date has recently been extended 3 years, however, the situation continues to be volatile.

c. Waste Characterization.

The rules in 10CFR Part 61 went into effect on December 27, 1983. The rules of specific interest to the Plum Brook Reactor components are those that concern 3-H, 60 Co, 63 Ni, and 59 Ni. The 1978 study was done primarily with regard to the impact of handling materials contaminated with these radionuclides. The requirement that we must now consider Part 61 regulations imposes a requirement for measurement of the quantities present prior to burial in addition to concern for health effects during the handling. This further complicates waste disposal.

d. Transportation Regulations.

10CFR Part 71.5 requires the notification of state governors when large quantities of radioactive materials are to be transported. This means that future waste shipment activities at PBRF must be coordinated through official NASA public information policies.

1.2.8 Asbestos Regulations

Asbestos demolition must be in accordance with the Environmental Protection Agency's standards of 40CFR61, Subpart A, General Provisions, and Subpart B, National Emission Standard for Asbestos. Requirements for emissions, air cleaning, reporting and waste disposal are covered.

Personnel working in areas with airborne asbestos must be protected in accordance with the Occupational Safety and Health Standard 29CFR1910.1001-Asbestos. Requirements for airborne concentrations, compliance methods, personal protective equipment, measurement methods, monitoring, caution signs and labels, housekeeping, record keeping and medical examinations are covered.

1.2.9 State of Ohio Regulation of Radiological Sources (Ref. 15)

Although the State of Ohio has never directly regulated radiological activities on Plum Brook Station (exclusive Federal jurisdiction), they do appear to have statuatory authority in some areas. In most normal situations the Federal Nuclear Regulatory Commission pre-empts state authority.

The Ohio Adjutant General's Office is the lead agency for all radiation incidents and accidents in Ohio. They plan and coordinate on a 24-hour basis and enlist the expertise of the Ohio Department of Health (ODH).

Ohio Revised Code 3701.90 allows the Ohio Department of Health to prohibit or abate the discharge of radioactive material into the air. In practice this jurisdiction in limited to X-rays and alpha, beta, and gamma rays emitted by radioactive materials. The ODH also has a milk collection and monitoring program and since 1980, has performed some monitoring for levels of radiation around nuclear power plants.

The Ohio Environmental Protection Agency (OEPA) has maximum contaminant levels for gross alpha activity, 226 Ra, 228 Ra, as well as for beta particle and photon radioactivity from man-made radionuclides in community water systems. The OEPA tests for the presence and levels in drinking water and can issue findings and orders if levels exceed standards (ORC 6111.13). In addition, nuclear power plants are required to have an Ohio National Pollutant Discharge Elimination System (NPDES) permit if they discharge. These are monitored by the OEPA (OAC-3745-33). Although PBRF is not a "power plant," the NPDES permit for Plum Brook Station does require that all substances monitored be reported. The OEPA has statuatory authority (ORC-3704) to monitor for airborne radiation, and, in fact, does perform ambient monitoring despite confusion as to what degree states may monitor.

1.2.10 Occupational Safety

The Occupational Safety and Health Standards listed in 29CFR1910 are still in effect substantially the way they were in 1978. Numerous minor changes have been implemented since then which will not substantially affect activities at the PBRF. There were, however, three major changes which could affect the future activities at the PBRF.

The first involves the requirement to perform sound level measurements on all noisy operations and equipment to determine if the noise generated by such activities exceeds certain time weighed average thresholds. If so, then corrective efforts must be implemented through engineering improvements, substitutions, or isolation. Employers are also required to have employees audiometrically tested periodically to determine if their noise exposure is causing job related hearing loss. This means that future dismantling or corrective repairs will have to be planned giving consideration to reduction of job noise.

The second change in Occupational Safety and Health Association (OSHA) Standards occurring since 1978 requires individual qualitative fit testing of personal respirators and medical certification that those employees who wear respiratory protection have no cardiopulmonary problems that would be aggravated by wearing respirators. This means that employees working on PBRF assignments will have to undergo periodic lung function, chest X-ray, EKG, and physician screening in order to obtain the necessary medical certification. This is due to the fact that many maintenance jobs during mothballing, and certainly future dismantling activities, will require respirators.

The third change involves the recent passage of employee "right to know" laws and the public and community "right to know" laws. These laws make it the responsibility of generators or manufacturers of hazardous chemicals, materials, substances, or products to advise employees, distributors, 2nd tier manufacturers, etc. of the hazards and health problems associated with the use of such substances. Most users are also advising their employees because under the interpretation of the laws it is possible for users to also become generators under certain conditions. Future activities at PBRF must be planned to minimize use of hazardous materials in maintaining or dismantling the PBRF and to ensure that all employees are properly trained and informed of the peculiar effects of each substance.

1.2.11 Ohio Water Standards

At the time the 1978 PBRF study was performed, the Plum Brook Station NPDES permit was issued by the USEPA through its Region V office in Chicago, Illinois. Since then Ohio Revised Code 6111 gave the OEPA statutory authority to issue permits to federal facilities. In 1983, Ohio assumed surveillance responsibilities for Plum Brook NPDES Permit OH0001392. Some changes in release limits were implemented in the most recent revision of that permit in March, 1985, and the permit number was changed to 21000002*BD. Following is a summary of potential discharge limits (Ref. 16) to be complied with.

	DAILY DISCHARGE LIMITATIONS	
	Average	Maximum
Flow	1.87 mgd	-
Chromium (Hexavalent)	0.05 mg/l	0.10 mg/l
Iron (Total)	-	1.00 mg/l
Lead (Total)	0.05 mg/l	0.10 mg/l
Nitrate (N)	10.00 mg/l	20.00 mg/l
Oil & Grease (Freon Ext.)	10.00 mg/l	15.00 mg/l
Phosphates (P)	1.00 mg/l	1.50 mg/l
Suspended Solids	20.00 mg/l	30.00 mg/l
Chemical Oxygen Demand	40.00 mg/l	60.00 mg/l
Copper	0.20 mg/l	0.30 mg/l
Dissolved Solids	750.00 mg/l	1000.00 mg/l
Total Chromium	0.10 mg/l	0.20 mg/l

(pH shall not be less than 6.5 nor greater than 9.0 and shall be monitored on a weekly grab sample. There shall be no discharge of floating solids or visible foam in other than trace amounts.)

Ohio Administration Code 3745-33 specifically requires nuclear power plants to have an Ohio NPDES permit if they discharge with monitoring performed by the OEPA. PBRF discharges would be covered under outfall 003 of the Plum Brook Station NPDES permit. Although no limits for radioactivity in liquid effluents are specified, reporting of any sampling results is required. The limits specified in 10CFR20 Appendix B would apply.

1.2.11.1 Lagoons

The OEPA has authority to require plan approval and a "permit to install" for lagoons. If lagoons contain hazardous waste, they will require a hazardous waste facility permit under Resource Conservation Recovery Act (RCRA). Generally a lagoon may not discharge, so no NPDES permit is required. ORC-3734 and OAC-3745-3 and -3745-31 implement these rules. Strictly speaking, the Emergency Retention Basin would not appear to be a lagoon since it is open to discharge cumulated precipitation which is not in excess of release limits. Likewise, the Cold Retention Basins, with or without roofs, have exchange with ground water to prevent floatation and are not lagoons per se. There is some question that they may be considered hazardous waste lagoons if they were used to store contaminated water. If so, then hazardous waste facility permits may be required (Ref. 15).

1.2.12 Ohio Solid Waste Regulations

Ohio has extensive regulations to implement the Federal RCRA PL94-580 effective November 19, 1980, as well s the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) passed as PL96-510 effective in December, 1980 (also known as "Superfund"). These acts severely limit and control what is placed in landfills, essentially place "cradle to grave" responsibility on the generators of the waste. CERCLA additionally addresses the prioritized correction of past environmental abuses and improprieties. Both the federal and state versions of this legislation specifically exclude radioactive materials regulated by the Nuclear Regulatory Commission (NRC) and rubble generated by construction or demolition. Because of the far reaching and profound effect of this legislation, it will be important to plan all future PBRF activities so as not to cause NASA to be considered as a "generator" of other hazardous materials.

1.2.13 Ohio Explosives Regulations (Ref. 15)

Ohio has adopted as part of its code the National Fire Protection Association Guidelines (NFPA 495). The Ohio fire code requires an annual permit which can be issued by an fire official. Regulations address the equipment, processes, and operations involving the manufacture, possession, storage, sale, transportation, and use of explosives (ORC 3737.22 and OAC 1301:7-7). Planning the controlled use of explosives in demolition activities might involve notifying other property owners within one-half mile of the blasting area and providing them with a blasting schedule.

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REFERENCES - TASK PRIORITY #1

1. "An Evaluation of the Options for Further Decommissioning of the Plum Brook Reactor Facility," prepared for NASA by Teledyne Isotopes, July, 1978.

2. "Decommissioning Commercial Nuclear Facilities: A Review and Analysis of Current Regulations," NUREG/CR-0671, August, 1979.

3. Nuclear Regulatory Commission 10CFR Parts 30, 40, 50, 51, 70, and 72, Decommissioning Criteria for Nuclear Facilities, Proposed Rule, Federal Register, Vol. 50, No. 28, February 11, 1985.

4. USNRC Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, June, 1974.

5. "Environmental Report, Plum Brook Reactor Dismantling," NASA Lewis Research Center, Amendment 1, February 18, 1981.

6. Personal Communication, David A. Miller (BRI) to Karl Feldman (USNRC), Status of Decommissioning Rulemaking and Residual Radioactivity Criteria, September 20, 1985.

7. Proposed Revision of 10CFR Part 20, "Standards for Protection Against Radiation, Rulemaking Issue (Notation Vote)," SECY-85-147-Part I, April 22, 1985.

8. Personal Communications, David A. Miller (BRI) to Robert Baker (USNRC), Status of 10CFR20 Proposed Rulemaking, September 19, 1985.

9. USNRC Regulatory Guide 8.8, Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable, Rev. 3, June, 1978.

10. USNRC Regulatory Guide 8.10, Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable, Rev. 1 and 1-R, September, 1975 and May, 1977.

11. ANSI Draft Standard N13.12, Surface Radioactivity Guides for Materials, Equipment, and Facilities to be Released for Uncontrolled Use, August, 1981.

12. "Fear of Improper Use of Plant Parts Influences Decommissioning Strategy," Inside NRC, November 12, 1984.

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13. ANSI/ANS-15.10-1981, Decommissioning of Research Reactors.

14. "Thoughts on Regulation Changes for Decommissioning," NUREG-0590, Rev. 2, August, 1980.

15. "A Guide to Environmental Jurisdictions," Jill Hansen, Environmental Information, Public Interest Center, Columbus, Ohio, June, 1980.

16. Ohio EPA Permit No. 21000002*BD (Application No. OH0001392), Issued to NASA Lewis Research Center, Plum Brook Station, Sandusky, Ohio (February 7, 1985).
ator" of other hazardous materials.

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APPENDIX 1.1

TABLE 1 - COMPARISON OF SALIENT ISSUES IN THE PRESENT 10CFR PART 20, WITH THE PROPOSED REVISIONS

TABLE 1. COMPARISON OF SALIENT ISSUES IN THE PRESENT 10 CFR PART 20 WITH THE PROPOSED REVISION

Issue	Present 10 CFR Part 20		Proposed Revision	
OCCUPATIONAL				
Limits	External			
	Whole body, head and trunk, active blood-forming organs, lens of eye, or gonads	1.25 rems/qtr or 3 rems/qtr with lifetime occupational exposure history and within 5(N-18) dose-averaging formula.	Whole body, head, trunk, arm above elbow, and leg above knee	5 rems/year (0.05 Sv/year) - includes summation of (external) deep dose equivalent and (internal) committed[a] effective dose equivalent. 3 rems (0.03 Sv) (external) maximum deep dose equivalent in any quarter.
			Lens of eye	15 rems/year (0.15 Sv/year)
	Hand and forearms; feet and ankles	18 3/4 rems/qtr (75 rems/yr)	Hand, elbow, arm below elbow, foot, knee, and leg below knee	50 rems/year (0.5 Sv/year)
	Skin of whole body	7 1/2 rems/qtr (30 rems/yr)	Skin (10 cm^2)	50 rems/year (0.5 Sv/year)
	No summation of internal (organ) doses.		Weighted organ doses for all organs are summed.	
	No summation of external and internal doses.		Doses from external and internal sources are summed.	

[a]Except for selected uranium and transuranic radionuclides for which the derived air concentrations (DACs) and annual limits of intake (ALIs) are hard to measure at levels found in the workplace. For these nuclides, the regulation may be based upon the effective dose equivalent received in the year rather than the committed effective dose equivalent.

TABLE 1. (Continued)

Issue	Present 10 CFR Part 20	Proposed Revision
	<u>Internal</u> Intake equivalent to 520 MPC-hours/qtr. Calculated to result in a 50-year committed dose of: Whole body 1.25 rems (5 rems/yr) Bone, thyroid, and skin 7.5 rems (30 rems/yr) Other organs 3.75 rems (15 rems/yr)	Annual limit of intake (ALI) equivalent to 2000 DAC-hours/year. Calculated DACs are based on the following: Organs are assigned weighting factors, based on the estimates of risk to that organ per unit of dose relative to the estimate of risk per unit of dose for uniform whole body exposure. "Capping" dose limit of 50 rems/year (0.5 Sv/year) used to avoid non-stochastic effects. For body parts other than those listed above:

Tissue	w_T	Inferred Dose Limit (rems/year)	Actual Dose Limit (rems/year)
Gonads	0.25	20	20
Breast	0.15	33	33
Red bone marrow	0.12	42	42
Lung	0.12	42	42
Thyroid	0.03	167	50
Bone surfaces	0.03	167	50
Each of 5 remaining organs with the largest dose	0.06	83	50

Issue	Present 10 CFR Part 20	Proposed Revision
Planned Special	5(N-18) dose averaging provided - with quarterly limits.	Planned special exposures allowed in addition to the annual limits from routine exposures. Limits set at 1 x annual limits/year from all events in a year and 5 x annual limits/lifetime from all events. 5(N-18) dose averaging provision is eliminated.

TABLE 1. (Continued)

Issue	Present 10 CFR Part 20	Proposed Revision
Embryo/Fetus	Not addressed.	Specific limits considered, but not included in proposed revision.
ALARA	Recommended.	ALARA program required.
Occupational reference level	None	Investigation level--set by licensee below annual limit.
BASIS FOR LIMITS	Biological damage or health effects would not be statistically observable.	"Acceptable" risk (10^{-4} per year for workers, 10^{-6} to 10^{-5} per year for members of the public) based on estimated radiation-induced fatal cancers and serious hereditary disorders. Upper limit of organ dose set to avoid non-stochastic (threshold) effects, such as cataracts.
INTERNAL DOSIMETRIC METHODOLOGY		
Irradiation	Dose to the most irradiated organ, i.e., "critical organ," used to limit intake via "Maximum Permissible Concentrations" (MPC).	Dose to each organ is calculated, weighted by a factor equating risk from dose to that organ to risk from 5 rems (0.05 Sv) of whole body irradiation, and then the products are summed. Values for ALIs and DACs have been calculated for each radionuclide.
	Doses from radionuclides deposited in non-critical organs are ignored.	Weighted doses to organs from radionuclides deposited anywhere in the body are summed.
Lung model	1959 ICRP-2 model used.	Improved 1966 model of ICRP Task Group on Lung Dynamics used.
Retention in lung	Aerosols ranked "Soluble" or "Insoluble."	Aerosols ranked by translocation and elimination rates, i.e., D (days), W (weeks), and Y (years).

TABLE 1. (Continued)

Issue	Present 10 CFR Part 20	Proposed Revision
	No consideration given for aerosol aerodynamic properties.	Assumes 1 μm AMAD. Adjustments for other aerosol size distributions, and physical and chemical properties are possible.
Translocation	Based on 1959 biological data.	Based on 1978 biological data from ICRP-30.
<u>PUBLIC</u>		
Limit	Implied limit for individuals of 0.5 rem/year to whole body, blood-forming organs, and gonads; 3 rems/year to bone and thyroid; and 1.5 rems/year to other organs. No summation of external and internal dose. No consideration of food pathways.	Explicit limit of 0.5 rem/year (5 mSv/year) for individuals from all sources. Includes summation of external and internal doses and food pathways.
Reference level	None.	0.1 rem/year (1 mSv/year) to member of the public as action level for licensee.
Collective dose cutoff level	None.	0.001 rem/year (0.01 mSv/year) per person cutoff level for evaluating collective doses to general population.
<u>MONITORING</u>		
Adult	Required at 25% of the basic quarterly limit (0.312 rem).	Required at 10% of the annual limit for deep dose equivalent (0.5 rem or 5 mSv). Required at 10% of the annual limit for eyes, skin, or extremities.
	Required for intakes greater than 25% of 520 MPC-hours in a quarter.	Required at 30% of the ALIs.
Minor	Required at 5% of the basic quarterly limit (0.0625 rem).	Required at 5% of the external annual limits for adults. Required at 5% of the ALIs for adults.

TABLE 1. (Continued)

Issue	Present 10 CFR Part 20	Proposed Revision
SEWER DISPOSAL	Concentration limits equivalent to 5 rems/year by potential ingestion.	Concentration limits equivalent to 0.5 rem/year (5 mSv/year) by potential ingestion.
RECORDS		
Determination of prior dose	Occupational exposure history required as condition for allowing 3 rems per quarter and use of 5(N-18) dose-averaging formula. Signed statements of dose during last quarter required upon employment.	Occupational exposure history (effective dose equivalent received during the current year and, when appropriate, all planned special exposures and over-exposures received during the lifetime of the individual) required for all individuals requiring provision of individual monitoring devices or services.
Current exposure records	Form NRC-5 includes only external dose. Includes items for calculating status under 5(N-18).	Revised Form NRC-5 includes external dose, internal dose, summation, and dose received during planned special exposures and as overexposures.
Effluent releases	Implied under survey requirement.	Explicitly required.
Planned Special Exposures	No provision.	Records required.
REPORTS		
Criteria for immediate notification of incidents	20 times the basic quarterly dose limits.	5 times the annual dose limits.
	Property damage $200,000.	Loss of facility use and property damage criteria deleted.
Overexposures of public	Required if limits for short-term radiation levels or annual effluent releases to unrestricted areas are exceeded.	Required if any individual in an unrestricted area exceeds 0.5 rem (5 mSv) in one year.

TABLE 1. (Continued)

Issue	Present 10 CFR Part 20	Proposed Revision
REPORTS (Continued)		
Planned special exposures	No provisions for planned special exposures.	Report required.
Exceeding reference level	No provisions.	Report required for exceeding 0.1-rem (1 mSv) level to members of public, unless licensee received prior approval for conducting operations which result in doses in excess of the reference level.
Individual monitoring reports	Annual statistical summary report required of 7 categories of licensees.	Same as present Part 20, except that doses will be effective dose equivalents.
	Termination report required of same 7 categories of licensees.	Same as present Part 20, except that doses will be effective dose equivalents.
Reports to individuals	Required by § 19.13(d) for any information reported to NRC. Applies only to overexposures and termination reports. Pursuant to § 19.13, other reports on exposures are available to the individual on request.	Same requirements as present Part 20, except that doses reported will be effective dose equivalents. In addition, licensees would report to individuals any planned special exposures; and licensees operating under § 20.205 (the exception for certain uranium and transuranic nuclides having very long effective half-lives) would report estimates of both annual effective dose equivalent and 50-year committed effective dose equivalent to their employees.

TELEDYNE ISOTOPES

AN EVALUATION OF THE PLUM BROOK REACTOR FACILITY AND DOCUMENTATION OF EXISTING CONDITIONS

VOLUME 2 - ITEMS OF RADIOLOGICAL SIGNIFICANCE ADDRESSED IN THE 1978 PBRF OPTIONS STUDY FOR WHICH ADDITIONAL INFORMATION IS NEEDED

VOLUME 2 OF A 6 VOLUME SERIES

Prepared For

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TELEDYNE ISOTOPES

This is Volume 2 of a series titled, "An Evaluation of the Plum Brook Reactor Facility and Documentation of Existing Conditions."

Following is a list of sub titles in the series:

Study Organization

Volume 1 - Review of Existing PBRF Data and Pertinent Regulatory Changes Since 1978 Which Would Affect Documentation of Present Conditions at the Plum Brook Reactor Facility

Volume 2 - Items of Radiological Significance Addressed in the 1978 PBRF Options Study for Which Additional Information is Needed

Volume 3 - Part 1 -Physical Characteriaztion of Radioactive/ Contaminated Areas at the PBRF
Part 2 - Appendices

Volume 4 - Update of the 1978 Cost Estimate for the Plum Brook Reactor Facility Dismantling Project

Volume 5 - Cost Estimates and Schedules to Maintain the Integrity of Barriers at the PBRF to Ensure Dry Safe Protective Storage for the Next 30 Years

Volume 6 - Plum Brook Reactor Facility Systems/Equipment Disposition Lists

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NOTICE

Requests for copies of this report must be submitted to:

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PREFACE

The National Aeronautics and Space Administration (NASA) owns the Plum Brook Reactor Facility (PBRF). This facility includes a 60 megawatt test reactor and a zero power pool type research reactor. The PBRF was mothballed in 1973 and placed in a dry safe configuration. NASA has made the decision to keep the PBRF in this safe storage configuration for an indefinite period. As a result of this decision it is important that NRC decommissioning regulations, methodology, technology, and activities be periodically tracked by NASA in order to optimize decision making and timing in the future. This report addresses further PBRF decommissioning in order to provide external feedback to NASA. The fact that PBRF decommissioning is discussed should in no way be interpreted to mean that such project plans are underway.

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VOLUME 2
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2.0 TASK PRIORITY #2: DEVELOP A LIST OF ITEMS OF RADIOLOGICAL SIGNIFICANCE ADDRESSED IN THE 1978 OPTIONS STUDY FOR WHICH ADDITIONAL INFORMATION IS NEEDED

The approach used to complete this task involved reviewing the 1978 Options Study to identify various assumptions and known facts incorporated into that report. It was also necessary to review additional activities since 1978 which would alter assumptions made originally. As a result of these reviews it was concluded that essentially all items of radiological significance would be addressed if the following activities were completed.

1. Institute a system by system review and comprehensive monitoring to ensure all questions are identified. Include the grounds and outdoor drainage systems including Pentolite Ditch. Open all sealed systems to verify conditions by inspection, sampling, and monitoring.

2. Comprehensively monitor all structures and grounds.

3. Identify and list all loose and fixed equipment.

4. Identify the major factors which will influence the decision of whether to commit items to rad waste disposal or to attempt to decontaminate.

5. Evaluate major piping systems such as the Primary Cooling Water System, and Quadrant and Canal pump out and recirculation systems to determine whether in-place decontamination is feasible versus removal from concrete embedment.

6. Develop a more detailed sequence procedure for removal of the reactor tank and its components in order to address all major radiological problems associated with that task.

By performing the above, subsequent cost development, labor effort, and scheduling would be based more on facts and less on assumptions. Following is the list of items for which further information is needed.

2.1 <u>INSTITUTE A SYSTEM BY SYSTEM REVIEW AND COMPREHENSIVE MONITORING TO ENSURE ALL QUESTIONS ARE IDENTIFIED</u>

It was decided to pre-classify each system with a simple code based on the likelihood of radioactive contamination. This would be of value in other tasks when it would be necessary to decide if an item was to be committed to radioactive waste disposal or an attempt would be made to decontaminate it. It is difficult to decontaminate piping and other hardware internally with any reliability unless the items are large enough to permit internal access. The following code was used:

IC - Probably Contaminated Internally
EC - Probably Contaminated Externally
PC - Predominantly Clean Except For Possible External Contamination In Control Zones

1000 Series

Primary Cooling Water Main System	IC-EC
Primary Cooling Water Bypass Clean Up System	IC-EC
Primary Cooling Water Degassifier System	IC-EC
Instrument Cooling Loop	IC-EC

1100 Series

Primary Cooling Water Shutdown Loop	IC-EC

1200 Series - Secondary Cooling Water System

Main Loop	PC
Auxiliary Loop	PC
Test Loop	EC
Filter Loop	PC

1300 Series

Shutdown Loop - Secondary Cooling Water System	EC

1400 Series

Process Water System	PC

1500 Series

Deionized Water System	PC

1600 Series

Domestic Water System	PC

1700 Series

Fire Water Protection System	PC

1800 Series

Quadrant & Canal Recirculation System	IC-EC

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<u>1900 Series</u>	
Quadrant & Canal Pump Out System	IC-EC
<u>2000 Series</u>	
Hot Drain System	IC
Including The Following Sumps:	
RB - Sub-Pile Room	IC
RB - Process Piping Pump Room	IC
RB - Decontamination Room Sump -15'	IC
RB - Reactor Sump -25' Annulus	IC
FH - Q&C Recirculation	IC
FH - Laundry	IC
ROLB - Chem Lab Sinks	IC
ROLB - Auxiliary	PC
PPH - Room 8	IC
Hot Lab - Hot Pipe Tunnel	IC
WHB - Laundry	IC
WHB - Floor Drains	IC
<u>2100 Series</u>	
Utility Air Systems	PC
Service Air	PC
Experiment Cooling Air Supply	IC-EC
<u>2200 Series - Waste Air System</u>	
Process Exhaust	PC
Experiment Cooling	PC
Storage Tank Tower	PC
<u>2300 Series - Hot Retention Area</u>	
Structure - Retention Pans	IC
Tanks	IC-EC
Pipe Chase	EC
<u>2300 Series - Cold Retention Area</u>	
North Reservoir	IC
South Reservoir	IC
<u>2400 Series - Auxiliary Chemicals System</u>	
Regeneration of Deionized Water Makeup	PC
Regeneration of Q&C Recirculation Deionizers	PC
Secondary Cooling Water pH Control	PC

<u>2500 Series</u>	
Raw Water System	PC
<u>2600 Series</u>	
Diesel Systems	PC
<u>2700 Series</u>	
Hydraulic Services System	PC
Except for Hydraulic Rabbits System	IC-EC
<u>2800 Series - Effluent Water Systems</u>	
Effluent Control Station	EC
Sludge Settling Basin	PC
Precipitator	PC
<u>2900 Series</u>	
PCW Instrument Cooling Loop	IC-EC
<u>3000 Series</u>	
Refrigeration - Air Conditioning Systems	PC
Quad Cooling System	EC
<u>3100 Series</u>	
Heating & Normal Ventilation System	PC
<u>3200 Series</u>	
Cold Drain System	PC
<u>3300 Series - Contaminated Air Ventilation System</u>	
Containment Vessel Vent System	IC
Reactor Tank Vent	IC
Hot Lab Ventilation (Cells, Work Area, etc.)	IC-EC
Hot Lab Hood & Decon Room (Exhaust)	IC-EC
Hot Lab Cell Vacuum (Exhaust)	IC-EC
Pump House Ventilation	IC
Hot Pipe Tunnel & Reactor Bldg. Ventilation	IC
<u>3400 Series</u>	
Vacuum Services System	PC

<u>3500 Series</u>	
Off Gas Clean Up & Storage System	IC-EC
<u>3600 Series</u>	
Gas Systems	PC
<u>3700 Series</u>	
Air Lock & Quadrant Door Systems	EC
<u>3800 Series</u>	
Helium Pressurization System	EC
<u>3900 Series</u>	
Neutron Poison Injection System	PC
<u>4000-6900 Series</u>	
Electrical Control Systems	PC
<u>7000 Series</u>	
Mock Up Reactor	IC-EC
<u>9000 Series - Fuel Systems</u>	
Fuel Element Test Loop	PC
Fuel Chute System	EC
<u>9100 Series</u>	
Experiment 62-01	IC-EC
<u>9200 Series</u>	
Hydraulic Rabbit System	IC
<u>9300 Series</u>	
Cold Gas Farm	PC

TELEDYNE ISOTOPES

2.2 COMPREHENSIVELY MONITOR ALL STRUCTURES AND GROUNDS

2.2.1 Grounds and Drainage System

Rooftops
Surface Soils
Deep Soil Cores
Catch Basins
Culverts
Water Effluent Monitoring Structure
Emergency Retention Basin
Pentolite Ditch
Surface Water
Ground Water
Biological Specimens
Background Comparison

2.2.2 Buildings and Structures

1111 - Reactor Building - Containment Vessel

Above Grade - Crane Rail & Polar Crane
0' Level
-15' Level Annulus
-25' Level Annulus
-40' Level Annulus
-44' Level Sub-Pile Room
Quadrant A
Quadrant B & Neutron Diffractor Test Assembly
Quadrant C
Quadrant D & Underwater Beam Room
Canal E
Reactor Tank Internals & Biological Shield Act.

1111 - Reactor Building - Outside Containment

Crane, Crane Rails & Other Above Grade Areas
Mezzanine Area
0' Level, Offices, Change Room & Decon Room
-15' Area
-25' Area Including PPP Room
Canal F
Canal G & Contents
Canal H & MUR
Deep Soil Core Sampling

1112 - Hot Lab

Hot Lab Storage Including Tritium Monitoring In Room 19
Off Gas Clean Up Area - Room 19A

TELEDYNE ISOTOPES

Hot Handling Area - Room 17, Including Crane & Rails
Hot Work Area - Room 16, Including Crane, Rails, and 80 Ton Door
Canals J & K, Including Deep Soil Core Sampling
Repair Shop - Room 22
Storage Room 24 & Sample Storage Cave
Decon Room 23
Cells 1 thru 7, Including Door Plugs and Roof Slabs
Mezzanine
Cold Area Rooms 8, 9, 10, 12, 14, and 15
Hot Pipe Tunnel & Sump Room

1131 - Service Equipment Building, Overhead Water Tank and Other External Structures

Spot Check

1132 - Fan House

Including Rooms 1, 4, 5, 6, 7, 8, and the Stack
Resin Pit

1133 - Waste Handling Building

Basement - Rooms 15 thru 19
First Floor - Rooms 1 thru 14

1134 - Primary Pump House

Pump Rooms 1 thru 3
Room 4 - Including Heat Exchangers & Strainer
Room 5 - Degassifier Room
Room 6 - Bypass Clean Up Room & Outdoor Resin Pits
Room 7 - Fuel Element Test Rig
Room 8 - Hood, Sink, Sump

1141 - Reactor Office & Lab Building

Basement
- Sump Room 11
- Hot Pipe Tunnel Connection
- Counting Room 10
- Calibration Lab Room 8
- Vault
- Elevator Sump

2nd Floor Chem Labs, Hoods, Sinks, etc.
Pipe Chases From 2nd Floor to Basement Sumps

TELEDYNE ISOTOPES

1154 - Cold Retention Area

Structures
(Note that the interior was listed previously with the 2300 Systems list in Section 2.1)

1155 - Hot Retention Area

Structures
(Note that the tanks, pans, and pipe chase were listed previously with the 2300 Systems list in Section 2.1)

2.3 IDENTIFY AND LIST ALL LOOSE AND FIXED EQUIPMENT

All major items of equipment were identified and listed by location in order to assure that they were monitored, classified, and listed for appropriate disposition. They were also coded as to whether they were loose items or items fixed to structure floors, walls, or ceilings. Their probable disposition was also listed based on the evaluating team's knowledge of their use, history, location, value, obsolescence, decontamination success probability, etc. Five classifications were used.

- Clean Scrap
- Clean Salvage
- Contaminated - Salvage To Another Licensee
- Contaminated - Attempt Decontamination To Clean Scrap Or Clean Salvage
- Contaminated - Dispose Of As Radiological Waste

It would be redundant to include this list here since it appears in its final format under Task Priority #6, Equipment Disposition List.

2.4 IDENTIFY THE MAJOR FACTORS INFLUENCING DECISIONS TO COMMIT TO RADIOLOGICAL WASTE DISPOSAL VS DECONTAMINATION

It was necessary to review certain criteria, in light of current regulations and PBRF conditions, before performing detailed radiological assessment to be sure that all information needed to make this decision for each item, system, structure, etc., was obtained during the course of the radiological and physical assessment to be performed under Task Priority #3. Following is a list of such factors and a brief discussion of each.

a. Radiation Level

The radiation level influences decisions to decontaminate in several ways. First, the more contaminant that is present, generally the more effort will be required to remove it to release levels. Second, the more that is present, generally the higher the radiation exposure will be to workers. Third, it can also influence the amount of other radiological waste generated which also must ultimately be disposed of.

b. Isotopic Composition

Isotopic composition is important in two ways. First, it determines the relative ease with which intrumentation can reliably detect it. Second, it can influence the type of waste classification, packaging, and costs of burial. Daughter by-products must also be considered.

c. Physical Form Of The Contaminant

Physical form of the contaminant is related in several ways. First, materials rendered radioactive by virtue of neutron irradiation cannot be decontaminated since the radionuclides are dispersed throughout the item's mass. Second, contaminants deposited on stainless steel in the primary system of the reactor as a corrosion film will be more persistent than those splashed onto a stainless steel liner of a hot cell. Third, contaminants penetrate, absorb, and spread differently depending on whether or not they are a liquid, solid, or gas. If a liquid, then the pH may also be important. Also, present regulations prohibit shipping of liquid radioactive wastes. They must be solidified and shipped as dry solid wastes.

d. Physical Form Of The Item Contaminated

Surface porosity of the item contaminated can greatly affect the effectiveness of various decontamination methods. A hard, hi-gloss, smooth surface can generally be decontaminated more readily than a soft, rough, porous surface. Stainless steel cleans easier than aluminum and lead. Wood, unsealed concrete, and corroded metal are the most difficult to decontaminate. The geometry or shape of a contaminated item can affect the ease with which it can be decontaminated. Generally, the more complex geometries with grooves, crevasses, threads, holes, etc., are more difficult to decontaminate than simple geometric forms such as cubes, slabs, sheets, etc. A small milling machine used in a hot cell would be more difficult to decontaminate than a stainless steel water bath tray of similar size. Small diameter pipe internally contaminated is difficult to decontaminate and <u>verify</u> to release levels.

e. Size and Weight

Large heavy contaminated items are expensive to dispose of as radiological waste. A five-ton cell door or roof slab could cost well into the thousands of dollars each to dispose of. Even though concrete is difficult to decontaminate, it would be more cost effective to decontaminate than disposing of a contaminated cell door through rad waste even if decontamination costs were several thousand dollars. On the other hand, the same amount of contamination deposited inside a 10' section of 4" diameter Schedule 40 metal pipe could be disposed of more economically as waste than attempting to decontaminate the pipe and <u>verifying</u> that it meets radiological release limits.

f. Occupational Dose Rates

All nuclear facilities have a responsibility to ensure occupational exposures to employees are as low as reasonably achievable (ALARA). An ALARA evaluation would also enter into the decisions of "decon vs rad waste." If substantial dose reductions to employees would occur as a result of preparing an item for disposal vs performing decontamination (or vice versa), then ALARA decisions could supercede other considerations.

g. Efforts To Conserve Space In Low Level Radiological Waste Burial Grounds

The National Low Level Radiological Waste Policy Act and the resulting political activities at the states and federal levels have resulted in a decreasing availability of burial space at the three remaining commercial disposal sites. All licensees are expected to take substantial action to minimize the quantities of radiological waste committed. Also, major contributors must receive a pre-approved allocation for a specific job or time period. This could influence the "decon vs rad waste" decision by causing licensees to perform more decontamination in order to conserve rad waste volume and quantities within allotments.

h. Scrap Or Salvage Value

Items with a relatively high scrap or salvage value make decontamination more feasible. The 80-ton door in the Hot Lab has a scrap value over $30,000 because of the large quantity of lead in it. Another example might be the optical periscopes, shield windows, and manipulators in the Hot Lab. Their high salvage value for re-use in other facilities makes decontamination (or partial decontamination) a clear preference over rad waste disposal. It may also be worthwhile to locate other licensees who could utilize various contaminated items (such as manipulators). Such items could be transferred to another licensee as is, thereby saving decontamination costs

i. Decontamination Factor (Expected Success)

Nearly any item or structure can be decontaminated if enough effort, resources, and expense are committed. As a general rule, first efforts are most successful and subsequent efforts (when needed) rapidly reach a point of diminishing returns. For this reason a decontamination factor of from 10 to 15 appears to be the maximum reasonable reduction feasible with conventional techniques on normal items. This factor will vary, of course, with the variety of conditions previously described in this section.

j. Cost

With the exception of ALARA, cost is perhaps the single most important consideration in deciding whether to decontaminate or to commit to radiological waste burial. Elements of cost affecting decontamination costs are labor, handling, special tooling, leasing or purchasing of special systems, materials and supplies, disposal of liquid or solid wastes generated by decontamination, and costs of verification to release levels. Elements of cost affecting radiological waste disposal are labor, handling and tooling, shielding, cask or container (packaging) rental or purchase, radiological classification of the waste, preparation of bills of lading, transportation, and burial costs.

This information identified under Section 2.4 was considered and listed as much as possible when performing the radiological surveys and classifications under Task Priority #3 and in developing the disposition lists under Task Priority #6. This information also triggered questions addressed in Section 2.5, following.

2.5 IN-PLACE DECONTAMINATION VS REMOVAL OF MAJOR EMBEDDED PIPING SYSTEMS

Several PBRF systems, which represent most of the internally contaminated piping embedded in concrete, have levels of contamination which might permit in-place decontamination instead of removal, packaging, and disposal as rad waste. The Primary Cooling Water System (1000 Series) was predominantly large diameter pipe (24" diameter). The Quadrant and Canal Pump Out System (1900 Series) was predominantly medium diameter (6"-10"). The Quadrant and Canal Recirculating System (1800 Series) was predominantly small diameter pipe (2"-4"). An evaluation of cost effectiveness of in-place decon vs removal and disposal was needed for these potentially high cost jobs. As a prelude to that evaluation, it was also necessary to evaluate appropriate techniques applicable to in-place decontamination for these as well as other systems.

These sub-tasks were subcontracted to Burns & Roe, Inc. of Oradell, New Jersey. They had performed similar evaluations in 1983 as part of the Shippingport Station Decommissioning Planning Project for the Department of Energy. They also had access to current costing rates, pricing techniques, and methodology. Their complete report appears herein as Appendix 2.1, Decontamination and Dismantling Methods Report, September, 1985.

Based on Burns & Roe, Inc.'s evaluation, it is concluded that removal is more cost effective than in-place decon and verification for the Primary Cooling Water System. Removal is the only viable option for the Quadrant and Canal Pump Out System and Recirculation System. The following table highlights these comparisons.

TABLE 2.1
PCW EMBEDDED PIPING DECONTAMINATION VS REMOVAL

	Direct Cost	Duration	Exposure
Decontamination	$1,074,000	10.0 Weeks	3.7 man-Rem
Removal	360,300	6.5 Weeks	6.0 man-Rem
Difference	$713,700	3.5 Weeks	-2.3 man-Rem

QUADRANT & CANAL EMBEDDED PIPING DECON VS REMOVAL

	Direct Cost	Duration	Exposure
Decontamination	Not A Viable Option*		
Removal	$372,500	10.0 Weeks	22.6 man-Rem

*Due to: High Decontamination Factor Required;
Poor Internal Condition of Piping (Highly Corroded);
Relatively Complicated Geometry;
Low Success Probability;
Inability to Verify Decontamination by Instrument Survey

Burns & Roe, Inc. also performed a cost sensitivity study of the various elements of cost. This study indicated that costs were conservative and not likely to be higher. Overall there might be a moderate decrease in cost estimates if all considerations were minimized.

2.6 REACTOR CORE AND TANK REMOVAL SEQUENCE

Part of the 1978 "Options" Study performed by Teledyne Isotopes included a conceptual plan for removing the reactor tank and its contents. That plan called for partial flooding of Quadrants A, C, and D and would have resulted in large quantities of mildly contaminated waste water to be disposed of by volume reduction, absorption, and disposal as rad waste. Since then the regulations have changed to eliminate liquid shipping in that manner. Now, all liquids must be solidified and shipped as dry solids material. This greatly increases labor and material costs, waste volume and weight, and overall disposal costs. It was therefore desirable to develop a concept for removing the tank and internals without flooding the Quadrants. A detailed conceptual plan was developed using that approach, and is presented in Appendix 2.2. This approach was jointly developed by Teledyne Isotopes and Burns & Roe.

This plan was priced out and estimated to cost $1,772,320 for labor, materials, demurrage, etc., to remove the tank and contents, package it into appropriate radiological containers, and ship it to licensed burial grounds. Burial costs would add another $196,344 for a total cost of $1,918,664. This was based on an estimated time scale of 6 months (26 weeks) to complete this task.

APPENDIX 2.1

PLUM BROOK REACTOR FACILITY
ENGINEERING STUDY

COMPARISON OF
DECONTAMINATION AND DISMANTLING
METHODS FOR PRIMARY COOLING WATER
AND QUADRANT & CANAL PIPING SYSTEMS

REV. 0

SEPTEMBER, 1985

Prepared by

BURNS AND ROE, INCORPORATED

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APPENDIX 2.1
TABLE OF CONTENTS

2.0 INTRODUCTION

2.0.1 Purpose

The purposes of this report are as follows:

(1) To compare in-situ decontamination vs removal and disposal by burial of the primary cooling water system and quadrant and canal piping systems in terms of methods, verification of decontamination to the applicable release limits, decontamination success probability, cost, duration, radiation exposure, and radwaste generation;

(2) To evaluate the decontamination methods and costs for other systems and structures; and

(3) To characterize decontamination wastes.

2.0.2 Background

The NASA Plum Brook Reactor Facility (PBRF) operated for ten years prior to shutdown in 1973. Upon shutdown, the facility was placed in a safe protective storage condition. All nuclear fuel and special nuclear and source materials were removed, and liquid radwastes were processed and discharged.

In 1978, under contract to NASA, Teledyne Isotopes performed a preliminary investigation entitled, "An Evaluation of the Options for Further Decommissioning of the Plum Brook Reactor Facility." This report is a part of a study being performed by Teledyne Isotopes and Burns and Roe, Inc. to update that document in view of any pertinent regulatory changes or changes in the physical plant and to evaluate the need for update due to the development of more detailed radiological classification data. Cost estimates are to be updated based on current methods and techniques, and radiologically significant items needing additional study are to be identified.

This report is, in part, based on the radiological surveys and sampling conducted by Teledyne Isotopes as a portion of this overall study. The focus is on decontamination and dismantling methods in general, and the decontamination or removal of the primary cooling water (PCW) and quadrant and canal (Q&C) systems in particular.

The PCW system is of special interest because it includes the largest contaminated piping in the PBRF, with approximately 270 feet of 24" piping embedded deep in concrete.

A decision needs to be made to either decontaminate this piping or to remove it from the concrete.

The Q&C piping system (including the recirculation system) is also of special interest because it includes approximately 1430 feet of 2" to 10" piping, generally embedded 2'6" deep in concrete. This represents most of the smaller embedded piping in the PBRF, and decontamination or removal costs developed for this piping will be applicable to other embedded piping.

2.0.3 General Approach

In Section 2.1, the most likely radioactive release limits are assumed, and the means of verification and the probability of successfully attaining and verifying the release limits are discussed in general for various pipe sizes and components. In Section 3.0, for non-embedded piping and components, internal decontamination to unrestricted release conditions and direct removal are evaluated.

In Section 2.3, decontamination and specific success probability as related to the embedded piping of the PCW and Q&C systems are evaluated. Direct removal of the PCW and Q&C systems embedded piping is also evaluated and, where appropriate, costs and benefits of decontamination are compared to direct removal. A cost sensitivity evaluation is also presented.

Results and conclusions are summarized in Section 2.4 and references are listed in Section 2.5.

2.1 DECONTAMINATION RELEASE LIMITS, VERIFICATION AND SUCCESS PROBABILITY

2.1.1 Decontamination Release Limits

The goal of decontamination for the systems considered in this report is to meet the requirements for unrestricted on-site release in accordance with NRC Regulatory Guide 1.86, June 1974, and with a direct radiation limit previously imposed on the PBRF decommissioning by the NRC. These limits may be summarized for the PBRF as follows:

Direct Radiation: <5 uR/hr (<0.005 mR/hr) above natural background (~5 uR/hr) at one meter from all surfaces.

Removable Contamination:

Alpha	<20 dpm/100 sq. cm.
Beta-Gamma	<1000 dpm/100 sq. cm.

Average (Total*) Contamination:

Alpha	<100 dpm/100 sq. cm.
Beta-Gamma	<5000 dpm/100 sq. cm.

Special Limits for the Emergency Retention Basin:

<5 pCi Sr 90/gram soil

*For PBRF, this was defined as "fixed," but "total" appears to be the proper interpretation of RG 1.86.

Regulatory Guide 1.86 also limits maximum total contamination levels for an area of 100 sq. cm. or less as follows:

Maximum (Total) Contamination:

Alpha	<3000 dpm/100 sq. cm.
Beta-Gamma	<15,000 dpm/100 sq. cm.

However, it is not clear at how many locations within a large system that credit could be taken for contamination up to the maximum limits. Therefore, for evaluation purposes, it is assumed that all surfaces must meet the removable and average contamination limits.

For embedded piping to be removed, the direct radiation limit is assumed to apply one meter from the surface of the unshielded pipe after removal. For embedded piping to be left in place after in-situ decon, the direct radiation limit is based on a survey of the internal pipe surfaces (less than one meter distance). The contamination limits are essentially contact readings and transferable wipe samples which should be applied all along the inside of the piping, and are therefore more restrictive.

2.1.2 Decontamination Verification and Probability of Success

2.1.2.1 Decontamination Verification

Verification would be conducted in detail only if the decontamination brought the contamination levels at accessible locations to levels approaching the release limits. Therefore, the dose rate to personnel conducting the verification would be very low. For example, the contact dose rate equivalent to 5000 dpm/100 sq. cm. is only about 0.08 mR/hr based on Co 60, the dominant isotopic source for the systems being considered herein.

For the 24" primary cooling water piping, contact readings and swipes could be taken by a man being lowered, pulled and lifted through the two 135 foot runs, starting at the reactor cavity end (see Figures 2.4 and 2.5 on pages 2-81 and 2-83). Although men did negotiate their way through this piping to check welds during construction, it would be much more difficult to do it with the radiological controls and protections that would be required now.

Some residual water is likely in the horizontal runs following decontamination. Double protective clothing, a cannister type respirator, a communications system and lighting would be required. The NASA Confined Space Entry Procedure would have to be followed. Ventilation could be provided by exhausting air from the reactor end of the pipe run via a HEPA filter. A cable or rope system would be required to gradually lower the man head first down the reactor end of the pipe run, to assist in movement through the horizontal runs, and to lift the man up the vertical runs outside containment. The readings and swipes would be taken ahead of the man to assure transferable contamination is not overly disturbed prior to sampling. Contact readings could be read out via the communication system, but swipes would have to be bagged for subsequent counting. The cable or rope system could be used to establish the sampling locations along the pipe run. The cable or rope could be pulled through the pipes by first pneumatically forcing a light plastic ball attached to a light line through the pipe run. A supply reel with brake would be required at the reactor end and a takeup reel with a motor-gear drive and brake would be required at the pump house end.

Another approach would use a similar cable or rope system but would be unmanned. Since a device to obtain representative swipes would be difficult to design and costly, a count rate limit equivalent to removable contamination limits could be adopted. The total contamination readings would have to be assumed to be transferable contamination values, also. A device to hold four detectors, 90 degrees apart and about one centimeter from the pipe wall, could be designed. However, the requirements of negotiating up to 6 elbows and 135 feet of pipe and for recording or transmitting the readings would also mean high hardware and development costs.

For 2" through 10" piping, it should be possible to design a probe capable of negotiating elbows. A probe with a surface detector and possibly swipe holders could be pushed and rotated through the pipes. Any pipe diameter not permitting access of an alpha sensitive probe would require removal of the pipe and disposal as radioactive waste.

For the 2" PCW drain lines, access could be obtained in the valve box in the corridor to the Subpile Room. Two elbows would have to be negotiated to reach the 24" PCW lines, and one elbow would be negotiated to reach the Subpile Room.

For the 4" and 6" PCW supply and return lines from the 24" PCW pipes to the pipe rings, access would have to be via the 24" PCW pipes from the reactor end. For the 4" line, two elbows and a 45 degree elbow must be negotiated to reach the pipe ring. For the 6" line, three elbows must be negotiated to reach the downcomer which could also be reached via one elbow from the other end after removing valve 20V54. However, reaching the pipe ring would not be practical due to the tee branch connection, but only about one foot of 4" line between the 6" riser and the pipe ring would be inaccessible. Exposed sections of the pipe rings could be removed making easy access to the embedded portions, but there are embedded reducing tees in each pipe ring connecting to a significant amount of additional embedded piping, some of which would be difficult to reach and monitor.

For the quadrant and canal piping, a probe could be inserted from both ends of the embedded runs. Access to the pumpout piping from the drain fittings could be a problem due to the 6" piping with one or two elbows before teeing into the long 10" runs. Access to both ends of the recirculating lines could be easily made by removing the risers at the flanges a few inches above the quadrant and canal floors and flanged valves in the pump room.

All of these verification schemes would require development and would be time consuming and costly. Furthermore, sampling all along the embedded pipe run should not be necessary if it is likely that the contamination at accessible locations is representative of the contamination throughout the entire run. This is in accordance with the NRC regulatory position given in Paragraph C.4.c of Regulatory Guide 1.86. As long as decontamination methods are designed to avoid crud deposition in piping low points and no special decontamination of the accessible ends of the embedded piping is made, these locations should be representative of the overall pipe run. Therefore, taking standard contact readings and swipes at accessible ends of embedded pipe runs, including weld surfaces where possible, is the recommended method for verification of decontamination.

This means of verification could also be applied to non-embedded piping by removing valves and other components and sampling at the locations thereby made accessible. For components with more complicated geometry, including crud trap areas such as crevices, decontamination and verification would generally require disassembly of the component. For old valves, pumps and heat exchangers with no re-use potential, such disassembly with its high labor costs and exposure is not economical or compatible with ALARA.

2.1.2.2 Decontamination Success Probability

The probability of successful decontamination is dependent on several factors including material of construction, surface conditions, geometry, contamination level, and decontamination method and techniques. Success is much more likely for the stainless steel PCW piping than it is for the carbon steel quadrant and canal piping which has rust and scale on interior surfaces. Success on piping is more likely than it is for valves, pumps, heat exchangers and most other components due to the crud traps that tend to be present in such components.

Items with contamination levels within a factor of two of the release limits are more likely to be successfully decontaminated by chemical methods in one application since the probability of everywhere attaining a given decontamination factor (DF)* decreases rapidly with increasing required DF. Table 2.2 summarizes in a general manner the probability of achieving successful in-situ decontamination of various components as a function of material and condition.

Since items to be decontaminated during the decommissioning are generally not to be reused, aggressive decontamination methods could be employed, but there is a tradeoff with safety considerations, radwaste generation and processing requirements. Also, experience at BONUS indicates that the more aggressive methods (nitric acid and phosphoric acid) do not necessarily result in high decontamination factors (Ref. 3).

Success probability of decontamination is furthe discussed in Section 2.2.1 and 2.3.1 for the specific systems and applicable decontamination methods.

2.2 NON-EMBEDDED PIPING AND COMPONENTS

Although this study deals primarily with the Primary Cooling Water (PCW) and Quadrant and Canal (Q&C) Pumpout and Recirculating Systems, the following discussions regarding decontamination and removal are applicable to all of the non-embedded portions of radioactivity contaminated systems as well.

2.2.1 Decontamination of Non-Embedded Piping and Components

2.2.1.1 Internal In-Situ Decontamination

Portions of systems that are not embedded in concrete typically include valves, pumps, heat exchangers, ion exchangers, filters, strainers,

*DF = $\frac{\text{Radioactivity Present Before Decontamination}}{\text{Radioactivity Present After Decontamination}}$

DF = 2	50% Reduction in Radioactivity
DF = 5	80% Reduction in Radioactivity
DF = 10	90% Reduction in Radioactivity
DF = 100	99% Reduction in Radioactivity

TABLE 2.2

SUCCESS PROBABILITY
IN-SITU
DECONTAMINATION FOR UNRESTRICTED RELEASE

Item	Material	Surface Condition	Beta/Gamma Contamination Level, Total/Removable, dpm/100 sq. cm.	Success Probability
Pipe	Stainless Steel	Good	<10,000/2,000	Good
Pipe	Stainless Steel	Good	<50,000/10,000	Fair
Pipe	Stainless Steel	Good	>50,000/10,000	Poor
Pipe	Carbon Steel	Good	<10,000/2,000	Good
Pipe	Carbon Steel	Poor	<10,000/2,000	Fair
Pipe	Carbon Steel	Poor	>10,000/2,000	Poor
Valves	Any	Good To Poor	>5,000/1,000	Poor
Pumps	Any	Good To Poor	>5,000/1,000	Poor
Heat Ex-changers	Any	Good To Poor	>5,000/1,000	Poor

*Without disassembly for decontamination, must reduce all internal surfaces to less than 5,000 dpm/100 sq. cm. total beta/gamma and less than 1,000 dpm/100 sq. cm. removable beta/gamma.

NOTE: Alpha contamination is present at relatively low levels in PBRF. Success probability to achieve LT 20 dpm/100 sq. cm. removable or LT 100 dpm/100 sq. cm. total alpha contamination would parallel beta-gamma success probabilities.

instrumentation and other components which generally must be removed from the piping system and disassembled to effect a thorough decontamination. This is especially true where the primary goal of decontamination is to meet the unrestrictive use limits of Regulatory Guide 1.86 as discussed in Section 2.1.1. Due to the complicated internal geometry of such components with crud traps such as crevices, plenums, etc., thorough in-situ decontamination to the unrestricted use limits is not likely, as discussed in Section 2.1.2 and in Reference 3 (5.1.1). The geometry of the piping is also generally complex, which increases the need to open the piping system in many places for those methods that employ an internal device that must traverse all of the piping. The effort to remove components and open piping to complete the decontamination and verification is likely to approach that of complete removal. Due to the characteristics and requirements of decontamination and verification methods, in-situ decontamination to unrestricted release conditions is not generally practical.

2.2.1.2 Decontamination After Removal

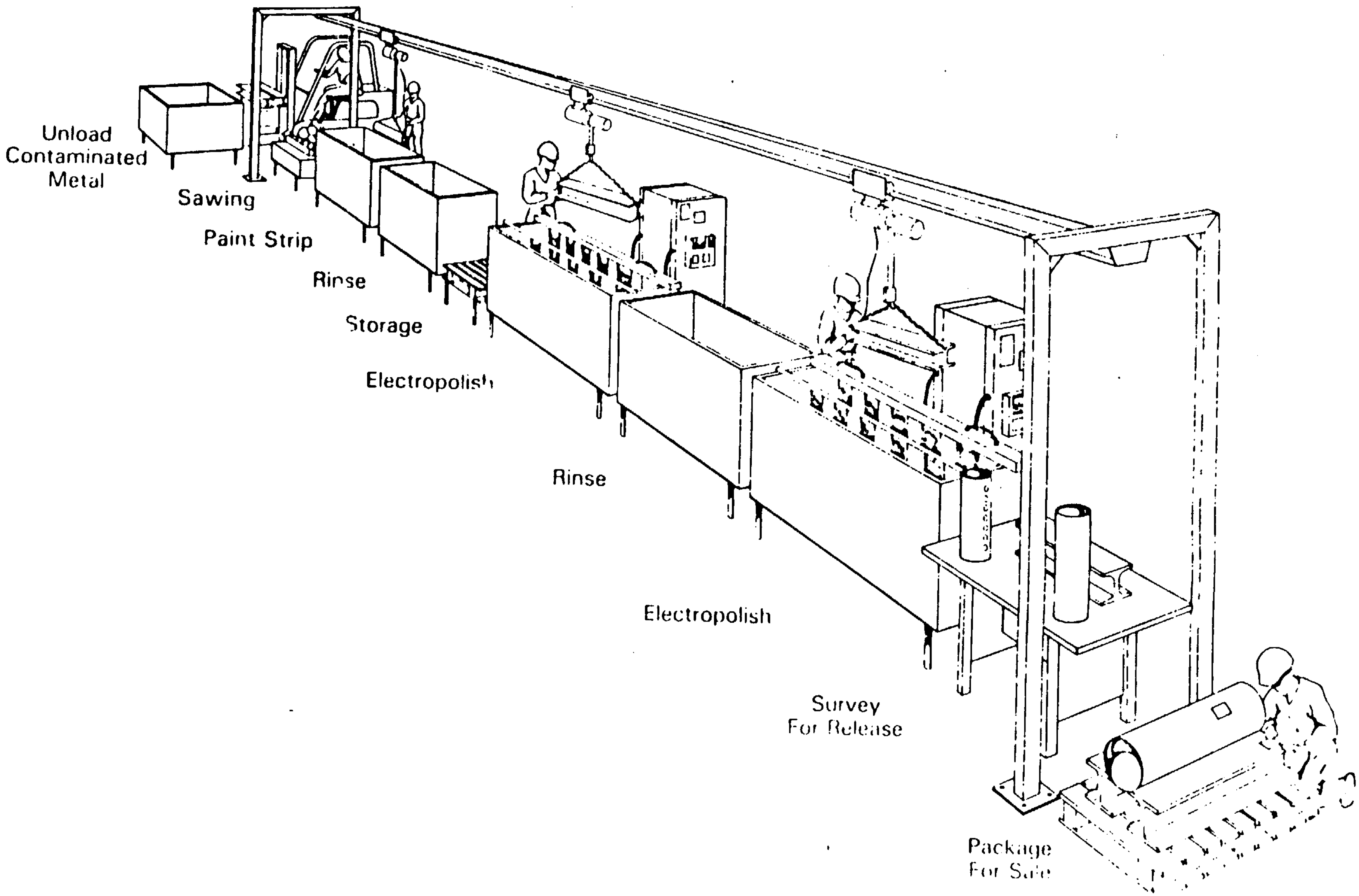
If piping and components are removed from the systems and sectioned or disassembled as required, several batch type decontamination methods (such as abrasive cleaning, vibratory finishing, ultrasonic cleaning, freon spray cleaning and electropolishing) could be used to reduce radioactive waste burial costs and provide a return on the scrap value of the materials. Decontamination utilizing electrolytic, chemical and vibratory abrasion methods have shown significant savings (up to 50%) relative to burial costs and decontamination costs at 35% to 40% of the value of released material (Ref. 23), but the costs of disassembly and personnel radiation exposure were not included in the evaluation. For components such as valves, pumps, and heat exchangers, the time, cost and exposure due to removal, disassembly, decontamination, verification and disposal of clean scrap and decontamination wastes will almost certainly exceed the cost resulting from removal, packaging and disposal at a radioactive waste burial ground. Decontamination of such components also has the risk of not attaining release limits or not bei able to demonstrate compliance with the release limits, in which case the shipping and burial costs would be incurred in addition to the decontamination costs. In addition, there is a risk of inadvertently releasing materials that do not meet the release limits. Therefore, contaminated components such as valves, pumps, and heat exchangers, which do not have re-use potential should be disposed of as contaminated waste without attempting internal decontamination. Larger components with relatively low radiation levels can be sealed and externally decontaminated to meet DOT shipping requirements, and shipped as their own container.

For items such as pipe, duct, liner plate and structural steel that have a relatively simple geometry after removal and segmenting, the cost savings of decontamination as described above (Ref. 23) should be attainable. Radiation exposure is likely to be somewhat higher for the decontamination approach, but this could be reduced or eliminated by decontaminating only relatively clean low radiation items, by using local shielding, and by using semi-remote handling wherever practical. An electropolishing facility similar to that shown in Figure 2.1 (Ref. 23) would be capable of processing a significant portion of the contaminated metal piping, ducts, liners, etc., at a probable cost savings. Such a facility would also be capable of decontaminating tools.

The economics of an electropolishing facility would depend on the intensity and duration of use. Although an overall savings would be likely for prompt decommissioning, the electropolishing equipment costs over the long duration of extended prompt decommissioning would likely result in increased costs. For example, the rental cost for Bartlett Nuclear's mobile trailer mounted system is $350 per day plus about $60 per day for labor. This does not include electrolyte solidification and consumable costs. Because of the uncertainties in decommissioning work, Bartlett Nuclear does not bid fixed price work (Ref. 17).

A detailed study of the economics of an electropolishing facility would be required to firmly establish any potential cost savings. This study would have to be based on an accurate estimate of the quantity of various items that could be

MODULAR ELECTROLYTIC DECONTAMINATION SYSTEM



2-26

FIGURE 2.

decontaminated together with a characterization of the materials, surface conditions and contamination levels. Surface conditions are important, since electropolishing requires relatively clean surfaces (Ref. 18), and the extent of pre-treatment equipment and effort would have a significant effect on the economics. Such information should be available when the present engineering study is complete. Also, the study should be based on the decommissioning mode selected by NASA, since costs are likely to be highly dependent on the intensity and duration of electropolishing facility use.

Since the economics of an electropolishing facility requires further detailed evaluation, the cost estimate for the present engineering study should be based on removing, packaging and shipping all radioactively contaminated materials to a radioactive waste burial ground. This approach should result in a conservative cost estimate.

2.2.1.3 Surface Decontamination

External surfaces of otherwise non-contaminated pipe, components, ductwork, electrical cabling and conduit, walls, floors, etc., may have to be decontaminated to meet the release limits. Generally, such contamination is loose or only semi-fixed and can be removed by hand application of various decontamination agents.

For the Shippingport Station Decommissioning Project, a study of decontamination methods was conducted which is applicable to similar applications at the PBRF (Ref. 13, ES 12.3). Various methods were evaluated, and decontamination agents for various applications were recommended as summarized in Table 2.3. Application concentration, waste generation and unit costs are also listed in Table 2.3.

NUTEK-600EL is a low foam non-phosphate cleaner marketed by Nuclear Technology Corporation of Amston, Connecticut. It can be applied by power buffing a 6.25% solution or by manual scrubbing a 12.5% solution to emulsify, remove and suspend

TABLE 2.3

SUMMARY OF RECOMMENDED DECONTAMINATION AGENTS FOR EXTERNAL DECONTAMINATION*

Decontamination Target	Decontaminant	Application Concentration	Liquid Waste Generation*** gal/sq ft	Unit Cost $/sq ft (1982)**
Exposed Concrete				
Loose Contamination	NUTEK 600 EL	12.5% Solution	0.1	1.02
	ALARA 1146 DECON	20-30 mil Strippable Coating	0.018 Compacted Solid	1.83
Semi-Fixed Contamination	NUTEX 69B	20% Solution	0.15	0.51
Coated Concrete				
Loose Contamination	NUTEX 600EL	12.5% Solution	0.1	1.02
	ALARA 1146	20-30 mil Strippable Coating	0.018 Compacted Solid	1.83
Semi-Fixed Contamination	NUTEX 69B	20% Solution	0.15	0.51
Fixed Contamination	Turco 6017	Full Strength	0.1	0.60
Steel Surfaces				
Loose Contamination	Industroclean	Full Strength Solution	0.08	0.45
Semi-Fixed Contamination	Feratone	17% Solution	0.15	0.92

* Ref. 13, ES 12.3
** Cost includes labor and chemicals, but not equipment costs.
***Rinse water included at 0.05 gal/sq. ft.

greases, oils and soils. NUTEX-69B is a strong surface cleaner applied in a 20% solution and allowed to soak on the concrete surfaces. It can also be used for wiping down steel surfaces.

ALARA 1146 DECON, marketed by Imperial Professional Coatings Co. of New Orleans, Louisiana, is a water base strippable coating that can be applied to concrete or steel surfaces to attract, absorb and bind contamination. After drying it may be pulled from the surface manually and compacted in 55 gallon drums.

Turco 6017, marketed by Turco Products of Carson, California, can be applied by squeegee to strip epoxy coatings from steel or concrete surfaces. When the epoxy coating crinkles, it is mopped off.

Industroclean, an AMWAY product, is an economical and effective cleaning compound that may be applied by brush or power cleaner to remove loose contamination. Feratone (Naval Jelly), by Penatone Inc., will dissolve several mils of rust and scale. It is generally applied by hand with sponges and removed after a short soak by rinsing or mopping with water.

2.2.2 Removal of Non-Embedded Piping and Components

As discussed in Section 2.2.1, all contaminated, non-embedded piping and components should be removed for decontamination and release for scrap value or for packaging, shipping and disposal at a radioactive waste burial ground. Removal should be accomplished by disconnecting flanges or other mechanical joints wherever possible.

When pipes must be cut, thermal or mechanical cutting methods may be used. The thermal methods include the plasma arc cutting process for all metals (Ref. 3, Section 8.3.1) and the oxygen burning (or oxyacetylene cutting) process (Ref. 3, Section 8.3.2) for carbon steel. These processes may be either by track controlled torch for remote operation or by hand held torch. Contaminated fumes are generated, which required appropriate airborne contamination control in addition to fire controls. To minimize the need for these controls, power hacksaws (or guillotine saws) may be used (Ref. 3, Section 8.3.5). If the piping is to be electropolished after removal, power hacksaws should be used wherever practical since torch cut ends have entrained contamination that cannot be removed by electropolishing. Where access is very difficult, however, such as the embedded piping being considered in Section 2.3, hand held torch cutting should be used to minimize concrete removal requirements. For ductwork, power nibblers and shears may be used (Ref. 3, Section 8.3.9).

All piping should be cut into approximately 5 foot lengths to fit into shipping containers or into electropolishing tanks. To speed this process, stationary power hacksaws may be moved to segmenting and packaging locations within each successive general work area. Hydraulic shears could also be used to segment smaller piping (about 2" and smaller) if it is not to be decontaminated.

2.3 EMBEDDED PIPING

This section compares decontamination and removal methods to determine the method that should be used for the embedded piping of the Primary Cooling Water and Quadrant and Canal pumpout and recirculation systems.

The Primary Cooling Water (PCW) system has two 24" diameter stainless steel lines embedded 9 feet below the floor of Canal "E" and Quadrant "B" in the containment and encased within a massive concrete pipe chase outside of containment. The Quadrant and Canal (Q&C) piping, generally embedded 2'6" below the canal and quadrant floors, ranges in size from 2" to 10" with a total of approximately 1430 feet of embedded pipe. These two piping systems account for most of the embedded piping at the PBRF and cover the full spectrum of embedded piping configurations.

Embedded piping decontamination to unrestricted use conditions is considered in 2.3.1, removal without decontamination is considered in 2.3.2, costs and benefits of the two methods are compared in 2.3.3 and a cost sensitivity evaluation is presented in 2.3.4.

2.3.1 Decontamination of Embedded Piping

Decontamination of embedded piping must expeditiously achieve the unrestricted use limits as described in 2.1.1 to be practical. If not, decontamination duration and cost would rapidly increase, and if the release limits eventually prove unattainable, most of the decontamination cost would be wasted because the radiation fields for the removal scenarios presented in 2.3.2 (Removal of Embedded Piping) are already low. Decontamination followed by removal could have a higher personnel exposure than removal without decontamination, since overall exposure durations for decontamination and removal would likely increase ove. the direct removal approach. Also, concentration of the radioactivity during decontamination would result in a more significant radiation source that must be properly processed, packaged and shipped. Therefore, the process to be used for the PCW or Q&C embedded piping must have a significant probability of attaining release limits in one application cycle.

The selected process for each application should have a reasonably high probability of achieving adequate decontamination factor (DF) to reach unrestricted release limits while resulting in wastes that can be economically processed. Since the PBRF radwaste processing system is not expected to be in operational condition due to years of layup without maintenance, it is assumed that temporary portable radwaste processing equipment would be required to support the selected decontamination process.

Decontamination processes may be categorized as chemical and non-chemical. Several of the non-chemical processes (Ref. 8, 9 and 19) may be eliminated from further consideration since they are not applicable or have not been developed and demonstrated for in-situ decontamination of pipe. These include vibratory finishing (Ref. 9, Section 6), ultrasonics (Ref. 9, Section 7), high-pressure freon (Ref. 9, Section 8), alternative electrolyte for electropolishing techniques (Ref. 9, Section 10), gels and pastes (Ref. 9, Section 12), strippable coatings (Ref. 9, Section 13), reflux decontamination (Ref. 9, Section 14), dry ice blasting (Ref. 9, Section 15), electrochemically-activated decontamination solutions (Ref. 9, Section 16), molten salt methods (Ref. 9, Section 17) and thermal erosion (Ref. 9, Section 18). Non-chemical processes that require further consideration include mechanical methods, high and ultrahigh pressure water, abrasive cleaning, electropolishing, steam/hot water cleaning and decontamination foams (Ref. 9, Sections 2, 3, 4, 5, 9, 11 and 12).

2.3.1.1 PCW Embedded Piping Decontamination

Contamination survey data taken by Teledyne Isotopes indicates that the PCW piping total beta-gamma contamination ranges from 25,000 to 100,000 dpm/100 sq. cm. Removable beta-gamma contamination ranges from 344 to 940 dpm/100 sq. cm. This is based on the assumption that the PCW piping contamination levels are similar to the valve housing contamination levels that were actually measured. It is likely that the PCW piping contamination levels are actually lower, and therefore, 100,000 dpm/100 sq. cm. total beta-gamma contamination should represent a conservatively high maximum.

Since site release would not occur for at least five years from the date of this survey, the contamination levels (which are mainly due to CO 60) can be expected to decrease by 50% or more (i.e., 50,000 dpm sq. cm. or less) prior to the final site survey. Thus, a decontamination factor of 10 would be adequate to reduce the maximum activity to less than 5,000 dpm/100 sq. cm. However, further contamination survey, such as at the reactor tank end of the lines, which is now inaccessible, could result in significantly higher readings. There is also the possibility that the release limits could be revised to lower values within the next five years. Therefore, a minimum DF of 20 or greater would be desirable to account for any change in survey data or release limits.

Teledyne Isotopes also conducted decontamination experiments using various chemicals. The results indicate that the contamination is in a thin, relatively adherent surface film.

Piping is mainly 24" diameter 304L stainless steel, but there is a considerable amount of smaller piping embedded in the reactor bioshield. This small piping is 304 stainless ranging in size from 1" to 6", and its configuration is relatively complicated.

2.3.1.1.1 Process Selection

Most of the non-chemical processes (mechanical, high and ultrahigh pressure water, abrasive cleaning, electropolishing, and steam/hot water cleaning) require an application device to reach all points within the piping. This is considered impractical due to the length of the runs, both horizontal and vertical, in the case of the 24" lines and due to the complicated geometry of the smaller piping in the bioshield. For the abrasive grit blasting process, it would also be impractical to remove all of the potentially contaminated grit from the lo low point runs of 24" piping since there is only one 2" drain connection per line. A foam would likely be ineffective due to its mild cleaning action relative to the film's apparent integrity. Therefore, none of the non-chemical decontamination methods is considered to have an adequate success probability for the PCW embedded piping.

There are several chemical decontamination processes that could be considered (Ref. 10, 21). Since the film to be removed was formed at low temperature, it is probably not as tenacious as films encountered in BWR or PWR reactors. Therefore, processes that have been effective on BWR and PWR piping should be even more effective on the PCW piping. To minimize radwaste processing requirements, a process should be used that permits all removed radioactivity to be collected on filters and ion exchangers, without the need for evaporation and solidification processes.

Data on the various chemical decontamination processes are summarized in References 3 and 11. The CAN-DECON process, marketed by London Nuclear, circulates at high velocity a dilute mixture of acidic complexing agents (less than 0.5 weight percent) and generates a minimum amount of radwaste in the form of spent ion exchange resin. DFs between 5 and 10 have been achieved on several reactor systems (Ref. 22). Since the PCW piping deposits were formed at low temperature, the CAN-DECON process may result in somewhat higher DFs. Thus, the CAN-DECON process may be effective in decontaminating the PCW piping to releasable limits (Ref. 12), and it may be the most economical method to use for this application. However, it is a proprietary process which complicates cost estimating for this unique application. Although CAN-DECON is not selected as the process for cost estimating, it should be further evaluated if a decision is made to proceed with decontamination of the PCW piping as the baseline approach.

The APACE and AP, Citrox, EDTA processes were both evaluated for use on the Shippingport Decommissioning (Ref. 13), and the APACE process had a somewhat lower cost and exposure. Therefore, the APACE process, which can be expected to produce a DF of about 50 (Ref. 3) will be used in this report as the assumed decontamination process. To avoid deposition of crud in piping low points, a recirculation method (rather than a fill and soak method) is selected.

The basic APACE procedure is as follows (Ref. 3):

1. Recirculate a solution of alkaline permangante (AP) at 250 degrees F for 24 hours.

2. Discharge diluted AP solution through a cooler to holdup tank.

3. Process diluted AP solution through mixed bed ion exchangers.

4. Use effluent water to prepare ammonium citrate, EDTA (ACE) solution.

5. Recirculate ACE solution at 250 degrees F for 24 hours.

6. Discharge diluted ACE solution through cooler to holdup tank.

7. Process diluted ACE solution through mixed bed ion exchangers.

8. Sample and discharge effluent water that meets release limits.

9. Dispose of ion exchange resin as radioactive waste.

2.3.1.1.2 Chemical Requirements

Solvent data for the APACE process is as follows (Ref. 3):

	Concentration
Alkaline Permaganate (AP)	
Na OH	100 gm/l
$KMnO_4$	13 gm/l
Ammonium Citrate (AC)	
$(NH_4)_2HC_6H_5O_7$	13 g/l
EDTA (Ref. 11)	1 gm/l

The PCW piping internal volume is estimated to be about 930 cu. ft. Assuming that the decontamination rig recirculation piping is about 25% of the PCW piping volume, solution volumes must be about 1163 cu. ft. Therefore, 8720 gallons of demineralized water would be required to mix with the following reagent quantities:

		Grams	Pounds
AP:	Na OH	3.3 E6	7277
	$KMnO_4$	4.3 E5	946
AC		4.3 E5	946
EDTA		3.3 E4	73

2.3.1.1.3 Radwaste Generation, Shipping and Burial

Ion exchange resin volume is normally the same order of magnitude as the system volume to be decontaminate (Ref. 11). Since this is really a function of total solution volume, a resin volume of 1200 cu. ft. is assumed. To avoid the need for a solidification system, high integrity containers (HICs) fitted with underdrains are used as filters and ion exchangers and serve as their own shipping container. HICs are assumed to have a useful capacity of 120 cu. ft. and a burial volume of 170 cu. ft. This 10 ion exchanger HICs are required for chemical removal. Assuming one filter HIC, the total waste burial volume is 1870 cu. ft.

The Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule (Ref. 26) includes weight and Curie surcharges. Each HIC weighs 900 pounds and holds approximately 9000 pounds of resin or filter media. For a total container weight of 9900 pounds, the weight surcharge is $550 per container. As further discussed in Section 2.3.2.2.7 (page 2-89), the total activity in the embedded PCW piping is only about 8 E-4 Curies, and there is no Curie surcharge for less than one Curie/shipment.

Based on a truckload net capacity limit of 42,000 pounds and a container weight of 9900 pounds, 4 containers can be included in each shipment. Fo 11 containers, a total of 2.75 truckloads are required.

2.3.1.1.4 Decontamination Rig Requirements

Any one of the Primary Cooling Water pumps located in the pumphouse could be used to produce a sufficiently high flow rate for the APACE process. Each pump has a 100 HP motor and is rated for 8650 gpm at 90 psi. The ceramic mechanical seals should tolerate the decontamination solutions, although a thorough evaluation of all materials that would be contacted by decontamination solutions would be required. Although the pumps have not been operated for 12 years, it may be possible to return one of them to operable conditions with minor repairs such as bearing replacement. The electric motors may also require servicing, but they are shielded from the pumps so that radiation levels ar low. The overall system would have t be leak tested to assure system integrity after such a long shutdown period.

To maximize the probability of successfully decontaminating the embedded 24" piping so as to avoid the high cost of removal, it would be advantageous to remove the more highly contaminated components such as the heat exchanger, strainer and expansion joints from the system and replace them with spool pieces. However, this would involve a considerable expense and radiation exposure. Therefore, the overall system should be considered for use in the decontamination circuit. Other existing PBRF components could also be evaluated for decontamination solution mixing and radwaste holdup. Special ion exchangers would certainly be required, however, to process the spent decontamination solutions.

To firmly establish the optimum usage of existing plant systems and components for decontamination of the PCW system, a detailed study would be required to define a workable system based on existing component and piping arrangements, shielding, etc. The physical condition and materials of construction of components and piping would then have to be evaluated to assure compatibility with decontamination solutions.

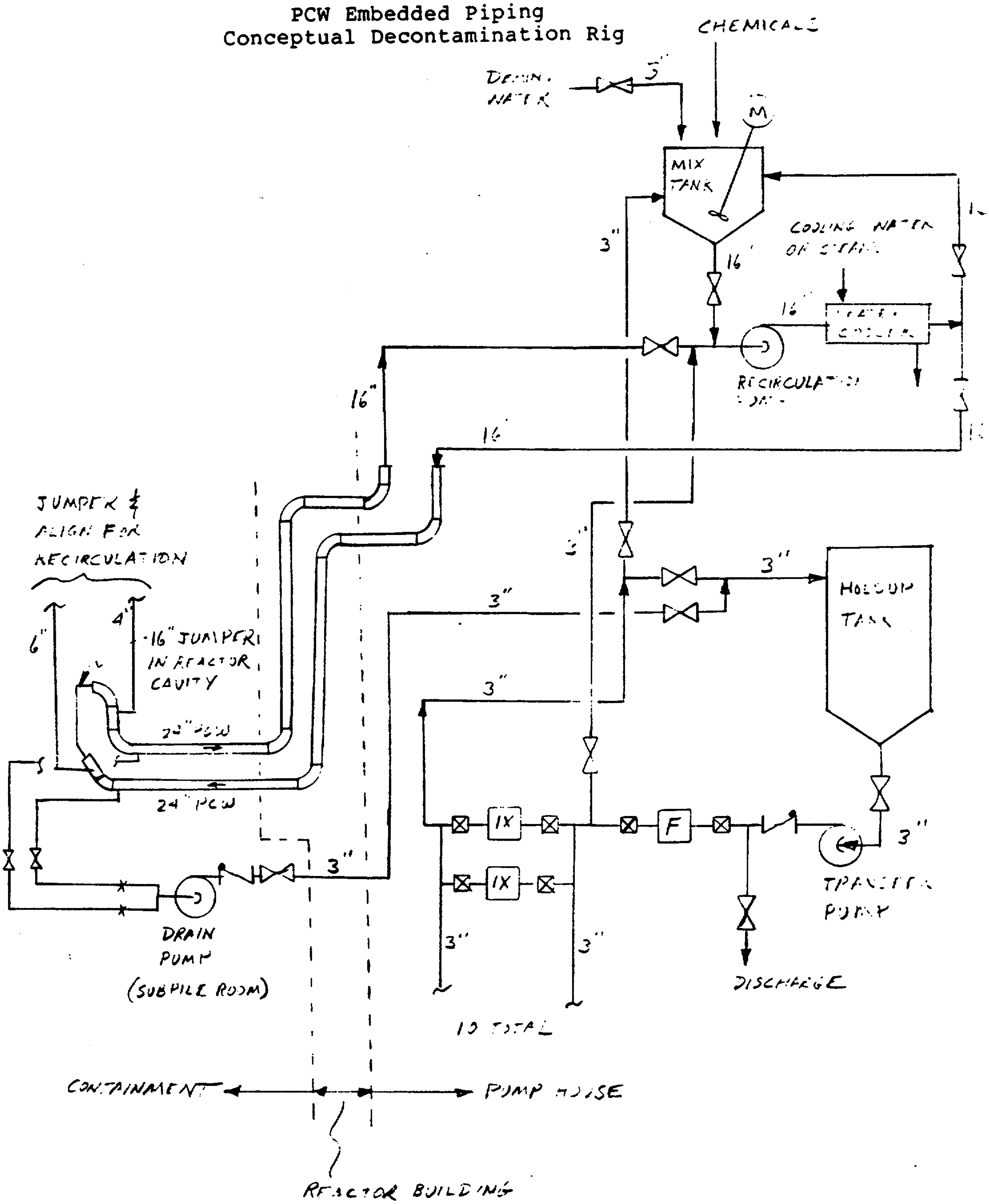
Therefore, to provide a conservative basis for estimating decontamination costs, duration and exposure, it is assumed that the existing plant components will not be used and that the decontamination contractor will provide a specially-designed decontamination rig. It is also assumed that this decontamination equipment will have future value to the contractor and therefore disposal costs do not apply. This approach results in a conservative estimate since existing components will be used only if it was demonstrated that a cost savings would result.

A conceptual decontamination rig is depicted in Figure 2.2. General component specifications are as follows:

Mix Tank	4500 gallons, stainless steel, electric mixer, and controls
Recirculating Pump	7000 gpm at 10 ft. TDH, stainless steel, electric motor and controls
Heater/Cooler	3.3E6 BTU/hr, stainless steel, 7000 gpm PCW tubeside flow, steam/water on shell
Hold Tank	9000 gallons, stainless steel
Transfer Pump	150 gpm at 100 ft. TDH stainless steel, electric motor and controls
Filter	120 cu. ft. HIC with charcoal (or other compatible filter media) and quick disconnects
Ion Exchanger	10-120 cu. ft. HICs with mixed bed (H-OH) resin and quick disconnects
Drain Pump	150 gpm at 100 ft. TDH, stainless steel, electric motor and controls
Piping	50'-16" stainless 200'-3" stainless
Valves	4-16" stainless, gate or butterfly; 6-3" stainless, gate, ball or butterfly; 2-3" stainless, check

FIGURE 2.2

PCW Embedded Piping
Conceptual Decontamination Rig



Sizing is based on mixing the solutions in two batches, producing a velocity of about 5 ft./sec. in the 24" piping, heating up in about four hours, holdup of one solution volume (8,720 gallons), draining the system in about one hour, and processing a solution volume (without filter or ion exchanger changeout) in about one hour. It is assumed that on-site systems may be used to provide cooling water and heating steam. The decontamination rig would be located in the pump house or outside in a temporary enclosure. A 3" line with drain pump would be run from the existing 2" drain lines in the Subpile Room to the holdup tank. The 24" PCW lines would be connected together in the reactor cavity to avoid the need to route large recirculation piping back to the decontamination rig. Both 24" lines would, therefore, be decontaminated at once. The drain pump could be used to continuously discharge through the drain lines, and the other piping embedded in the bioshield would be interconnected and aligned to produce recirculation, using drain pump discharge if necessary. Continuous filtration could be accomplished by collecting drain pump discharge in the holdup tank and pumping it through the filter and back to the recirculation stream using the transfer pump.

2.3.1.1.5 PCW Piping Decontamination Procedure

2.3.1.1.5.1 Initial Conditions

Initial conditions are assumed to be as follows:

1. All radioactive piping and equipment either decontaminated or removed from the pump house with 24" pipes cut off just above the floor anchor.

2. Reactor tank and any activated concrete removed from the reactor bioshield.

2.3.1.1.5.2 Procurement

1. Prepare specifications for decontamination rig and chemicals.

2. Evaluate bids and place order.

2.3.1.1.5.3 Installation

1. Install decontamination rig, including HICs, and hookup to electric power, demineralized water, processed waste discharge, cooling water, and steam/condensate systems.

2. Install 16" piping from decontamination rig to 24" PCW pipes in pump house and install 16" jumper between 24" pipes in reactor cavity.

3. Install drain pump in Subpile Room with 3" piping from 2" drain lines and to decontamination rig.

4. Install jumpers and align bioshield piping to produce recirculation.

5. Fill system with demineralized water and pressure and leak test the system.

2.3.1.1.5.4 Operations

1. Operate drain pump to drain 24" PCW piping and transfer the demineralized water to the mix and holdup tanks.

2. Mix and heat AP solution in two batches and fill the recirculation loop.

3. Start recirculation pump and continue heatup to 250 degrees F.

4. Recirculate at 250 degrees F for eight hours (since the film was deposited at lower temperature and a relatively low DF is required, this relatively short circulation time should be adequate).

5. Stop recirculation and align drain pump discharge to drain spent AP solution to the holdup tank via the heater/ cooler for cooling.

6. Operate transfer pump to process spent AP solution through the filter and ion exchnagers, discharging water to the mix tank.

7. Mix and heat ACE solution in two batches and fill the recirculation loop.

8. Recirculate at 250 degrees F for eight hours (sampling would determine actual duration).

9. Stop recirculation and align drain pump discharge to drain spent ACE solution to holdup tank via the heater/cooler for cooling.

10. Flush system with clean water and analyze flush water for contaminants. Survey PCW piping at accessible locations to assure release limits are met.

11. Operate transfer pump to recirculate spent ACE solution through filter and ion exchangers, discharging water back to holdup tank until sampling indicates that the water meets chemical (EPA/NPDES) and radioactivity (10CFR20) discharge limits.

12. Discharge water, monitoring as required.

13. Disconnect HICs and ship to radioactive burial ground (assume Hanford, WA).

14. Remove decontamination rig (assume contractor will take this away for future use).

2.3.1.1.6 PCW Piping Decontamination Productivity Factors

	Applicable Manhours	Work Time Increase Factors
Work at a Height	Non-Applicable	-
Work in Confined Space	Installation work in and around bioshield	0.20
Use of Respirators	Installation work connecting decontamination rig to PCW piping	0.25
Radioactivity Protection Controls	Installation and operation work	0.10
Protective Clothing	Installation and operation work	0.20
Work Break and Transit	Installation and operation work	0.10

2.3.1.1.7 PCW Piping Decontamination Cost

The estimated cost for decontaminating the embedded PCW piping is summarized in Table 2.4. The total estimated cost is $1,074,000 in 1985 dollars (no escalation). A contingency of 20% is included.

The overall productivity factor developed for decontamination rig installation is equivalent to a factor of 1.62. For decontamination operations, it is 1.45.

The estimated cost for the assembled decontamination rig without the HICs is $91,789. The 11 HICs are estimated to cost $354,000, and chemicals are estimated at $5,931. Decontamination rig installation and test costs are estimated at $108,020 and operation and rig removal costs are estimated a $18,770. Shipping and burial cost

TABLE 2.4

Direct Cost Summary by Bid Item

3764-01

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 1 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
DECONTAMINATION						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST (FROM PAGE 2 OF 2)				3273	78,749	499,761	70,570	—	649,080
	CRAFT SUPPORT LABOR (7% OF D.L.)				229	5512				5512
	NON-CRAFT SUPPORT (6% OF D.L.)				196	4725				4725
	SUBTOTAL				3698	88,986	499,761	70,570		659,317
	PAYROLL TAXES & INSURANCE (48.8% OF LABOR)					43,425				43,425
	SUBTOTAL					132,411	499,761	70,570		702,742
	SMALL TOOLS (6% OF LABOR + P/RT & I)					—	7945	—		7945
	EQUIP. F.O.M. (7% OF LABOR + P/RT & I)					—	9269			9269
	SUBTOTAL					132,411	516,975	70,570		719,956
	SALES TAX (5% OF TAXABLE MAT'L)					—	25,849	—		25,849
	SUBTOTAL					132,411	542,824	70,570		745,805
	CONTINGENCY (20%)					26,482	108,564	14,114		149,160
	SUBTOTAL					158,893	651,388	84,684		894,965
	O/H & PROFIT (@ 20%)					31,807	130,312	16,916		179,035
Bid Item: 4.1.1.5 / Project Area:	Total				3698	190,700	781,700	101,600		1,074,000

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TABLE 2.4 (Con't)

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 2 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
DECONTAMINATION						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
1.	INITIAL CONDITIONS				–	–	–	–	–	–
2.	PROCUREMENT/ASSEMBLY				–	–	413,331	–	–	413,331
3.	INSTALLATION				1569	37,333	85,930	–	–	123,263
4.	OPERATION & REMOVAL				504	12,600	500			13,100
	TRANSPORTATION AND DISPOSAL				–	–	–	70,570	–	70,570
	SUBTOTAL				2073	49,933	499,761	70,570	–	620,264
	INSTALLATION PRODUCTIVITY +62%				973	23,146				23,146
	OPERATION PRODUCTIVITY +45%				227	5620				5,620
	Total					78,749	499,761	70,570		030

Bid Item: 4.1.1.5 Project Area:

12230 1M

totals $70,570 and the various markups total $424,920.

2.3.1.1.8 PCW Piping Decontamination Duration

The schedule for embedded PCW piping decontamination is shown in Figure 2.3 . The overall duration is estimated to be approximately 10 weeks.

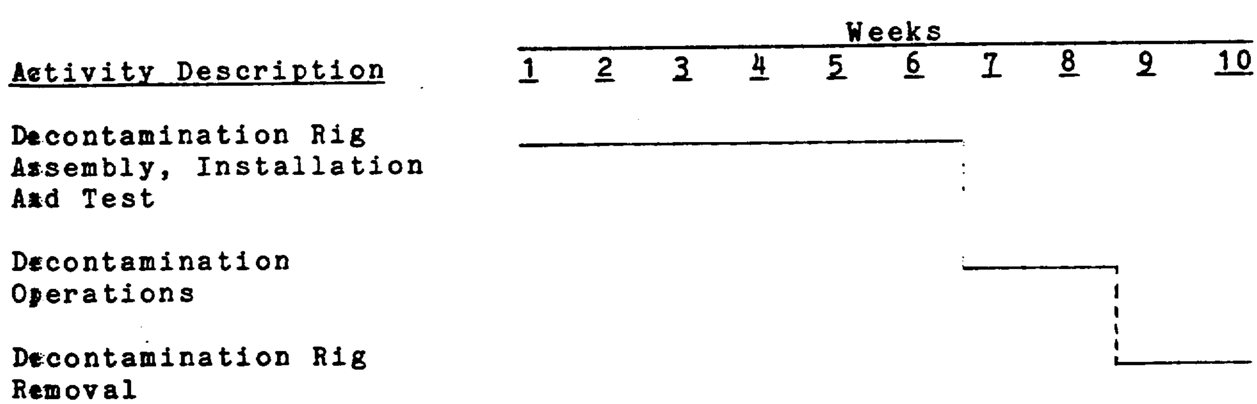
2.3.1.1.9 PCW Piping Decontamination Exposure

The estimated occupational radiation exposure for the PCW embedded piping decontamination is summarized on Table 2.5. The total exposure is estimated to be approximately 3.7 man-Rem.

Exposure during radwaste transportation is not included but would be very low.

FIGURE 2.3

PCW EMBEDDED PIPING DECONTAMINATION SCHEDULE



NOTE: Decontamination rig equipment procurement duration is not included.

TABLE 2.5

PCW EMBEDDED PIPING DECONTAMINATION EXPOSURE ESTIMATE

Activity Description	General Area Dose Rate (mR/hr)	Estimated General Area Work Time Manhours	Contact Dose Rate (mR/hr)	Estimated Contact Work Time Manhours	Estimated Occupational Exposure man-m Rem
Decontamination Rig Installation and Test (a)	0.05(b)	786	5(d)	525(c)	2831
Operations	0.05(b)	390	5(f)	167(e)	855
Decontamination Rig Removal	0.05(b)	120(g)	-	-	6
TOTAL					3692

(a) Decontamination Rig Assembly Manhours are not included since this should be done outside radiation areas.

(b) Since all radioactively contaminated piping and equipment are to be removed from the various work areas prior to embedded PCW piping decontamination, the general area dose rate should generally meet the 5uR/hr (0.005 mR/hr) dose rate limit for release so that a dose rate of 0.05 mR/hr is conservatively high.

(c) Approximately 40% of the total installation and test manhours are assumed to be spent close to the PCW piping.

(d) Based on direct radiation measurements taken by Teledyne Isotopes in June 1985, the PCW piping has a dose rate less than 5 mR/hr.

(e) Approximately 30% of the operations manhours are assumed to be spent close to the decontamination rig or HICs.

(f) Due to the large resin volume, the dose rate on the HICs will be less than the PCW pipe dose rate.

(g) It is assumed that the decontamination rig meets release limits after operations.

2.3.1.2 Q&C Embedded Piping Decontamination

The Q&C embedded piping is Sch 80 carbon steel, ranging in size from 3" to 10". The internal surfaces of accessible pumpout piping are highly corroded with rust, scale and deposits. Data taken by Teledyne Isotopes indicate that the maximum required DFs for removable and total contamination are 4.5 and 1380, respectively. The internal condition of the recirculation piping is unknown, but survey data indicates that contamination is 10 to 100 times less than the pumpout piping.

2.3.1.2.1 Process Selection

There are several non-chemical processes that could be considered for Q&C piping (Ref. 8 and 9). The honing (surface grinding) technique being developed at TMI (Ref. 14) has worked well in laboratory tests, but results during mockup testing have not been consistently good. The hone is capable of cleaning 4" to 8" pipe with insertion distances of 40 to 50 feet. Honing piping 3" and smaller and expansions or contractions have been problematic. Due to the configuration of the Q&C pumpout piping (6" piping teeing into 10" piping) and the 3" size of the recirculation piping, the honing system being developed at TMI would not be effective. The configuration of the pumpout piping would also be a problem for the mechanical methods described in Section 2 of Reference 9. Also, there is little or no experience in the use of such systems for radioactive pipe decontamination.

The use of flexible lance and high pressure water (1000 to 20,000 psi) may not achieve a releaseable surface because fixed contamination is difficult to remove (Ref. 9, Section 3). Ultrahigh pressure water (20,000 to 60,000 psi) at pressures of 40,000 to 45,000 psi readily remove films, scale and contamination down to white metal, but hard spray water supply piping is required above 35,000 psi, making cleaning inside long lengths of small piping difficult (Ref. 9, Section 4). Water abrasive blasting (Ref. 9, Section 5) could be considered, but development of suitable spray nozzle would be required for 8" to 12" I.D. piping, and application to piping less than 8" I.D. is not considered practical (Ref. 15). Also, assuring grit removal from all portions of the piping may require a high velocity water flush.

In-situ electropolishing has been used to decontaminate small diameter piping, but insertion of an internal cathode device is limited to about 30 feet (Ref. 9, Section 9). Electropolishing experience in Germany reported by KWU (Ref. 16) indicates DFs somewhat greater than 150, but the device is designed for short lengths of large reactor coolant piping. Steam generator tubes about 0.7 inches in diameter have also been electropolished with DF values of 40 to 100 (Ref. 20). In-situ electropolishing has not used successfully to any extent in the U.S. (Ref. 17). Electropolishing requires a relatively clean surface to be effective (Ref. 18), which is not the case with the Q&C pumpout piping.

Wet steam (with the addition of acid) has been used to clean scale and corrosion products containing fixed contamination from the inside of pipes up to 1800 feet in length (Ref. 9, Section 11). A mixing nozzle must be inserted down the pipe, which could be a problem at the floor drain end of the pumpout piping due to the elbows in the 6" piping. Performance data is not readily available.

Foam, generated from phosphoric acid or acidic mixture and air or nitrogen in a foam generator, can be pumped through pipes and removed by water rinsing or spraying. The foam's cleaning action is rather mild, and the DFs of 5 to 50 that have been attained were on relatively clean surfaces (Ref. 9, Section 12).

For decontamination of carbon steel, phosphoric acid (H_3PO_4) and sulfamic acid (NH_2SO_3H) are effective chemical decontamination reagents (Ref. 3 and 11). Phosphoric acid has the advantage of being a faster process with a typical DF of 20, whereas the typical DF for sulfamic acid is only 3. However, if phosphoric acid remains in contact with steel surfaces longer than 20 minutes, a film forms on surfaces causing redeposition of the contamination.

Because of the high DF required for the embedded pumpout piping, its poor internal condition, and its relatively complicated geometry, none of the chemical or non-chemical methods are considered to have a significant success probability. Therefore, removal of the embedded pumpout piping is the only viable option. The embedded recirculation piping may be within release limits, in which case decontamination would not be required. However, the embedded recirculation piping is, for the most part, adjacent to embedded pumpout piping that must be removed. Therefore, the recirculation piping should be removed with the pumpout piping unless further survey results confirm that it is within release limits. If it does meet release limits, it could be left in place or removed and set aside for unrestricted on-site use.

2.3.2 Removal of Embedded Piping

Removal of the PCW and Q&C embedded piping requires consideration of removal method, radwaste generation, cost, duration and radiation exposure. The removal of the piping first requires removal of non-radioactive reinforced concrete. For the PCW piping outside of containment, the steel sheathing around the pipes must be removed. Then the pipes must be cut and removed. Most of the piping, however, must be removed directly from the concrete matrix. The following is a discussion of historical information on controlled blasting and metal cutting techniques applicable to embedded piping removal.

For the Elk River decommissioning, various methods to remove concrete structures were evaluated (Ref. 1). Controlled blasting was selected as the method to use in removing large volumes of concrete and testing was done to verify the method. Controlled blasting was successfully accomplished on Elk River and on other decommissioning projects (Ref. 2), and it remains the method of choice for large volume concrete removal. Blast vibrations should not be a concern at the isolated PBRF site.

Similar data on the removal of reinforced concrete by controlled blasting is given in References 3 and 4, and the removal rate and cost data from Reference 4 is given in Table 2.6. The unit costs are in 1980 U.S. dollars and include crew cost, explosives, dust control measures, and subcontractor overhead and profit. Shipping and disposal costs are not included. The range of removal rates and costs shown reflect the difficulties associated with each type of concrete and the inefficiency of working in a radioactive environment. A typical blasting crew consists of the blasting expert, six laborers and one equipment operator (Ref. 4).

An approach to developing unit costs for concrete removal is given in Reference 5 for various concrete configurations. Local labor rates must be factored into the various unit rates to make them useable. The blasting parameters used in Reference 5 are generally consistent with blast design formulas given in Reference 6.

The effective use of blast mats and water fog spray to control dust and the spread of contamination is described in References 2 and 7. Standard steel cable blast mats are 10' x 12' and weigh 3000 pounds (Ref. 6). A water mist (fog) can be produced using commercially available misting nozzles and standard tap water pressure (Ref. 7). For PBRF, a fog spray should be required only around the bioshield where some activated concrete may exist.

TABLE 2.6

CONTROLLED BLASTING
CONCRETE REMOVAL RATES AND COSTS*

Concrete Type	Removal Rate cu. yd./8 hr. day	Removal Cost (1980) $/cu. yd.
Massive Reinforced Standard		
Concrete: Non-Radioactive	10-400	100
Radioactive	4-6**	
	100***	400
Massive Non-Reinforced Standard Concrete (Non-Radioactive)	250	13
Non-Reinforced High Density Concrete (Radioactive)	6-8**	35
Lightly Reinforced Standard		
Concrete: Non-Radioactive	100****	35
Radioactive	6-8**	

* From Reference 4

** Actual removal rates including inefficiency due to personnel contamination.

*** High removal rate possible if adequate space is available to use large capacity loading and hauling equipment.

**** Up to 1000 cu. yd./day reported.

Drilling has been done using both high-speed rotary percussion track (crawler) mounted drills (Ref. 2) which are capable of drilling a 6-foot deep hole in 3.5 minutes (Ref. 3) and slower hand held rotary percussion drills which can drill a 1" to 2" diameter hole 5' deep within 5 minutes (Ref. 7). Due to set-up time considerations, a hand held drill is about as fast as a track drill for holes 3' to 4' deep, but a hand held drill cannot penetrate rebar whereas a track drill can punch through rebar up to size #6 (Ref. 7).

Controlled blasting could probably be used successfully to directly loosen piping from the concrete without breaking the pipe (Ref. 7), but to be conservative, concrete removal by blasting to within about 6" of pipe followed by the use of paving breakers to expose the pipe will be assumed for estimating purposes.

Paving breakers (jack hammer or pneumatic drill) typically weighing 90 pounds would be used to remove small horizontal surfaces whereas chipping hammers, typically weighing 24 pounds, can be used to remove small vertical or overhead surfaces. They could be used in conjunction with controlled blasting to excavate around blast holes to improve access and to excavate embedded pipes out of the surrounding concrete. Removal rates and costs from Ref. 3 are summarized in Table 2.7. For almost all embedded piping removal, jack hammers would be used rather than chipping hammers.

TABLE 2.7

JACK HAMMER AND CHIPPING HAMMER
CONCRETE REMOVAL RATES AND COSTS*

Concrete Type	Removal Rate cu. yd./ 8 hr. day	Removal Cost (1980) $/cu. yd.	Removal Rate cu. yd./ 8 hr. day	Removal Cost (1980) $/cu yd.
Non-Reinforced**	20	32	1	$640/cu. yd.
Reinforced Concrete***	12	62	<1	>$744/cu. yd.

* Reference 3
** Crew consists of one light equipment operator and two laborers.
*** Crew consists of one light equipment operator, two laborers and one iron worker.

Rebar can be cut using hydraulic bolt cutters, but an oxyacetylene torch is normally used (Ref. 7). The steel sheathing around the PCW pipes outside containment could also be cut by oxyacetylene torch. Oxyacetylene torch may be used to cut carbon steel pipe, but plasma arc torch should be used for stainless steel pipe cutting (Ref. 3, Table 8.1). Hand held torches can be used since pipe walls are thin enough and the survey data indicates that radiation levels will be low. Hand held torch cutting minimizes the access that must be opened around the pipe cut locations. Torch operators must wear filter masks, and a high volume ventilation system should be provided to draw contaminated fumes through HEPA filters (Ref. 3). Data on plasma arc cutting is given in Ref. 3, Sections 6.3.2 and 8.3.1 and Ref. 4, Section 3.2. Data on oxyacetylene torch cutting (oxygen burner) is given in Ref. 3, Section 6.3.3 and 8.3.2 and Ref. 4, Section 3.3.

2.3.2.1 Quadrant & Canal (Q&C) Embedded Pipe Removal

2.3.2.1.1 Initial Conditions

1. All non-embedded radioactive piping and equipment either decontaminated or removed from quadrants and canals.

2. Gates between Quadrants "C" and "A" and Canal "F" and gate between Canal "F" and "G" removed.

3. Bulkhead between Canal "H" and "G" removed.

4. Quadrant and canal surfaces decontaminated such that concrete to be removed can be considered clean.

5. Risers removed from recirculation (purge) and overflow piping.

2.3.2.1.2 Q&C Pipe Data (Teledyne Isotopes Letter of 6/25/85)

- Mainly 3", 6" and 10"
- Carbon Steel
- Sch 80

2.3.2.1.3 Reinforced Concrete Data

Slab at 0'0" North of Canal "G" (PF-001660):

- 8" Thick with #4 x #4 on 6" x 6" Mesh Reinforcing
- Compacted Fill Below

Containment Mats (PF-00171):

- #11 Bar at 12" OC x #11 Bar at 12" OC at Containment OD, 12" Deep

Canal "F" and "G" Floor (PF-00155, 00162):

- Top #11 at 4" OC x #8 at 12" OC
- Bottom #8 at 4" OC x #8 at 12" OC

Reactor Building El. -25' Floor (PF-00156 and 157):

- #4 x #4, 6" x 6" Mesh
- 7" Thick
- Fill Below

Quad Divider Walls (PF-00171, Section 5 and 00172):

- Vertical, #11 at 8" OC, Each Face
- Horizontal, #8 at 12" OC, Each Face
- Diagonal/Vertical, #11 at 4" OC, Each Face, El. -15' to -30'

Quad OD Wall (PF-00171, Section 1/221 and 00172):

- Vertical, 4 Curtains, #8 at 12" OC Down to El. -28'
- Hoops, 4 Curtains, 1.5" dia. at 4-1/2" OC

2.3.2.1.4 Reference Drawings for Q&C Embedded Piping Removal

PF-00155	PF-00375
156	376
157	385
162	770
166	850
171	855
172	PF-04645

2.3.2.1.5 Productivity Factors for Q&C Embedded Piping Removal

Same as for PCW piping removal given in Section 2.3.2.2.5 (page 2-87).

2.3.2.1.6 Concrete Removal Estimates for Q&C Embedded Piping Removal

Concrete removal is estimated in Table 2.8 based on concrete removal to within about 6" of the piping by controlled blasting with final exposure and loosening of pipes from the concrete by jack hammer.

2.3.2.1.7 Q&C Contaminated, Embedded Piping Estimate for Shipping and Burial

Embedded Q&C piping to be removed is described in Table 2.9. The total lengths of the various pipe sizes are summarized in Table 2.10.

Since each size pipe can be nested in the next larger pipe, the 300' of 10" pipe can nest all of the 4", 6" and 8" pipe and 300' of the 3" pipe (only one length of 3" pipe will fit in a 6" pipe). Also, one 3" pipe can be placed between four 10" pipes. Thus, containers to hold 300' of nested 10" pipe and 270' of 3" pipe would be required. After cutting into 5' lengths, about 54 segments of non-nested 3" pipe must be placed in containers. Based on the B-25 container (see 2.3.2.2.7, page 2-89), 16 lengths of nested 10" pipe plus 9 lengths of 3" pipe (or 144 lengths of only 3" pipe) can be loaded in one container. Four (4) containers will hold the nested 10" pipe plus all of 3" pipe. To account for packaging inefficiencies, five (5) containers 80% filled are assumed for cost estimating. The burial volume based on 98 cu. ft. per container is 490 cu. ft.

The Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule (Ref. 28) includes surcharges for weight and Curie content. The total weight of the embedded Q&C piping is estimated to be 39,340 pounds. Each container would, therefore, contain

TABLE 2.8

Concrete Removal to Remove Q&C Embedded Piping

Area	Location	Blasting	Jack Hammer
Quad "D"	Floor	None	7'x3'x3' deep = 63 ft^3 = 2.3 yd^3
Quad "C"	Floor	None	8'x3'x3' deep = 72 ft^3 = 2.7 yd^3
Quad "B"	Floor	None	(4'x 1.5' + 1.5' x 1.5) x 3' deep = 25 ft^3 = 0.9 yd^3
Quad "A"	Floor	None	8'x3'x3' = 72 ft^3 = 2.7 yd^3
RB Annulus Basement	Floor	3.5'x41' x 1.5 deep = 2.15 ft^3 = 8 yd^3	2'x41'x1' deep = 82 ft^3 = 3 yd^3
	Tunnel Under Quad "D" Wall	4'tk x 3.5'w x 4'h = 56 ft^3 = 2 yd^3	2'x4'x1' deep = 8 ft^3 = 0.3 yd^3
Canal "E"	Floor Area 1	250 ft^2 x 1.5' deep = 375 ft^3 = 13.9 yd^3	155 ft^2 x 1' deep = 155 ft^3 = 5.7 yd^3
	Floor Are 2	56 ft^2 x 1.5' deep = 84 ft^3 = 3.1 yd^3	42 ft^2 x 1' deep = 42 ft^3 = 1.6 yd^3 12 ft^2 x 2.5' deep = 30 ft^3 = 1.1 yd^3 Total = 2.7 yd^3
	Floor Area 3	45 ft^2 x 1.5' deep = 68 ft^3 = 2.5 yd^3	22 ft^2 x 1' deep = 22 ft^3 = 0.8 yd^3
	Floor Area 4	39 ft^2 x 1.5' deep = 59 ft^3 = 2.2 yd^3	20 ft^2 x 1' deep = 20 ft^3 = 0.7 yd^3
	Tunnel Under Quad "C" Wall	3' tk x 4'w x 4'h = 48 ft^3 = 1.8 yd^3	3' th x 3'w x 1' deep = 0.3 yd^3

Concrete Removal to Remove Q&C Embedded Piping

Area	Location	Blasting	Jack Hammer
Canal "E" (con't)	2 Tunnels Under Quad "B" Wall	2 (3'tk x 4'w x 4'h) = 96 ft^3 = 3.6 yd^3	3'tk x 1.5 w x 1' deep = 4.5ft^3 = 0.2 yd^3 3'tk x 3'w x 1' deep = 9 ft^3 = 0.3 yd^3 Total = 0.5 yd^3
	Tunnel Under Quad "A" Wall	3'tk x 3'w x 4'h = 36 ft^3 = 1.3 yd^3	3'tk x 1.5'w x 1' deep = 4.5 ft^3 = 0.2 yd^3
RB North of Canal "G"	Floor Slab Fill	.67' tk x 15' x 12' = 120 ft^3 = 4.5 yd^3 (Remove 180 ft^2 x 27' = 4860 ft^2 of compacted fill, shoring as required)	-
	Containment Wall	-	Cut steel liner with torch and remove. Then tunnel around pipes 1'tk x 8' x 1' = 8 ft^3 = 0.3 yd^3
	Canal "F" Wall	2.5'tk x 6'w x 3'h = 45 ft^3 = 1.7 yd^3	2.5tk x 5' x 1' = 13 ft^3 = 0.5 yd^3
Canal "F","G", & "H"	Floor Area 1	7' x 12' x 1.5' deep = 126 ft^3 = 4.7 yd^3	5' x 12' x 1' deep = 60 ft^3 = 2.2 yd^3
	Canal "F" Wall	2.5'tk x 6'w x 3'h = 45 ft^3 = 1.7 yd^3	2.5'tk x 5' x 1' = 13 ft^3 = 0.5 ft^3
	Floor Area 2	422 ft^2 x 1.5' = 633 ft^3 23.4 yd^3	25 ft^2 x 2.6' = 65 ft^3 = 2.4 yd^3 350 ft^2 x 1' = 350 ft^3 = 13 yd^3 Total = 15.4 yd^3
	Canal "F" Wall	2.5'th x 14' x 3'h = 105 ft^3 = 3.9 yd^3	2.5'th x 13'x1'= 33 ft^3 = 1.2 yd^3
	Tunnel Under Canal "G" to "F" Wall	2'tk x 3'w x 4'h = 24 ft^3 = 0.9 yd^3	3'tk x 1.5w x 1'deep = 4.5 ft^3 = 0.2 yd^3

TABLE 2.8 (Cont'd)

Concrete Removal to Remove Q&C Embedded Piping

Area	Location	Blasting	Jack Hammer
RB Southwest at El -25' and Pump Room	Floor Area 1 Including digging under pump room wall	(19' x 3' + 21' x 13' + 12' x 10') x 1.5' = 675 ft^3 =25 yd^3	(2' x 16' + 2' x 16' + 3.5' x 19' + 4' x 9' + 1/2 (7' x 6') + 15' x 5') x 1' = 263 ft^3 = 9.7 yd^3
	Floor Area 2 Including digging under pump room wall	15.5' x 14.5' x 1.5' = 337 ft^3 = 12.5 yd^3	15.5' x 13' x 1.2' = 242 ft^3 = 9 yd^3
	Trench and Sump Floor Area	3.5' x 10' x 3.5' = 123 ft^3 = 4.5 yd^3	2' x 15' x 1' = 30 ft^3 = 1.1 yd^3
	3 Cont. Wall Penetrations	-	Cut steel liner with torch and remove, then tunnel around pipes 1'tk x (1.5 + 1.5 + 4) x 1' = 7 ft^3 = 0.3 yd^3
Hot Lab Bldg. Dry Hot Storage	Floor	(15' + 11') x 3' x 2.5 = 195 ft^3 = 7.2 yd^3	39' x 2.5' x 1.5' = 146 ft^3 = 5.4 yd^3
	3 Tunnels Thru Wall	3 x (5'tk x 4'w x 4'h) = 240 ft^3 8.9 yd^3	3 (5'tk x 2'w x 1') = 30 ft^3 = 1.1 yd^3
Canal "J" & "K"	Floor	(41' x 3' + 9' x 3') x 3.5" deep = 525 ft^3 = 19.4 yd^3	(41' x 2' + 9' x 2') x 1' = 100 ft^3 = 3.7 yd^3 4' x 3' x 4.5' deep = 54 ft^3 = 2 yd^3 (2' x 9' + 2' x 8" + 35' x 3' + 5' x 2' + 45' x 2') x 1.5 = 306 ft^3 = 11.3 yd^3 Total = 17 yd^3

TABLE 2.8 (Cont'd)

Concrete Removal to Remove Q&C Embedded Piping

Area	Location	Blasting	Jack Hammer
Canal "J" & "K" (con't)	South Wall Tunnel	4'tk x 15'w x 4'h = 240 ft^3 = 8.9 yd^3	4'tk x 15'w x 1'd = 60 ft^3 = 2.2 yd^3
Valve Pit Area	Floor	9' x 5' x 1.5' = 54 ft^3 = 2 yd^3	3' x 8' x 1' = 24 ft^3 = 0.9 yd^3
	RB Wall	2'tk x 5'w x 4'h = 40 ft^3 = 1.5 yd^3	2'tk x 3'w x 1'd = 6 ft^3 = 0.2 yd^3
Totals		170 yd^3	90 yd^3

TABLE 2.9

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	-25' Quad D	Pump Out	6/10	8/1	2'-6"	2 Floor Drains	375
RB	-25' Quad D	Recirc	3	1	2'-6"	Excludes 22' Flanged Riser	375/376
RB	-25' Quad C	Pump Out	6/10	8/1	2'-6"	2 Floor Drains	376
RB	-25' Quad C	Recirc	3	1	-	Excludes 22' Flanged Riser	376
RB	-25' Quad B	Pump Out	6/10	3/1	2'-6"	Piping Under Quad Wall 2 Pool Drains	376
RB	-25' Quad B	Recirc	3	8	2'-6"	4' Under Quad Wall Closed line so may be clean. Extent of riser uncertain.	376
RB	-25' Quad A	Pump Out	6/10	8/1	2'-6"	2 Floor Drains	376
RB	-25' Quad A	Pump Out	10	4	2'-6"	3' Under Quad Wall	376
RB	Annulus Basement	Quad D Pump Out	10	39	2'-6"		375/376
RB	Annulus Basement	Quad D Pump Out	10	4	-	Undewr Quad "D" Wall	375
RB	Annulus Basement	Quad D Recirc	3	41	2'-6"		375/376
RB	Annulus Basement	Quad D Recirc	3	4	-	Under Quad "D" Wall	375

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	Canal "E" EL-25'	Quad D Pump Out	10	40	2'-6"		376
	Canal "E" EL-25'	Quad D Recirc	3	40	2'-6"		376
	Canal "E" EL-25'	Quad C Pump Out	10	2.5	-	Under Quad C Wall	376
	Canal "E" EL-25'	Quad C Pump Out	10	24	2'-6"		376
	Canal "E" EL-25'	Quad C Recirc	3	3	-	Under Quad C Wall	376
	Canal "E" EL-25'	Quad C Recirc	3	25	2'-6"		376
	Canal "E" EL-25'	Quad B Recirc	3	18	2'-6"		376
	Canal "E" EL-25'	Canal "E" Pump Out	6	22	2'-6"	3 Floor Drains	376
	Canal "E" EL-25'	Canal "E" Pump Out	8	8	2'-6"		376
	Canal "E" EL-25'	Canal "E" Pump Out	10	5	2'-6"		376
	Canal "E" EL-25'	Canal "E" Recirc	3	1	2'-6"	Excludes Riser	376
	Canal "E" EL-25'	Quad B Pump Out	10	15	2'-6"		376
	Canal "E" EL-25'	Quad A Pump Out	10	13	2'-6"		376

TABLE 2.9 (Cont'd)

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	0'0" Slab and Compacted Fill North of Canal "G"	Quad D Pump Out	10	1.5	-	Under Cont. Wall	376
		Quad D Pump Out	10	15	27'-6"	In Fill	376
		Quad D Pump Out	10	2.5	-	Under Canal "F" Wall	376
		Quad D Recirc	3	1.5	-	Under Cont. Wall	376
		Quad D Recirc	3	19	27'-6"	In Fill	376
		Quad D Recirc	3	2.5	-	Under Canal "F" Wall	376
		Quad C Pump Out	10	1.5	-	Under Cont. Wall	376
		Quad C Pump Out	10	11	27'-6"	In Fill	376
		Quad C Pump Out	10	2.5	-	Under Canal "F" Wall	376
		Quad C Recirc	3	1.5	-	Under Cont. Wall	376
		Quad C Recirc	3	14	27'-6"	In Fill	376
		Quad C Recirc	3	2.5	-	Under Canal "F" Wall	376
		Quad B Recirc	3	1.5	-	Under Cont. Wall	376

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
		Quad B Recirc	3	9	27'-6"	In Fill	376
		Quad B Recirc	3	2.5	-	Under Canal "F" Wall	376
RB	Canal "F", "G", & "H" EL- 25'	Quad "D" Pump Out	10	12	2'-6"		376
		Quad "D" Recirc	3	12	2'-6"		376
		Quad "C" Pump Out	10	12	2'-6"		376
		Quad "C" Recirc	3	12	2'-6"		376
		Quad "B" Recirc	3	12	2'-6"		376
		Canal "H" Pump Out	6	62	2'-6"	One Floor Drain	376
		Canal "H" Recirc	3	72	2'-6"	Excludes Riser	376
		Canal "H" Overflow	4	38	4'-3"	Excludes Riser	376
		Canal "H" Overflow	8	19	4'-3"	Excludes Risers	376
		Canal "G" Pump Out	6	23	2'-6"	One Floor Drain	376
		Canal "G" Recirc	3	21	2'-6"	Excludes Riser	

TABLE 2.9 (Cont'd)

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG: PF-00XXX
		Canal "F" Pump Out	6	1	2'-6"	One Floor Drain	
		Canal "F" Recirc	3	1	2'-6"	Excludes Riser	
		Dry Hot Storage Drain	4	21	3'-2"	Includes 2' Under Canal "G" to "F" Wall	
RB	-25' El SW & Pump Room	Quad D Pump Out	10	2.5	-	Under Canal "F" Wall	376
		Quad D Pump Out	10	21	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad D Recirc	3	2.5	-	Under Canal F Wall	376
		Quad D Recirc	3	20	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad C Pump Out	10	2.5	-	Under Canal "F" Wall	376
		Quad C Pump Out	10	24	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad C Recirc	3	2.5	-	Under Canal "F" Wall	376
		Quad C Recirc	3	23	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad B Recirc	3	2.5	-	Under Canal "F" Wall	376
		Quad B Recirc	3	26	2'-6"	Includes 9" Under Pump Room Wall	376

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	-29' El SW & Pump Room (Cont'd)	Canal "E" Pump Out	10	2	-	Under Cont. Wall	376
		Canal "E" Pump Out	10	21	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal "E" Recirc	3	2	-	Under Cont. Wall	376
		Canal "E" Recirc	3	20	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad B Pump Out	10	1	-	Under Cont. Wall	376
		Quad B Pump Out	10	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad A Pump Out	10	1	-	Under Cont. Wall	376
		Quad A Pump Out	10	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal F Recirc	3	2.5	-	Under Canal "F" Wall	376
		Canal F Recirc	3	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal F Pump Out	6	2.5	-	Under Canal "F" Wall	376
		Canal F Pump Out	6	16	2'- "	Includes 9" Under Pump Room Wall	376
		Canal G Recirc	3	2.5	-	Under Canal "F" Wall	376

TABLE 2.9 (Cont'd)
EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	-25' El SW & Pump Room (Cont'd)	Canal G Recirc	3	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal G Pump Out	6	2.5	-	Under Canal "F" Wall	376
		Canal G Pump Out	6	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal "H" Recirc	3	2.5	-	Under Canal "F" Wall	376
		Canal "H" Recirc	3	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal "H" Pump Out	6	2.5	-	Under Canal "F" Wall	376
		Canal "H" Pump Out	6	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal F,G H Overflow	8	2.5	-	Under Canal "F" Wall	376
		Canal F,G H Overflow	8	30	4'-3"	Includes 9" Under Pump Room Wall and 5' under trench	376
		Dry Hot Storage Drain	4	2.5	-	Under Canal "F" Wall	376
		Drain	4	16	3'-2"	Includes 9" Under Pump Room Wall	376
		HLB Pump Out	6	11	2	Includes 9" Under Pump Room Wall	376
		HLB Pump Out	6	2	-	Under RB Wall	376

TABLE 2.9 (Cont'd)

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
		HLB Recirc	3	13	2	Includes 9" Under Pump Room Wall	376
		HLB Recirc	3	2	-	Under RB Wall	376
HLB	Dry Hot Storage Cell, -25'	DHS Pump Out	4	38	3'-2"	2 Floor Drains	4645
		DHS Pump Out	4	5		Under DHS Wall	4645
		DHS Pump Out	6	6	1.5'	Sealed Floor Drain, Line Should Be Clean	4645
		DHS Pump Out	6	8	-	Under DHS Wall	4645
		DHS Recirc	3	2	1.5	Excluding Riser	4645
		DHS Recirc	3	5	-	Under DHS Wall	4645
		DHS Overflow	4	2	4'-3"	Excluding Riser	4645
		DHS Overflow	4	5	-	Under DHS Wall	4645
HLB	Canal "J" & "K" El- 25	DHS Pump Out	6	12	1.5	Should Be Clean	4645
		DHS Pump Out	6	4	-	Under Canal "J" Wall	4645
		Canal J Pump Out	6	8	1.5	One Floor Drain	4645

TABLE 2.9 (Cont'd)

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
		Canal J Pump Out	6	4	-	Under Canal "J" Wall	4645
		Canal K Pump Out	6	44	1.5	One Floor Drain	4645
		Canal K Pump Out	6	6	-	Under Canal "J" Wall	4645
		Canal K Recirc	3	32	1	Excluding Riser	4645
		Canal K Recirc	3	4	-	Under Canal "J" Wall	4645
		Canal J Recirc	3	2	1	Excluding Riser	4645
		Canal J Recirc	3	4	-	Under Canal "J" Wall	4645
		DHS Recirc	3	12	1		
		DHS Recirc	3	4	-	Under Canal "J" Wall	4645
		Overflow	4	62	4'-3"	Excluding Risers	4645
		Overflow	4	4	-	Under Canal "J" Wall	4645
HLB	Valve Pit Area, -25'	Pump Out	6	6	2	From Valve Pit to RB Wall	4645
	Valve Pit Area, -25'	Recirc	3	7	2	From Valve Pit to RB Wall	4645

about 7868 pounds of piping. Based on a container weight of 900 pounds, each container would weigh approximately 8768 pounds.

Barnwell's April 15, 1985 Rate Schedule indicates a weight surcharge of $550 per container. The embedded Q&C piping is estimated to have an internal surface area of 1.82 E6 sq. cm. Based on the maximum measured beta-gamma dose rate of 345 mR/hr (which is equivalent to approximately 6.9 E6 dpm/100 sq. cm.), the total activity in all the embedded Q&C piping is less than 0.06 Curies. There is no surcharge for shipments of less than 1 Curie.

The total weight of the embedded Q&C piping and containers is approximately 43,840 pounds. Although this could probably be shipped in one truck load, two truck loads were assumed for estimating purposes.

TABLE 2.10

Q&C EMBEDDED PIPING SUMMARY

Q&C Pipe Size, in.		Total Horizontal* Length, ft.	Sch 80 ID in.	Sch 80 OD in.
3		570	2.9	3.5
4		200	3.826	4.5
6		300	5.761	6.625
8		60	7.625	8.625
10		300	9.564	10.75
	Total	1430		

*Vertical runs are negligible.

2.3.2.1.8 Q&C Embedded Pipe Removal Procedures

Four general procedures cover removal of all of the Q&C embedded piping: Concrete Removal from Floors, Concrete Removal Under Walls; Slab and Compacted Fill Removal and Piping Removal. All concrete to be removed is assumed to be non-radioactive.

2.3.2.1.8.1 Concrete Removal From Floors

Concrete is first removed to within 6" of the pipe by controlled blasting and the remaining concrete cover is removed by jack hammers.

Operations:

1. Move drilling equipment (track drill where possible) into position

2. Drill vertical holes to within 3" of top of embedded pipe.

3. Place charges and stemming (material placed in hole to prevent gases from escaping upon detonation).

4. Place blast mats.

5. Evacuate area and detonate charges.

6. Verify all charges have detonated.

7. Remove mats.

8. Check for contamination (none expected since drill holes are at least one charge diameter from pipe. Ref. 7)

9. Cut rebar with torch and pile on floor nearby.

10. Remove rubble with small backhoe if space permits or by hand (shovel) and pile on floor nearby.

11. Remove concrete with jack hammer above and on sides of pipe until it is loose, and at predetermined locations excavate under pipe to provide access for cutting torch (at all elbows and about every 20' along runs).

2.3.2.1.8.2 Concrete Removal Under Walls

After trenching up to walls from both sides, a hole about 4' high is to be blasted through the wall with the bottom of the hole located about 1' above the pipe(s), thereby permitting access to remove the remaining concrete cover using jack hammers. The width of the blasted hole should be 3 feet or more, depending on the number of adjacent pipes embedded under the wall.

1. Move drilling equipment (track drill where possible) into position.

2. Drill horizontal holes through wall.

3. Place charges and stemming.

4. Place blast mats.

5. Evacuate area and detonate charges.

6. Verify all charges have detonated.

7. Remove mats.

8. Check for contamination (none expected).

9. Cut rebar with torch and pile locally.

10. Remove rubble using backhoe or shovel and pile locally.

11. Remove concrete with jack hammer above and sides of pipe until loose.

2.3.2.1.8.3 Slab and Compacted Fill Removal

Concrete floor slab about 8" thick on Elevation 0'-0" in the Reactor Building is to be removed by controlled blasting, the fill down to the pipes is to be removed, shoring as required.

1. Move hand drilling equipment into position.

2. Use hand drills to drill holes in slab.

3. Place charges and stemming.

4. Place blast mats.

5. Evacuate area and detonate charges.

6. Verify all charges have detonated.

7. Remove mats.

8. Cut mesh reinforcing with torch or hydraulic cutter.

9. Remove rubble and mesh to local pile.

10. Remove fill, shoring as required (about 27' of fill must be removed to reach pipes), and pile locally.

2.3.2.1.8.4 Piping Removal

1. Install contamination controls (plastic sheet under cutting locations and elephant trunk to exhaust fan with the HEPA filter) at cut locations and at a segmenting area nearby.

2. Cut pipe using hand held oxyacetylene torch at pre-determined locations, normally every 20' and at all elbows.

3. Pry pipe from concrete and cover ends with plastic sheet and tape.

4. Rig if necessary to move pipe to segmenting area.

5. Segment pipe into about 5' lengths using

power hacksaw or oxy-torch.

6. Nest 3", 4", 6", 8" and 10" pipe and load into shipping containers (remove end coverings as required).

7. Remove contamination controls and bag plastic sheeting.

8. Survey area.

9. Erect safety barriers as required.

2.3.2.1.9 Q&C Pipe Removal Cost

The estimated cost for removal of the embedded Q&C piping is summarized in Table 2.11. The total estimated cost is $372,500 in 1985 dollars (no escalation). A contingency of 20% is included.

For clean concrete removal, the penalty evaluated for reduced productivity (due to work inside a nuclear facility) increased the manhours and costs by a factor of 1.74. For contaminated pipe removal, manhours and costs were increased by a factor of 1.85. These factors are consistent with the factors used for similar work in other decommissioning estimates (Ref. 5 and 13).

The unit rates developed and used in this estimate are summarized in Table 2.12.

Table 2.11 Estimated Cost of Q & C
Embedded Pipe Removal

Direct Cost Summary by Bid Item

3764-01
Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 1 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q&C PIPE REMOVAL (EMBEDED)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST (FROM PAGE 2 OF 2)				4691	112,132	15,905	27,677		155,714
	CRAFT SUPPORT LABOR (7% OF D.L.)				328	7849	–	–		7849
	NON-CRAFT SUPPORT (6% OF D.L.)				281	6,728	–	–		6728
	SUBTOTAL				5,300	126,709	15,905	27,677		170,291
	PAYROLL TAXES & INSURANCE (48.8% OF LABOR)					61,834				61,834
	SUBTOTAL					188,543	15,905	27,677		232,125
	SMALL TOOLS (6% OF LABOR + PART II)					–	11,313	–		11,313
	EQUIP. F.O.M (7% OF LABOR + PART II)					–	13,198	–		13,198
	SUBTOTAL					188,543	40,416	27,677		256,636
	SALES TAX (5% OF TAXABLE MAT'L)					–	2021	–		2021
	SUBTOTAL					188,543	42,437	27,677		258,657
	CONTINGENCY (20%)					37,709	8487	5535		51,731
	SUBTOTAL					226,252	50,924	33,212		310,388
	O/H & PROFIT (±20%)					45,248	10,176	6688		62,112
Bid Item 2.2.2 / Project Area 13.1	Total				5300	271,500	61,100	39,900		372,500

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TABLE 2.11 (Cont'd)

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: AHK
Checked by:
Page 2 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q&C PIPE REMOVAL (EMBEDDED)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours CONC.	Manhours PIPE	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	QUAD "D"				14	11	597	106			703
	QUAD "C"				16	11	645	111			756
	QUAD "B"				6	12	428	94			522
	QUAD "A"				16	14	715	135			850
	RB ANNULUS				37	72	3078	865			3943
	"CANAL "E"				135	212	8314	2457			10,771
	RB BASEMENT				7	-0-	173	89			262
	NORTH OF CANAL "G"				296	85	8940	974			9914
	CANALS "F", "G", & "H"				216	275	12,225	3406			15,631
	SOUTHWEST RB @ ELEV -25' & PUMP ROOM				222	378	14,342	4103			18,445
	HOT LAB BUILDING				48	-0-	1167	291			1458
	HOT DRY STORAGE				27	67	2248	705			2953
	CANAL "J" & "K"				177	184	8673	2393			11,066
	VALVE PIT AREA				12	15	611	196			807
	CONTAINERS, TRANSPORTATION & DISPOSAL								27,677		27,677
	SUBTOTAL				1233	1376	62,176	15,905	27,677		105,758
											22,344
	CONCRETE PRODUCTIVITY + 242!		24.50		912		22,344				27,612
	PIPING PRODUCTIVITY + 852		23.60			1170	27,612				
					2145	2546					

Bid Item	Project Area					Total Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
2.2.2.		Total				4691	112,132	15,905	27,677		155,714

B223 3/11M

TABLE 2.12

UNIT RATES SUMMARY*

Activity Description	Manhours/ Unit	Aver. Crew Labor Cost $/MH	Material Cost $/Unit	Total Rate $/Unit
Non-Radioactive Concrete Removal by Controlled Blasting - Rubble Piled Adjacent to Removal Location	2.3/CY	25	27/CY	84.50/CY
Non-Radioactive Concrete Removal by Jack Hammer - Rubble Piled Adjacent to Removal Location	5.8/CY	24	18/CY	157.20/CY
Excavate Clean Compacted Fill	1.5/CY	23.28	11/CY	35.92/CY
Contaminated Pipe Removal - 2.5" to 8" Diameter, Including Cutting to 5' Lengths and Packaging	0.9/LFP	23.60	6.25/LFP	27.49/LFP
Contaminated Pipe Removal - 8" Diameter and Larger, Including Cutting to 5' Lengths and Packaging	1.05/LFP	23.60	7.30/LFP	32.08/LFP
Sectioning 24" Diameter Pipe	0.2/LFC	23.60	0.10/LFC	4.82/LFC

CY = Cubic Yard; LFP - Linear Feet of Pipe; LFC = Linear Feet of Cut

*These unit rates are used to estimate major work activities. Other unit rates for minor activities were selected by the estimator, based in part on References 26 and 27.

2.3.2.1.10 Q&C Pipe Removal Duration

The schedule for embedded Q&C piping removal is shown in Figure 2.4. The overall duration for this work is estimated to be approximately 10 weeks, based on a peak of 3 crews for concrete removal and 3 crews for pipe removal.

2.3.2.1.11 Q&C Pipe Radiation Exposure

The estimated occupational radiation exposure for the removal of the Q&C embedded piping is summarized in Table 2.13 (Page 2-82). The total exposure is estimated to be approximately 22.6 man-rem, based on current dose rate measurements. The decay of dose rate prior to the embedded Q&C piping removal work could reduce this estimated exposure by 50% or more if Co 60 is currently the dominant radionuclide, as expected. Exposure during radwaste transportation is not included but would be very low.

2.3.2.2 Primary Cooling Water (PCW) Embedded Pipe Removal

After the Q&C embedded piping is removed, the PCW embedded piping (which runs under the Q&C piping in several locations) may be removed. The configuration of the PCW pipes is shown in Figures 2.5 and 2.6 (pages 2-83 and 2-84). Pipe cut locations for removal are shown by heavy lines and cuts at local segmenting areas are shown by dashed lines.

FIGURE 2.4

Q&C EMBEDDED PIPING REMOVAL SCHEDULE

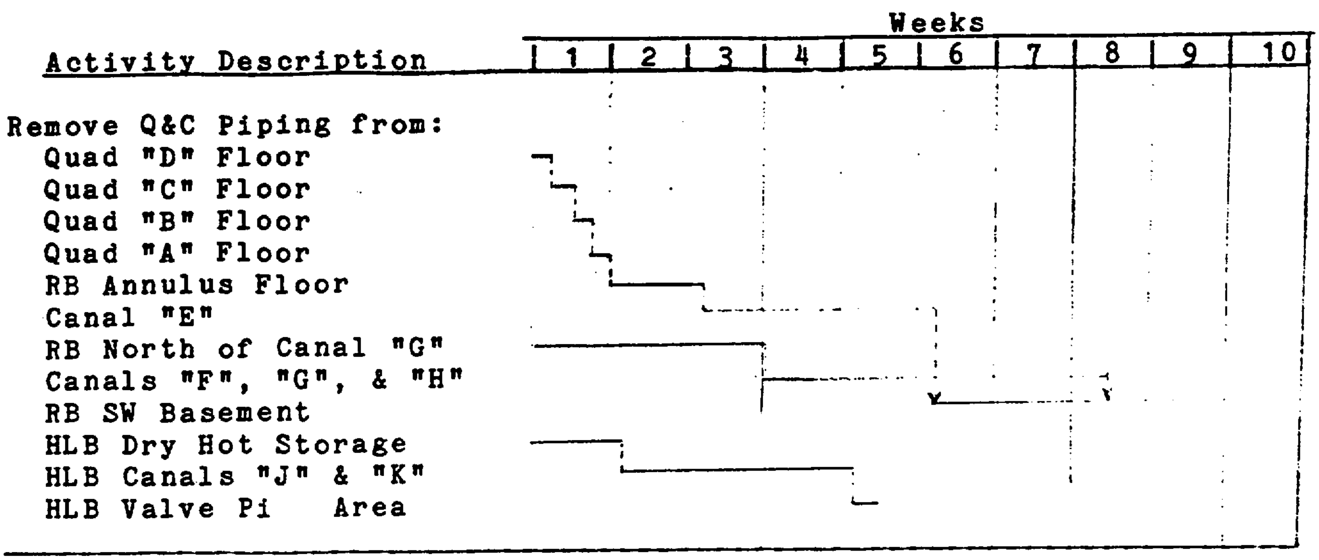

TABLE 2.13

Q&C EMBEDDED PIPING REMOVAL EXPOSURE ESTIMATE

Activity Description	General Area Dose Rate (mR/hr)	Estimated General Area Work Time Manhours	Contact Dose Rate (mR/hr)	Estimated Contact Work Time Manhours	Estimated Occupational Exposure man-m Rem
Clean Concrete Removal	0.05(a)	1445	5(c)	700(b)	3,572
Piping Removal	0.05(a)	646	10(e)	1900(d)	19,032
Total					22,604

(a) Since all radioactivity contaminated piping and equipment are to be removed from the various work areas prior to embedded Q&C piping removal, the general area dose rate should generally meet the 5 uR/hr (0.005 mR/hr) dose rate limit for release so that a general area dose rate of 0.05 mR/hr is conservatively high.

(b) Approximately 33% of the total concrete removal manhours are assumed to be spent close to the Q&C piping, including all of the jack hammer removal manhours and about 80 manhours due to fill removal operations.

(c) Since some concrete (shielding) will exist around the Q&C piping during most of the concrete removal operations, an average of 5 mR/hr is considered conservative relative to the maximum pipe dose rate discussed in (e) below.

(d) Approximately 75% of the pipe removal manhours are assumed to be spent near the Q&C piping due to the use of hand held torch for cutting operations.

(e) Based on direct radiation measurements taken by Teledyne Isotopes in June 1985, the Q&C pipe dose rate ranges from 0.23 to 20 mR/hr ($\simeq$ 5 mR/hr average) for pumpout piping and from 0 to 2.5 mR/hr for recirculation piping. Therefore, an average contact dose rate of 10 mR/hr is considered conservatively high.

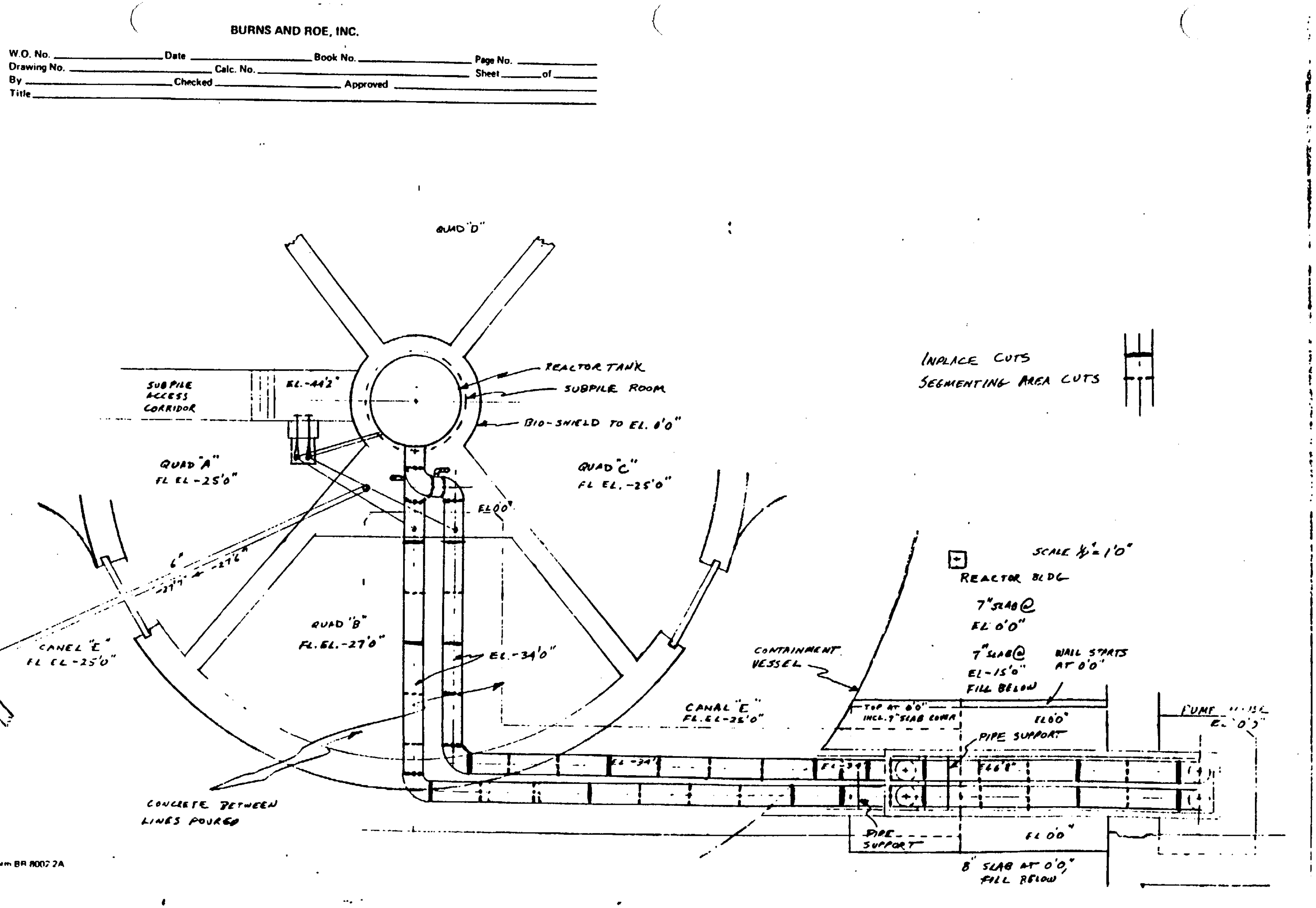

FIGURE 2.5 - Plan View of Primary Cooling System Piping

BURNS AND ROE, INC.

W.O. No. ______ Date ______ Book No. ______ Page No. ______
Drawing No. ______ Calc. No. ______ Sheet ______ of ______
By ______ Checked ______ Approved ______
Title ______

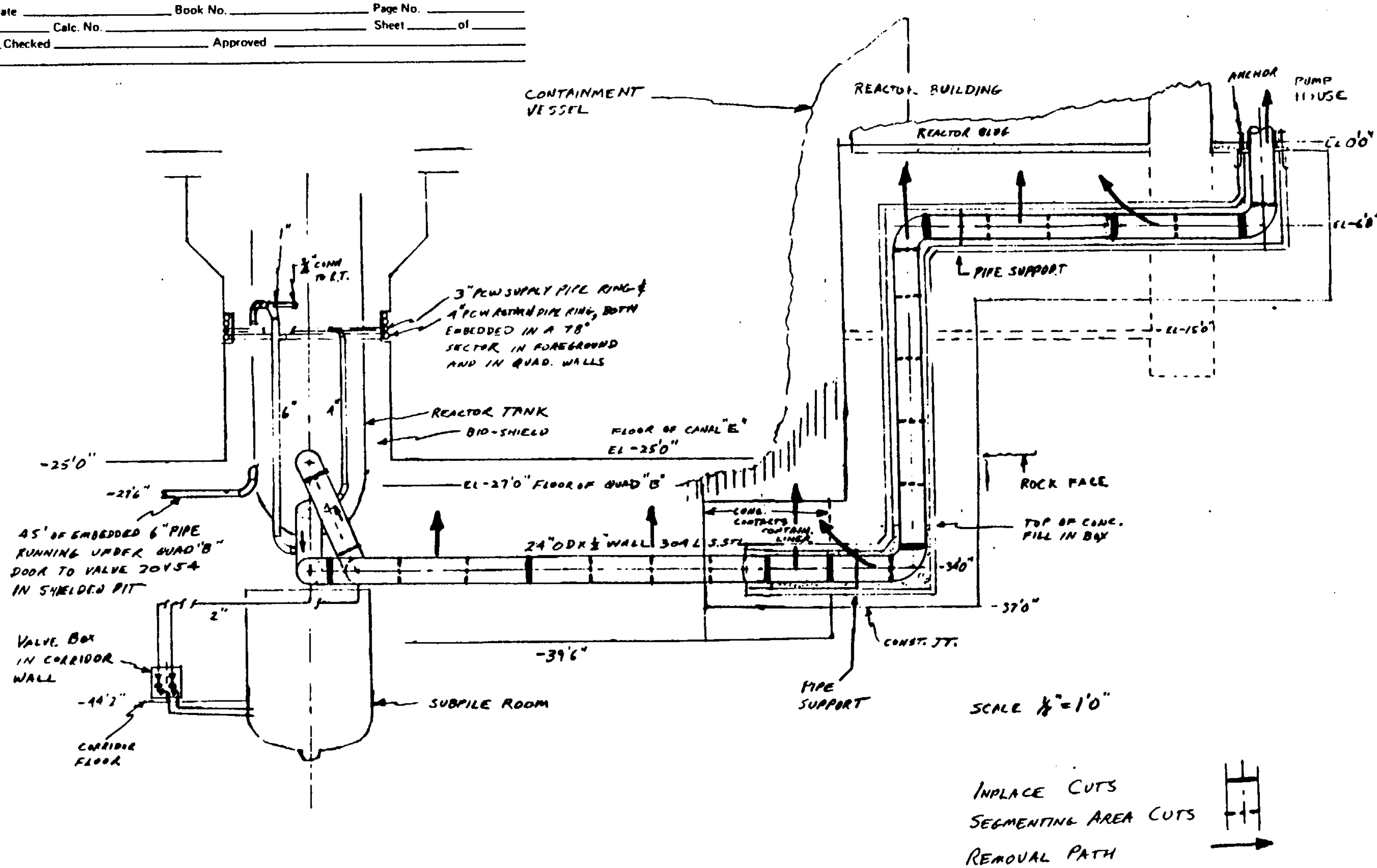

FIGURE 2.6 - ELEVATION VIEW OF PRIMARY COOLING SYSTEM PIPING

Form BR R002 2A

2.3.2.2.1 Initial Conditions

1. All non-embedded radioactive piping and equipment either decontaminated or removed from pump house with 24" pipes cut off just above floor anchor and closed with plastic and tape.

2. Reactor tank and any activated concrete removed from the reactor bioshield.

3. Quad "A" to Canal "E" gate removed.

4. Canal "E" and Quads "A", "B" and "C" cleared of equipment and surfaces decontaminated.

5. Embedded quadrant and canal piping removed.

2.3.2.2.2 PCW Pipe Data (PF-00382)

- 24" OD x 1/2" Wall
- 304L Stainless Steel
- Approx. 270 Linear Ft. Pipe
- 10 LR 90 Degree Elbows
- Steel Sheathing Outside Containment (PF-00126)
- Two Pipe Supports Outside Containment (PF-00382 and 00424)

2.3.2.2.3 Reinforced Concrete Data

Chase Outside Containment (PF-00159 and 00152, Note 7):

- 3000# Concrete
- Rebar, #6 at 18" OC, Each Way, All Around

Slab Above Chase at 0'0" Outside Containment (PF-00166):

- 8" Slab on Chase and Compacted Fill, #4 x #4 on 6" x 6" Mesh Reinforcement

Slab at 15'0" Outside Containment (PF-00159):

- 6" Slab, #4 x #4 on 6" x 6" Mesh

Containment Mats (PF-00171):

#11 Bar at 12" OC x #11 Bar at 12" OC at Containment OD, 12" Deep

Reactor Pedestal (PF-00176):

- High Density Concrete Poured Inside Steel Plate Liners to El. 2'-0"
- Quad "B" Surface - #8, 6" OC, Horizontal and Vertical With 1/2" CS Plate Liner
- Upper Protrusion Outer Layer - #8, Hoops 4" OC, Verticals 6" OC, 1/4" CS Plate Liner
- Shell Outer/Upper Protrusion Inner Layer - #8, Hoops 4" OC, Vertical 6" OC, 1/4" CS Plate Liner

Central Platform (PF-00177 & 00178):

- Standard Concrete El. - 2'0" to 0'0"
- Outside Surface - #8 Hoops 4" OC
- Top and Bottom Surface - #9 Partial Hoop, 4" OC; #8 Radial on 4" OC at Reactor Tank

Quadrant Divider Walls (PF-00171, Section 5 and 00172):

- Vertical - #11 at 8" OC, Each Face
- Horizontal - #8 at 12" OC, Each Face
- Diagonal/Vertical - #11 at 4" OC, Each Face (El. -15' to -30')

Quadrant OD Wall (PF-00171, Section 1/221 and 00172):

- Vertical - 4 Curtains #8 at 12" OC Down to El. -28'
- Hoops - 4 Curtains 1-1/2" Diameter at 4-1/2" OC

2.3.2.2.4 Reference Drawings for PCW Embedded Pipe Removal

PF-00126	PF-00178
152	249
155	250
159	375
160	376
161	382
165	387
166	392
170	423
171	424
172	452
176	454
177	

2.3.2.2.5 Productivity Factors for PCW Embedded Pipe Removal

	Applicable Manhours	Work Time Increase Factors
Work at a Height	None	-
Work in Confined Space	All	0.20
Use of Respirators	Pipe Cutting	0.25
Radioactivity Protection Controls	Pipe Cutting	0.10
Protective Clothing	All	0.20
Work Break & Transit	All	0.10

See "Cost Estimating Scope & Guidelines" for method of application (Ref. 24).

2.3.2.2.6 Concrete Removal Estimates for PCW Embedded Pipe Removal

Numbers correspond to removal procedures numbers in 2.3.2.2.8 (i.e., 1. corresponds to 2.3.2.2.8.1)

1. Concrete Volume = 10 ft. x 2 ft. x 5 ft. deep = 100 cu. ft. = 3.7 cu. yd.

2. Concrete Volume = (11 ft. x 4.5 ft. deep + 3 ft. x 4.5 ft. deep) x 23 ft. long = 1449 cu. ft. = 53.7 cu. yd.

3. Slab Volume (8" Thick) = 0.67 tk. x 1/2 (13 ft. x 15 ft.) = 65 cu. ft. = 2.4 cu. yd.

Fill Volume = 1/2 (13 ft. x 15 ft.) x 28 ft. deep = 2730 cu. ft. = 101 cu. yd.

Concrete Volume = 6 ft. x 8 ft. x 4 ft. deep + 1/2 (7 ft. x 8 ft. x 4 ft. deep) = 304 cu. ft. = 11.3 cu. yd.

Concrete Fill Inside Steel Sheathing Around 24" Pipes (Horizontal and Vertical) = 1.5 ft. deep x 6 ft. wide x 14 ft. long = 126 cu. ft. = 4.7 cu. yd.

4. Blasting Concrete Volume = 6 ft. deep x [1/2 x 10.5 ft. x 11 ft. + 10.5 ft. x 13 ft. + 1/2 x 25 ft. x (4 ft. + 10.5 ft.) + 4 ft. x 20 ft.] = 2733 cu. ft. = 101 cu. yd.

Jack Hammer Concrete Volume = (4 ft. deep x 8 ft. wide - 2 ft. x 3.4 ft. 40 ft. long = 1008 cu. ft. = 37 cu. yd.

5. Blasting Concrete Volume = 4 ft. deep x 14 ft. x 20 ft. long = 1120 cu. ft. = 41.5 cu. yd.

Jack Hammer Concrete Volume = (4 ft. deep x 10 ft. wide - 2 ft. x 3.4 ft) 20 ft. long = 674 cu. ft. = 25 cu. yd.

6. Blasting Concrete Volume (Above El. -25') = 25 ft. high x 1/2 x 9 ft. x (10 ft. + 25 ft.) = 3938 cu. ft. = 146 cu. yd.

Blasting Concrete (El. -25' to El. -35') = 10 ft. deep x [1/2 x 9 ft. x (10 ft. + 25 ft.) - 10 ft. x 7 ft.] = 875 cu. ft. = 32.4 cu. yd.

Jack/Chipping Hammer Concrete Volume N 10 ft. deep x 10 ft. x 7 ft. = 700 cu. ft. = 26 cu. yd.

7. Blasting Concrete Volume = 38 ft. long x 4 ft. wide x 1.5 ft. deep = 228 cu. ft. = 8.5 cu. yd.

Jack/Chipping Hammer Concrete Volume = 38 ft. long x 2 ft. wide x 1 ft. deep = 76 cu. ft. = 2.8 cu. yd.

2.3.2.2.7 PCW Contaminated Embedded Piping Estimate for Shipping and Burial

Use of a B-25 container by Container Products Corporation with a capacity of 90 cu. ft. is assumed (Ref. 25). The interior is about 45" wide, 45" high and 71" long. The exterior is 46" x 51" x 72", giving a burial volume of 98 cu. ft. In 10 gauge construction, the capacity is 10,000 pounds, and its weight is 900 pounds.

The 24" PCW piping will be cut into 54 pipe segments, each of which will fit into the container lengthwise. The 54 segments and the 10 elbows will be sectioned lengthwise into semi-circular pieces to improve packaging efficiency. Thus, 108 semi-circular pipe sections and 20 semi-circular elbow sections must be placed in containers. Each container will hold 12 pipe sections or 8 elbow sections, requiring 9 containers for pipe and 3 containers for elbows. Thus, 12 containers will be required for a total burial volume of 1176 cu. ft.

These containers could also be loaded with small components and pipes to fill the voids.

The Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule (Ref. 26) includes a weight surcharge of $275 per container for container weights between 1001 and 5000 pounds. Each container of embedded PCW piping is estimated to weigh approximately 4700 pounds. Therefore, a surcharge of $275 per container is applicable. The embedded PCW piping is estimated to have an internal surface area of 1.8 x 10E6 sq. cm. Based on an activity of 100,000 dpm/100 sq. cm., the total activity in all of the embedded PCW piping is less than 8 x 10E-4 Curies. There is no surcharge for shipments less than 1 Curie.

Based on a truckload net capacity limit of 42,000 pounds and a container weight of 4700 pounds, 1.5 truckloads are required to ship the 12 containers of embedded PCW piping.

2.3.2.2.8 PCW Pipe Removal Procedures

PCW pipe removal is covered by the following seven procedures. Blasting parameters given herein are for estimated purposes only, and each blast design must be done by an expert blaster.

2.3.2.2.8.1 Remove Vertical PCW Lines from Pump House Floor

Two vertical segments of 24" PCW pipe, each approximately 5 feet long, each with a long radius elbow, are to be removed. The concrete floor slab between the pipes and the adjacent pump house/reactor building wall is to be removed by controlled blasting by drilling vertical holes with a hand held drill, loading the holes with explosives, placing blast mats and detonating. Jack hammers will be used to clear the access if necessary, and oxyacetylene torch will be used to cut rebar and the steel sheathing box. Concrete rubb. and steel will be left in separate piles on the pump house floor. The PCW pipes will be cut at the bottom of the elbows using plasma-arc torch and rigged from the pit to a segmenting/sectioning area. The elbows will be cut from the pipe segments and elbows will be sectioned and loaded into shipping containers.

Operations:

1. Check equipment and move into pump house on El. 0'0" via blocked up openings (PF-00452) or roof hatch No. 7 (PF-00454).

2. Remove 10 nuts from anchor (PF-00424).

3. Rig to anchor.

4. Move drilling equipment into position.

5. Drill vertical holes (2" diameter, spaced 1 ft. x 2 ft., 4.5 ft. deep, covering 2 ft. x 10 ft. area) and remove equipment.

6. Place charges in holes.

7. Place blast mats.

8. Evacuate area and detonate charges.

9. Verify all charges have detonated.

10. Remove blast mats.

11. Check for radioactive contamination (none expected due to steel sheathing around pipes).

12. Cut rebar with torch and pile on pump house floor.

13. Remove rubble and pile on pump house floor.

14. Clear access with jack hammers.

15. Cut steel sheathing with torch. Check sheathing for contamination (none expected) and remove to pile if clean.

16. Adjust rigging.

17. Install contamination controls at cut locations and at segmenting/sectioning area - plastic sheet under cover and elephant trunk to exhaust fan with HEPA filter.

18. Cut 24" pipes at bottom of elbows with hand held plasma-arc torch (2 cross cuts).

19. Separate and cover ends (4) with plastic sheet and tape.

20. Lift pipe and elbows from pit and move to segmenting/sectioning area.

21. Cut elbows from pipe segments (2 cross

cuts) and section by cutting pipes and elbows in half lengthwise (4 cuts x 5.5 ft. + 2 cuts x 6 ft. + 2 cuts x 3 ft. = 40 ft. total longitudinal cut).

22. Load 4 pipe sections and 4 elbow sections into shipping containers.

23. Remove contamination controls and bag plastic sheet for disposal.

24. Conduct final area contamination survey.

25. Install safety fence or cover excavation (do not backfill).

2.3.2.2.8.2 Remove Horizontal PCW Lines at El. 6'8" From Pump House and Reactor Building

Two horizontal runs of 24" PCW pipe, each approximately 26' long, are to be removed. The floor slab and the top and one side of the massive concrete pipe chase are to be removed by controlled blasting.

Operations:

1. Check equipment and move into reactor building on El. 0'0" north of Canal "H" (PF-00152).

2. Move drilling equipment into position.

3. Drill vertical holes (2" diameter, spaced 2 ft. x 3 ft. x 4 ft. deep covering a 7 ft. x 23 ft. area and 9 ft. deep covering a 4 ft. x 23 ft. area) and remove equipment.

4. Place charges.

5. Place blast mats.

6. Evacuate area and detonate charges.

7. Verify all charges have detonated.

8. Remove blast mats.

9. Check for contamination (none expected).

10. Cut rebar with torc and pile locally.

11. Remove rubble and pile locally.

12. Clear access with jack hammers.

13. Cut steel sheathing top and sides by torch and pile locally after checking sheathing for contamination.

14. Rig to piping.

15. Install contamination controls at 4 cut locations and at segmenting/sectioning area.

16. Cut 24' pipes using hand held torch at top of elbow and 16' from elbow (4 cross cuts).

17. Cut pipe support.

18. Lift two pipe sections, covering open ends (8) and move to segmenting area.

19. Pull two 10' sections from chase under wall, lift and move to segmenting area.

20. Cut 24" PCW pipes into N 5' sections (6 cross cuts total) and section each segment (20 cuts x 5 ft. = 100 ft. total longitudinal cut).

21. Load 20 sections of 24" pipe, about 5' long each, into shipping containers.

22. Remove contamination controls and bag plastic sheeting.

2.3.2.2.8.3 Remove Horizontal PCW Lines at El. -34'0" and Vertical Run From -6'8" Down to -34'0"

Two horizontal runs of 24" PCW pipe, one 10' long and one 8' long, each with an elbow, and two vertical runs, each 24' long, each with an elbow, are to be removed. The concrete floor slab in the reactor building adjacent to the containment above the pipe chase is to be removed by controlled blasting, the fill down to the pipe chase is to be removed, shoring as required, and the top of concrete pipe chase is to be removed by controlled blasting. The sheathing is to be cut by torch, and the concrete fill around the 24' pipes is to be removed by jack hammers.

Operations:

1. Remove the 8" thick floor slab (98 sq. ft.).

2. Remove fill and shore as required (down 28', but should be rock side walls below El. -25'), piling on El. 0'0".

3. Move drilling equipment into position.

4. Drill vertical holes (1-1/2" diameter, spaced 2 ft. x 3 ft. x 3 ft. deep covering 44 sq. ft.) and remove equipment.

5. Place charges.

6. Place blast mats.

7. Evacuate area and detonate charges.

8. Verify all charges have detonated.

9. Remove mats.

10. Check for contamination (none expected).

11. Cut rebar with torch.

12. Load rubble in lift buckets and pile locally on El. 0'0".

13. Clear access with jack hammers.

14. Move drilling equipment into position on El. -35'.

15. Drill horizontal holes (1-1/2" diameter, spaced 2 ft. x 2 ft. x 3.5 ft. deep covering a 4 ft. x 8 ft. area) and remove.

16. Repeat steps 5 thru 13.

17. Cut steel sheathing by torch and remove to local pile if radioactively clean.

18. Remove concrete fill around pipes with chipping and jack hammers.

19. Rig to horizontal pipes.

20. Rig to vertical pipes at elbows at El. -6'8".

21. Install contamination controls at cut locations (6).

22. Cut 24" pipes using hand torch at containment and 5' from containment (4 cross cuts).

23. Cut pipe support from north pipe.

24. Lift pipe segments (2), covering open ends

(8) and move to segmenting area.

25. Cut 24" pipes at top of elbows (2 cross cuts at El. -32').

26. Lift vertical pipes (2), covering ends (4) and move to segmenting area.

27. Cut pipe support from south pipe.

28. Pull 2 sections from under concrete chase, lift and move to segmenting area.

29. Cut each vertical pipe into 5 segments and elbow (5 cross cuts) and section each piece (20 cuts x 5 ft. + 2 cuts x 6 ft. + 2 cuts x 3 ft. = 118 ft. total longitudinal cut).

30. Cut elbow from two horizontal segments (2 cross cuts) and section 4 segments and 2 elbows (6 cuts x 5 ft. + 2 cuts x 3 ft. + 2 cuts x 6 ft. + 2 cuts x 3 ft. = 54 ft. total longitudinal cut).

31. Load 28 sections of pipe and 8 sections of elbow into shipping containers.

32. Remove contamination controls and bag plastic sheeting.

33. Conduct final survey of area.

34. Install fence or cover excavation at El. 0'0" (do not backfill).

2.3.2.2.8.4 Remove PCW Lines From Containment Under Canal "E" Floor

Two horizontal runs of 24" PCW piping, each about 35' long, are to be removed by a combination of controlled blasting and jack hammers.

Operations:

1. Move equipment inside containment and into Canal "E" on El. -25'.

2. Move drilling equipment into position.

3. Drill vertical holes [2" diameter, spaced 2 ft. x 3 ft., 6 ft. deep covering an area 10.5 ft. wide by 32 ft. long (average)] and remove equipment.

4. Place charges.

5. Place blast mats.

6. Evacuate area and detonate charges.

7. Verify all charges have detonated.

8. Remove blast mats.

9. Check for contamination (none expected since blasting down only 6 ft., leaving 2 ft. of concrete around pipes).

10. Cut rebar with torch and pile in canal.

11. Remove rubble and pile in canal.

12. Drill horizontal holes (2" diameter, spaced 2 ft. x 3 ft. x 4 ft. deep, 20 ft. x 6 ft. area) to excavate a hole under the Quad B wall extending from El. -32' to El. -26', 20' wide and 4' deep, and remove equipment.

13. Repeat steps 4 to 11.

14. Remove remaining concrete cover (about 1 ft.) and concrete around 24" pipes using jack hammers.

15. Rig pipes (4).

16. Install contamination controls for pipe cuts (4) and segmenting area.

17. Cut 3/8" thick containment steel shell around the two 24" pipes.

18. Cut 24" pipes approximately 20 ft. from containment shell (2 cross cuts).

19. Lift 2 pipe sections, cover ends (4) and move to segmenting area.

20. Cut 24" pipes from elbows (2 cross cuts).

21. Pull pipes from under wall, covering ends (4).

22. Lift 2 pipe sections to segmenting area.

23. Cut pipes into approximately 5 ft. lengths (10 cross cuts total) and section each segment (2 x 14 x 5 ft. = 140 ft. total longitudinal cut).

24. Load 28 sections into shipping containers.

25. Remove contamination controls and bag plastic sheeting.

2.3.2.2.8.5 Remove PCW Lines From Under Quad "B" Floor

Two horizontal runs of 24" PCW piping, each about 20' long and each with an elbow, are to be removed by a combination of controlled blasting and jack hammers.

Operations:

1. Move equipment into Quad "B" on El. -27'.

2. Move drilling equipment into position.

3. Drill vertical holes (2" diameter, spaced 2 ft. x 3 ft. x 4 ft. deep, 14 ft. x 20 ft. area) and remove equipment.

4. Place charges.

5. Place blast mats.

6. Evacuate area and detonate charges.

7. Verify all charges have detonated.

8. Remove blast mats.

9. Check for contamination (none expected).

10. Cut rebar with torch and pile on Quad "B" floor.

11. Remove rubble and pile on Quad "B" floor.

12. Remove remaining concrete cover (N 2') and concrete around 24" pipes using jack hammers, opening through to excavation in Canal "E".

13. Rig pipes (4).

14. Install contamination controls for pipe cuts (4) and segmenting area.

15. Cut 24" pipes about 1' and 11" from Quad "B" north wall (4 cross cuts).

16. Lift 2 pipes from north end, covering ends (8), and move to segmenting area.

17. Lift and pull 2 pipes from under Quad

"B" wall, lift and remove to segmenting area.

18. Cut piping into approximately 5 ft. lengths (7 cross cuts total) and section 9 segments and 2 elbows (8 x 2 x 5 ft. + 2 x 3 ft. + 4 x 6 ft. + 4 ft. x 3 ft. = 122 ft. total longitudinal cut).

19. Load 18 pipe sections into shipping containers.

20. Remove contamination controls and bag plastic sheeting.

21. Conduct survey of Canal "E" and Quad "B" areas.

22. Place or cover Canal "E" on El. -25' and Quad "B" on El. -27' for safety and to prevent bioshield rubble from falling into excavation.

2.3.2.2.8.6 Remove PCW Lines From Quad "B" Bioshield

Two 24" PCW lines, two 2" drain lines and 4" and 6" PCW supply and return lines are to be removed by controlled blasting and jack hammers. Other potentially contaminated pipes embedded in the Quad "B" bioshield will also be removed.

Operations:

1. Move drilling equipment to El. 0'0" on central platform.

2. Drill vertical holes avoiding embedded pipes (1-1/2" diameter, spaced 2 ft. x 3 ft. x 3 ft. deep, covering 158 sq. ft. and remove equipment).

3. Place charges.

4. Place blast mats and start fog spray.

5. Evacuate area and detonate charges.

6. Verify all charges have detonated.

7. Remove fog spray and blast mats.

8. Check for contamination and load any contaminated rubble into a shipping container.

9. Cut rebar with torch and pile on a clean Quad floor.

10. Cut liner steel and remove and dump rubble to a clean Quad A, B or C floor.

11. Remove pipes from bioshield as uncovered (see Table 2.14), and section and load into shipping container if activated or contaminated.

12. Repeat Steps 1 to 11 to demolish Quad "B" bioshield down to El. -25'. Based on about 3 ft. per shot about 8 cycles are required.

13. Repeat Steps 1 to 11 to excavate down to El. -35', leaving about 2 ft. of concrete around the PCW pipes.

14. Remove concrete around PCW lines using jack hammers, rigging to 24" lines as concrete support is removed.

15. Excavate down to El. -37' to expose 2" drain lines from under 24" PCW lines to valve box and to reactor cavity using jack and chipping hammers.

16. Install containment controls.

17. Cut 2" drain lines from under 24" PCW lines to valve box and to reactor cavity, covering ends and moving to segmenting area.

18. Cut remaining 4" and 6" supply and return risers from 24" lines, cover ends and move to segmenting area.

19. Lift 24" lines to segmenting area.

20. Cut 24" PCW lines near mitered joint and at end of each elbow (5 cross cuts) and section 5 pipe segments and 2

elbows (4 x 2 x 5 ft. + 2 x 2 ft. + 2 x 6 ft. + 2 x 3 ft. = 62 ft. total longintudinal cut).

21. Load 10 pipe sections and 4 elbow sections into shipping containers.

22. Remove contamination controls and bag plastic sheeting.

23. Conduct final survey of excavation.

24. Fence or cover excavation for safety at El. -25/-27'.

TABLE 2.14

EMBEDMENTS IN QUAD "B" CONCRETE BIOSHIELD

Item	Drawing	Size
Thermal Column	PF-00249 & 00250	4 feet
Reactor Tank Vent (CA)	PF-00382 & 00376	2 inches
Hot Drain (SRP)	PF-00382 & 00376	2-1/2 inches
Hot Drain Pipe Ring	PF-00387	4 inches
Hot Drain	PF-00376	6 inches
Waste Air-Process Pipe Ring	PF-00387	4 inches
Process Waste Cooling Air	PF-00376	6 inches
Quadrant Sleeve	PF-00382 & 00375	3 inches
PCW Return Pipe Ring	PF-00387	4 inches
Inst. Service & Hot Drain	PF-00382	6 inches
Conn. to RT	PF-00382	1 inch
PCW Supply Pipe Ring	PF-00387	3 inches
Inst. Service	PF-00382	4 inches
PCW Supply - Inst.	PF-00392	2-1/2 inches
WA-Process	PF-00392	2-1/2 inches
HD-Inst.	PF-00392	2-1/2 inches
PCW Return - Inst.	PF-00392	3 inches
2 Valve Boxes with Shield Plugs	PF-00392	-
Pressure Transducer Sensing Lines in Sleeve	PF-00392	-
Valve 29V38 Extension Operator	PF-00392	-

2.3.2.2.8.7 Remove 6" PCW Return Pipe From Under Quad "A" and Canal "E" Floors

A 6" run of pipe embedded 2'6" below the El. -25' floor is to be removed. Removal is similar to that required for the embedded quadrant and canal water lines. Controlled blasting is used to excavate within 0.5 to 1 ft. of the pipe and the remaining concrete cover is removed by jack hammers.

Operations:

1. Move drilling equipment to El. -25' in Quad "A".

2. Drill vertical holes (3/4" diameter, spaced 1 ft. x 1 ft., 1.5 ft. deep, covering 3 ft. x 29 ft.) and remove equipment.

3. Place charges.

4. Place blast mats.

5. Evacuate area and detonate charges.

6. Verify all charges have detonated.

7. Remove mats.

8. Check for contamination (none expected).

9. Cut rebar with torch and pile on floor.

10. Remove rubble and pile on floor.

11. Remove concrete around 6" line using jack hammers, tunneling under containment wall.

12. Rig to pipe.

13. Install contamination controls.

14. Cut 6" pipe at valve box and about 20 ft. from valve box (2 cross cuts).

15. Lift two segments of 6" pipe to segmenting area.

16. Cut 6" pipe into 8 segments (6 cross cuts).

17. Load 8 segments into shipping container.

18. Remove contamination controls and bag plastic.

19. Conduct final survey.

20. Cover trench at El. -25' for safety.

2.3.2.2.9 PCW Pipe Trench Cost

The estimated cost for removal of the embedded PCW piping is summarized in Table 2.15. The total estimated cost is $360,300 in 1985 dollars (no escalation). A contingency of 20% is included.

The overall productivity factor for the clean concrete removal work is equivalent to a factor of 1.74, whereas it is 1.89 for embedded contaminated pipe removal. These factors are consistent with those used for simi-

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TABLE 2.15

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF Estimate by: RHK Page 1 of 2
Client: TELEDYNE ISOTOPES Checked by: Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST (FROM PAGE 2 OF 2)				3871	93,974	15,492	54,348		163,814
	CRAFT SUPPORT LABOR (7% OF D.L.)				271	6,578	–	–		6,578
	NON-CRAFT SUPPORT (6% OF D.L.)				232	5638	–	–		5638
	SUBTOTAL				4374	106,190	15,492	54,348		176,030
	PAYROLL TAXES & INSURANCE (48.8% OF LABOR)					51,821	–	–		51,821
	SUBTOTAL					158,011	15,492	54,348		227,851
	SMALL TOOLS (6% OF LABOR + P/R T&I)					–	9481	–		9,481
	EQUIP. F.O.M. (7% OF LABOR + P/R T&I)					–	11,061	–		11,061
	SUBTOTAL					158,011	36,034	54,348		248,393
	SALES TAX (5% OF TAXABLE MAT'L)					–	1802	–		1802
	SUBTOTAL					158,011	37,836	54,348		250,195
	CONTINGENCY (20%)					31,602	7567	10,870		50,039
	SUBTOTAL					189,613	45,403	65,218		300,234
	O/H & PROFIT @ 20%					37,887	9,077	13,082		60,066
Bid Item / Project Area	Total				4374	227,500	54,500	78,300		360,300

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TABLE 2.15 (Cont'd)

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project PBRF | Estimate by BHK | Page 2 of 2
Client TELEDYNE ISOTOPES | Checked by | Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						

(Schedule Data columns: Work Item, Hours, MP, ET, Fixed Date, Description)

Account	Detail Item Description	Quantity	Unit	MH/ Unit	CONC Manhours	PIPE Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
1	PUMPHOUSE FLOOR				9	29	910	250			1160
2	HORIZ. LINES @ EL 6'-8" IN PH. 2 RB				124	73	4823	1825			6648
3	HORIZ. PCW LINES @ EL -34' & VERT -6'-8" TO -34'				285	124	9710	1617			11,327
4	PCW LINES FROM CONT. UNDER CANAL "E" FLOOR				418	92	13155	3900			17,055
5	REMOVE PCW LINES FROM UNDER QUAD "B" FLOOR				241	88	7756	2016			9772
6	REMOVE PCW LINES FROM QUAD "A" BIO SHIELD				545	45	14,536	5304			19,840
7	REMOVE 6" PCW RETURN UNDER QUAD "A" & CHANNEL ""				36	43	1899	580			2479
	CONTAINERS, TRANSPORTATION & DISPOSAL								54,348		54,348
	SUBTOTAL				1688	474	52,989	15,492	54,348		122,829
	CONCRETE PRODUCTIVITY +74%		24.50		1249		30,601				30,601
	PIPING PRODUCTIVITY +93%		23.60			440	10,384				10,384
	TOTAL				2937	934					

Bid Item	Project Area		Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
		Total	[illegible]	93,974	15,492	54,348		163 [illegible]

lar work in other decommissioning estimates (Ref. 5 and 13).

The unit rates developed and used in this estimate are summarized in Table 2.12 (page 2-79).

2.3.2.2.10 PCW Pipe Removal Duration

The schedule for embedded PCW piping removal is shown in Figure 2.7. The overall duration is estimated to be 6.5 weeks, based on a peak of 3 crews for concrete removal and 3 crews for pipe removal.

2.3.2.2.11 PCW Pipe Removal Radiation Exposure

The estimated occupational radiation exposure for the PCW embedded piping removal is summarized in Table 2.16. The total exposure is estimated to be approximately 6 man-rem, based on current dose rate measurements. The decay of dose rate prior to the embedded PCW pipe removal work would reduce this estimated exposure by 50% or more if Co 60 is currently the dominant radionuclide as expected.

Exposure during radwaste transportation is not included but would be very low.

2.3.3 Cost/Benefit Comparisons

The cost, duration and exposure estimates for decontamination and removal of the PCW embedded piping is summarized in Table 2.17. Removal is clearly the best approach in terms of direct cost and duration. The estimated exposure for removal is somewhat higher than for decontamination, but on the basis of $2000 per man-rem (Ref. 13, App. J), the equivalent cost penalty would be only $4600, which is negligible in comparison to the large cost and duration savings offered by removal.

FIGURE 2.7

PCW EMBEDDED PIPING REMOVAL SCHEDULE

Activity Description

Remove Vertical PCW Lines From Pump House Floor

Remove Horizontal PCW Lines at El. -6'8" From Pump House and Reactor Building

Remove Horizontal PCW Lines at El. -34'-0" and Vertical Run From El. -6'8" Down to 34'0"

Remove PCW Lines From Containment Under Canal "E" Floor

Remove PCW Lines From Under Quad "B" Floor

Remove PCW Lines From Quad "B" Bioshield

Remove 6" PCW Return Pipe From Under Quad "A" and Canal "E" Floors

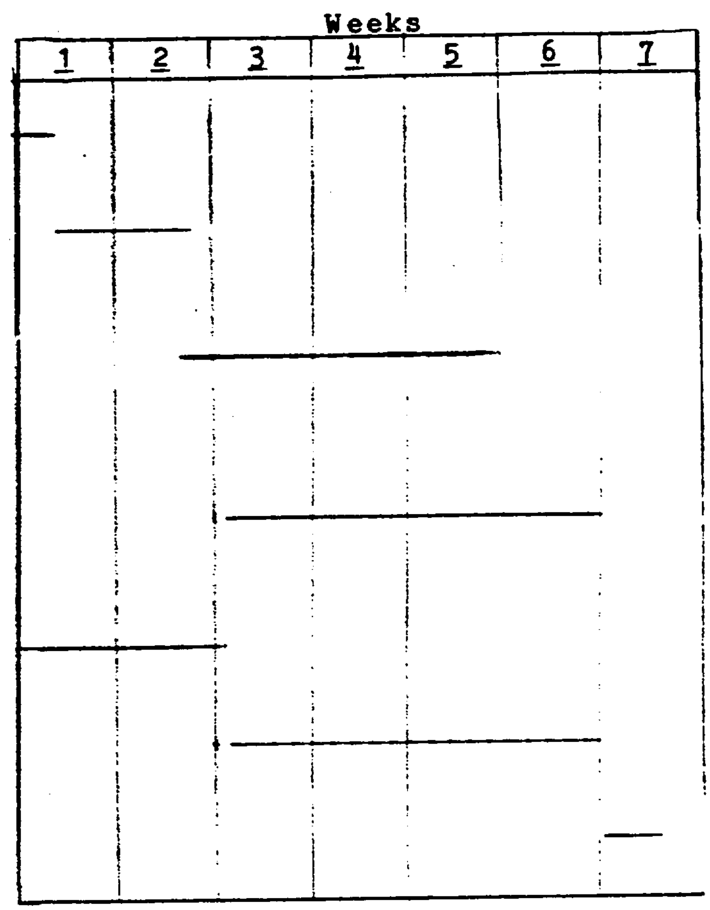

TABLE 2.16

PCW EMBEDDED PIPING REMOVAL EXPOSURE ESTIMATE

Activity Description	General Area Dose Rate (mR/hr)	Estimated General Area Work Time Manhours	Contact Dose Rate (mR/hr)	Estimated Contact Work Time Manhours	Estimated Occupational Exposure man-m Rem
Clean Concrete Removal	0.05(a)	1762	2(c)	1175(b)	2438
Piping Removal	0.05(a)	234	5(e)	700(d)	3512
Total					5950

(a) Since all radioactively contaminated piping and equipment are to be removed from the various work areas prior to embedded PCW piping removal, the general area dose rate should generally meet the 5 uR/hr (0.005 mR/hr) dose rate limit for release so that a general area dose rate of 0.05 mR/hr is conservatively high.

(b) Approximately 40% of the total concrete removal manhours are assumed to be spent close to the PCW piping, including all of the jack hammer removal manhours and about 120 manhours due to blasting and fill removal operations.

(c) Since some concrete (shielding) will exist around the PCW piping during most of the concrete removal operations, an average of 2 mR/hr is considered conservative relative to the maximum pipe dose rate discussed in (e) below.

(d) Approximately 75% of the pipe removal manhours are assumed to be spent near the PCW piping due to the use of hand held torch for cutting operations.

(e) Based on direct radiation measurements taken by Teledyne Isotopes in June 1985, the PCW pipe south of the strainer has a dose rate of <5 mR/hr. The maximum contamination level of 100,000 dpm/100 sq. cm. would equate to only about 2 mR/hr of Co 60 inside the piping.

TABLE 2.17

PCW EMBEDDED PIPING DECONTAMINATION VS REMOVAL

	Direct Cost	Duration	Exposure
Decontamination	$1,074,000	10 weeks	3.7 man-Rem
Removal	360,300	6.5 weeks	6 man-Rem
Difference	$ 713,700	3.5 weeks	-2.3 man-Rem

NOTE: The following exerpt from Reference 13, Appendix J, explains the concept of the dollar value per man-Rem saved.

"A cost/benefit analysis was made based on the costs and exposure incurred in contaminated removal, decontamination and decontamination removal. The results are displayed by a graph and chart of Delta Cost/Delta man-Rem, for the different DFs and decontamination processes used. Delta Cost is the difference in cost between contaminated removal and decontamination and removal of the same system. Delta man-Rem is the difference in incurred man-Rem for the same alternatives. Therefore, Delta Cost/Delta man-Rem represents a dollar value per man-Rem saved due to decontamination.

This parameter may then be used to evaluate the worth of decontamination by applying a criteria for financial worth of a man-Rem saved and comparing the results to this criteria.

To determine a criteria, 10CFR50, Appendix I was used as a guideline. Appendix I establishes a criteria for the worth of a saved man-Rem to the general public and used a value of $1,000/saved man-Rem as the criteria in improving radwaste processing systems. A much more conservative figure of $10,000/saved man-Rem has been used by certain nuclear facilities in the United States, but it should be emphasized this is not an industry, nor government standard. However, this report used this figure as its criteria, acknowledging it as an extreme upper bound when deciding on the cost effectiveness of decontamination."

2.3.4 Cost Sensitivity

The purpose of this cost sensitivity evaluation is to determine if plausible changes in the various cost elements of the decontamination and removal estimates for the PCW embedded piping could be large enough to offset the cost advantage estimated for the removal approach, which (before markup) is $485,266. The cost element breakdown for the decontamination and removal estimates are summarized in Table 2.18, along with a qualitative indication of potential cost variation.

For the removal approach, variation could exist in the takeoff quantities or in the unit rates. Since takeoff quantities (including concrete removal volumes, pipe cutting requirements and radwaste volumes) were estimated in considerable detail directly from the PBRF drawings, only small variation would be expected.

Unit rates of $84.50/CY and $157.20/CY used for concrete removal by controlled blasting and jack hammer, as given in Table 2.12 (page 2-79) include costs for waste packaging but do not include the decrease in productivity due to work in a radiation area. For controlled blasting, the corresponding rate of $35/CY (from Table 2.6, page 2-53) escalated at 5% per year would be about $45/CY in 1985 dollars, including lower area productivity but excluding packaging. Since the costs of lower productivity are comparable to the costs of packaging, the unit rate used for controlled blasting appears to be conservatively high.

TABLE 2.18

PCW EMBEDDED PIPING COST SENSITIVITY
(Costs in 1985 Dollars)

Cost Element	Decon	Potential Cost Variation	Removal	Potential Cost Variation
Decontamination Rig	$ 91,789	Modest to Large Decrease		
Waste Containers	$354,000	Large Decrease	$ 11,088	Small
Chemicals	$ 5,931	Small		
Installation	$108,020	Modest Decrease		
Operations	$ 18,770	Modest Decrease		
Shipping	$ 4,302	Small Decrease	$ 2,091	Small
Disposal	$ 66,268	Modest Decrease*	$ 41,169	Small*
Concrete Removal by Controlled Blasting			$ 50,883	Modest Decrease
Concrete Removal by Jack Hammer			$ 27,458	Modest Decrease
Fill Removal			$ 6,400	Small
Pipe Removal			$ 24,725	Small
	$649,080	Modest Decrease	$163,814	Modest Decrease

*Based on current rates remaining stable.

Likewise, for concrete removal by jack hammer, the rates of $32/CY and $62/CY from Table 2.7 (page 2-54) escalated to 1985 would be about $41/CY and $79/CY, excluding lower radiation area productivity and packaging. The rate of $157.20/CY used is about twice as high as the $79/CY rate for reinforced concrete, which is more than enough to account for packaging. Furthermore, since most of the jack hammer work will not involve reinforced concrete, the rate used should be conservatively high.

For cutting pipe, Table 11.3 of Reference 3 gives a rate of $16/ft. of pipe length for piping greater than 8" in diameter. This would escalate to about $20/ft. in 1985 dollars. This unit rate and the unit rate of $32.08/ft. used for estimating (which includes packaging) appear consistent.

For pipe sectioning, a rate of $4.82/ft. of cut was used. Since sectioning should be a relatively efficient operation, that rate appears consistent with the rate of $0.35/in. of cut given in Table 11.1 of Reference 3, which equates to $5.38/ft. cut escalated to 1985.

Overall, the cost for the removal approach is likely to be somewhat less, rather than greater, than the estimated cost.

Radioactive waste disposal cost could escalate drastically over the next few years, but this would tend to have a greater effect on the decontamination approach due to its larger estimated waste volume. Also, it may be practical to expose and loosen pipes directly by controlled blasting without breaking the pipes. This would tend to reduce the cost of the removal approach.

For the decontamination approach, the most significant potential for cost variation would be in decontamination rig equipment and installation costs and in waste container and associated disposal costs. Table 11.6 of Ref. 3 gives $73,000 in 1980 dollars for a 1000 gallon decontamination rig. Escalated at 5% per year to 1985, this would be $93,168. Therefore, the $91,789 estimated for a 9000 gallon rig could be low. On the other hand, if the contractor already has a suitable rig, only a useage charge of about $10,000 would be required, for a savings of about $82,000.

There is some potential for reducing ion exchange resin volume requirements and ion exchange resin unit cost. As indicated in Reference 3 (pages 5-7 and 5-18), the Shippingport Station decontamination program required a resin volume of only 80% of the system volume, whereas 100% was used in the cost estimate. Although ion exchange resin cost can be volatile, commercial grade resin at \$165/CY could be used rather than the \$250/CY for nuclear grade resin used in the estimate. Potential estimated cost reductions would be \$150,400 for waste containers (includes ion exchange resin), \$783 for shipping and \$11,501 for disposal.

Since the minimum disposal cost for the decontamination approach would still exceed the disposal cost for the removal approach, an increase in disposal rates would still have a greater affect on decontamination costs.

There appears to be potential for reduced installation and operations costs. If installation time could be reduced to about 3 weeks, labor costs would be reduced by about 50% or by \$15,500. If operations could be completed in one week, a savings of \$9700 would result.

The maximum potential reduction in decontamination cost for the APACE process is about \$270,000, assuming the best of circumstances. This is only about 55% of the total differential of the estimated costs and, therefore, there is essentially no possibility that decontamination would be more cost effective than removal.

2.4 CONCLUSIONS AND RECOMMENDATIONS

Internal decontamination of piping and components to meet the unrestricted release limits is generally not practical and/or economical. The cost estimate for the PBRF decommissioning should therefore be based on the removal, packaging and shipping of all activated or internally contaminated items, with disposal at a low level radioactive waste disposal facility. This includes the embedded PCW and Q&C piping. Only costs for external decontamination of otherwise non-radioactive items to unrestricted release limits and of shipping containers to DOT limits of 10CFR173 should be included.

The following should be considered for further study in FY 1986:

1. Survey the inside surface of the PCW pipes to determine if the pipes have a significantly different contamination level than the available valve body measurements. It may be possible to demonstrate that the activity on the PCW pipes will decay below the applicable release limits within the time frame of the extended prompt decommissioning mode.

2. Detailed cost evaluation of an electropolishing facility.

3. Obtain a decontamination contractor's cost estimate and success probability estimate for the PCW piping, using the CAN-DECON or other dilute decontamination process.

2.5 REFERENCES

1. Experiences in Decontamination/Decommissioning of the Elk River Reactor, by D. McCannon and J. F. Nemec, April 1, 1974.

2. Proceedings of the Concrete Decontamination Workshop, PNL-SA-8855, September 1980, "Experiences in Removing Surfaces with Explosives," K. G. Anderson, pp. 99-108.

3. Decommissioning Handbook, DOE/EV/10128-1, November 1980.

4. Cutting Techniques as Related to Decommissioning of Nuclear Facilities, NEA Experts Report, February 1981.

5. Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates, AIF Draft Report, TLG Engineering, Inc., 1985.

6. Blasting Operations, Gary B. Hemphill, P.E., McGraw-Hill, 1981.

7. Personal Communication with Mr. K. Anderson, Controlled Blasting Expert, July 11, 1985.

8. Nuclear News, Vol. 28, No. 8, June 1985, "Non-Chemical Decontamination Techniques," pp. 112-116.

9. Evaluation of Non-Chemical Decontamination Techniques for Use on Reactor Coolant Systems, EPRI NP-2690, October 1982.

10. Nuclear News, Vol. 28, No. 8, June 1985, "Chemical Decontamination: An Overview," R. A. Shaw and C. J. Wood, pp. 107-111.

11. Decontamination Methods as Related to Decommissioning of Nuclear Facilities, NEA Experts Report, March 1981.

12. Personal Communication, R. Oakes, BRI to T. Beaman, London Nuclear, June 25, 1985.

13. Decommissioning Plan, Shippingport Station Decommissioning Project, Document No. RL/SFM 83-4, Volume No. XI, "ES 12.2, Cost/Benefit Analysis for the Decontamination of the Shippingport Atomic Power Station Primary Systems" and "ES 12.3, Decontamination Methods."

14. Personal Communication, R. Oakes, BRI to V. Gilbert, GPU at TMI, June 27, 1985.

15. Evaluation of Abrasive Grit-High-Pressure Water Decontamination, EPRI NP-2691, October 1982.

16. Executive Conference on Decontamination, ANS, "Decontamination of Power Reactors: The Cost, Benefits and Consequences," September 16-19, 1984.

17. Personal Communication, R. Oakes, BRI to B. Bartlett, Bartlett Nuclear Inc., June 25, 1985.

18. Electropolishing as a Decontamination Technique - Progress and Applications, PNL-SA-6858, April 1978.

19. Plant Decontamination Methods Review, EPRI NP-1168, May 1981.

20. Personal Communication, R. Oakes, BRI to K. Faroehlick, Utility Power Corporation (KWU), June 25, 1985.

21. Decontamination Methods, PNL-SA-7770 Rev. 1, L. D. Perrigo and J. R. Divine, May 1980.

22. Cost Effectiveness of Dilute Chemical Decontamination, LNL-18, J. E. LeSurf, London Nuclear, and G. D. Weyman, Vermont Yankee Nuclear Power Corporation, 1981.

23. Impact of Advanced Decontamination Technology on Nuclear Waste Management Economics, H. W. Arrowsmith and H. R. Gardner, Quadrex Corporation, December 1981.

24. C. S. Ehrman, Burns and Roe, Inc. letter to J. E. Ross, Teledyne Isotopes, "Cost Estimating Scope and Guidelines," BT-3, June 21, 1985.

25. Waste Containers for Decommissioning, DOE/RLO-SFM-82-6, Sept. 1982, pp. 43, 44.

26. Building and Construction Cost Data, 1984, R. S. Means.

27. 1984 Labor Rates for the Construction Industry, R. S. Means.

28. Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule, Effective April 15, 1985 with Southeast Regional Compact Fee corrected to $0.462 per cu. ft.

BR

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project PARF　Estimate by RHK　Page 1 of 2

Client TELEDYNE ISOTOPES　Checked by　Revision number

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						

Account	Detail [illegible]	Quantity	Unit	[illegible]	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST ([illegible])				[illegible]	[illegible]	15,498	54,348		163,814
	CRAFT SUPPORT LABOR (7% of D.L.)				204	6578	–	–		6578
	NON-CRAFT SUPPORT (6% of D.L.)				235	5638	–	–		5638
	SUBTOTAL				[illegible]	106,190	[illegible]	54,348		176,030
	PAYROLL TAXES & INSURANCE ([illegible] of LABOR)					[illegible]	–	–		51,821
	SUBTOTAL					158,011	15,492	54,348		227,851
	SMALL TOOLS (6% of [illegible] MAT'L)					–	[illegible]	–		9,481
	EQUIP. E.O.M. (7% of [illegible] MAT'L)					–	[illegible]	–		11,061
	SUBTOTAL					158,011	36,034	54,348		248,393
	SALES TAX (5% of TAXABLE MAT'L)					–	[illegible]	–		1802
	SUBTOTAL					158,011	[illegible]	54,348		250,195
	CONTINGENCY (20%)					31,602	[illegible]	14,870		50,039
	SUBTOTAL					189,613	45,403	65,218		300,234
	O/H & PROFIT @ 20%					37,887	9,097	13,082		60,066
Total					4374	227,500	54,500	78,300		360,300

Bid Item　Project Area

BR2230 (6/83) 1M

COST SUPPORT FOR PCW EMBEDDED PIPE REMOVAL

BR

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: BHK
Checked by:
Page 2 of 2
Revision number:

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE [illegible]						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Conc Manhours	Pipe Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
1	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]			1160
2	[illegible]				134	[illegible]	[illegible]	[illegible]			6648
3	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]			16,887
4	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]			12,055
5	[illegible]				211	[illegible]	[illegible]	[illegible]			9972
6	[illegible]				545	[illegible]	[illegible]	[illegible]			19,840
7	[illegible]				35	[illegible]	[illegible]	[illegible]			2479
	Contaminated transportation & disposal								54,348		54,348
	Subtotal				[illegible]	[illegible]	52,930	15,492	54,348		122,827
	[illegible] productivity +262.1		[illegible]		[illegible]		30,601				30,601
	Piping productivity +892		[illegible]			440	10,384	[illegible]			10,384
	Total					[illegible]	93,974	15,492	54,348		[illegible]

Bid Item | Project Area

2-122

PBRF PRODUCTIVITY ASSESSMENT

TASK: PCW CONCRETE REMOVAL

DATE: 8/12/85

PRODUCTIVITY FACTOR		PRODUCTIVITY MULTIPLIER		MANHOURS SUBJECT TO PROD. FACTOR		MANHOURS
ESTIMATED NORMAL MANHOURS	ENM	—				1688
WORK AT HEIGHT	A	N/A	x		=	
WORK IN CONFINED SPACE	B	0.20	x	1688	=	338
USE OF RESPIRATORS	C	0.25	x	(NORMAL)	=	
SUBTOTAL						2026
RADIOACTIVITY OR ASBESTOS CONTROL	D	0.10	x	2026	=	203
SUBTOTAL						2229
PROTECTIVE CLOTHING	E	0.20	x	2229	=	446
SUBTOTAL						2675
WORK BREAKS & TRANSIT	F	0.10	x	2675	=	268
TOTAL ESTIMATED MANHOURS						2943
RATIO OF (TOTAL)/(NORMAL)						1.74

PBRF PRODUCTIVITY ASSESSMENT

DATE: 8/12/85

TASK: RCW PIPING REMOVAL

PRODUCTIVITY FACTOR		PRODUCTIVITY MULTIPLIER		MANHOURS SUBJECT TO PROD. FACTOR		MANHOURS
ESTIMATED NORMAL MANHOURS	ENM	—				494
WORK AT HEIGHT	A	N/A	x		=	
WORK IN CONFINED SPACE	B	0.20	x	494	=	99
USE OF RESPIRATORS	C	0.25	x	200	=	50
SUBTOTAL						643
RADIOACTIVITY OR ASBESTOS CONTROL	D	0.10	x	643	=	64
SUBTOTAL						707
PROTECTIVE CLOTHING	E	0.20	x	707	=	141
SUBTOTAL						848
WORK BREAKS & TRANSIT	F	0.10	x	848	=	85
TOTAL ESTIMATED MANHOURS						933
RATIO OF (TOTAL)/(NORMAL)						1.89

ER

3764-01
Burns and Roe
Construction Group, Inc.

Direct Cost Estimate Detail

Project PBKF
Client TELEDYNE ISOTOPES
Estimate by BHK
Checked by
Page 1 of 1
Revision number

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						
1. PUMPHOUSE FLOOR						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	Break & Remove											
	Concrete	3.7	cy	2.3	25.00	27.00	9	225	100			325
	PCW Pipe 24"	20	PIPE LF	1.05	23.60	7.30	21	496	146			642
	+ Horiz. Cut	40	CUT LF	0.2	23.60	.10	8	189	4			193
	Subtotal						38	910	250			1160

Bid Item Project Area

Total

BR2231 (6/85) 4M

BR

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ENGINES
Estimate by: RHK
Checked by:
Page 1 of 1
Revision number:

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						
2 HORIZONTAL LINES AT ELEV. 6'-8" IN [illegible]						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	BLAST & REMOVE											
	CONCRETE	527	cy	2.3	25.00	[illegible]	124	3100	1450			4550
	PCW PIPE 24"	50	PIPE LF	1.05	23.60	7.30	53	12[illegible]	365			1616
	+ HORIZ CUT	100	[illegible]	0.2	23.60	.10	20	472	10			482
	SUBTOTAL						197	4823	1825			6648
								4823	1825			6648

Bid Item | Project Area

Total

[illegible]231 [illegible] 4M

2-126

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project ______ Estimate by ______ Page ___ of ___

Client ______ Checked by ______ Revision number ___

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						
3. HORIZONTAL PCW LINES AT ELEV -3[illegible]'-0" & VAULT [illegible] @ [illegible] TO [illegible]"						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	BLAST & REMOVE CONC	23.1	CY	2.3	25.00	27.00	53	1325	624			1949
	JACKHAMMER & REMOVE CONC	13.7	CY	5.8	24.00	18.00	80	1920	247			2167
	EXCAVATE FILL MAT'L	101	CY	1.5	23.28	1.00	152	3539	101			3640
	PCW PIPE 24"	86	LF	1.05	23.60	7.30	90	2124	628			2752
	HORIZ. CUT	174	LF	0.2	23.60	0.10	34	802	17			819
							405	9710	1617			11327
								9710				11,327
						PIPE	129					

Bid Item	Project Area

Total

BR2231 (6/85) 4M

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BR

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project ______ Estimate by ______ Page ______ of ______

Client ______ Checked by ______ Revision number ______

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						
4. PCW LINES FROM CONTAINMENT UNDER CONTROL "A" FLOOR						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	BLAST & REMOVE CONCRETE	101	cy	2.3	25.00	27.00	233	5825	2727			8552
	JACKHAMMER & REMOVE CONCRETE	37	cy	5.8	24.00	17.50	215	5160	648			5808
	PCW PIPE 24"	201	LF	1.05	23.60	7.30	74	1740	511			2257
	HORIZ CUT	140	LF	0.2	23.60	0.10	14	330	14			344
	CONTAINMENT CUT	16	LF	0.2	23.60	0.10	4	94	-			94
	SUBTOTAL						540	13,155	[illegible] 3900			17,055
					CONC	448						
					PIPE	92						

Bid Item	Project Area

Total

BR2231 (6/85) 4N

ER

Direct Cost Estimate Detail

Burns and Roe
Construction Group, Inc.

Project ______________________ Estimate by ______________________ Page ______ of ______

Client ______________________ Checked by ______________________ Revision number ______

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						
5. REMOVE PCW LINES FROM UNDER QUAD "B" FLOOR						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	BLAST & REMOVE											
	CONCRETE	41.5	cy	2.3	25.00	27.00	96	2400	1121			3521
	JACK HAMMER &											
	REMOVE CONCRETE	25	cy	5.8	24.00	17.50	145	3480	438			3918
	PCW PIPE 24"	61	LF	1.05	23.60	7.30	164	1510	445			1955
	HORIZ CUT	120	LF	0.2	23.60	0.10	24	566	12			578
	SUBTOTAL						429	7956	2016			9972
								7956	2016			
					Conc.	241						
					Pipe	.88						

Bid Item	Project Area

Total

BR

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project ______ Estimate by ______ Page ______ of ______

Client ______ Checked by ______ Revision number ______

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						
6. REMOVE PCW LINES FROM QUAD "B" BIOSHIELD						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	BLAST & REMOVE CONCRETE	171	cy	2.3	25.00	27.00	394	9850	4617			14,467
	JACK HAMMER & REMOVE CONCRETE	26	cy	5.8	24.00	17.50	151	3624	455			4079
	PCW PIPE 24"	31	LF	1.05	23.60	7.30	33	779	226			1005
	+ HOLE CUT	62	LF	0.2	23.60	0.10	12	283	6			289
	SUBTOTAL						590	~~14,536~~	~~5304~~			19,840
								14,536	5304			

CONC 545
PIPE 45

Bid Item | Project Area

Total

BR2231 (6/85) 4.

2-130

BR

Direct Cost Estimate Detail

Burns and Roe
Construction Group, Inc.

Project ______________ Estimate by ______________ Page ______ of ______
Client ______________ Checked by ______________ Revision number ______

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						
2. REMOVE 6" PCW RETURN UNDER BLDG "A" AND BLDG "B" FLOORS						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	BLAST & REMOVE CONCRETE	8.5	CY	2.3	25.00	27.00	20	500	230			730
	JACKHAMMER & REMOVE CONCRETE	2.8	CY	5.8	24.00	18.00	16	384	50			434
	PCW RETURN PIPE 6"	48	LF	0.9	23.60	6.25	43	1015	300			1315
	SUBTOTAL						79	1899	580			2479
								1849	580			

Bid Item	Project Area

Total

BR2231 (6/85) 4M

BR

Burns and Roe Construction Group, Inc.

Direct Cost Estimate Detail

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 1 of 1
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
CONTAINERS, TRANSPORTATION & DISPOSAL						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
2.2	B-25 CONTAINERS	12	EA			724				8688		
	F.O.B. SITE (10 MILES EA)									2400		
	TRANSPORT TO BARNWELL, SC	1½	TRUCK LOADS									
	1-WAY $1.76/MI x 684					1204/LD				1806		
	SPECIAL STATE FEES					50/LD				75		
	TRAILER DEMURRAGE					70/LD				105		
	TRAILER DELIVERY					270/LD				405		
	SUBTOTAL									2391		
2.3	WASTE DISPOSAL CHARGES											
	BASE DISPOSAL CHARGE	12 x 98	CF			24.94				29,329		
	SPECIAL NUCLEAR MAT'L	NA	GRAM			1.25				0		
	WEIGHT SURCHARGE	12	CONT			275				3300		
	CURIE SURCHARGE	N/A								0		
	CASK HANDLING FEE	N/A								0		
	TAXES & SPECIAL FUNDS	12 x 98	CF			2.262				2660		
	SITE SET-UP, MISC. NAC	N/A										
	SUBTOTAL									41,169		

Bid Item	Project Area

	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Total									51,318		

BR2231 (6/85) 4.

3764-01

Burns and Roe Construction Group, Inc.

Direct Cost Summary by Bid Item

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 1 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
DECONTAMINATION						

Account	Detail Item Description	Quantity	Unit	M&I Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST [illegible]				[illegible]	78,749	499,761	70,570	–	649,080
	CRAFT SUPPORT [illegible]				329	5512				5512
	NON-CRAFT SUPPORT (6% of DL)				[illegible]	4725				4725
	SUBTOTAL				[illegible]	88,986	499,761	70,570		659,317
	PAYROLL TAXES & INSURANCE (49.5% of LABOR)					43,425				43,425
	SUBTOTAL					132,411	499,761	70,570		702,742
	SMALL TOOLS [illegible]					–	7945			7945
	EQUIP. F.O.M. [illegible]					–	9269			9269
	SUBTOTAL					132,411	516,975	70,570		719,956
	SALES TAX (5% of TAXABLE MAT'L)					–	25,849	–		25,849
	SUBTOTAL					132,411	542,824	70,570		745,805
	CONTINGENCY (20%)					26,482	108,564	14,114		149,160
	SUBTOTAL					158,893	651,388	84,684		894,965
	O/H & PROFIT (20%)					31,807	130,312	16,916		179,035
	Total				3698	190,700	781,700	101,600		1,074,000

Bid Item: 4.1.1.5 Project Area:

BR2230 (6/83) 1M

COST SUPPORT FOR IN-PLACE DECONTAMINATION OF PCW PIPE

ER

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: DHK
Checked by:
Page 2 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
DECONTAMINATION						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
1.	INITIAL [illegible]				-	-	[illegible]	-	-	-
2.	PROCUREMENT [illegible]				[illegible]	[illegible]	413 331	-	-	413,331
3.	INSTALLATION [illegible]				[illegible]	37 333	85 930	-	-	123,263
4.	OPERATION [illegible]				[illegible]	12,600	[illegible]			13,100
	TRANSPORTATION [illegible]				-	-	-	70,570	-	70,570
	[illegible]				[illegible]	49 933	498 761	[illegible]	-	620,264
	INSTALLATION PRODUCTIVITY + 62%				773	23,146				23,146
	OPERATION PRODUCTIVITY + 45%				227	5,620				5,620

Bid Item	Project Area
4.1.1.5	

Total	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
					78,249	499,761	70,570		80

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2230

PBRF PRODUCTIVITY ASSESSMENT

TASK: Decontamination Rig Installation DATE: 8/12/85

PRODUCTIVITY FACTOR		PRODUCTIVITY MULTIPLIER		MANHOURS SUBJECT TO PROD FACTOR		MANHOURS
ESTIMATED NORMAL MANHOURS	ENM	—				1569
WORK AT HEIGHT	A		x		=	
WORK IN CONFINED SPACE	B	0.20	x	775	=	155
USE OF RESPIRATORS	C	0.25	x	120	=	30
SUBTOTAL						1754
RADIOACTIVITY OR ASBESTOS CONTROL	D	0.10	x	1754	=	175
SUBTOTAL						1929
PROTECTIVE CLOTHING	E	0.20	x	1929	=	386
SUBTOTAL						2315
WORK BREAKS & TRANSIT	F	0.10	x	2315	=	232
TOTAL ESTIMATED MANHOURS						2547
RATIO OF (TOTAL)/(NORMAL)						1.62

PBRF PRODUCTIVITY ASSESSMENT

DATE: 8/16/85

TASK: Decontamination Operation

PRODUCTIVITY FACTOR		PRODUCTIVITY MULTIPLIER		MANHOURS SUBJECT TO PROD FACTOR		MANHOURS
ESTIMATED NORMAL MANHOURS	ENM	—				504
WORK AT HEIGHT	A	—	x	0	=	0
WORK IN CONFINED SPACE	B	0.20	x	0	=	0
USE OF RESPIRATORS	C	0.25	x	0	=	0
SUBTOTAL						504
RADIOACTIVITY OR ASBESTOS CONTROL	D	0.10	x	504	=	50
SUBTOTAL						554
PROTECTIVE CLOTHING	E	0.20	x	554	=	110
SUBTOTAL						664
WORK BREAKS & TRANSIT	F	0.10	x	66	=	66
TOTAL ESTIMATED MANHOURS						730
RATIO OF (TOTAL)/(NORMAL)						1.45

BR

\#3764-01

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 1 of 2
Revision number:

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PROCUREMENT:						
DECONTAMINATION RIG						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	4500 GAL MIX TANK 316 SS.	1	Ea	24	23.60	3000	24	566	3000			3566
	ELECTRIC MIXER 1 HP	1	Ea	16		1000	16	378	1000			1378
	RECIRCULATING PUMP 2000 GPM SS 10 HP	1	Ea	80		15,000	80	1888	15,000	[illegible]		16,888
	HEAT EXCHANGER SS TUBE TYPE 3.3x10[6] BTU/hr	1	Ea	80		25,000	80	1888	25,000			26,888
	9000 GAL HOLDING TANK SS	1	Ea	32		5000	32	755	5000			5755
	150 GPM TRANSFER PUMP SS	1	Ea	24		2200	24	566	2200			2766
	FILTER 120 FT³ H/C W/ CHARCOAL AND QUICK DISCONNECTS	1	Ea	24		10,000	24	566	10,000			10,566
	SUBTOTAL PAGE 1						280	6607	61,200			67,807

Bid Item	Project Area
4.1.1.5	2

Total

BR2231 (6/85) 4M

ER

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: BHK
Checked by:
Page 2 of 2
Revision number:

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
PROCUREMENT						
DECONTAMINATION AIG						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	ION EXCHANGER	10	EA	24	23.60	34,400	240	5664	344,000			349,664
	124CF HICS W/ HOH											
	RESIN & QUICK DISCONNECTS											
	DRAIN PUMP 150GPM 100'	1	EA	40		2200	40	944	2200			3144
	316SS											
	REAGENTS:											
	NaOH	7277	LB			.135			982			982
	$KMnO_4$	946	LB			2.21			2091			2091
	$(NH_4)_2HC_6H_5O_7$	946	LB			2.79			2639			2639
	EDTA	73	LB			3.00			219			219
	SUBTOTAL FROM PAGE 1						280	6608	61,240			67,807
	SUBTOTAL						560	13,215	413,331			426,546
→	CARRY IN INSTALLATION						<560>	<13,215>				<13,215>

Bid Item	Project Area		Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
		Total	-	413,331			331

BR2231 (6/ 84

Burns and Roe Construction Group, Inc.

Direct Cost Estimate Detail

Project: PBAF
Client: Teledyne Isotopes
Estimate by: RHK
Checked by:
Page 1 of 1
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
INSTALLATION						
DECON SYSTEM						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
1	ASSEMBLE DECON RIG											
	SKIDS & SUPPORTS	ALLOW			25.00		120	3000	2000			5000
	PIPING	ALLOW			23.66		40	944	1500			2444
	ELECTRICAL	ALLOW			25.33		40	1013	2000			3013
	EQUIPMENT (INTO PLACEMENT)				23.60		560	13,215				13,215
2-4	OFF-SKID PIPING											
	16" 316SS PIPE	50	LF	1.6	23.60	78	80	1888	3900			5788
	3" " "	200	LF	.55		11	110	2596	2200			4796
	16" " ELLS	4	EA	8.0		900	32	755	3600			4355
	3" " "	15	EA	1.3		26	20	472	390			862
	16" " WELDS	12	EA	21		-	252	5947	-			5947
	3" " "	45	EA	2.7		-	122	2879	-			2879
	16" " GATE VALVES	4	EA	6.0		11,500	24	566	46,000			46,566
	3" " " "	6	EA	1.3		580	8	189	3180			3369
	3" " CHECK "	2	EA	1.3		580	3	71	1160			1231
	16" W.N. 150LB FLANGE	4	EA	3.0		2000	12	283	8000			8283
	16" S.O. " "	4	EA	2.8		1500	11	260	6000			6260
	3" W.N. " "	8	EA	1.0		140	8	189	1120			1309
	3" S.O. " "	8	EA	0.9		110	7	165	880			1045
5	LEAK TEST W/ DEMIN. H_2O	800	GAL				40	944	2000			2944
	TEMP REPAIRS	ALLOW					40	944	1000			1944
-	ELECTRICAL [illegible]	ALLOW			[illegible]		40	1013	1000			2013
Total							1569	37,333	85,930			123,263

Bid Item	Project Area

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ER

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: Teledyne Isotopes
Estimate by: K.H.K.
Checked by:
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Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
OPERATION & REMOVAL						
DECON SYSTEM						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
1.	OPERATION											
	9 MON 3 MEN 25 SHIFTS				25.00		384	9600				9600
	x 8 HRS											
2	REMOVAL	ALLOW			25.00		NA	3000	500			3500
Total							5[illegible]	12,600	500			1[illegible]

Bid Item | Project Area

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BR

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project PAAF　　Estimate by RHK　　Page 1 of 1

Client TELEDYNE ISOTOPES　　Checked by ____　　Revision number ____

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
TRANSPORTATION & DISPOSAL OF DQCF HICs						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
2.2	HICS	11	EA									
	TRANSPORT TO BARNWELL SC, 2.75		TRUCK (EA)									
	1-WAY $1.76/MI x 684					1204/TR				3811		
	SPECIAL STATE FEES				1369	50/TR				138		
	TRAILER DEMURRAGE					40/TR				110		
	TRAILER DELIVERY					270/TR				143		
	SUBTOTAL									4202		
	WASTE DISPOSAL CHARGES											
	BASE DISPOSAL CHARGE	11x170	CF			24.99				46,628		
	SPECIAL NUCLEAR MAT'L	N/A										
	WEIGHT SURCHARGE	11	CNT			550				6050		
	CURIE SURCHARGES	N/A										
	CASK HANDLING	N/A										
	TAXES & SPECIAL FUNDS	11x170	CF			7.262				13,580		
	SITE SET-UP, MISC	N/A										
	SUBTOTAL									66,258		

Bid Item	Project Area

	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Total									70,570		

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3764-01
Burns and Roe
Construction Group, Inc.

Direct Cost Summary by Bid Item

Project PARF
Client TELEDYNE ISOTOPES
Estimate by RHK
Checked by
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Revision number

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
Q&C PIPE REMOVAL (EMBEDED)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST (FROM [illegible])				4691	112,132	15,905	27,677		155,714
	CRAFT SUPPORT LABOR (7% OF D.L.)				328	7849	-	-		7849
	NON-CRAFT SUPPORT (6% OF D.L.)				281	6728	-	-		6728
	SUBTOTAL				5,300	126,709	15,905	27,677		170,291
	PAYROLL TAXES & INSURANCE ([illegible] OF LABOR)					61,834				61,834
	SUBTOTAL					188,543	15,905	27,677		232,125
	SMALL TOOLS (6% OF LABOR + PART I)					-	11,313	-		11,313
	EQUIP. F.O.M. (7% OF LABOR + PART I)					-	13,198	-		13,198
	SUBTOTAL					188,543	40,416	27,677		256,636
	SALES TAX (5% OF TAXABLE MAT'L)					-	2021	-		2021
	SUBTOTAL					188,543	42,437	27,677		258,657
	CONTINGENCY (20%)					37,709	8487	5535		51,731
	SUBTOTAL					226,252	50,924	33,212		310,388
	O/H & PROFIT (± 20%)					45,248	10,176	6658		62,112
Total					[illegible]00	271,500	61,100	39,900		[illegible]2,500

Bid Item 2.2.2. Project Area

COST SUPPORT FOR RE-
MOVAL OF QUADRANT &
CANAL PIPING

BR

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: AHK
Checked by:
Page 2 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q2C PIPE REMOVAL (EMBEDDED)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Conc. Manhours	Pipe Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	QUAD "D"				14	11	597	106			703
	QUAD "C"				6	11	645	111			756
	QUAD "B"				6	134	428	94			522
	QUAD "A"				16	14	[illegible]	[illegible]			850
	[illegible]				47	721	[illegible]	865			3943
	[illegible]				188	212	[illegible]	2457			10,771
	[illegible]				7	[illegible]	173	[illegible]			262
	NORTH OF CANAL "G"				276	85	[illegible]	[illegible]			9914
	CANALS "F" "G" & "H"				216	275	[illegible]	3406			15,631
	[illegible] 25' [illegible]				[illegible]	276	14,342	4103			18,445
	[illegible]				41	[illegible]	[illegible]	295			1458
	HOT DRY [illegible]				27	167	[illegible]	705			2753
	CANAL "J" [illegible]				178	184	[illegible]	2377			11,066
	VALVE PIT [illegible]				12	25	[illegible]	[illegible]			807
	[illegible] TRANSPORTATION & DISPOSAL								[illegible]		27,677
	SUMMARY				1233	1376	62,176	15,905	27,677		105,758
	CONCRETE MANHOURS + 2421		24.50		912		22,344				22,344
	PIPING MANHOURS + 852		23.60			1170	27,612				27,612

Bid Item	Project Area
2.2.2.	13.1

	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Total	4691	112,132	15,905	27,677		155,714

BR2230 (6/83) 1M

PBRF PRODUCTIVITY ASSESSMENT

TASK: Q&C CONCRETE REMOVAL

DATE: 8/12/85

PRODUCTIVITY FACTOR		PRODUCTIVITY MULTIPLIER		MANHOURS SUBJECT TO PROD. FACTOR		MANHOURS
ESTIMATED NORMAL MANHOURS	ENM	—				1233
WORK AT HEIGHT	A	N/A	x		=	
WORK IN CONFINED SPACE	B	0.20	x	1233	=	247
USE OF RESPIRATORS	C	0.25	x	(Normal)	=	
SUBTOTAL						1480
RADIOACTIVITY OR ASBESTOS CONTROL	D	0.10	x	1480	=	148
SUBTOTAL						1628
PROTECTIVE CLOTHING	E	0.20	x	1628	=	326
SUBTOTAL						1954
WORK BREAKS & TRANSIT	F	0.10	x	1954	=	195
TOTAL ESTIMATED MANHOURS						2149
RATIO OF (TOTAL)/(NORMAL)						1.74

PBRF PRODUCTIVITY ASSESSMENT

TASK: Q&C PIPING REMOVAL

DATE: 8/12/85

PRODUCTIVITY FACTOR		PRODUCTIVITY MULTIPLIER		MANHOURS SUBJECT TO PROD. FACTOR		MANHOURS
ESTIMATED NORMAL MANHOURS	ENM	—				1376
WORK AT HEIGHT	A	N/A	x		=	
WORK IN CONFINED SPACE	B	0.20	x	1376	=	275
USE OF RESPIRATORS	C	0.25	x	412	=	103
SUBTOTAL						1754
RADIOACTIVITY OR ASBESTOS CONTROL	D	0.10	x	1754	=	175
SUBTOTAL						1929
PROTECTIVE CLOTHING	E	0.20	x	1929	=	386
SUBTOTAL						2315
WORK BREAKS & TRANSIT	F	0.10	x	2315	=	232
TOTAL ESTIMATED MANHOURS						2547
RATIO OF (TOTAL)/(NORMAL)						1.85

BR

3761-01
Burns and Roe
Construction Group, Inc.

Direct Cost Estimate Detail

Project PBRF
Client TELEDYNE ISOTOPES
Estimate by BHK
Checked by
Page 1 of 1
Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q.I.C PIPE REMOVAL - (EMBEDDED)						
RECIRCULATING WATER - REACTOR BUILDING						
QUAD "D"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	JACKHAMMER - FLOOR											
	7'x3'x3'	2.3	CY	5.8	24.00	18.00	14	336	41			377
	PUMP OUT PIPING											
	6"Ø	8	LF	0.7	23.60	6.25	8	189	50			239
	10"Ø	1	LF	1.05	23.60	7.30	1	24	8			32
	RECIRC PIPING 3"Ø	1	LF	0.7	23.60	6.25	1	24	7			31
	FLOOR DRAINS	2	EA	0.5	23.60	—	1	24				24
							25	597	106			703
	CONC						14					
	PIPING						11					

Bid Item	Project Area
2.2.2	

Total							Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Total							14 / 11	597	106			703

BR2231 (6/83) 3M

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BR

Direct Cost Estimate Detail

3764-01
Burns and Roe Construction Group, Inc.

Project PBRF
Client TELEDYNE ISOTOPES
Estimate by RHK
Checked by
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Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q.1.C. PIPE REMOVAL (EMBEDDED)						
RECIRCULATING WATER-REACTOR BUILDING						
QUAD "C"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
B.1.	JACKHAMMER - FLOOR											
	8'x3'x3'	2.7	CY	5.8	24.00	18.00	16	384	48			432
	PUMP OUT PIPE 6"Ø	8	LF	0.9	23.60	6.25	8	189	50			239
	10"Ø	1	LF	1.05	23.60	7.30	1	24	7			31
	FLOOR DRAINS	2	EA	0.5	23.60	–	1	24	–			24
	RECIRC 3"Ø	1	LF	0.9	23.60	6.25	1	24	6			30
							27	645	111			756
							11					
						CONC.	16					
						PIPE	11					

Bid Item	Project Area
2.2.2	

Total: Manhours 27

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BR2231 (6/83) 3M

BR

Direct Cost Estimate Detail

3764-01
Burns and Roe Construction Group, Inc.

Project PBRF
Client TELEDYNE ISOTOPES
Estimate by BHK
Checked by
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Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q1C PIPE REMOVAL						
RECIRCULATING WATER - REACTOR BUILDING						
QUAD "B"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
B.1	JACKHAMMER - FLOOR											
	4'x1.5'x3'	.7	cy									
	1.5'x1.5'x3'	.3	cy									
		1.0	cy	5.8	24.00	18.00	6	144	18			162
	RIP OUT PIPE 6"Ø	3	LF	0.9	23.60	6.25	3	71	19			90
	10"Ø	1	LF	1.05	23.60	7.30	1	24	7			31
	PLUG DRAINS	2	EA	0.5	23.60	-	1	24	-			24
	RECIRC 3"Ø	8	LF	0.9	23.60	6.25	7	165	50			215
							18	428	94			522
						CONC	6					
						PIPE	12					

Bid Item: 2.1.2 Project Area:

Total

BR2231 (6/83)

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3764.01
Burns and Roe Construction Group, Inc.

Direct Cost Estimate Detail

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: BHK
Checked by:
Page 1 of 1
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
QAC PIPE REMOVAL RECIRCULATING WATER - REACTOR BUILDING QUAD "A"						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
B.1	JACKHAMMER - FLOOR											
	5'x3'x3'	2.7	CY	5.8	24.00	18.00	16	384	48			432
	PUMP OUT 6"ø	8	LF	0.9	23.60	6.25	7	165	50			215
	10"ø	5	LF	1.05	23.60	7.30	6	142	37			179
	FLOOR DRAINS	2	EA	0.5	23.60	—	1	24				24
							30	715	135			850
						AUG	16					
						PIPE	14					

Bid Item: 2.2.2
Project Area:

Total

BR2231 (6/83) 3M

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3764.01
Burns and Roe
Construction Group, Inc.

Direct Cost Estimate Detail

Project PBRF
Client TELEDYNE ISOTOPES
Estimate by BHK
Checked by
Page 1 of 1
Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
GEC PIPE REMOVAL						
RECIRCULATING WATER - REACTOR BUILDING						
REACTOR BUILDING ANNULUS						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	BLASTING - FLOOR											
	3.5'x41'x1.5'	8	CY	2.3	25.00	27.00	19	475	216			691
	JACKHAMMER - FLOOR											
	2'x41'x1'	3	CY	5.8	24.00	18.00	18	432	54			486
	QUAD "D" P.O. 10"	43	LF	1.05	23.60	7.30	45	1062	314			1376
	QUAD "D" RECIRC 3"	45	LF	0.7	23.60	6.25	47	1109	281			1390
							129	3078	865			3943
						CONC	37					
						PIPE	92					

Bid Item	Project Area
2.2.2.	

Total

BR2231 (6/83) 3M

ER

Direct Cost Estimate Detail

3764-01
Burns and Roe
Construction Group, Inc.

Project PERF
Client Teledyne Isotopes
Estimate by BHK
Checked by
Page 1 of 4
Revision number

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
QIC Pipe Removal						
Recirculating Water - Reactor Building						
Canal "E"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	Blasting - Floor Area 1											
	(Near Guads C&B)											
	260SF x 1.5'	13.7	CY	2.3	25.00	22.00	32	800	325			1125
	Jackhammer -											
	Floor Area 1											
	155SF x 1'	5.7	CY	5.8	24.00	18.00	33	792	100			892
	Blasting - Floor Area 2											
	(Near Guad Door H17)											
	56SF x 1.5'	3.1	CY	2.3	25.00	22.00	7	175	84			259
	Jackhammer											
	Floor Area 2											
	42SF x 1' + 12SF x 2.5'	2.7	CY	5.8	24.00	18.00	16	384	48			432
	Blasting - Floor Area 3											
	(Near Guad B)											
	45SF x 1.5'	2.5	CY	2.3	25.00	22.00	6	150	68			218
	Jackhammering											
	Floor Area 3											
	22SF x 1'	.8	CY	5.8	24.00	18.00	5	120	14			134

Carry forward to sheet 4: 99 | 2421 | 689 | 3110

Bid Item	Project Area
2.2.2	

Total

BR2231 (6/83) 3M

ER

Direct Cost Estimate Detail

3764-01
Burns and Roe Construction Group, Inc.

Project: PBRF
Client: Teledyne Isotopes
Estimate by: RHC
Checked by:
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Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
QJC PIPE REMOVAL						
RECIRCULATING WATER - REACTOR BUILDING						
CANAL "E"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	BLASTING - FLOOR AREA 4											
	(NEAR QUAD "A")											
	39 SF x 1.5'	2.5	cy	2.3	25.00	22.00	6	150	68			218
	JACKHAMMER											
	FLOOR AREA 4											
	20 SF x 1'	0.7	cy	5.8	24.00	18.00	4	96	12			108
	BLASTING - TUNNEL UNDER											
	QUAD "C" WALL											
	3' x 4' x 4'	1.8	cy	2.3	25.00	27.00	7	175	49			224
	JACKHAMMER - TUNNEL											
	UNDER QUAD "C" WALL											
	3' x 3' x 1'	.3	cy	5.8	24.00	18.00	2	48	35			83
	CARRY FORWARD TO SHEET 4						19	469	164			633

Bid Item	Project Area
2.2.2	

Total

BR2231 (6/83)

BR

Direct Cost Estimate Detail

311.9.11
Burns and Roe Construction Group, Inc.

Project: PERF
Client: Teledyne Isotopes
Estimate by:
Checked by:
Page 3 of 4
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
WC. 111 Removal						
Recirculating Water - Reactor Building						
Canal "E"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	Blasting - 2 Tunnels under Quad "A" Wall 2x3'x4'x4'	3.6	cy	2.3	25.00	27.00	9	225	97			322
	Jackhammer - 2 Tunnels under Quad "A" Wall 3'x1.5'x1'+3'x3'x1'	0.5	cy	5.8	24.00	18.00	3	72	9			81
	Blasting - Tunnel under Quad "A" Wall 3'x3'x4'H	1.3	cy	2.3	25.00	27.00	3	75	35			110
	Jackhammer - Tunnel under Quad "A" Wall 3'x1.5'x1'	0.2	cy	5.8	24.00	18.00	2	48	4			52
	Carry forward to sheet 4						17	420	145			565

Bid Item: 2.2.2
Project Area:

Total

BR2231 (6/83) 3M

2-153

BR

Direct Cost Estimate Detail

3764-01
Burns and Roe Construction Group, Inc.

Project PBRF
Client TELEDYNE ISOTOPES

Estimate by ______
Checked by ______

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Revision number ______

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
O&C PIPE REMOVAL						
RECIRCULATING WATER - REACTOR BUILDING						
CANAL "E"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	QUAD "D" P.O. 10"	40	LF	1.05	23.60	7.30	42	991	292			1283
	" RECIRC 3"	40	LF	0.9		6.25	36	850	250			1100
	QUAD "C" P.O. 10"	26.5	LF	1.05		7.30	28	661	193			854
	" RECIRC 3"	28	LF	0.9		6.25	25	590	175			765
	QUAD "B" RECIRC 3"	18	LF	0.9			16	378	113			491
	CANAL "E" P.O. 6"	22	LF	0.9			20	472	138			610
	" " 8"	8	LF	0.9			7	165	50			215
	" " 10"	5	LF	1.05		7.30	5	118	37			155
	" RECIRC 3"	1	LF	0.9		6.25	1	24	6			30
	QUAD "B" P.O. 10"	15	LF	1.05		7.30	16	378	110			488
	QUAD "A" P.O. 10"	13	LF	1.05		9	14	330	95			425
	FLOOR DRAINS	3	EA	0.5		—	2	47	-			47
	SUBTOTAL					PIPE →	212	5204	1459			6663
	SHEET 1					COM. 135	99	2421	693			3114
	SHEET 2						19	469	164			633
	SHEET 3						17	420	145			565
	TOTAL						347	8314	2457			10721

Bid Item	Project Area

Total

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3764-01

Burns and Roe Construction Group, Inc.

Direct Cost Estimate Detail

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: BHK
Checked by:
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Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
O&C PIPE REMOVAL						
RECIRCULATING WATER - REACTOR BUILDING						
BASEMENT						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	BLASTING - TUNNEL UNDER QUAD "D" WALL 4'x3.5'x4'H	2	cy	2.3	25.00	27.00	5	125	54			179
	JACKHAMMER - BARREL UNDER QUAD "D" WALL 2'x4'x1'	.3	cy	5.8	24.00	18.00	2	48	35			83
							7	173	89			262
							1	7				

Bid Item	Project Area
2.1.2	

Total

2764-01
Burns and Roe
Construction Group, Inc.

Direct Cost Estimate Detail

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: BHK
Checked by:
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Revision number:

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
O&C PIPE REMOVAL						
RECIRCULATING WATER - REACTOR BUILDING						
NORTH OF CANAL "G"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	BLASTING - TUNNEL											
	.67'x15'x12'	4.5	cy	2.3	25.00	27.00	11	275	122			397
	EXCAVATE FILL MAT'L											
	180SF x 27'	180	cy	1.5	23.28	1.00	270	6286	180			6466
	BLASTING - CONTAINMENT WALL											
	1'x8'x1'	0.3	cy	2.3	25.00	27.00	1	25	10			35
	CUT & REMOVE 1" LINER											
	8'x1'	8	SF									
	CUT	12	LF	.2	25.00		4	100	20			120
	REMOVE	326	LB	.01	25.00		3	75				75
Bid Item 2.2.2. / Project Area 13.1	Total: CRAIG TOWNSEND DISTRICT 3						[illegible]	6761	332			7023

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3744-01
Burns and Roe
Construction Group, Inc.

Direct Cost Estimate Detail

Project PBRF
Client TELEDYNE ISOTOPES

Estimate by BHK
Checked by

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Revision number

Description of Bid Item or Specification	Schedule Data					
	Work Item	Hours	MP	ET	Fixed Date	Description
Q.I.C. PIPE REMOVAL						
RECIRCULATING WATER - REACTOR BUILDING						
NORTH OF CANAL "F"						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	BLASTING - CANAL "F"											
	WALL											
	2.5' x 6' x 3'	1.7	cy	2.3	25.00	27.00	4	100	46			146
	JACKHAMMER - CANAL											
	"F" WALL											
	2.5' x 5' x 1'	0.5	cy	5.8	24.00	18.00	3	72	9			81

Bid Item	Project Area
2.2.2.	13.1

CARRY FORWARD TO SHEET 3

	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Total						7	172	55			227

BR2231 (6/83) 3M

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Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project PBRF Estimate by RHK Page 3 of 3
Client TELEDYNE ISOTOPES Checked by Revision number

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
O/C PIPE REMOVAL						
RECIRCULATING WATER						
NORTH OF CANAL "G"						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	QUAD "D" P.O. 10"	17	LF	1.05	23.60	7.20	20	472	139			611
	" RECIRC 3"	23	LF	0.9		6.25	21	496	144			640
	QUAD "C" P.O. 10"	15	LF	1.05		7.20	16	378	110			488
	" RECIRC 3"	18	LF	0.9		6.25	16	378	113			491
	QUAD "B" RECIRC 3"	13	LF	0.9		5	12	283	81			364
	SUBTOTAL					PIPE	85	2007	587			2594
	SHEET 1				296		289	6761	332			7093
	SHEET 2						7	172	55			227
	SUBTOTAL						381	8940	974			9914

Bid Item: 2.2.2. Project Area: 13.1

Total

BR2231 (6/85)

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BR

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PEAF   Estimate by: LWK
Client: TELEDYNE ISOTOPES   Checked by:
Page 1 of 2   Revision number:

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
QIC PIPE REMOVAL						
RECIRCULATING WATER						
CANALS "F", "G" & "H"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	BLASTING - FLOOR AREA 1 7'x12'x1.5'	4.7	CY	2.3	25.00	27.00	11	275	127			402
	JACKHAMMER - FLOOR AREA 1 5'x12'x1'	2.2	CY	5.8	24.00	18.00	13	312	39			351
	BLASTING - CANAL "F" WALL 2.5'x6'x3'	1.7	CY	2.3	25.00	27.00	4	100	46			146
	JACKHAMMER CANAL "F" WALL 2.5'x5'x1'	0.5	CY	5.8	24.00	18.00	3	72	9			81
	BLASTING - FLOOR AREA 2 422 SF x1.5'	23.4	CY	2.3	25.00	27.00	54	1350	632			1982
	JACKHAMMER FLOOR AREA 2 25 SF x 2.6' + 350 SF x1'	15.4	CY	5.8	24.00	18.00	89	2136	277			2413
	BLASTING - CANAL "F" WALL 2.5'x11'x3'	3.9	CY	2.3	25.00	27.00	9	175	105			280
	JACKHAMMER - CANAL "F" WALL 2.5'x13'x1'	1.2	CY	5.8	24.00	18.00	29	696	21			717
Bid Item: 2.2.2 / Project Area: 13.1	(ONE) CARRY FORWARD TO SHEET 2 — Total						212	5116	1256			6372

BR2231 (6/83) 3M

ER

Direct Cost Estimate Detail

Burns and Roe
Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 2 of 2
Revision number:

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
Q&C PIPE REMOVAL						
RECIRCULATING WATER						
CANALS "F", "G", & "H"						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	QUAD "D" P.O. 10"	12	LF	[illegible]	23.60	7.30	13	307	88			395
	" RECIRC 3"	12	LF	[illegible]		6.25	11	260	75			335
	QUAD "C" P.O. 10"	12	LF	1.05		7.30	13	307	88			395
	" RECIRC 3"	12	LF	0.9		6.25	11	260	75			335
	QUAD "B" RECIRC 3"	12	LF				11	260	75			335
	CANAL "H" P.O. 6"	62	LF				56	1322	388			1710
	" RECIRC 3"	72	LF				65	1534	450			1984
	" OVERFLOW 4"	38	LF				34	802	238			1040
	" " 8"	19	LF				17	401	119			520
	CANAL "G" P.O. 6"	23	LF				21	496	144			640
	" RECIRC 3"	21	LF				19	[illegible]	[illegible]			579
	CANAL "F" P.O. 6"	1	LF				1	[illegible]	[illegible]			30
	" RECIRC 3"	1	LF				1	[illegible]	[illegible]			30
	HOT DRY STG DRAIN 4"	21	LF				19	[illegible]	[illegible]			579
	FLOOR DRAINS	3	EA				3	[illegible]	[illegible]			90
	SUBTOTAL (PIPING)						295	6964	2033			[illegible]
	SHEET 1						212	5116	1256			6372
	SUBTOTAL						507	12,080	3289			15369
	[illegible] UNDER GLF											
	[illegible]	0.9	CY	5.8	23.40	18.00	5	120	90			210
	[illegible]	0.2	CY	2.3	25.00	22.00	1	25	27			52
	TOTAL						513	12,225	3406			15631

Bid Item | Proje[ct A]rea

Total

ER

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
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Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
Q&C PIPE REMOVAL						
RECIRCULATING WATER						
SOUTHWEST BB @ ELEV -25' & PUMP ROOM						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	BLASTING - FLOOR AREA 1											
	17'x3' + 21'x13' + 11'x10' x1.5'	25	cy	2.3	25.00	27.00	57.5	1438	675			2113
	JACKHAMMER - FLOOR AREA 1											
	2'x16' + 2'x12' + 3.5'x19'	9.7	cy	5.8	24.00	18.00	56.3	1351	175			1526
	+ 4'x7' + ½(7'x6') + 15'x5') x1											
	BLASTING - FLOOR AREA 2											
	15.5' x 14.5' x 1.5'	12.5	cy	2.3	25.00	27.00	28.8	719	338			1057
	JACKHAMMER FLOOR AREA 2											
	15.5' x 13' x 1.2'	9	cy	5.8	24.00	18.00	52.2	1253	162			1415
	BLASTING - TRENCH & SUMP ROOM											
	3.5' x 10' x 3.5'	4.5	cy	2.3	25.00	27.00	10.4	260	122			382
	JACKHAMMER - TRENCH & SUMP											
	2' x 15' x 1'	1.1	cy	5.8	24.00	18.00	6.4	154	20			174

CARRY FORWARD TO PAGE 3: Manhours 212, Labor 5175, Taxable Materials 1492, Total 6667

Bid Item: 1.1.2 | Project Area:

Total

BR2231 (6/83) 3M

Burns and Roe Construction Group, Inc.

Direct Cost Estimate Detail

Project PBRF
Client Teledyne Isotopes
Estimate by RHK
Checked by
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Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q1C Pipe Removal						
Recirculating Water						
Southwest RB @ Elev -25' 2 Pump Room						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	Jackhammer (2)											
	Containment wall											
	Penetrations											
	1'x(1.5+1.5+.4)x1'	.3	cy	5.8	24.00	18.00	2	48	5			53
	Cut liner plate				25.00		8	200				200

Bid Item Project Area

Total: Carry forward to Page 3 | 248 | 5 | | | 53

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ER

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: AHK
Checked by:
Page 3 of
Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
QAC PIPE REMOVAL						
RECIRCULATING WATER						
SOUTHWEST RB @ ELEV -25' 2 PUMP ROOM						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	QUAD "D" P.O. 10"	23.5	LF	1.05	23.60	7.30	25	570	172			
	" RECIRC 3"	22.5	LF	0.9		6.25	20	472	141			
	QUAD "C" P.O. 10"	26.5	LF	1.05		7.30	28	661	193			
	" RECIRC 3"	25.5	LF	0.9		6.25	23	543	159			
	QUAD "B" RECIRC 3"	28.5	LF	0.9		6.25	26	614	178			
	CANAL "C" P.O. 10"	23.0	LF	1.05		7.30	24	566	168			
	" RECIRC 3"	22.0	LF	0.9		6.25	20	472	138			
	QUAD "A" P.O. 10"	17.0	LF	1.05		7.30	18	425	124			
	QUAD "A" P.O. 10"	17.0	LF	1.05		7.30	18	425	124			
	CANAL "F" RECIRC 3"	18.5	LF	0.9		6.25	17	401	116			
	" P.O. 6"	18.5	LF				17	401	116			
	CANAL "G" RECIRC 3"	18.5	LF				17	401	116			
	" P.O. 10"	18.5	LF	1.05		7.30	19	448	135			
	CANAL "H" RECIRC 3"	18.5	LF	0.9		6.25	17	401	116			
	" P.O. 6"	18.5	LF				17	401	116			
	CANAL "F", "G", "H" O/F 8"	32.5	LF				29	684	203			
	HAS DRAIN 4"	18.5	LF				17	401	116			
	HLB P.O. 6"	[illegible]	LF				12	283	81			
	RECIRC 3"	15.0	LF				14	330	94			
	SUBTOTAL					PIPE	378	8919	2606			11525
	PAGE 1					CONC	212	5175	1492			6667
	PAGE 2						16	248	5			253
	TOTAL						606	14,342	4103			18,445

Bid Item	Project Area
2.2.2	

Total

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BR2231 (6/85) 4M

ER

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF　　Estimate by: KHK　　Page 1 of 1

Client: TELEDYNE ISOTOPES　　Checked by: ______　　Revision number: ______

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
QAC PIPE REMOVAL						
RECIRCULATING WATER						
HOT LAB BUILDING						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
B.1.	BLAST - FLOOR											
	(15'+11')X3'X2.5'	7.2	cy	2.3	25.00	27.00	16.6	415	194			609
	JACKHAMMER - FLOOR											
	37'x2.5'x1.5'	5.4	cy	5.8	24.00	18.00	31.3	752	97			849
	SUBTOTAL						47.7	1167	291			1458

Bid Item	Pr[illegible]	Area
2.2.1		

Total

BR

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PERF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
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Revision number:

Description of Bid Item or Specification:
GAC PIPE REMOVAL
RECIRCULATING WATER
DRY HOT STORAGE

Work Item	Hours	MP	ET	Fixed Date	Description

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	BLAST - 3 TUNNELS THRU WALL 3x(5'x4'x4')	8.9	cy	2.3	25.00	27.00	20.5	513	240			753
	JACKHAMMER - 3 TUNNELS 3x(5'x2'x1')	1.1	cy	5.8	24.00	18.00	6.4	154	20			174
	CARRY FORWARD TO SHEET 2						26.9	667	260			927

Bid Item: 2.2.2.
Project Area:

Total

BR2231 (6/83) 3M

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BR

Burns and Roe
Construction Group, Inc.

Direct Cost Estimate Detail

Project PBRF   Estimate by RHK   Page 2 of 2
Client TELEDYNE ISOTOPES   Checked by   Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
OLC PIPE REMOVAL						
RECIRCULATING WATER						
DRY HOT STORAGE						

(Schedule Data: Work Item, Hours, MP, ET, Fixed Date, Description)

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	DHS P.O 4"	430	LF	0,9	23.60	6.25	39	920	269			1189
	6"	140	LF				13	307	88			395
	DHS RECIRC 3"	20	LF				7	165	44			209
	DHS OVERFLOW 1"	20	LF				7	165	44			209
	FLOOR DRAINS	2	EA	0,5		-	1	24	-			24
	SUBTOTAL					PIPE	67	1581	445			2026
	SHEET 1 OF 2					CABLE	27	667	260			927
	SUBTOTAL						94	2248	705			2953

Bid Item	Project Area
2.2.2	13..

Total

BR

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF — Estimate by: AHK — Page 1 of 2

Client: TELEDYNE ISOTOPES — Checked by: — Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q.C. PIPE REMOVAL						
RECIRCULATION WATER						
CANAL "J" & "K"						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1 -	BLAST - FLOOR											
	(41'x3'+9'x3')x3.5	19.4	cy	2.3	25.00	27.00	45	1125	524			1649
	JACKHAMMER - FLOOR											
	(41'x2'+9'x2')x1'	3.7	cy									
	4'x3'x4.5'	17.0	2	cy	5.8	24.00	18.00	100	2400	306			2706
	(2'x7'+2'x8")x3'+											
	(8'x2'+45'x2')x1.5	11.3	cy									
	BLAST - SOUTH WALL TUNNEL											
	4'x15'x4'	8.9	cy	2.3	25.00	27.00	20.5	513	240			753
	JACKHAMMER - SOUTH WALL TUNNEL											
	4'x15'x1'	2.2	cy	5.8	24.00	17.50	13	312	39			351

Bid Item	Project Area
2.1.2	

Total — CARRY FORWARD TO SHEET 2 — Manhours: 179 — Labor: 4350 — Taxable Materials: 1109 — Total: 5459

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BR2231 (6/83) 3M

BR

Direct Cost Estimate Detail

Burns and Roe
Construction Group, Inc.

Project IDRF
Client [illegible] ISOTOPES
Estimate by RHK
Checked by
Page 2 of 2
Revision number

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
O/C PIPE REMOVAL						
RECIRCULATION WATER						
CANAL "J" & "K"						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor \$/MH	Mat'l \$/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	DHS P.O. 6"	16.0	LF	0.9	23^{66}	6^{25}	14	330	100			430
	CANAL "J" P.O. 6"	12.0	LF				11	260	75			335
	CANAL "K" P.O. 6"	50.0	LF				45	1062	313			1375
	FLOOR DRAIN	1	EA	0.5		–	1	24	–			24
	CANAL "K" RECIRC 3"	36.0	LF	0.9		6^{25}	32	755	225			980
	CANAL "J" RECIRC 3"	6.0	LF				6	142	38			180
	DHS RECIRC 3"	16.0	LF				15	354	100			454
	O/F 4"	66.0	LF				60	1416	413			1829
	SUBTOTAL					[illegible]	184	4343	1264			5607
	SHEET 1 OF 2					[illegible]	179	4350	1109			5459
	SUBTOTAL						363	8693	2373			11066

Bid Item	Project Area
2.2.2.	13.1

Total

RR2231 (6/85) 4N

ER

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project PBRF
Client TELEDYNE ISOTOPES
Estimate by EHK
Checked by
Page 1 of 1
Revision number

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
QRC PIPE REMOVAL						
RECIRCULATING WATER						
VALVE PIT AREA						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
B.1	BLAST - FLOOR											
	(9'x5'x1.5')	2	cy	2.3	25.00	27.00	4.6	115	54			169
	JACKHAMMER - FLOOR											
	3'x8'x1'	0.9	cy	5.8	24.00	18.00	5.2	125	16			141
	BLAST - BB WALL											
	2'x5'x4'	1.5	cy	2.3	25.00	27.00	3.5	58	40			98
	JACKHAMMER - BB WALL											
	2'x3'x1'	0.2	cy	5.8	24.00	18.00	1.2	29	4			33

Bid Item: 3.2.2 | Project Area:

CARRY FORWARD TO SHEET 2

	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Total	15	327	114			441

BR2231 (6/83) 3M

BR

Direct Cost Estimate Detail

Burns and Roe
Construction Group, Inc.

Project PBRF
Client TELEDYNE ISOTOPES

Estimate by RHK
Checked by

Page ______ of ______
Revision number ______

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
Q1C PIPE REMOVAL						
RECIRCULATING WATER						
VALVE PIT AREA						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
13.1	P.O. 6"	6	LF	0.9	23.66	6.33	6	142	38			180
	RECIRC 3"	7	LF	"	"	"	6	142	44			186
	SUBTOTAL					PIPE	12	284	82			366
	SHEET 1 OF 2					CONC	15	327	114			441
	SUBTOTAL						27	611	196			807

Bid Item: 2.2.2. Project Area: 13.1

Total

31 16 IM

BR

Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 1 of 1
Revision number:

Description of Bid Item or Specification
CONTAINERS, TRANSPORTATION & DISPOSAL

Schedule Data					
Work Item	Hours	MP	ET	Fixed Date	Description

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
2.2	B-25 CONTAINERS	5	EA			724				3620		
	F.O.B. SITE									2400		
	TRANSPORT TO BARNWELL, SC.	2	TRUCK LOADS									
	1-WAY $1.76/MI x 684					1204/TR				2408		
	SPECIAL STATE FEES					50/TR				100		
	TRAILER DEMURRAGE				1561	40/TR				80		
	TRAILER DELIVERY					270/TR				540		
	SUBTOTAL									9148		
2.3	WASTE DISPOSAL CHARGES											
	BASE DISPOSAL CHARGE	5x98	CF			24.96				12,231		
	SPECIAL NUCLEAR MATERIAL	N/A	GRAM			1.25				0		
	WEIGHT SURCHARGE	5	CONT			550				2750		
	CURIE SURCHARGE	N/A								0		
	CASK HANDLING FEE	N/A								0		
	TAXES & SPECIAL FUNDS	5x98	CF			7.24				3548		
	SITE SET-UP, MISC. N.O.C.	N/A				-				0		
	SUBTOTAL									18,529		
	Total									27,677		

Bid Item	Project Area

BR2231 (6/85) 4M

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Direct Cost Estimate Detail

Burns and Roe Construction Group, Inc.

Project PBRF — Estimate by RMC — Page ____ of ____

Client TELEDYNE ISOTOPES — Checked by ____ — Revision number ____

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
UNIT PRICE WORKUP						
CLEAN REINFORCED CONCRETE REMOVAL - JACKHAMMER						
(RUBBLE REMAINS ALONGSIDE DEMOLITION)						

Account	Detail Item Description	Quantity	Unit	MH/ Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
REF. (1)	PAGE VII B-5 CREW (LESS F.E. LOADER OPERATOR)											
	(1) LABORER FOREMAN			REF (2)	23.78		8	190.24				
	(4) LABORERS				23.28		32	744.96				
	(1) LIGHT OPERATOR				27.17		8	217.36				
	(1) AIR COMP. 250 CFM								112.20			
	AIR TOOLS & ACCESS								24.60			
	2-50' HOSES								12.80			
	25 CY/DAY PRODUCTION											
	TOTAL DAILY COST						48	1152.56	149.60			
	COST/CY						1.92	46.10	5.98			
	LINE 550 ADD 200% FOR SMALL QUANTITY						5.76	138.30	17.94			

Bid Item	Project Area

DAY COST/CY

Total			5.5	26.08	18.00							

BUILDING & CONSTRUCTION COST DATA 1984 - R.S. MEANS SECTION 2.1 45 550

Direct Cost Estimate Detail

Burns and Roe
Construction Group, Inc.

Project PART
Client TELEDYNE ISOTOPES
Estimate by RHK
Checked by
Page ____ of ____
Revision number ____

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
UNIT PRICE WORKUP						
CLEAN REINFORCED CONCRETE REMOVAL - CONTROLLED BLASTING						
(RUBBLE REMAINS ALONG SIDE DEMOLITION)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	(6) LABORERS			8hr(6)	23.28		48	1117.44				
	(2) TECHNICIANS (BLASTING)			8hr(2)	30.00		16	480.00				
	(1) OPERATOR			8hr(1)	27.17		8	217.36				
	(1) FIREMAN			8hr(1)	23.78		8	190.24				
	750 CFM COMPR.								249.70			
	TRACK DRILL								156.20			
	EXPLOSIVES								325.00			
(3)	PRODUCTION • 35 cy/day											
	DAILY COST				25.06		80	2005.04	734.90			
	COST/cy						2.286					
	SAY COST/cy			2.286	25.06	21.60						
Total				2.3	25.00	22.00						

Bid Item | Project Area

BR2231 (6/85) 4M

Burns and Roe
Construction Group, Inc.

Direct Cost Estimate Detail

Project PBRF
Client TELEDYNE ISOTOPES
Estimate by AHK
Checked by
Page ____ of ____
Revision number ____

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
UNIT PRICE WORKUP						
REMOVAL OF CONTAMINATED PIPE 28"ø						
(INCLUDES PUTTING INTO 5' LENGTHS AND LOADING INTO CONTAINERS)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
REF (3)	(U63) PAGE 32											
	(2) LABORERS				23.28		16	372.48				
	(1) PIPE FITTER				24.73		8	197.84				
	(1) LIGHT OPERATOR				22.17		8	177.36				
	(½) FITTER FOREMAN				25.23		4	100.92				
	FORKLIFT								100			
	CONSUMABLES								150			
LB(2) a	INST. CONTAM. CONTR. 15MIN											
PF b	SET UP SAW 15MIN											
OP, LB(1) c	RIG & SHORE PIPE (10MIN) N.C. (b)											
PF d	CUT PIPE 20MIN											
PF e	REMOVE SAW 10MIN											
LB(2) f	BAG ENDS 15MIN											
OP g	TRANSPORT (10MIN) N.C.											
LB(2) h	PACKAGE (15MIN) (d)											
LB(2) i	REMOVE CONT. CONT. (10MIN) (e)											
	70MIN											
	DAILY COST				23.572		36	848.64	250			
	DAILY PRODUCTION 480MIN / 70MIN	× 5FT / 1	= 34.3 FT/DAY									

Bid Item	Project Area

	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Say			1.		7.27						
Total			1.05	23.60	7.30						

231 (6/85) 4M

ER

Direct Cost Estimate Detail

Burns and Roe
Construction Group, Inc.

Project: PDRF (?)
Client: TELEDYNE ... (?)
Estimate by: RHK (?)
Checked by:
Page ____ of ____
Revision number ____

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
UNIT PRICE WORKUP						
REMOVAL OF CONTAMINATED PIPE 2.5" TO 8" (?)						
(INCLUDES CUTTING INTO 5' LENGTHS AND [illegible] AND CONTROLS) (?)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH.	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
REF (1) (?)	(UGL) PAGE 30 (?)											
	(2) LABORERS (?)											
	(1) PIPEFITTER											
	(1) LIGHT OPERATOR											
	(1/2) FITTER FOREMAN (?)											
	DITTO FOR 28" (?)											
	REDUCE CUTTING TIME											
	BY 10 MIN											
	⇒ 60 MIN											
				23.52 (?)			36	846.60 (?)	250			
	DAILY PRODUCTION $\frac{480 \text{ MIN}}{60 \text{ MIN}} \times \frac{5 \text{ FT}}{1}$ = 40 FT/DAY											

Bid Item | Project Area

	Quantity	Unit	MH/Unit	Labor $/MH.	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Total	5 ft (?)		0.9	21.60	6.25						

BR2231 (6/85) 4M

Burns and Roe Construction Group, Inc.

Direct Cost Estimate Detail

Project: PAAF

Client: ATLANTIC ISOTOPES

Estimate by: RHK

Checked by:

Page ____ of ____

Revision number ____

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
UNIT PRICE WORKUP						
REMOVAL OF CONTAMINATED PIPE 6 1/2"						
(INCLUDES CUTTING INTO 5' LENGTHS AND PACKING INTO CONTAINERS)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
REF (3)	U(61) PAGE 28											
	(2) LABORERS				20.18		16	322.48				
	(1) PIPEFITTER				24.73		8	192.84				
	(1) FITTER FOREMAN				25.23		4	100.92				
	CONSUMABLES								150			
2 LB	a INSTALL CONT. CNTR. 15 MIN											
PF	b SET UP SAW 5 MIN											
PF	c CUT PIPE 5 MIN											
PF	d REMOVE SAW 5 MIN											
2 LB	e CAP ENDS 5 MIN											
2 LB	f TRANSFER (10 MIN)(2 PC)											
2 LB	g PACKAGE (5 MIN)(2)											
2 LB	h REMOVE CONT. CNTR. 5 MIN											
	40 MIN											
	DAILY COST				23.97		28	621.24				
	DAILY PRODUCTION $\frac{480 MIN}{40 MIN} \times \frac{5 FT}{1}$ = 60 FT/DAY											

Bid Item	Project Area

	Quantity	Unit	MH/Unit	Labor $/MH	Mat'l $/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
Total			.44 .47	24.00	2.50						

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APPENDIX 2.2

SEQUENCE FOR REMOVING REACTOR TANK AND TANK INTERNALS WITHOUT FLOODING QUADRANTS

SEQUENCE FOR REMOVING REACTOR TANK AND TANK INTERNALS WITHOUT FLOODING QUADRANTS

It was necessary to develop a sequential approach to remove the reactor core and other in-tank components in order to develop an accurate estimate of labor, waste disposal costs, occupational exposure, and time schedules related to this major phase of decommissioning. Although this is not a detailed engineering plan, it contains information which would facilitate future development of such a plan. It should be noted that, although this approach relates to prompt dismantling of the reactor, it would be the same general approach followed for delayed dismantling.

In Teledyne Isotopes' 1978 Preliminary Study an approach was developed for removing the reactor tank internals. That approach called for flooding the quadrants with approximately 6'-7' of water for shielding when removing the various beam tubes and other tank and bioshield penetrations. The risk of contamination of such shielding water is substantial and the cost of processing or disposal are significant. For this reason an alternate approach was developed for removing the reactor tank internals without flooding the quadrants.

Item numbers in this procedure refer to those key pieces of equipment for which neutron activation calculations were performed in 1978 and updated in 1985. All other in-tank items are assumed to be contaminated predominantly with stainless steel activation isotopes (60 Co, 55 Fe, 63 Ni, 59 Ni) and 152 Eu, 154 Eu, 155 Eu to the extent of 100,000 beta-gamma d/m/100 sq. cm. based on evaluation of the Primary Cooling Water System Hot and Cold Legs. Figures 2.1 thru 2.4 on pages 2-212 thru 2-215 provide identification keys. Activity calculations performed in 1978 for various points in time are shown on pages 2-216 thru 2-241.

NOTES ON REMOVING TANK INTERNALS

1. Everything removed from the tank is to be disposed of as activated and/or contaminated waste.

2. Suitable self-draining shielded containers must be available for removal of all items from the tank and remote transfer of such items to shipping containers or casks with liners (cask/liner).

3. Radiation monitoring must be performed whenever any piece is brought near the surface of the water.

4. Selection of shipping containers should be based on size of the larger irradiated pieces in order to minimize the amount of

cutting or breaking to be performed. Large flat pieces may have to be cut or broken to fit into an in-tank cask before they can be removed from the tank if larger containers are not available. For example:

a. The North and South Be plates (approx. 39"x36"x1").
b. The East and West Al plates (approx. 39"x29"x1").
c. The upper and lower grids (approx. 36"x29"x4.5").

Note presence of any beryllium pieces removed so that accountability of tritium content may be made.

SPECIAL TOOLS REQUIRED

1. A right-angle straight socket drive with about an 8' handle. This could be power drive.

2. A set of extension wire cutters for removing safety wire from bolts. Also a set of "duck bills" for untwisting and/or pulling wires off.

3. An extension tool for bending the tabs or the holding devices on the South beryllium plate.

4. A pump-filter rig for picking up scrap in tank.

5. A saw or plasma arc torch for cutting off thimbles. (Note: Plasma arc cutting equipment is not available on station and will have to be leased.)

6. A saw or plasma arc torch for cutting large pieces prior to removal from the tank.

7. A special jig/tool for breaking Beryllium plates may be needed if appropriately sized containers are not available. (A preliminary design concept is contained in a memo placed in the PBRF decommissioning file.) This method is preferred over high temperature cutting techniques because of the Tritium contained within the Beryllium.

8. An internal pipe cutter for cutting the control rod guide tubes between the Reactor Tank and Sub-pile Room.

SEQUENCE FOR REMOVING REACTOR TANK INTERNALS

1. Provide a source of deionized water to the CV by filling the elevated tank with deionized water purchased and brought in by NASA tank trucks. Approximately 50,000 gallons will be required.

About 15,000 gallons of water will be needed in the tank and primary lines. Another 15,000 gallons will be available for one turnover and refill if in-tank activities cloud the water. Another 20,000 gallons will be in the elevated tank for gravity feed in the event of an emergency leak.

NOTE: Deionized water is specified for the tank so that, if the tank water becomes contaminated, it can be cleaned up by deionization before release. If domestic water is used, it would rapidly deplete the deionizer.

2. Set up a shielded cask/liner loading area in Quadrant A.

3. Set up an LSA container loading area and cutting station in Quadrant C.

4. Set up a moveable shield and a closed circuit TV for remote crane operations.

5. Sample Reactor Tank purge gas in the Fan House to make certain there are no toxic products in the gas (i.e., oxides of nitrogen) and to ensure airborne radioactivity (tritium) is within acceptable concentrations.

6. Shut off the purge.

7. At -25' level in the Reactor Building, remove Reactor Tank drain valve 10V56. Cut off the piping downstream of 10V56. Install a hand operated valve.

8. Install a filter, deionizer and pump downstream of the new 10V56 valve.

9. Run a new stainless steel line, or use an existing line, from the pump to the zero level of the CV to return the "clean" water to the Reactor Tank or to discharge this water to a clean hold tank. This hold tank may have to be purchased or relocated from other areas of Plum Brook Station. If a hold tank is used it should be sized and placed at the 0' level of the CV based on floor loading. The largest size should be selected.

10. Assure blind flanges are installed and tight on all beam holes, through tubes, and instrument tube flanges. Run 10,000 gallons of deionized water into the tank. This should be enough to just cover the core box. Put air bleed lines on PCW pipes in the PPH and also bleed the tank of increased air pressure. Monitor the Sub-pile Room and the nozzles in the quadrants for leaks. If leaks appear, attempt to stop them by tightening flanges. If they cannot be stopped, it will be necessary to collect the leakage and pump it back to the reactor tank.

11. Add more deionized water to the tank to bring the total to 13,500 gallons. This will bring the water level up to about 7' above the top of the core box.

12. Remove the shrapnel shields. Perform radiation monitoring after each shield is removed. If radiation levels exceed desirable limits, add more water to the tank.

NOTE: Seven feet of water over the core should be enough to reduce radiation levels to very low values.

13. Remove Reactor Tank hatch cover and lower it into Quadrant C for packaging. Visually check level of water in tank.

14. Cut off all leads, tubes, cables, etc. which exit through dome penetrations and lower the pieces into Quadrant C for packaging.

NOTE: Some Vertical Adjustable Facility Tubes (VAFTS) are suspended by cables or wires from within the dome penetrations.

15. Remove the V-2 test facility (Item 26) through the reactor tank dome penetration, lower it into Quadrant C, cut it into sections, and load it into LSA containers. If radiation levels become too high, cut off the top flange and lower the V-2 back into the tank, setting it on the metering plate for later removal. (Note: V-1 was removed before shutdown in 1973.) Most of the activity in V-2 will be in the lower 39". This lower section should meet LSA waste criteria. The upper section will be contaminated but should also meet LSA waste criteria.

16. Remove the Reactor Tank dome, lower it into Quadrant C, cut into sections and load it into LSA containers. The top flange will be removed in 4 sections. Then the top hatch section will be cut out. The remaining dome will be cut into 9 arc sections.

17. Unbolt all experiment hardware in the tank and remove to Quadrant C. This should include, but not be limited to VAFTS, items hung from the thermal shields, hydraulic rabbit tubes, etc. Most of these items will be small volume, LSA material with low level activation. Total weight should approximate 100 lbs.

18. Adjust the level of water in the Reactor Tank until the radiation level is at a practical value (equal to or less than 10 mR/hr).

19. Fabricate and install a work platform within the tank slightly above the water level. Also install a water level alarm, a fixed audible radiation monitor, a blower and an "elephant's trunk" duct to supply air to workers in tank. Cover

the tank walls with plastic to minimize spread of contamination. Lights will also be required.

20. Remove cable clamps from instrument rings, collect in basket and lower into Quadrant C for packaging. There are approximately 75 of these steel "L" shaped clamps (approx. 3"x6"x.5" each) bolted to the reactor tank above the thermal shields. These are likely to be LSA material totaling 191 lbs. in weight.

NOTE: During completion of Steps 21 thru 45, approximately 75 stainless steel bolts will be removed during core disassembly. These items (Item 4) collectively weigh about 5 lbs. and are Type B waste. They should be containerized under water in-tank until ready for disposal.

21. Remove the 10 rod guide roller cages (Item 1) from core grid. Place in underwater shielded transfer container and remove from the tank to shipping cask/liner in Quadrant A. (These are likely to be Type B waste, 12,500g (28 lbs.) total weight and 3"x3"x3.5" each.)

21a. Remove the upper core lattice grid and transfer to Quadrant A for packaging. This item (part of Item 25) is the portion of the upper grid which covers the 44 "L" spaces and is in 2 pieces. It is likely to be Type A waste, 39"x13"x2.5" and weighs approx. 35,000 grams (83 lbs.).

22. Verify that none of the beam tube shielding plugs extend inside the inner thermal shield. (Refer to shutdown sketches to verify this.)

23. Remove aluminium grid hold down angle (3"x3"x30") bolted to the top of the north Beryllium plate and move to Quadrant A for packaging. This is likely to be Type A material, weighing 249 grams (.55 lbs.).

24. Saw or torch off HB-1, HB-3, and HB-2 (Item 34), ITD-2, ITD-3, ITD-4, and ITD-5 as close to inner thermal shield as possible. Saw off in order stated. Remove all pieces to Quadrant C for packaging. Note that HB-1, -2, and -3 will <u>each</u> weigh about 11,300g (25 lbs.) and be approximately 924 cu. in. each in volume. They are 24"x7" diameter and are likely to be LSA waste. ITD-2, -3, -4, and -5 will <u>each</u> weigh approximately 10,000g (22 lbs.) and be 24"x6.5" diameter and also be LSA material. (Note that there are 2 ITD-3 thimbles.)

<u>CAUTION</u>: 1. If HB-2 still has the stainless steel insert with a tungsten end piece in place, the end section cutting will be more difficult and the removed section will be substantially heavier.

2. HB-3 may have a stainless steel columnator with a Beryllium end piece in place. If so, then cutting the end section will be more difficult and the weight will be higher.

3. As an alternative it may be better to remove the HB-2 and HB-3 inserts under shielded conditions and then re-seal the flanges before cutting the inner beam tube extensions.

25. Repeat 24 for ITA-1, ITA-2, ITC-1 and ITC-2 (22 lbs. each).

26. Repeat Step 24 for HB-6 (Item 28), HB-4, and HB-5 (Item 29). The inner section of HB-6 weighs approximately 17,200g (38 lbs.) and is 28"x16" OD. HB-4 and -5 inner sections are 28"x6.75" OD and weigh approximately 16,900g (37.3 lbs. each). All 3 should be LSA.

27. Cut and remove to Quadrant C for packaging the in-tank part of HT-2 (Items 32 and 33) as follows:

a. Cut off the near core portion of HT-2 (Item 32) outside clamps on both ends.
b. Cut HT-2 off near inner thermal shield on both ends.
c. Loosen clamps (2 each 2"x12" aluminum split ring clamps with 1 bolt).
d. Remove all pieces. The near core portion of HT-2 (Item 32) will be approximately 39"x9" diameter and weigh 31,400g (69 lbs.). It will likely be LSA waste. The two outer portions will be slightly smaller in length (~33") and will weigh a total of 54,400g (60 lbs. each). They also will be LSA waste.

28. Cut off and remove HT-1 (Item 31) to Quadrant C for packaging as follows:

a. Cut off HT-1 near outside of core box on both ends.
b. Cut off HT-1 near inner thermal shield on both ends.
c. Remove two loose pieces of HT-1 from tank (Item 31). These items will weigh a total of 43,200g (48 lbs.) and are approximately 33"x9" diameter. They are likely to be LSA material.

29. Remove the remaining twenty-one R piece plugs from Be-R pieces in a shielded container to Quadrant A for packaging. Eleven R piece plugs were previously removed and placed in Hot Dry Storage. They were removed during operations to install rabbit tubes, VAFTS, and plug experiments. These plugs are

stainless steel center pieces and are likely to be Type B waste. Size is 2.1" diameter, and length is approximately 38". Items 18, 19, 20, and 21 show the Co 60 and Fe 55 activity due to these plugs. They weigh 17.8Kg each (39 lbs.), 374Kg total (825 lbs.).

30. Unbolt and remove Reflector Grid to Quadrant A for packaging. This is the part of the upper grid which covers the R pieces and is part of Item 25. It is approximately 36"x16"x2.5" and weighs approximately 58,000g (128 lbs.). It is likely to be Type A waste.

31. Remove top portion of R pieces from the A & B rows in a shielded container to Quadrant A for packaging. These are the Beryllium pieces from Items 20 and 21. They are 4.2" square x 15" long. They have a high inventory of Tritium and are likely to be Type B waste. There are 16 in this portion of the reflector. They should weigh approximately 8,100g each (18 lbs.).

32. Remove the 8 R pieces from the D row (Item 18) to Quadrant A for packaging. These are approximately 38"x4.2" square each (36 lbs. each) and are collectively Type B waste with a large inventory of Tritium.

33. Remove the center lockalloy section from the flow divider plate to Quadrant A for packaging. This flow divider plate consists of 5 sections of lockalloy (each 6"x39"x1") stacked on edge horizontally in an aluminum frame (Item 24). It weighs approximately 49,000g (108 lbs.) and will most likely be Type B waste due to the H3 inventory.

34. Loosen HT-1 clamp on each end of core box as much as possible.

35. Remove bolts from North Core Box Be Plate (Item 17) on both ends, remove plate, and lower into Quadrant A for packaging. If a cask of sufficient size cannot be obtained, then break up the plate under water before removal and loading into casks. Fracturing of beryllium plate must be performed under water to ensure control of released tritium. This item is likely to be Type B waste due to its H3 content. It is 39"x36"x1" and weighs 42,000g (92.6 lbs.).

36. Remove bolts from flow divider plate frame (aluminum frame portion of Item 24) on both ends and remove plate frame to Quadrant A for packaging. This is the aluminum frame which holds the lockalloy sections covered in Step 33. This item is likely to be Type A waste. It is a picture frame configuration 39"x35"x1"x1" and weighs an estimated 3,300g (7.3 lbs.).

37. Remove bolts from bottom and South end of one core box side plate (Item 37). Remove plate to Quadrant A for packaging. It is approximately 39"x29"x1" and weighs approximately 50,000g (110 lbs.). It is Type A waste.

38. Repeat Step 37 for other core box side plate (Item 37).

39. Remove center section of HT-1 (Item 30) to Quadrant A for packaging. This item is approximately 39"x9" diameter and weighs 24,700g (54.5 lbs). It will most likely be Type A waste.

40. Remove bolts from bottom of far South core box plate (Item 36) and bend holding tabs with special tool, then remove plate to Quadrant C for packaging. It is 39"x36"x1" and weighs 62,500g (138 lbs.). It is likely to be LSA waste.

41. Remove balance of Be-R pieces (16 lower sections of A and B rows and 8 from C row)(Items 21, 20, and 19) to Quadrant A for packaging. Rows A and B lower sections are approximately 4.2" square x 15" long (18 lbs. each). Row C items are approximately 38"x4.2" square (45 lbs. each). All Row A and B items will be Type B waste and Row C should be Type A waste.

42. Clean up metal chips, saw dust and any other scrap from the metering plate and core grid cover plates using a pump-filter rig fabricated in-house. Note that the lower grid cover plate was inserted after all "L" pieces were removed at shutdown to prevent debris from falling to the bottom of the tank. It is contaminated (LSA) but not activated, but will have to be removed at this step. It is heavy gauge sheet metal.

43. Cut up and remove metering plate (Item 16) and section into its 6 basic segments, and lower into Quadrant A for packaging. It is approximately 88" in diameter x .5" stainless steel plate. It weighs 392,000g (863 lbs.) and will be Type B waste.

> NOTE: Pieces of plate are bolted together with 5/16" bolts with castle nuts and cotter pins. Metering plate is bolted to lower grid and on the outside edge. Plate will have to be disassembled or cut to remove.

44. Unbolt lower grid (Item 38) from core support (upper flow grid, Item 2) and remove from tank to Quadrant A for packaging. It is 36"x29"x4.5" and weighs 168,000g (370 lbs.). It will be Type A waste.

45. Unbolt the 10 stainless steel rod guides from the Rod Guide Housing and transfer to Quadrant A for packaging. The upper 1' will be activated. Cut the upper 1' off. These rod guides are approximately 4.2" square x 43" long (51 lbs. each). If the

upper sections are cut off, then the lower sections will be LSA. The upper sections are likely to be Type B waste.

NOTE: At this time remove the 75 stainless steel bolts (stored in-tank as Type B waste) to casks and transfer out to Quadrant A (see Note after Step 20).

46. Remove in-tank portion of the stainless steel fuel chute to Quadrant C for packaging. This is approximately 200 lbs. and 10 cu. ft. in volume. It is LSA and is contaminated but not activated.

47. Torch-cut (underwater) the upper flow guide (Item 2) into pieces small enough to place into a cask and transfer to Quadrant A for packaging. Remove as much as possible of this piece because it has a fairly high activity especially near the top. See Drawings PF07757 thru PF07761. It will be approximately 5'x5'x3' and weigh 123,000g (271 lbs.). This stainless steel piece will be Type B waste.

48. Torch-cut (underwater) the 1/8"x3/4" banding strip which is welded to the upper (Item 2) and lower flow guide (Item 3) and to the tank flow guide (part of the tank, Item 13) and transfer to Quadrant C for packaging. This 20' long strip (~6.4 lbs.) will be LSA waste.

49. Remove the nuts which hold down the lower flow guide (Item 3) to the flow guide (Item 13, part of the tank). If nuts cannot be removed, torch-cut (Item 13) below nuts. These items will be LSA. Item 3 is 5'x5'x3' and weighs 123,000g (271 lbs.).

Remove lower flow guide (Item 3) and rod drive box (Item 14) as a unit and transfer to Quadrant C for packaging. The upper foot of the rod guides should have been cut off prior to removal (see Step 45). Remove to Quad C and cut into pieces small enough to fit into available shipping casks. (Item 14 is approximately 40"x40"x16" and weighs 700,000g; 1544 lbs.) These items are LSA.

NOTE: These pieces are slightly activated, but radiation levels are low enough that pieces can be fairly large, depending on size of containers available.

50. Remove loose debris from the bottom of the tank.

51. Lower water level in the Reactor Tank below the level of the cut-off experiment and instrument tubes. Monitor the radiation level when lowering the water level. If the radiation at the in-tank platform is too high, it is probably from debris. Locate and remove.

51a: NOTE: A number of small bolts, brackets, etc. with low activity (LSA waste) will be accumulated both within and outside of the tank during performance of Steps 52 thru 64. They can be containerized until completion of Step 64 and processed as LSA waste.

52. From the dry Quadrant D, unbolt the HB-1 shielding plug. Remove the remaining part of the HB-1 thimble. Remove the sleeve external to the thimble. Remove all other parts from HB-1 (Item 35). Reference Drawings PF07849 - PF97852. All items are LSA.

HB-1 Shield Plug (3 pieces: 1 aluminum, 6"x24.75"; 1 lead, 11.5"D x 6" and 1 lead, 6"D x 3". Total weight is 116.1Kg; 256 lbs.)
HB-1 Thimble (Item 35; aluminum, 6.75"D x 50" x .38" wall. Total weight is 17.7Kg; 39 lbs.)
HB-1 Sleeve (aluminum, 9"D x 42" x .8" wall. Total weight is 45.9Kg; 101 lbs.)
HB-1 Fabri-Valve (stainless steel, 16"D x 5" wide. Weight is 125.6Kg)
HB-1 Water Cooled Flange (stainless steel,16"Dx4.7" wide. Weight is 97.1 Kg; 214 lbs.)

53. Repeat Step 52 for HB-3 and the five instrument thimbles in Quad D. Reference Drawings same as Step 52. All items are LSA.

HB-3 Shield Plug (lead, 7 pieces, 13"x1", 157.8Kg in weight)
HB-3 Thimble (Item 35, aluminum, 6.75"D x 50" x .38" wall. Weight is 17.7Kg)
HB-3 Sleeve (aluminum, 9"D x 42" x .87" wall. Weight is 45.9Kg)
HB-3 Collimator (stainless steel, 6"D x 50", weighing 204.1Kg)
IT Shield Plug (6.9"D x 18" solid aluminum and 3.5"D x 9" lead. Total weight is 72.6Kg for each IT Shield Plug)

NOTE: All 5 IT Shield Plugs are identical.

54. Remove gate valve and other appurtenances on HB-2 thimble in Quad D. Remove inner shield. Remove outer tube (Item 35). All items are LSA.

HB-2 Gate Valve (stainless steel, 16"D flange x 5" wide. Weight is 125.6Kg)
HB-2 Thimble (Item 35, stainless steel, 9"D x 50" x .25". Weight is 45.4Kg)
HB-2 Inner Shield (stainless steel, 7"D x 50" x .38". Weight is 52.9Kg)
HB-2 Shield Plug (solid aluminum, 6"D x 26.75", lead, 11.5"D x 3.5", lead, 6"D x 3". Total weight is 118.8Kg)

HB-2 Water Cooled Flange (stainless steel, 16"D x 4.7" wide. Weight is 97.1Kg)
HB-2 Fabri-Valve (stainless steel, 16"D x 4.9" wide. Weight is 125.6Kg)

55. In Quad A repeat Step 52 for HT-1 (Item 31), HT-2 (Item 33), and ITA-1 and -2. Reference Drawings PF07825, PF07840, and PF07881. All items are LSA.

HT-1 Shield Plug (stainless steel, 10"D x 14.25" x .5" plus 803 cu. in. lead shot and 16.5"D x 10" x 4" lead ring. Total weight is 286.1Kg)
HT-1 Thimble (Items 34 and 35, aluminum 12.8"D x 45" x .5" wall. Total weight is 80.3Kg)
HT-2 Shield Plug (aluminum, 11"D x 20.75" x .5" wall, plus 1972 cu. in. lead shot. Total weight is 306Kg)
HT-2 Thimble (Items 34 and 35, aluminum, 12.8"D x 45" x .5" wall. Total weight is 80.3Kg
IT Shield Plug (solid aluminum, 6.9"D x 18" plus lead plug 3.5"D x 9". Total weight is 72.7Kg for each IT Shield Plug. There are 2 IT tubes [ITA-1 and ITA-2] in Quadrant A.)

56. In Quad C repeat Step 52 for HT-1 (Item 31), HT-2 (Item 33), and instrument thimbles (ITC-1 and -2). Reference Drawings in Step 55. All items are LSA.

HT-1 Shield Plug (aluminum, 10.25"D x 61" x .38" plug 5,033 cu. in. of lead shot. Total weight is 927.1Kg)
HT-1 Thimble (Items 34 and 35, aluminum, 12.8"D x 45" x .5" wall. Weight is 80.3Kg)
HT-2 Shield Plug (same as HT-1)
HT-2 Thimble (Items 34 and 35, same as HT-1)
IT Shield Plug (solid aluminum, 6.9"D x 18" plus lead, 3.5"D x 9". Total weight is 72.7Kg for each IT Shield Plug. There are 2 IT tubes (ITC-1 and ITC-2) in Quadrant C.)

57. In Quad B repeat Step 52 for HB-4 and HB-5 (Item 29), and HB-6 (Item 28). Reference Drawings PF07855 thru PF07867. Note that it will be necessary to torch cut and remove the dummy thermal shields (3 each approximately 45"D x 2", weighing 409Kg each) attached to the in-tank portions of HB-4, -5, and -6 since each of those beam tubes are welded to the dummy thermal shields and cannot be withdrawn from Quadrant B until this is performed. It will also be necessary to unbolt the drain hole in the lower outer portion of the thermal column in Quad B in order to drain the steel shot (46.6 cu. ft. weighing 5,511Kg). These shielding materials should be considered as activated LSA. HB-4, -5, and -6 also have a total of 2,268KG (7.04 cu. ft.) of lead shot in them which must be removed if sectioning is performed.

HB-4,-5 Shield Plugs (aluminum, 8.7"D x 38.75" x 4" weighing 58.1Kg, plus 1621 cu. in. of lead shot weighing 302.1Kg for each plug)
HB-4,-5 Thimble (A 3-stepped aluminum tube varying from 6.7"D to 9.7"D and a total of 12'2" long. Weight is 66.9Kg each.) These two thimbles will have to be cut in half.
HB-4,-5 Tube Liner (A 3-stepped stainless steel liner varying from 7"D to 10"D and a total of 10'8" long. Weight is 108.4Kg each.) These two liners will have to be cut in half.
HB-6 Shield Plug (aluminum, 17.5"D x 41" x 4", weighing 149.7Kg plus 8925 cu. in. of lead shot weighing 1664Kg)
HB-6 Thimble (A 3-stepped aluminum tube varying from 15.8"D to 18.8"D x 12'4" long, weighing 211.4Kg.) This thimble will have to be cut in half.
HB-6 Tube Liner (A 3-stepped stainless steel tube varying from 16.4"D to 19.4"D x 10'3" long, weighing 223Kg.) This liner will have to be cut in half.

58. Unbolt the flanged housing for the thermal column in Quad B. Remove the thermal column assembly (HB-4, -5, and -6 and the shield mix were removed in Step 57). Note that the inner end of the thermal column has approximately 17.5 cu. ft. of high density concrete as an inner shield. The thermal column will be highly unbalanced as it is withdrawn from the bioshield. Cut off the heavy end of the thermal column (approximately 2' with the high density concrete and tube weighing about 1865Kg). Both pieces should be LSA with some activation. The inner section of the thermal column will be approximately 40" OD x 2' long. The outer section will be approximately 46" OD x 8.5' long and weigh 1361Kg empty. The outer section will have to be cut off (~2').

59. Unbolt the four centering tabs from the inner upper thermal shield (Item 5) then lift out shield. Place in Quadrant C. Cut into pieces small enough to fit into available shipping containers. Reference Drawing PF00238.

NOTE: All thermal shields are tapped for "eye" bolts to be used as lifting "eyes." This shield is slightly activated, but not so much that it will have to be cut remotely. It will weigh 3800Kg and is 7'9" OD x 4'4" high. It is LSA waste (2" thick curved steel plate).

60. Remove eight holddown bolts on middle upper thermal shield (Item 6). Lift out of tank and place in a quadrant. Do not place in a quadrant with another shield. Cut into pieces small enough to fit into available shipping containers. Reference Drawing PF00238. This item weighs 4700Kg and is 8'3" OD x 5'1' high. It is 2" thick curved steel plate and is LSA waste.

TELEDYNE ISOTOPES

61. Repeat Step 60 for outer upper shield (Item 7) which is 5700Kg and 8'9" OD x 5'9" high. This LSA waste is 2" curved steel plate.

62. Remove orifice plate (part of Item 16, under upper thermal shields). Remove eight bolts holding metering plate to thermal shield support brackets. Reference Drawing PF00238. Note that

the metering plate was cut and removed in Step 43. The orifice plate and outer portion of the metering plate should be LSA waste. Transfer them to Quadrant C for cutting and packaging. They are a doughnut shaped ring 9' OD x 7'3" ID x .5" thick plate, estimated to weigh 126Kg.

63. Torch-cut top and triangular pieces off of eight thermal shield support brackets and transfer them to Quadrant C for packaging. See Drawing PF00238, Detail 3. These small items are LSA waste (9.38" x 8" x 6" x .5" plate weighing 6706g each).

64. Torch-cut or remove six .75" bolts from each bracket. Remove the back piece of the eight (8) support brackets to Quadrant C for packaging. Do not remove the plate with bolt taps welded to tank wall. See above referenced Drawing. These bolts will be LSA waste.

64a. NOTE: Remove ten (10) small baskets of nuts and bolts collected during disassembly Steps 52 thru 64 to Quadrant C as LSA waste. See Step 51a.

65. Remove two lower thermal shields (Items 8&9). Place in a quadrant and cut into pieces small enough to fit into available shipping containers. See Drawing PF00276. Both items will be LSA waste. The lower inner TS weighs 3800Kg and is 8'3" OD x 50" high. The outside lower TS weighs 4100Kg and is 8'9" OD x 50" high.

66. At this point, level of activity in tank should be low enough to permit in-tank work without water in the tank. Slowly draw water from the tank through 10V56 into the waste storage tank. Monitor radiation levels while draining. If radiation levels exceed desired limits, determine source and remove. It is probable that activated pieces may be lodged in the "V" where the flow guide (Item 13) is attached to the tank and in the bottom of the tank. If so, remove with a pump-filter rig. (See Step 42)

67. Torch cut the tank flow guide (Item 13) into convenient sizes and remove it to Quad C. It is a conical 1" thick steel plate, 9' diameter at the bottom tapering to 4' diameter at the top, and is approximately 3' high. It weighs 2100Kg and is LSA waste.

68. Cut and remove the intermediate Control Rod Guide Tubes (10 each). They are approximately 4.18" sq. x 32" long and weigh 17.1Kg each. They will be LSA waste.

REMOVE PRESSURE VESSEL

The Pressure Vessel is only slightly activated (in the near core region) and contaminated. The activation is low enough (~30mR/hr) that a person can work, under controlled conditions, directly on the tank without receiving an overexposure. Contamination is likely to be well fixed in the range of 100,000 d/m/100 sq. cm. which will produce a radiation field of approximately 5 mR/hr.

This procedure assumes that <u>all</u> in-tank components have been removed and that the small loose activated/contaminated pieces have been removed. Remove loose surface contamination on tank surfaces before cutting and removal in order to minimize airborne concentrations when cutting. Drain all remaining liquid from the tank.

The Pressure Vessel is A-201 steel with a 10% thickness of 304 stainless steel clad on the inside. The Pressure Vessel is 9' in diameter and approximately 31' long. The upper portion is 1" thick. Near the core it is 2" thick and the hemispherical section at the bottom is .75" thick. The Pressure Vessel is surrounded by a .18" layer of insulation. There is some question concerning the nature of this insulation. One drawing specifies asbestos and another drawing specifies magnesia. Assume that the vessel removal will be done with a plasma arc torch and cuts will be made from the inside. Before the tank insulation is disturbed, the asbestos content must be determined. Any further work on asbestos insulation must be performed in an approved manner.

1. Cut off the upper reactor tank flange and section into 4 pieces. It will weigh a total of 389Kg (858 lbs.) and be LSA waste.

2. Install an adjustable height work platform in the vessel. The platform should probably be supported from the lily pad.

3. Cut around each of the 24 gooseneck shaped experiment penetrations. Remove these from the trench. These will weigh a total of 10,008g (22 lbs). There are 20 each of 2"D x 12" tubes and 4 each of 4"D x 12" tubes.

4. Mark off a horizontal line 5' below the tank top side wall for a circumferential cut. Then mark off the 5' high cylinder section for 9 vertical cuts to permit 9 each arc sections to be cut.

5. Weld a lifting eye or bail on the top edge of each tank section to be cut. Attach to the small crane hook.

6. Cut out a cylindrical section of the vessel 5' high. If the cut out section contains a vessel penetration, cut around the penetration, including the external nozzle support gussets, and leave the pipe in place. This will be removed later (i.e. HB-1,-2,-3 etc.). Make sure when cutting that the cutting angle will permit removal of the cut out piece.

7. Next make the nine vertical cuts to permit removal of the 9 equal arc sections to Quadrant C for packaging. Each section will be approximately 5' x 3.3' x 1" thick plate with a 4.5' radius arc. It will weigh approximately 460Kg (1014 lbs.) and be LSA waste.

8. Move to the next lower 5' section and repeat Steps 4 thru 7 above.

9. Move to the next lower 5' section and repeat Steps 4 thru 7 above. Note that the tank walls are 2" thick plate in the lower 2/5 portion of this region and will weigh 644Kg (1420 lbs.).

10. Move to the next lower 5' section and repeat Step 9 above. Each 5'x3.3'x2" thick plate weighs about 917Kg (2022 lbs.).

11. Move to the next lower level. Burn off the remaining portion of the tank flow guide (Item 13) in segments and remove from the tank to Quadrant C for packaging. Most of this item should have been removed in Step 67.

12. The next circumferential cut will be made about 3' below the previous one at the break between the straight side and the bottom head. Make this cut and divide the cylinder into 9 sections by arc cutting. These pieces will be approximately 3' x 3.3' x 2" thick steel plate with a 4.5' radius arc. It will weigh 367Kg (809 lbs.) and be LSA waste.

NOTE: The vessel support legs attached to the outside of the Pressure Vessel are buried in the biological shield concrete. Refer to drawings for location so they may be cut around when removing the tank wall segments. Grind all contamination from the remaining tank wall pieces (4).

13. Cut off at the reactor tank inside wall the four instrument thimbles which extend upward into the vessel and remove. Two are approximately 4" OD x 6'9" long and weigh 72 lbs. each, and the other two are approximately 4" OD x 3' long and weigh 32.4 lbs. They will be LSA waste.

14. Cut the bottom of the vessel into 9 arc sections and remove. Leave the 3' diameter tank bottom in place with the 10 Control Rod Tubes attached. Each arc section will be approximately 3' x 3.3" x 1' in area x 3/4" thick. This LSA waste will weigh 120Kg (265 lbs.) each.

15. Clean the inside of the 10 Control Rod Tubes to prevent spread of loose contamination. A bottle type brush, detergent solution, and absorbent material should be adequate. Install contamination collection provisions in the Sub-pile Room, remove the control rod tube closures, and complete the tube cleaning. Leave contamination collection provisions in place for Step 18.

NOTE: The control rod drives have been removed from the Sub-pile Room.

16. Cut off the 10 Control Rod Tubes just below the weld that secures them to the reactor tank bottom (about 1.5" below face of tank bottom). This requires an internal pipe cutter for ~2.5" pipe.

17. Pry up and remove the 3' diameter section of the reactor tank bottom. This dish is 1" thick and will weigh approximately 131Kg (289 lbs.). It should be LSA waste.

18. The remaining portion of the 10 Control Rod Tubes are welded to the bottom of the steel pan that holds the Lead Shielding Plug, making removal difficult. Therefore, ream the 10 tubes until release limits are met. Each tube is about 2.5" ID x 3' long.

19. After the Reactor Tank has been removed, it will be necessary to remove or decontaminate the tank penetration extension arms embedded in the bioshield. For cost estimating purposes, it will be assumed that an internal pipe cutter will be used to cut each tube 6" from the inside bioshield wall and that the first 6" of pipe will be removed by chipping concrete away as necessary to remove the pipe sections and any attached external gussets. The rest of the length of each tube will be reamed out under WBS element 2.2.2.10. These include:

<u>Quad A</u>

1. HT-1 Tank Tube (16"D x 31"L x .5" stainless steel weighing 143.3Kg)
2. HT-2 Tank Tube (16"D x 31"L x .5" stainless steel weighing 143.3Kg)
3. ITA-1 Tank Tube (7.5"D x 30"L x .25" stainless steel weighing 22.7Kg)

4. ITA-2 Tank Tube (7.5"D x 30"L x .25" stainless steel weighing 22.7Kg)

<u>Quad C</u>

5. HT-1 Tank Tube (16"D x 31"L x .5" stainless steel weighing 143.3Kg)

6. HT-2 Tank Tube (16"D x 31"L x .5" stainless steel weighing 143.3Kg)

7. ITC-1 Tank Tube (7.5"D x 30"L x .25" stainless steel weighing 22.7Kg)

8. ITC-2 Tank Tube (7.5"D x 30"L x .25" stainless steel weighing 22.7Kg)

<u>Quad D</u>

9. HB-1 Tank Tube (10.25"D x 28" x .38" stainless steel weighing 43.4Kg)

10. HB-2 Tank Tube (10.25"D x 28" x .38" stainless steel weighing 43.4Kg)

11. HB-3 Tank Tube (10.25"D x 28" x .38" stainless steel weighing 43.4Kg)

    NOTE: This tube, along with the thermal column sleeve, removed completely with 12" of surrounding concrete in WBS 2.2.2.13.

12. ITD-2 Tank Tube (7.5"D x 30" x .25" stainless steel weighing 22.7Kg)

13. ITD-3 Tank Tube (<u>2 each</u>, 7.5"D x 30" x .25" stainless steel weighing 22.7Kg)

14. ITD-4 Tank Tube (7.5"D x 30" x .25" stainless steel weighing 22.7Kg)

15. ITD-5 Tank Tube (7.5"D x 30" x .25" stainless steel weighing 22.7Kg)

<u>Sub-Pile Room</u>

2 each IT tubes with thermocouples, sleeves and shielding (intact) - 4" Sched 40 pipe x 6'11" long weighing 197.5Kg each.

2 each Fission Monitor Tubes (empty) - 4" Sched 40 pipe x 10'7-1/4" long weighing 110.2Kg each.

NOTE: These were closed tubes so that removal and reaming should not be required.

These penetration arms were attached to the Reactor Tank with 4 steel reinforcing gussets each welded at 90 degrees from the penetration centerline. It will be necessary to make an interior sleeve cut to separate the outer arms of these sleeves from the gussetted portion embedded in the concrete bioshield. The embedded portions may have to be removed by chipping away several cubic feet of concrete around the inner 1' length of the sleeves.

All waste generated should be LSA.

SEQ. NO.	ITEM NO.	DESCRIPTION	ACTIVITY (mCi)	ISOTOPES	DOSE RATE (mR/hr)	WEIGHT (Kg;Lb)	SIZE (Inches)	VOLUME (Cu Ft)	SPECIFIC ACTIVITY (mCi/gm)	RADIOLOGICAL WASTE CLASS
13	-	Tank Hatch	3.0E-3	60Co,59Ni,55Fe,3H	1.0E1	131;289	36Dx1	.6	2.3E-8	LSA
14	-	Leads, Tubes, Cables	1.0E0	60Co,59Ni,55Fe,3H	LT 1.0E1	153;337	-	2.0	6.5E-6	LSA
15	26	V2 Lower 3', Near Core, Aluminum	4.3E3	60Co,63Ni,26Al,55Fe	2.0E3	15;33	8Dx39	1.1	2.9E-1	LSA
15	26	V2 Upper, Above Core, Aluminum	3.8E2	60Co,63Ni,26Al,55Fe	LT 1.0E2	90;198	8Dx252	7.3	4.0E-3	LSA
16	-	Reactor Tank Dome Flange	1.0E-3	-	LT 5.0E0	389;857	108Dx6x15	1.8	2.6E-9	LSA
16	-	Reactor Tank Dome	5.4E-2	60Co,59Ni,55Fe,3H	LT 1.0E1	1768;3894	108Dx.8	8.0	3.0E-8	LSA
17	-	Rabbits, VAFTS, Coupons	1.0E1	60Co,59Ni,55Fe,3H	LT 3.0E1	222;489	-	2.9	4.5E-5	LSA
20	-	75 Cable Clamps	1.0E-2	-	LT 1.0E1	87;191	3x6x.5 EA	0.4	1.2E-7	LSA
21	1	10 Rod Guide Roller Cages, Stainless Steel	5.8E4	60Co,59Ni,63Ni,55Fe	9.7E6	13;28	3x3x3.5 EA	0.2	4.6E0	Type B
21A	25	Upper Core Grid, Alum, Note: 55759gm is in Reflector Grid, and not used here.	1.6E4	60Co,63Ni,55Fe,26Al	6.1E3	38;83	36x13x2.5	0.7	4.4E-1	Type A
23	-	Aluminum Grid Hold Down Angle on N. Beryllium Plate	1.1E2	60Co,55Fe,63Ni,26Al	LT 1.0E2	.2;.5	3x3x30x.2	0.003	4.4E-1	Type A
24	34	In-Tank Sections HB-1, -2,-3	3.0E1	55Fe	LT 1.0E2	34;75	7Dx24 EA	1.6	8.8E-4	LSA
24	34	In-Tank Sections ITD-2, -3,-4,-5, Alum Pipe, (ITD-2 Has 2 Thimbles)	5.0E1	-	LT 1.0E2	50;110	6.5Dx24 EA	2.3	1.0E-3	LSA
25	-	ITA-1,-2, and ITC-1,-2, Alum Pipe	4.0E1	55Fe	LT 1.0E2	40;88	6.5Dx24 EA	1.8	1.0E-3	LSA
26	28	HB-6	2.0E0	55Fe	LT 2.0E1	17;38	16Dx28	3.3	1.2E-4	LSA
26	29	HB-4,-5	4.0E0	55Fe	LT 2.0E1	34;74	6.75Dx28	1.2	1.2E-4	LSA
27	32	HT-2 Near Core Section	9.1E2	60Co,55Fe,63Ni,26Al	2.0E3	31;69	9Dx39	1.4	2.9E-2	LSA
27	33	HT-2 Outside Core But In-Tank, 2 Pieces	1.6E2	55Fe	LT 1.0E2	54;120	9Dx33 EA	2.4	2.8E-3	LSA
28	31	HT-1 In-Tank Outside Core, Alum, 2 Pieces	2.5E3	60Co,55Fe,63Ni,26Al	4.0E2	43;95	9Dx33 EA	2.4	5.7E-2	LSA
29	18	7 RD Piece Plugs	6.6E3	60Co;55Fe	2.1E5	125;274	2.1Dx38 EA	0.6	5.3E-2	Type A
29	19	7 RC Piece Plugs	2.9E4	60Co,55Fe,113Cd	7.5E5	125;274	2.1Dx38 EA	0.6	2.4E-1	Type B
29	20	3 RB Piece Plugs	3.8E4	60Co,55Fe,113Cd	2.2E6	53;118	2.1Dx38	0.2	7.1E-1	Type B
29	21	4 RA Piece Plugs	1.4E4	60Co,55Fe,113Cd	9.6E6	71;157	2.1Dx38 EA	0.3	1.9E0	Type B
30	25	Reflector Grid (Upper) Alum (Represents 60% of Grid)	2.4E4	60Co,55Fe,63Ni,26Al	6.1E3	56;123	36x16x2.5	0.8	4.4E-1	Type A
31	20	Upper Half of R Pieces From Row B (8 Pieces)	2.2E6	3H,26Al	2.2E6	65;143	4.2x4.2x15 EA	1.2	3.4E-1	Type B
31	21	Upper Half of R Pieces From Row A (8 Pieces)	1.1E7	3H,26Al	9.6E6	65;143	4.2x4.2x15 EA	1.2	1.7E2	Type B
32	18	R Pieces From Row D (8 Pieces)	9.6E4	3H	2.1E5	130;287	4.2x4.2x38 EA	3.1	7.4E-1	Type B (Type A EA)
33	24	5 Center Sections of Lockalloy From Flow Divider Plate	7.6E6	60Co,55Fe,63Ni,3H	3.3F3	49;108	6x39x1 EA	0.7	1.6E2	Type B

TABLE 2.2 - Radiological Classification Summary of the PBRF Reactor Tank and Contents Arranged by Sequence of Removal

SEQ. NO.	ITEM NO.	DESCRIPTION	ACTIVITY (mCi)	ISOTOPES	DOSE RATE (mR/hr)	WEIGHT (Kg;Lb)	SIZE (Inches)	VOLUME (Cu Ft)	SPECIFIC ACTIVITY (mCi/gm)	RADIOLOGICAL WASTE CLASS
35	17	North Core Box Beryllium Plate	2.4E6	60Co,55Fe,3H,113Cd	1.0E6	42;93	39x36x1	0.8	5.7E1	Type B
36	24	Aluminum Frame for Lock-alloy Divider	5.4E3	60Co,55Fe,63Ni,26Al	3.3E3	3;7	39x35x1	0.1	1.7E0	Type A
37	37	Core Box Side Plate - Alum	3.7E4	60Co,55Fe,63Ni,26Al	7.5E3	50;110	39x29x1	0.7	0.7E0	Type A
38	37	Core Box Side Plate - Alum	3.7E4	60Co,55Fe,63Ni,26Al	7.5E3	50;110	39x29x1	0.7	0.7E0	Type A
39	30	HT-1 In-Core Portion	2.8E4	60Co,55Fe,63Ni,26Al	8.0E3	25;55	9Dx39	1.4	1.1E0	Type A
40	36	Far South Core Box Plate	1.8E3	55Fe	2.9E2	63;138	39x36x1	0.8	2.8E-2	LSA
41	21	Beryllium R Pieces From Lower Half of "A" Row (8 Pieces)	1.1E7	3H	9.6E6	65;143	4.2x4.2x15 EA	1.2	1.7E2	Type B
41	20	Beryllium R Pieces From Lower Half of "B" Row (8 Pieces)	2.2E6	3H	2.2E6	65;143	4.2x4.2x15 EA	1.2	3.4E1	Type B
41	19	Beryllium R Pieces From "C" Row (8 Pieces)	6.4E5	3H	7.5E5	163;360	4.2x4.2x38 EA	3.1	3.9E0	Type A
43	16	Metering Plate - SS (Will Divide Into 6 Sections)	1.5E4	60Co,59Ni,63Ni,55Fe	8.3E4	392;863	0.5x88D	1.8	3.7E-2	Type B
44	38	Lower Grid - Aluminum	2.1E5	60Co,63Ni,55Fe,26Al	2.2E4	168;370	36x29x4.5	2.7	1.2E0	Type A
GENL	4	75 SS Nuts & Bolts (Held Core Together)	1.2E4	60Co,63Ni,59Ni,55Fe	2.2E7	2;4	1x1.5 EA	0.1	6.2E0	Type B
45	-	SS Rod Guides (Upper) - 10 Each	2.7E4	60Co,59Ni,63Ni,55Fe	1.3E5	23;51	4.2x4.2x43 EA	4.4	1.2E0	Type B
46	-	Fuel Chute - SS	1.0E2	60Co,55Fe	1.0E5	91;200	-	10.0	1.1E-3	LSA
47	2	Upper Flow Guide - SS	1.4E5	60Co,59Ni,63Ni,55Fe	7.0E6	123;271	60x60x36	75	1.1E0	Type B
48	-	Banding Strip on Flow Guide	5.0E1	60Co,55Fe	LT 5.0E1	3;6	.125x.75x20	0.01	1.7E-2	LSA
49	3	Lower Flow Guide - SS	7.0E0	60Co,63Ni,55Fe	3.5E2	123;271	60x60x36	75	5.7E-5	LSA
49	14	Rod Drive Box	1.0E1	60Co,55Fe	LT 2.0E1	700;1542	40x40x16	2.6	1.4E-5	LSA
52	-	Quad D, HB-1 Shield Plug Piece 1 of 3, Solid Alum;	3.0E-1	60Co,55Fe,63Ni	LT 3.0E1	33;72	6x24.75	0.4	9.2E-6	LSA
		Piece 2 of 3, Lead;	3.0E-1	60Co,55Fe,63Ni	LT 3.0E1	68;149	11.5Dx3.5	0.2	4.4E-6	LSA
		Piece 3 of 3, Lead	3.0E-1	60Co,55Fe,63Ni	LT 3.0E1	16;35	6Dx3	0.05	1.9E-5	LSA
52	-	Quad D, HB-1 Thimble, Alum, 3/6" Wall	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	18;39	6.75Dx50x.38	1.0	5.7E-4	LSA
52	-	Quad D, HB-1 Sleeve, Alum, 7/8" Wall	1.0E0	60Co,55Fe,63Ni	LT 3.0E1	46;101	9Dx42x.88	1.5	2.2E-5	LSA
52	-	Quad D, HB-1 Water Cooled Flange - SS	1.0E0	60Co,55Fe,63Ni	LT 3.0E1	97;214	16Dx4.6	0.5	1.0E-5	LSA
52	-	Quad D, HB-1 Fabri-Valve, SS	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	126;277	16Dx5	0.6	8.0E-5	LSA
53	-	Quad D, HB-3 Shield Plug, 6 Lead Pieces;	1.0E0	60Co,55Fe,63Ni	LT 3.0E1	148;327	13Dx1	0.5	6.7E-6	LSA
		1 Lead Piece	1.0E0	60Co,55Fe,63Ni	LT 3.0E1	10;21	8Dx1	0.03	1.1E-4	LSA
53		Quad D, HB-3 Thimble, Alum	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	18;39	6.75Dx50x.38	1.0	5.7E-4	LSA
53	-	Quad D, HB-3 Sleeve, Alum	1.0E0	60Co,55Fe,63Ni	LT 3.0E1	46;101	9Dx42x.88	1.5	2.2E-5	LSA
53	-	Quad D, HB-3 Collumator, SS	1.0E2	60Co,55Fe,63Ni	LT 1.0E2	204;450	6Dx50	0.8	4.9E-4	LSA
53	-	Quad D, ITD Shield Plugs, 1 per Each of the 5 ITDs, Solid Aluminum;	5.0E0 EA	60Co,55Fe,63Ni EA	LT 3.0E1 EA	33;72 EA	6.9Dx18 EA	0.4 EA	1.5E-4 EA	LSA EA
		ITI Shield Plugs, 1 per Each of the 5 ITDs, Lead	5.0E0 EA	60Co,55Fe,63Ni EA	LT 3.0E1 EA	49;88 EA	3.5Dx9 EA	0.05 EA	1.3E-4 EA	LSA EA

TABLE 2.2 - Radiological Classification Summary of the PBRF Reactor Tank and Contents Arranged by Sequence

SEQ. NO.	ITEM NO.	DESCRIPTION	ACTIVITY (mCi)	ISOTOPES	DOSE RATE (mR/hr)	WEIGHT (Kg;Lb)	SIZE (Inches)	VOLUME (Cu Ft)	SPECIFIC ACTIVITY (mCi/gm)	RADIOLOGICAL WASTE CLASS
54	-	Quad D, HB-2 Gate Valve, SS;	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	126;277	16D Fl x5	0.6	8.0E-6	LSA
		Quad D, HB-2 Thimble, SS;	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	45;100	9Dx50x.25	1.8	2.2E-4	LSA
		Quad D, HB-2 Inner Shield SS;	1.0E0	60Co,55Fe,63Ni	LT 3.0E1	53;117	7Dx50x.38	1.1	1.9E-5	LSA
		Quad D, HB-2 Shield Plug 1 Piece of 3, Solid Alum;	3.0D-1	60Co,55Fe,63Ni	LT 3.0E1	35;78	6Dx26.75	0.4	9.2E-6	LSA
		Piece 2 of 3, Lead;	3.0E-1	60Co,55Fe,63Ni	LT 3.0E1	68;149	11.5Dx3.5	0.2	4.4E-6	LSA
		Piece 3 of 3, Lead	3.0E-1	60Co,55Fe,63Ni	LT 3.0E1	16;35	6Dx3	0.05	1.9E-5	LSA
		Quad D, HB-2 Water Cooled Flange - SS	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	97;214	16Dx4.7	0.5	1.0E-4	LSA
		Quad D, HB-2 Fabri-Valve, SS	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	126;277	16Dx5	0.6	8.0E-5	LSA
55	-	Quad A, HT-1 Shield Plug, Piece 1 of 3, SS;	3.0E-1	60Co,55Fe,63Ni	LT 3.0E1	36;78	10Dx14.25x.5	0.6	8.4E-6	LSA
		Piece 2 of 3, Lead Shot;	3.0E-1	60Co,55Fe,63Ni	LT 3.0E1	150;330	-	0.5	2.0E-6	LSA
		Piece 3 of 3, Lead Ring;	3.0E-1	60Co,55Fe,60Ni	LT 3.0E1	101;222	16.5Dx10x4	1.2	3.0E-6	LSA
		HT-1 Thimble, Aluminum	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	80;177	12.8Dx45.5	3.4	1.2E-4	LSA
55		Quad A, HT-2 Shield Plug, Piece 1 of 2, Alum;	5.0E-1	60Co,55Fe,63Ni	LT 3.0E1	16;35	11Dx20.75x.5	1.1	3.1E-5	LSA
		Piece 2 of 2, Lead Shot;	5.0E-1	60Co,55Fe,63Ni	LT 3.0E1	291;641	-	1.1	1.7E-6	LSA
		HT-2 Thimble, Aluminum	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	80;177	12.8Dx45x.5	3.4	1.2E-4	LSA
55	-	Quad A, ITA-1 & ITA-2 Shield Plugs, 1 per Each ITA, Solid Aluminum;	5.0E0 EA	60Co,55Fe,63Ni EA	LT 3.0E1 EA	33;72 EA	6.9Dx18 EA	0.4 EA	1.5E-4 EA	LSA EA
		ITA-1 & ITA-2 Shield Plugs, 1 per Each ITA, Lead	5.0E0 EA	60Co,55Fe,63Ni EA	LT 3.0E1 EA	40;88	3.5Dx9 EA	0.05 EA	1.3E-4 EA	LSA EA
56	-	Quad C, HT-1 & HT-2 Shield Plugs, 1 per Each HT, Alum;	5.0E-1 EA	60Co,55Fe,63Ni EA	LT 3.0E1 EA	33;72	10.25Dx61x.38EA	2.9 EA	1.5E-5 EA	LSA EA
		HT-1 & HT-2 Shield Plugs, 1 per Each HT, Lead Shot;	5.0E-1 EA	60Co,55Fe,63Ni EA	LT 3.0E1	927;2042 EA	-	2.9 EA	5.4E-7 EA	LSA EA
		HT-1 & HT-2 Thimbles, 1 per Each HT, Aluminum	1.0E1 EA	60Co,55Fe,63Ni EA	LT 3.0E1 EA	80;177 EA	12.8Dx45x.5 EA	3.4 EA	1.2E-4 EA	LSA EA
56	-	Quad C, ITC-1 & ITC-2 Shield Plugs, 1 per Each ITC, Solid Aluminum;	5.0E0 EA	60Co,55Fe,63Ni EA	LT 3.0E1 EA	33;72 EA	6.9Dx18 EA	0.4 EA	1.5E-4 EA	LSA EA
		ITC-1 & ITC-2 Shield Plugs, 1 per Each ITC, Lead	5.0 E0 EA	60Co,55Fe,63Ni EA	LT 3.0E1 EA	40;88 EA	3.5Dx9 EA	0.05 EA	1.3E-4 EA	LSA EA
57	-	Quad B, HB-4,-5,-6 Dummy Thermal Shields, 3 Each, SS;	1.0E2 TL	60Co	1.0E2 TL	409;901 EA	45Dx2 EA	1.8 EA	8.1E-5 EA	LSA EA
		HB-4 & HB-5 Shield Plugs, 1 per Each HB, Alum;	5.0E0 EA	55Fe,26Al	LT 3.0E1 EA	58;128	8.7Dx38.8x.- EA	1.3 EA	8.6E-5 EA	LSA EA
		1 per Each HB, Lead Shot	5.0E0 EA	210Pb	LT 3.0E1 EA	302;665	-	0.9 EA	1.7E-5 EA	LSA EA

TABLE 2.2 - Radiological Classification Summary of the PBRF Reactor Tank and Contents Arranged by Sequence of Removal

SEQ. NO.	ITEM NO.	DESCRIPTION	ACTIVITY (mCi)	ISOTOPES	DOSE RATE (mR/hr)	WEIGHT (Kg;Lb)	SIZE (Inches)	VOLUME (Cu Ft)	SPECIFIC ACTIVITY (mCi/gm)	RADIOLOGICAL WASTE CLASS
57	-	Quad B, HB-4 & HB-5 Thimbles, Alum, 3 Step Design, 3 Dimensional per Thimble;	1.0E1 EA	55Fe	LT 3.0E1 EA	67;147 EA	6.7Dx70.6x.4 EA	4.2 TL	1.5E-4 EA	LSA EA
		HB-4 & HB-5 Thimbles Continued;	-	-	-	-	8.2Dx36x.4 EA	-	-	-
		HB-4 & HB-5 Thimbles Continued;	-	-	-	-	9.7Dx39.1x.4 EA	-	-	-
		HB-4 & HB-5 Tube Liners, SS, 3 Step Design, 3 Dimensional per Liner;	1.0E2 EA	60Co,55Fe,63Ni	1.0E2 EA	108;239	7Dx52x.3 EA	4.2 TL	9.2E-4 EA	LSA EA
		HB-4 & HB-5 Tube Liners, Continued;	-	-	-	-	8.5Dx36x.3 EA	-	-	-
		HB-4 & HB-5 Tube Liners, Continued	-	-	-	-	10Dx40.1x.3 EA	-	-	-
		Quad B HB-6 Shield Plug, Piece 1 of 2, Alum;	5.0E0	55Fe,26Al	LT 3.0E1	150;330	17.5Dx40.8x.4	5.7	3.3E-5	LSA
		Piece 2 of 2, Lead Shot	5.0E0	210Pb	LT 3.0E1	1664;3665	-	5.2	3.0E-6	LSA
		Quad B HB-6 Thim., Alum, 3 Step Design, 3 Dimen.;	1.0E1	55Fe	LT 3.0E1	211;466	15.8Dx71x.5	19.6	4.7E-5	LSA
		Thimble Continued;	-	-	-	-	17.8Dx36x.5	-	-	-
		Thimble Continued	-	-	-	-	18.8Dx39.8x.5	-	-	-
		Quad B, HB-6 Tube Liner, SS, 3 Step Design, 3 Dimensions;	1.0E2	60Co	1.0E2	223;491	16.4Dx45.4x.3	18.2	4.5E-4	LSA
		Tube Liner Continued;	-	-	-	-	18.4Dx36x.3	-	-	-
		Tube Liner Continued	-	-	-	-	19.4Dx41.3x.3	-	-	-
		Quad B, Thermal Column Steel Shot (White Iron Shot)	1.0E1	60Co,55Fe,63Ni	LT 3.0E1	5511;12139	-	46.6	1.8E-6	LSA
		Quad B; Thermal Column Liner, SS, 3 Step Design, 3 Dimensions;	1.0E2	60Co,55Fe,63Ni	1.0E2	957;2107	40.2Dx15.7x.4	90.2	1.0E-4	LSA
		Liner Continued;	-	-	-	-	41.8Dx82.5x.5	-	-	-
		Liner Continued;	-	-	-	-	44.2Dx24.5x.4	-	-	-
58	-	Quad B, Thermal Column High Density Concrete, 2 Dimensions;	1.0E1	?	3.0E1	1865;4108	39.4Dx9.8	17.7	5.4E-6	LSA
		Thermal Column Continued	-	-	-	-	40.8Dx14.3	-	-	-
		Quad B, Thermal Column, SS, 2 Step Design, 2 Dimens.;	1.0E2	60Co,55Fe,63Ni	3.0E1	1361;2997	44.3Dx75.8x.6	92.9	7.3E-5	LSA
		Thermal Column Continued	-	-	-	-	46.3Dx26.3x.6	-	-	-
59	5	Inner Upper Thermal Shield	LT 1.0E1	60Co,55Fe,63Ni	3.0E1	3800;8370	93Dx52x2	17.6	2.6E-6	LSA
60	6	Middle Upper Thermal Shield	LT 1.0E1	60Co,55Fe,63Ni	3.0E1	4700;10352	99Dx61x2	22.0	2.1E-6	LSA
61	7	Outer Upper Thermal Shield	LT 1.0E1	60Co,55Fe,63Ni	3.0E1	5700;12555	105Dx69x2	26.3	1.8E-6	LSA
62	16	Orifice Plate (Part of Item 16 Under Upper Thermal Shields)	LT 1.0E1	60Co,55Fe,63Ni	LT 5.0E1	126;278	98Dx20x.5	1.8	7.9E-5	LSA
63	-	Thermal Shield Support Brackets, SS, 8 Each, L Shaped	LT 1.0E0	60Co,55Fe,63Ni	3.0E1	7;15 EA	9.4x8x6x.5 EA	.04 EA	1.5E-4 EA	LSA EA

TABLE 2.2 - Radiological Classification Summary of the PBRF Reactor Tank and Contents Arranged by Sequence of Removal

SEQ. NO.	ITEM NO.	DESCRIPTION	ACTIVITY (mCi)	ISOTOPES	DOSE RATE (mR/hr)	WEIGHT (Kg;Lb)	SIZE (Inches)	VOLUME (Cu Ft)	SPECIFIC ACTIVITY (mCi/gm)	RADIOLOGICAL WASTE CLASS
64	-	Bolts, .75 Inch, 6 Each	LT 1.0E0	60Co	3.0E1	.9;2 EA	.75x4 EA	.001 EA	1.1E-3 EA	LSA EA
65	8	Lower Inner Thermal Shield	LT 1.0E1	60Co	LT 3.0E1	3800;8730	99Dx50x2	18	2.6E-6	LSA
65		Lower Outer Thermal Shield	LT 1.0E1	60Co	LT 3.0E1	4100;9031	105Dx50x2	19.1	2.4E-6	LSA
67	13	Tank Flow Guide, SS, Conical Shape, 4' Dia. at Top 9' Dia. at Bottom x 1"	LT 1.0E1	60Co	LT 3.0E1	2100;4626	48Dx108x1	5.8	4.8E-6	LSA
68		Intermediate Control Rod Guide Tubes, SS, 10 Each	LT 1.0E0 EA	60Co,55Fe EA	LT 2.0E1 EA	17;38 EA	4.1x4.1x32 EA	.3 EA	5.8E-5 EA	LSA EA
RPV1	-	Upper Reactor Tank Flange, Cut into 4 Pieces	LT 1.0E0	60Co	LT 3.0E1	389;857	108Dx6x1.5	1.8	2.6E-6	LSA
RPV3	-	Upper Experiment Penetrations, Gooseneck Shaped, 20 Each	LT 4.0E-2 EA	60Co	LT 3.0E1 EA	.4;.9	2Dx12 EA	.02 EA	9.6E-5 EA	LSA EA
RPV3	-	Upper Experiment Penetrations, Gooseneck Shaped, 4 Each	LT 4.0E-2 EA	60Co	LT 3.0E1 EA	.8;1.8	4Dx12 EA	.09 EA	4.8E-5 EA	LSA EA
(RPV6 thru	-	Upper 2 Rows of Tank Wall, 18 Each, Arc Cut Sections	LT 1.0E0 EA	50Co,55Fe	LT 3.0E1 EA	459;1010 EA	60x40x1 EA	2.1 EA	2.2E-6 EA	LSA EA
PPV10)	-	Middle 2 Rows of Tank Wall, 18 Each, Arc Cut Sections	LT 1.0E0 EA	60Co,55Fe	LT 3.0E1 EA	917;2020 EA	60x40x2 EA	4.1 EA	1.1E-6 EA	LSA EA
RPV12	-	Lower Row (3') Tank Wall, 9 Each, Arc Cut Sections	LT 1.0E0 EA	60Co,55Fe	LT 3.0E1 EA	367;808 EA	40x36x2 EA	1.7 EA	2.7E-6 EA	LSA EA
RPV13	-	Instrument Thimbles, 2 EA	LT 1.0E0 EA	60Co,55Fe	LT 3.0E1 EA	33;72 EA	4Dx81 EA	0.6 EA	3.0E-5 EA	LSA EA
RPV13		Instrument Thimbles, 2 EA	LT 1.0E0 EA	60Co,55Fe	LT 3.0E1 EA	15;32 EA	4Dx36 EA	0.3 EA	6.8E-5 EA	LSA EA
RPV14	-	Reactor Tank Bottom, 9 Each, Arc Cut Sections	LT 1.0E0 EA	60Co,55Fe	LT 3.0E1 EA	120;265 EA	36x39x12x.8 EA	0.5 EA	8.3E-6 EA	LSA EA
RPV17	-	Reactor Tank Bottom - 3' Diameter Section	LT 1.0E0	60Co,55Fe	LT 3.0E1	131;289	.36Dx1	0.6	7.6E-6	LSA
RPV19	-	Quad A, HT-1 & HT-2 Tank Tubes, SS	LT 1.0E1 EA	60Co,55Fe	LT 1.0E1 EA	143;316 EA	16Dx31x.5 EA	3.6 EA	7.0E-5 EA	LSA EA
RPV19	-	Quad A, ITA-1 & ITA-2 Tank Tubes, SS	LT 1.0E1 EA	60Co,55Fe	LT 1.0E1 EA	23;50 EA	7.5Dx30x.3 EA	0.8 EA	4.4E-4 EA	LSA EA
RPV19	-	Quad C, HT-1 & HT-2 Tank Tubes, SS	LT 1.0E1 EA	60Co,55Fe	LT 1.0E1 EA	143;316 EA	16Dx31x.5 EA	3.6 EA	7.0E-5 EA	LSA EA
RPV19	-	Quad C, ITC-1 & ITC-2 Tank Tubes, SS	LT 1.0E1 EA	60Co,55Fe	LT 1.0E1 EA	23;50 EA	7.5Dx30x.3 EA	0.8 EA	4.4E-4 EA	LSA EA
RPV19	-	Quad D, HB-1,HB-2, and HB-3 Tank Tubes, SS	LT 1.0E1 EA	60Co,55Fe	LT 3.0E1 EA	43;96 EA	10.3Dx28x.4 EA	1.3 EA	2.3E-4 EA	LSA EA
RPV19	-	Quad D, ITD-2,ITD-3 (2 ea), ITD-4, & ITD-5 Tank Tubes, SS, 5 Each	LT 1.0E1 EA	60Co,55Fe	LT 1.0E1 EA	23;50 EA	7.5Dx30x.3 EA	0.8 EA	4.4E-4 EA	LSA EA
RPV19	-	Sub-Pile Room, IT Tubes, Schedule 40, 2 Each	LT 1.0E1 EA	60Co,55Fe	LT 1.0E1 EA	198;435 EA	4Dx83 EA	0.6 EA	5.1E-5 EA	LSA EA
RPV19	-	Sub-Pile Room, Fission Monitor Tubes, Schedule 40, 2 Each	LT 1.0E1 EA	60Co,55Fe	LT 1.0E1 EA	110;243 EA	4Dx127.3 EA	0.9 EA	9.1E-5 EA	LSA EA

TABLE 2.2 - Radiological Classification Summary of the PBRF Reactor Tank and Contents Arranged by Sequence of Remov

NOTE: Not shown are Beam Tubes HB-1 thru HB-6 nor Vertical Tubes V-1 and V-2. See Figures 2.2, 2.3, and 2.4 for other detail.

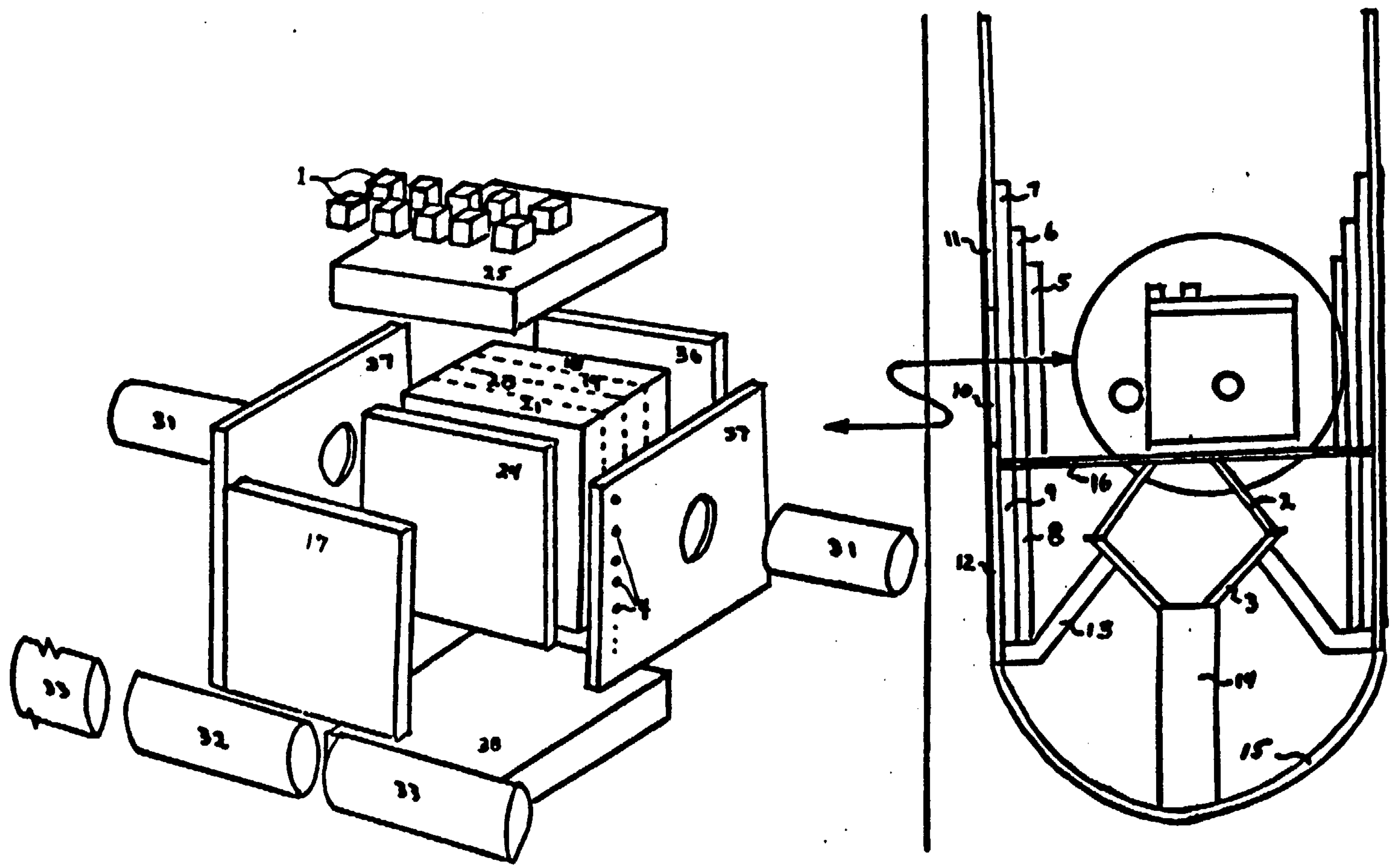


FIGURE 2.1 - Illustration of Core Sections and Tank Components Used in Activation Analysis

Indicates: 11-"R" Piece Beryllium Plugs Removed to Hot Dry Storage

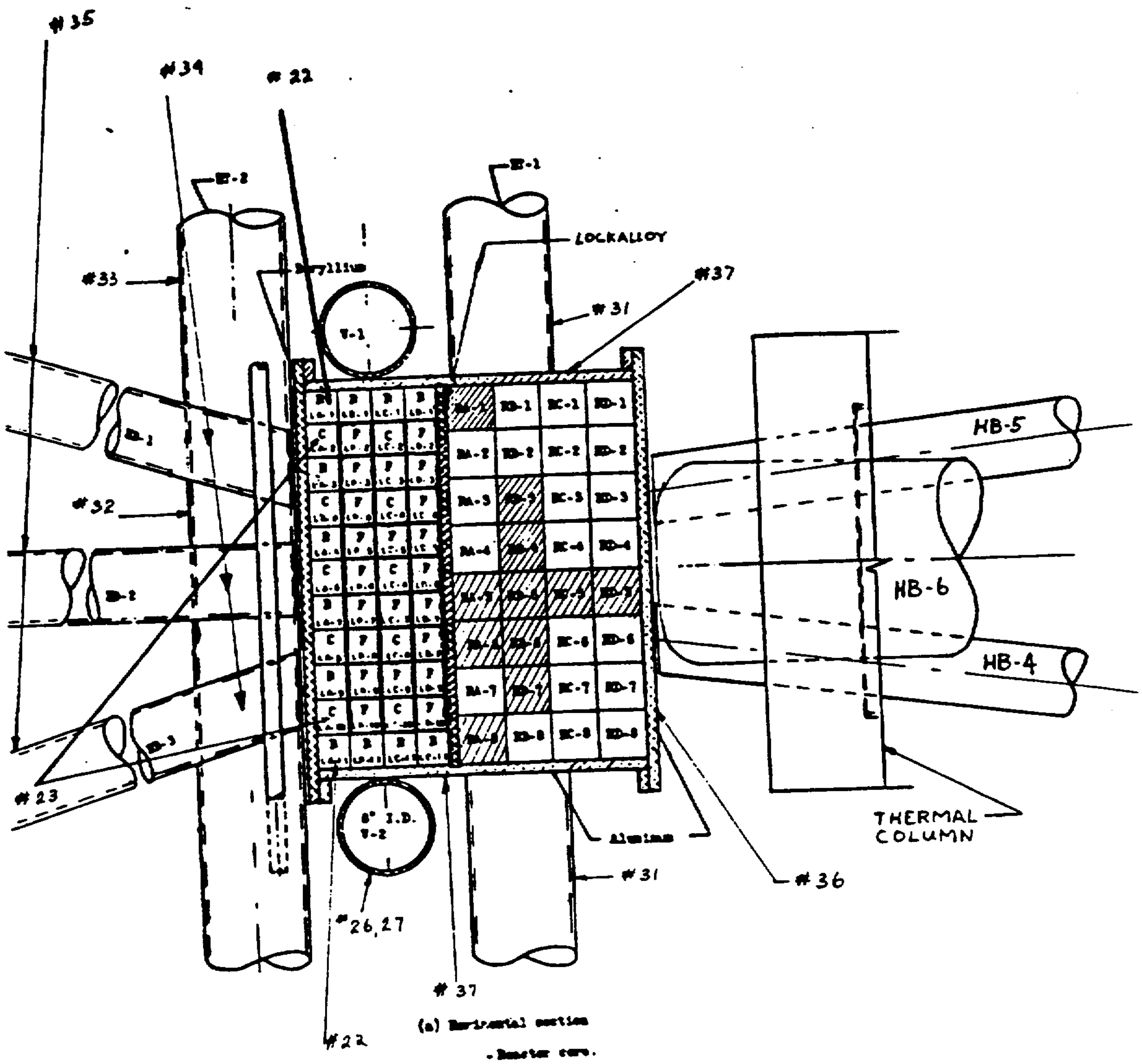
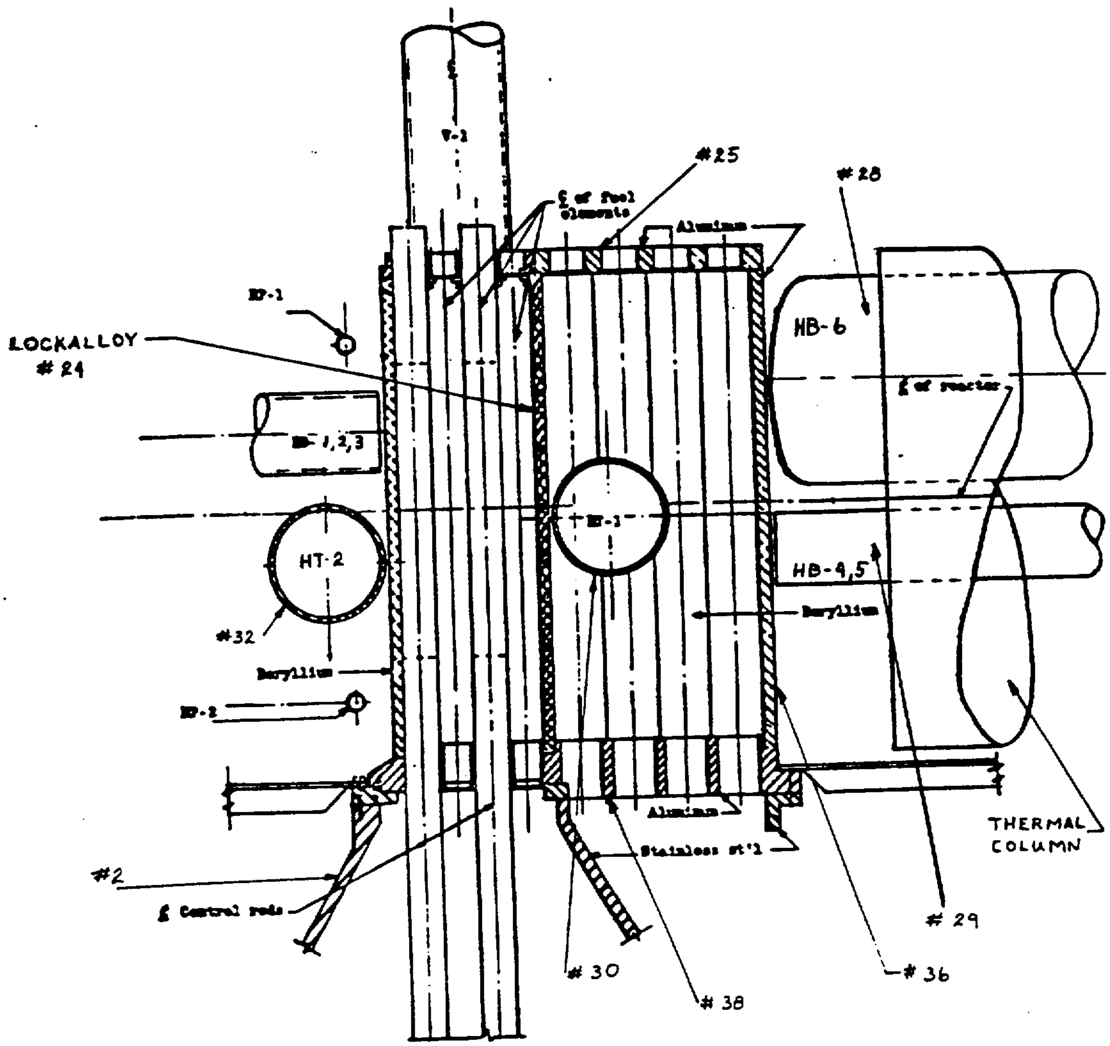


FIGURE 2.2 - PBRF - Reactor Core Segments



(b) Vertical section

Continued. Reactor core.

FIGURE 2.3 - PBRF Reactor Core Segments

No. Pieces	
1	Top Hatch 3' dia. x 1'
9	Top Dome 4'x3.3' ea.
4	Dome Flange 8'x1.3' ea.
4	Tank Flange 8'x1.3' ea.
9	Tank Wall 5'x3.3' ea.
9	Tank Wall 5'x3.3' ea.
9	Tank Wall 5'x3.3' ea.
9	Tank Wall 5'x3.3' ea.
9	Tank Wall 3'x3.3' ea.
9	Tank Bottom 4'x3.3' ea.
1	Bottom Dish 3' dia.
73 Piece Total	
9	Sub-Pile Room Dish 5'x3.3'

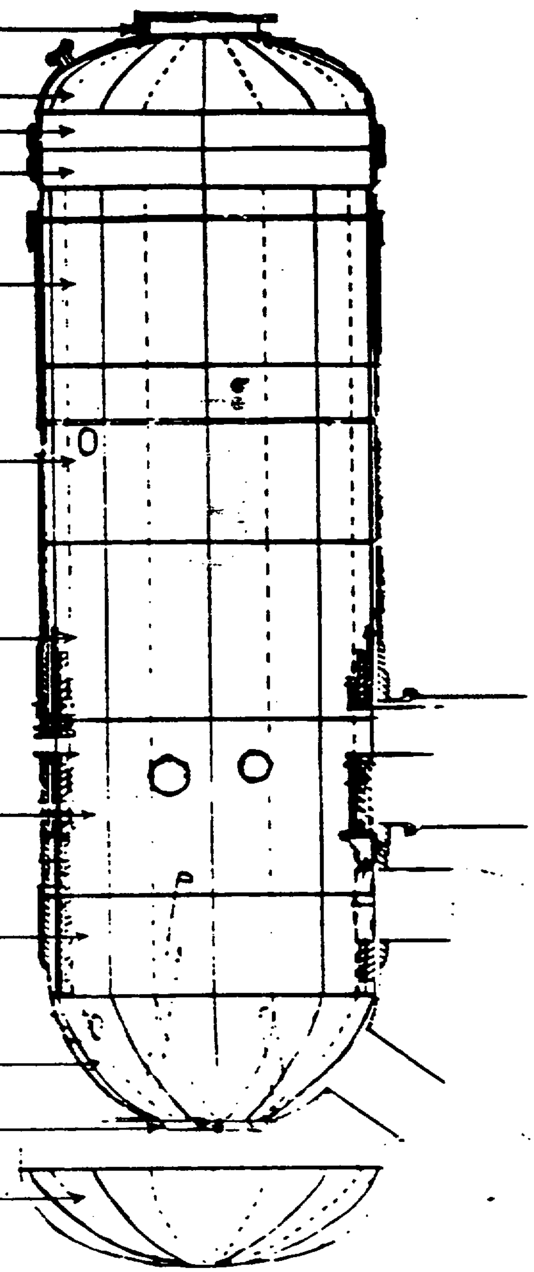


FIGURE 2.4 - PBRF Reactor Tank Segmenting Scheme

TABLE 2-3

SELECTED REACTIONS WITH THEIR CROSS SECTIONS AND ENERGY YIELDS

TYPE OF MATERIAL - 304 STAINLESS STEEL

REACTION NUMBER	REACTIONS	FOUR GROUP CROSS SECTIONS (CM^2/GM) GROUP-1	GROUP-2	GROUP-3	GROUP-4
1	Ni-58(N,γ)Ni-59	.000	.000	.000	.300-01
2	Ni-58(N,P)Co-58	.923-03	.000	.000	.000
3	Ni-58(N,P)Co-58m, Co-58	.904-04	.000	.000	.000
4	Ni-60(N,P)Co-60	.134-04	.000	.000	.000
5	Ni-62(N,γ)Ni-63	.270+04	.736-03	.249-03	.563-03
6	Fe-54(N,γ)Fe-55	.000	.000	.000	.143-02
7	Fe-54(N,P)Mn-54	.353-04	.000	.000	.000
8	Co-59(N,γ)Co-60	.638-04	.138-03	.485-01	.215+00
9	Co-59(N,γ)Co-60m, Co-60	.486-04	.105-03	.370-01	.163+00
10	Mn-55(N,2N)Mn-54	.548-06	.000	.000	.000

REACTION NUMBER	HALF-LIFE (HOURS)	GAMMA ENERGY YIELD (MEV/DIS) * 0.10-0.50	0.50-0.90	0.90-1.60	1.60-...
1	.701+09	.779-02	.000	.000	.000
2	.170+04	.000	.818+00	.000	.810-02
3	.900+01	.250-02	.000	.000	.000
3D	.170+04	.000	.818+00	.000	.810-02
4	.462+05	.000	.000	.250+01	.000
5	.105+07	.000	.000	.000	.000
6	.814-09	.730-02	.000	.000	.000
7	.698+04	.000	.840+00	.000	.000
8	.462+05	.000	.000	.250+01	.000
9	.175+00	.588-01	.000	.399-02	.000
9D	.462+05	.000	.000	.250+01	.000
10	.698+04	.000	.840+00	.000	.000

Starred (*) item - Yields are divided into four energy ranges (MEV).

TABLE 2-3 (Cont'd)

SELECTED REACTIONS WITH THEIR CROSS SECTIONS AND ENERGY YIELDS

TYPE OF MATERIAL - LOCKALLOY

REACTION NUMBER	REACTIONS	FOUR GROUP CROSS SECTIONS (CM^2/GM) GROUP-1	GROUP-2	GROUP-3	GROUP-4
1	Al-27(N,2N)Al-26	.519-03	.000	.000	.000
2	Fe-54(N,γ)Fe-55	.000	.000	.000	.143-02
3	Fe-54(N,P)Mn-54	.353-04	.000	.000	.000
4	Cu-63(N,ALPHA)Co-60	.472-05	.000	.000	.000
5	Cu-63(N,P)Ni-63	.203-04	.000	.000	.000
6	Be-(2N,2ALPHA)H-3 *	.268-02	.000	.000	.000

Starred (*) items - This is an artificial designation used to describe the approximation that was used in calculating the Tritium buildup.

REACTION NUMBER	HALF-LIFE (HOURS)	GAMMA ENERGY YIELD (MEV/DIS) 0.10-0.50	0.50-0.90	0.90-1.60	1.60-..
1	.613+10	.000	.000	.448-01	.183+01
2	.236+05	.730-02	.000	.000	.000
3	.698+04	.000	.840+00	.000	.000
4	.462+05	.000	.000	.250+01	.000
5	.105+07	.000	.000	.000	.000
6	.111+06	.000	.000	.000	.000

TABLE 2-3 (Cont'd)

SELECTED REACTIONS WITH THEIR CROSS SECTIONS AND ENERGY YIELDS

TYPE OF MATERIAL - 356-T & 6061 T-6 - ALUMINUM

REACTION NUMBER	REACTIONS	FOUR GROUP CROSS SECTIONS (CM^2/GM) GROUP-1	GROUP-2	GROUP-3	GROUP-4
1	Fe-54(N,γ)Fe-55	.000	.000	.000	.143-02
2	Fe-54(N,P)Mn-54	.353-04	.000	.000	.000
3	Cu-63(N,ALPHA)Co-60	.472-05	.000	.000	.000
4	Cu-63(N,P)Ni-63	.203-04	.000	.000	.000
5	Mn-55(N,2N)Mn-54	.548-06	.000	.000	.000
6	Zn-64(N,γ)Zn-65	.405-04	.127-02	.364-03	.203-02
7	Ti-46(N,P)Sc-46	.410-05	.000	.000	.000
8	Al-27(N,2N)Al-26	.519-03	.000	.000	.000

REACTION NUMBER	HALF-LIFE (HOURS)	GAMMA ENERGY YIELD (MEV/DIS) 0.10-0.50	0.50-0.90	0.90-1.60	1.60-..
1	.236+05	.730-02	.000	.000	.000
2	.698+04	.000	.840+00	.000	.000
3	.462+05	.000	.000	.250+01	.000
4	.105+07	.000	.000	.000	.000
5	.698+04	.000	.840+00	.000	.000
6	.588+04	.000	.000	.499+00	.000
7	.202+04	.000	.890+00	.112+01	.000
8	.613+10	.000	.000	.488-01	.183+01

TABLE 2-3 (Cont'd)

SELECTED REACTIONS WITH THEIR CROSS SECTIONS AND ENERGY YIELDS

TYPE OF MATERIAL - BERYLLIUM

REACTION NUMBER	REACTIONS	FOUR GROUP CROSS SECTIONS (CM^2/GM) GROUP-1	GROUP-2	GROUP-3	GROUP-4
1	Fe-54(N,γ)Fe-55	.000	.000	.000	.143-02
2	Fe-54(N,P)Mn-54	.353-04	.000	.000	.000
3	Be-(2N,ALPHA)H-3 *	.268-02	.000	.000	.000
4	Al-27(N,2N)Al-26	.519-03	.000	.000	.000
5	Cd-112(N,γ)Cd-113m	.129-03	.315-07	.172-05	.387-04
6	Cd-114(N,γ)Cd-115m,In-115	.000	.176-09	.958-08	.217-06
7	Co-59(N,γ)Co-60	.638-04	.138-03	.485-01	.215+00
8	Co-59(N,γ)Co-60m, Co-60	.486-04	.105-03	.370-01	.163+00

REACTION NUMBER	HALF-LIFE (HOURS)	GAMMA ENERGY YIELD (MEV/DIS) 0.10-0.50	0.50-0.90	0.90-1.60	1.60-...
1	.236+05	.730-02	.000	.000	.000
2	.698+04	.000	.840+00	.000	.000
3	.111+06	.000	.000	.000	.000
4	.613+10	.000	.000	.448-01	.183+01
5	.123+06	.265-03	.000	.000	.000
6	.103+04	.146-02	.000	.345-01	.000
7	.462+05	.000	.000	.250+01	.000
8	.175+00	.588-01	.000	.399-02	.000
8D	.462+05	.000	.000	.250+01	.000

Starred (*) item - This is an artificial designation used to describe the approximation that was used in calculating the Tritium buildup.

TABLE 2-4

MATERIAL COMPOSITION

TYPE MATERIAL	COMPOSITION	WEIGHT FRACTION
304 Stainless Steel	Iron	.649
	Chromium	.20
	Nickel	.12
	Manganese	.02
	Silicon	.01
	Cobalt	.001
	Phosphorus	.00045
	Sulfur	.0003
356-T Cast Aluminum	Aluminum	.9035
	Silicon	.075
	Iron	.006
	Magnesium	.004
	Manganese	.003
	Zinc	.003
	Titanium	.002
	Copper	.002
6060-T6 Aluminum	Aluminum	.9585
	Magnesium	.012
	Silicon	.008
	Iron	.007
	Copper	.004
	Chromium	.0035
	Zinc	.0025
	Manganese	.0015
	Titanium	.0015
Lockalloy	Beryllium	.5137
	Aluminum	.38
	$BeO + Al_2O_3$	.10
	Silicon	.002
	Iron	.002
	Carbon	.001
	Copper	.0008
Beryllium	Beryllium	.996
	Iron	.0014
	Aluminum	.0009
	Silicon	.0008
	Magnesium	.0006
	Cadmium	.000002
	Cobalt	.000005

TABLE 2.5 FLUX (ϕ) x 10^{14} AND WEIGHTS IN GRAMS

ITEMS & MATERIALS	ϕ_1	ϕ_2	ϕ_3	ϕ_4	WEIGHT
1. CONTROL ROD ROLLER GUIDES (10) 304-SS	.5	.5	.25	.14	.125+5
2. UPPER FLOW GUIDE 304-SS	.01	.04	.03	.008	.123+6
3. LOWER FLOW GUIDE 304-SS	.01-4	.04-4	.03-4	.008-5	.123+6
4. 75 MISCELLANEOUS BOLTS 304-SS	.1	.1	.1	.06	.194+4
5. INSIDE UPPER THERMAL SHIELD 304-SS	.3-8	.4-8	.05-8	.008-8	.376+7
6. MIDDLE UPPER THERMAL SHIELD 304-SS	.2-8	.2-8	.03-8	.16-11	.470+7
7. OUTSIDE UPPER THERMAL SHIELD 304-SS	.1-8	.1-8	.02-8	.3-13	.565+7
8. INSIDE LOWER THERMAL SHIELD 304-SS	.1-8	.2-8	.2-9	.6-10	.380+7
9. OUTSIDE LOWER THERMAL SHIELD 304-SS	.5-9	.5-9	.5-10	.2-13	.410+7
10. PRESSURE VESSEL "NEAR" CORE 304-SS	.1-8	.2-8	.3-10	.1-14	.341+7
11. PRESSURE VESSEL "ABOVE" CORE 304-SS	.1-10	.1-10	.1-9	.1-12	.291+7
12. PRESSURE VESSEL "BELOW" CORE 304-SS	.1-10	.1-10	.5-10	.7-13	.291+7
13. FLOW GUIDE (PART OF TANK) 304-SS	.1-10	.1-10	.5-10	.7-13	.212+7
14. ROD DRIVE BOX & MISC. MECH. 304-SS	.1-10	.1-10	.5-10	.7-13	.704+6
15. TANK BOTTOM 304-SS	.1-12	.1-12	.5-12	.2-14	.230+7
16. METERING/ORIFICE PLATE 304-SS	.1-3	.1-3	.1-3	.3-3	.592+6
17. NORTH CORE BOX PLATE BERYLLIUM	.5	1.	1.5	6.	.420+5
18. 8 RD PIECES WITH PLUGS BERYLLIUM	.15-2	.3-2	.6-2	.2	.163+6
19. 8 RC PIECES WITH PLUGS BERYLLIUM	.01	.02	.04	.7	.163+6
20. 8 RB PIECES WITH PLUGS BERYLLIUM	.1	.2	.3	3.	.113+6

TABLE 2.5 FLUX (ϕ) x 10^{14} AND WEIGHTS IN GRAMS (Cont'd)

ITEMS & MATERIALS	ϕ_1	ϕ_2	ϕ_3	ϕ_4	WEIGHT
21. 8 RA PIECES WITH PLUGS BERYLLIUM	.5	1.	1.8	5.	.113+6
22. 8 L-1, 11 TYPE PIECES NO PLUGS-BERYLLIUM *	.8	1.	1.5	4.	.544+5
23. LA-2 THRU LA-10 NO PLUGS-BERYLLIUM *	1.5	2.5	3.	6.	.612+5
24. FLOW DIVIDER PLATE LOCKALLOY	2.	3.	3.	4.5	.491+5
25. UPPER GRID 6061 T-6 Al	.6	.7	.8	1.5	.937+5
26. V-2 "NEAR" CORE 6061 T-6 Al	.1	.1	.2	1.0	.150+5
27. V-2 "ABOVE" CORE 6061 T-6 Al	.1-3	.1-3	.2-3	.1-3	.139+5
28. HB-6 (FIRST 28") 6061 T-6 Al	.1-4	.4-4	.1-3	.3-3	.172+5
29. HB-4, HB-5 (FIRST 28") 6061 T-6 Al	.1-4	.4-4	.1-3	.3-3	.169+5
30. HT-1, IN CORE PORTION 6061 T-6 Al	.3	.4	.4	4.	.247+5
31. HT-1, ENDS OUTSIDE CORE BOX-6061 T-6 Al	.1-1	.16-1	.3-1	.2	.432+5
32. HT-2, IN CORE PORTION 6061 T-6 Al	.3-1	.4-1	.5-1	1.	.314+5
33. HT-2, OUTSIDE CORE BOX 6061 T-6 Al	.1-2	.1-2	.1-2	.1-1	.544+5
34. HB-1, -2, -3 (First 24") 6061 T-6 Al	.1-3	.1-3	.1-3	.1-2	.113+5
35. HB-1, -2, -3 (>24") 6061 T-6 Al	.3-5	.3-5	.3-5	.1-4	.107+5
36. FAR SOUTH CORE BOX PLATE 6061 T-6 Al	.6-3	.1-3	.2-2	.1	.620+5
37. CORE BOX SIDE PLATES (2) 356-T Al	.3	.3	.5	3.	.100+6
38. LOWER GRID 356-T Al	1.5	1.5	2.	5.	.165+6

Starred (*) items not in the core as of June 1973.

NOTE: Item numbers correspond to the identification numbers on the sketches of Figures 2.1 thru 2.4.

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.139+00	.139+00	.139+00	.139+00	.139+00	.139+00	.139+00	.139+00
2	Co-58	.398+03	.720-05	.130-12	.234-20	.462-28	.000	.000	.000
3	Co-58m	.529+02	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.390+02	.708-06	.128-13	.231-21	.416-29	.000	.000	.000
4	Co-60	.258+01	.133+01	.694-00	.358+00	.186+00	.358-02	.134-03	.358-06
5	Ni-63	.116+02	.113+02	.110+02	.106+02	.103+02	.870+01	.751+01	.581+01
6	Fe-55	.638+03	.176+03	.485+02	.134+02	.370+01	.162-02	.257-05	.237-10
7	Mn-54	.800+02	.103+01	.133-01	.172-03	.222-05	.103-16	.370-26	.000
8	Co-60	.136+03	.702+02	.364+02	.188+02	.977+01	.188+00	.703-02	.188-04
9	Co-60m	.315+03	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.103+03	.535+02	.278+02	.144+02	.743+01	.144+00	.535-02	.143-04
10	Mn-54	.384-01	.494-03	.639-05	.824-07	.106-08	.494-20	.177-29	.000
TOTAL		.178+04	.315+03	.125+03	.578+02	.315+02	.916+01	.768+01	.595+01

ITEM 1 - CONTROL ROD ROLLER GUIDES (10) - 304 STAINLESS STEEL

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.276+00	.276+00	.276+00	.276+00	.276+00	.276+00	.276+00	.276+00
2	Co-58	.271+03	.490-05	.884-13	.160-20	.288-28	.000	.000	.000
3	Co-58m	.360+02	.000+00	.000	.000	.000	.000	.000	.000
3D	Co-58	.265+02	.482-06	.870-14	.157-21	.284-29	.000	.000	.000
4	Co-60	.176+01	.911+00	.472+00	.244+00	.127+00	.244-02	.910-04	.244-06
5	Ni-63	.315+02	.306+02	.297+02	.289+02	.281+02	.236+02	.204+02	.158+02
6	Fe-55	.124+03	.343+03	.944+02	.260+02	.717+01	.315-02	.501-05	.460-10
7	Mn-54	.544+02	.703+00	.908-02	.117-03	.151-05	.701-17	.251-26	.000
8	Co-60	.347+03	.180+03	.932+02	.483+02	.250+02	.482+00	.180-01	.482-04
9	Co-60m	.804+03	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.265+03	.137+03	.710+02	.368+02	.190+02	.367+00	.137-01	.367-04
10	Mn-54	.261-01	.337-03	.435-05	.561-07	.725-09	.336-20	.120-29	.000
TOTAL		.308+04	.692+03	.289+03	.140+03	.797+02	.247+02	.207+02	.160+02

ITEM 2 - UPPER FLOW GUIDE - 304 STAINLESS STEEL

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
		JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.276-05	.276-05	.276-05	.276-05	.276-05	.276-05	.276-05	.276-05
2	Co-58	.271-01	.490-09	.884-17	.160-24	.288-32	.000	.000	.000
3	Co-58m	.360-02	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.265-02	.482-10	.870-18	.157-25	.283-33	.000	.000	.000
4	Co-60	.176-03	.911-04	.472-04	.244-04	.127-04	.244-06	.910-08	.244-10
5	Ni-63	.284-02	.276-02	.268-02	.261-02	.253-02	.213-02	.184-02	.142-02
6	Fe-55	.124-01	.343-02	.944-03	.260-03	.717-04	.315-07	.501-10	.460-15
7	Mn-54	.544-02	.703-04	.908-06	.117-07	.151-09	.701-21	.251-30	.000
8	Co-60	.179-01	.925-02	.479-02	.248-02	.128-02	.248-04	.924-06	.248-08
9	Co-60m	.413-01	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.136-01	.705-02	.365-02	.189-02	.979-03	.189-04	.704-06	.189-08
10	Mn-54	.261-05	.337-07	.435-09	.561-11	.725-13	.336-24	.120-33	.000
TOTAL		.127+00	.226-01	.121-01	.727-02	.488-02	.218-02	.185-02	.142-02

ITEM 3 - LOWER FLOW GUIDE - 304 STAINLESS STEEL

REACTION NUMBER	ISOTOPE	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
		JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.326-01	.326-01	.326-01	.326-01	.326-01	.326-01	.326-01	.326-01
2	Co-58	.428+02	.772-06	.139-13	.252-21	.454-29	.000	.000	.000
3	Co-58m	.567+01	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.418+01	.759-07	.137-14	.247-22	.447-30	.000	.000	.000
4	Co-60	.277+00	.144+00	.744-01	.385-01	.200-01	.385-03	.143-04	.384-07
5	Ni-63	.161+01	.156+01	.152+01	.147+01	.143+01	.120+01	.104+01	.804+00
6	Fi-55	.147+03	.405+02	.112+02	.308+01	.848+00	.372-03	.592-06	.544-11
7	Mn-54	.858+01	.111+00	.143-02	.185-04	.238-06	.110-17	.396-27	.000
8	Co-60	.306+02	.158+02	.820+01	.425+01	.220+01	.424-01	.158-02	.424-05
9	Co-60m	.707+02	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.233+02	.121+02	.625+01	.323+01	.168+01	.323-01	.120-02	.323-05
10	Mn-54	.411-02	.531-04	.685-06	.884-08	.114-09	.529-21	.190-30	.000
TOTAL		.335+03	.702+02	.272+02	.121+02	.621+01	.131+01	.108+01	.836+00

ITEM 4 - MISCELLANEOUS BOLTS (75) - 304 STAINLESS STEEL

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.844-07	.844-07	.844-07	.844-07	.844-07	.843-07	.843-07	.843-07
2	Co-58	.249-02	.450-10	.811-18	.146-25	.264-33	.000	.000	.000
3	Co-58m	.330-03	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.243-03	.442-11	.798-19	.144-26	.260-34	.000	.000	.000
4	Co-60	.162-04	.836-05	.433-05	.224-05	.116-05	.224-07	.835-09	.224-11
5	Ni-63	.738-04	.717-04	.697-04	.677-04	.658-04	.553-04	.479-04	.369-04
6	Fe-55	.380-03	.105-03	.289-04	.796-05	.219-05	.963-09	.153-11	.141-16
7	Mn-54	.500-03	.645-05	.833-07	.108-08	.139-10	.643-22	.231-31	.000
8	Co-60	.141-03	.730-04	.378-04	.196-04	.101-04	.196-06	.729-08	.195-10
9	Co-60m	.326-03	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.107-03	.556-04	.288-05	.149-04	.773-05	.149-06	.556-01	.149-10
10	Mn-54	.239-06	.309-08	.399-10	.515-12	.665-14	.308-25	.110-34	.000
TOTAL		.461-02	.320-03	.170-03	.113-03	.871-04	.558-04	.480-04	.370-04

ITEM 5 - INSIDE UPPER THERMAL SHIELD - 304 STAINLESS STEEL

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.211-08	.211-08	.211-08	.211-08	.211-08	.211-08	.211-08	.211-08
2	Co-58	.208-02	.375-10	.677-18	.122-25	.221-33	.000	.000	.000
3	Co-58m	.276-03	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.203-03	.369-11	.666-19	.120-26	.217-34	.000	.000	.000
4	Co-60	.135-04	.698-05	.361-05	.187-05	.969-06	.187-07	.697-09	.187-11
5	Ni-63	.463-04	.450-04	.437-04	.425-04	.413-04	.347-04	.300-04	.232-04
6	Fe-55	.951-05	.262-05	.723-06	.199-06	.549-07	.241-10	.384-13	.352-18
7	Mn-54	.417-03	.538-05	.695-07	.897-09	.116-10	.536-22	.192-31	.000
8	Co-60	.640-04	.332-04	.172-04	.889-05	.461-05	.889-07	.331-08	.888-11
9	Co-60m	.148-03	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.488-04	.253-04	.131-04	.678-05	.351-05	.677-07	.252-08	.676-11
10	Mn-54	.200-06	.258-08	.333-10	.430-12	.555-14	.257-25	.922-35	.000
TOTAL		.330-02	.118-03	.784-04	.602-04	.504-04	.349-04	.300-04	.232-04

ITEM 6 - MIDDLE UPPER THERMAL SHIELD - 304 STAINLESS STEEL

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
		JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.476-10	.476-10	.476-10	.476-10	.476-10	.476-10	.476-10	.475-10
2	Co-58	.125-02	.225-10	.407-18	.734-26	.133-33	.000	.000	.000
3	Co-58m	.166-03	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.122-03	.222-11	.400-19	.723-27	.130-34	.000	.000	.000
4	Co-60	.810-05	.419-05	.217-05	.112-05	.583-06	.112-07	.419-09	.112-11
5	Ni-63	.283-04	.275-04	.267-04	.259-04	.252-04	.212-04	.183-04	.141-04
6	Fe-55	.214-06	.591-07	.163-07	.449-08	.124-08	.543-12	.864-15	.794-20
7	Mn-54	.251-03	.323-05	.418-07	.539-09	.696-11	.322-22	.116-31	.000
8	Co-60	.499-04	.258-04	.134-04	.693-05	.359-05	.692-07	.258-08	.691-11
9	Co-60m	.115-03	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.380-04	.197-04	.102-04	.528-05	.273-05	.527-07	.196-08	.527-11
10	Mn-54	.120-06	.155-08	.200-10	.258-12	.333-14	.154-25	.554-35	.000
TOTAL		.203-02	.804-04	.525-04	.392-04	.321-04	.213-04	.183-04	.141-04

ITEM 7 - OUTSIDE UPPER THERMAL SHIELD - 304 STAINLESS STEEL

REACTION NUMBER	ISOTOPE	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
		JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.640-07	.640-07	.640-07	.640-07	.640-07	.640-07	.640-07	.639-07
2	Co-58	.840-03	.152-10	.274-18	.494-26	.892-34	.000	.000	.000
3	Co-58m	.111-03	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.820-04	.149-11	.269-19	.486-27	.877-35	.000	.000	.000
4	Co-60	.545-05	.282-05	.146-05	.756-06	.392-06	.756-08	.282-09	.755-12
5	Ni-63	.370-04	.360-04	.349-04	.339-04	.330-04	.277-04	.240-04	.185-04
6	Fe-55	.288-03	.795-04	.219-04	.604-05	.167-05	.731-09	.116-11	.107-16
7	Mn-54	.168-03	.218-05	.281-07	.363-09	.468-11	.217-22	.778-32	.000
8	Co-60	.775-04	.401-04	.208-04	.108-04	.558-05	.108-06	.401-08	.107-10
9	Co-60m	.179-03	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.591-04	.306-04	.158-04	.820-05	.425-05	.820-07	.305-08	.819-11
10	Mn-54	.807-07	.104-08	.135-10	.174-12	.224-14	.104-25	.373-35	.000
TOTAL		.185-02	.191-03	.950-04	.598-04	.449-04	.280-04	.241-04	.186-04

ITEM 8 - INSIDE LOWER THERMAL SHIELD - 304 STAINLESS STEEL

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Ni-59	.230-10	.230-10	.230-10	.230-10	.230-10	.230-10	.230-10	.230-10
2	Co-58	.453-03	.818-11	.148-18	.266-26	.481-34	.000	.000	.000
3	Co-58m	.601-04	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.443-04	.805-12	.145-19	.262-27	.473-35	.000	.000	.000
4	Co-60	.294-05	.152-05	.788-06	.408-06	.211-06	.408-08	.152-09	.407-12
5	Ni-63	.994-05	.966-05	.938-05	.912-05	.886-05	.745-05	.645-05	.497-05
6	Fe-55	.104-06	.286-07	.788-08	.217-08	.599-09	.263-12	.418-15	.384-20
7	Mn-54	.909-04	.117-05	.152-07	.196-09	.253-11	.117-22	.420-32	.000
8	Co-60	.924-05	.478-05	.248-05	.128-05	.665-06	.128-07	.478-09	.128-11
9	Co-60m	.214-04	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.704-05	.365-05	.189-05	.978-06	.506-06	.977-08	.364-09	.976-12
10	Mn-54	.435-07	.562-09	.726-11	.937-13	.121-14	.560-26	.201-35	.000
TOTAL		.699-03	.208-04	.146-04	.118-04	.102-04	.747-05	.645-05	.497-05

ITEM 9 - OUTSIDE LOWER THERMAL SHIELD - 304 STAINLESS STEEL

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Ni-59	.957-12	.957-12	.957-12	.957-12	.957-12	.957-12	.957-12	.956-12
2	Co-58	.753-03	.136-10	.246-18	.443-26	.800-34	.000	.000	.000
3	Co-58m	.100-03	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.736-04	.134-11	.242-19	.436-27	.787-35	.000	.000	.000
4	Co-60	.489-05	.253-05	.131-05	.679-06	.352-06	.678-08	.253-09	.678-12
5	Ni-63	.316-04	.307-04	.298-04	.290-04	.282-04	.237-04	.205-04	.158-04
6	Fe-55	.431-08	.119-08	.328-09	.903-10	.249-10	.109-13	.174-16	.160-21
7	Mn-54	.151-03	.195-05	.252-07	.325-09	.420-11	.195-22	.698-32	.000
8	Co-60	.545-05	.282-05	.146-05	.757-06	.392-06	.756-08	.282-09	.755-12
9	Co-60m	.126-04	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.415-05	.215-05	.111-05	.577-06	.299-06	.576-08	.215-09	.576-12
10	Mn-54	.724-07	.935-09	.121-10	.156-12	.201-14	.932-26	.334-35	.000
TOTAL		.114-02	.402-04	.338-04	.310-04	.292-04	.237-04	.205-04	.158-04

ITEM 10 - PRESSURE VESSEL "NEAR" CORE - 304 STAINLESS STEEL

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
		JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.817-10	.817-10	.817-10	.817-10	.817-10	.817-10	.817-10	.816-10
2	Co-58	.643-05	.116-12	.210-20	.378-28	.683-36	.000	.000	.000
3	Co-58m	.853-06	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.628-06	.114-13	.206-21	.372-29	.672-37	.000	.000	.000
4	Co-60	.417-07	.216-07	.112-07	.579-08	.300-08	.579-10	.216-11	.578-14
5	Ni-63	.584-06	.567-06	.551-06	.535-06	.520-06	.437-06	.378-06	.292-06
6	Fe-55	.368-06	.101-06	.280-07	.771-08	.213-08	.932-12	.148-14	.136-19
7	Mn-54	.129-05	.167-07	.215-09	.278-11	.358-13	.166-24	.596-34	.000
8	Co-60	.126-04	.654-05	.339-05	.175-05	.909-06	.175-07	.653-09	.175-11
9	Co-60m	.292-04	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.962-05	.498-05	.258-05	.134-05	.692-06	.134-07	.498-09	.133-11
10	Mn-54	.618-09	.798-11	.103-12	.133-14	.172-16	.795-28	.285-37	.000
TOTAL		.617-04	.122-04	.656-05	.364-05	.213-05	.468-06	.380-06	.292-06

ITEM 11 - PRESSURE VESSEL "ABOVE" CORE - 304 STAINLESS STEEL

REACTION NUMBER	ISOTOPE	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
		JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.572-10	.572-10	.572-10	.572-10	.572-10	.572-10	.572-10	.571-10
2	Co-58	.643-05	.116-12	.210-20	.378-28	.683-36	.000	.000	.000
3	Co-58m	.853-06	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.628-06	.114-13	.206-21	.372-29	.672-37	.000	.000	.000
4	Co-60	.417-07	.216-07	.112-07	.579-08	.300-08	.579-10	.216-11	.578-14
5	Ni-63	.360-06	.350-06	.340-06	.330-06	.321-06	.270-06	.234-06	.180-06
6	Fe-55	.258-06	.710-07	.196-07	.540-08	.149-08	.653-12	.104-14	.955-20
7	Mn-54	.129-05	.167-07	.215-09	.278-11	.358-13	.166-24	.596-34	.000
8	Co-60	.633-05	.328-05	.170-05	.879-06	.455-06	.879-08	.327-09	.877-12
9	Co-60m	.146-04	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.482-05	.250-05	.129-05	.670-06	.347-06	.669-08	.249-09	.668-12
10	Mn-54	.618-09	.798-11	.103-12	.133-14	.172-16	.795-28	.285-37	.000
TOTAL		.357-04	.623-05	.336-05	.189-05	.113-05	.286-06	.234-06	.180-06

ITEM 12 - PRESSURE VESSEL "BELOW" CORE - 304 STAINLESS STEEL

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE			ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
		JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.417-10	.417-10	.417-10	.417-10	.417-10	.416-10	.416-10	.416-10
2	Co-58	.468-05	.846-13	.153-20	.276-28	.497-36	.000	.000	.000
3	Co-58m	.621-06	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.458-06	.832-14	.150-21	.271-29	.489-37	.000	.000	.000
4	Co-60	.304-07	.157-07	.815-08	.422-08	.219-08	.422-10	.157-11	.421-14
5	Ni-63	.262-06	.255-06	.248-06	.241-06	.234-06	.197-06	.170-06	.131-06
6	Fe-55	.188-06	.517-07	.143-07	.393-08	.108-08	.476-12	.757-15	.695-20
7	Mn-54	.940-06	.121-07	.157-09	.202-11	.261-13	.121-24	.434-34	.000
8	Co-60	.461-05	.239-05	.124-05	.641-06	.332-06	.640-08	.238-09	.639-12
9	Co-60m	.107-04	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.351-05	.182-05	.942-06	.488-06	.253-06	.488-08	.182-09	.487-12
10	Mn-54	.450-09	.581-11	.750-13	.969-15	.125-16	.579-28	.208-37	.000
TOTAL		.260-04	.454-05	.245-05	.138-05	.822-06	.208-06	.171-06	.131-06

ITEM 13 - FLOW GUIDE (PART OF TANK) - 304 STAINLESS STEEL

REACTION NUMBER	ISOTOPE			ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
		JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Ni-59	.138-10	.138-10	.138-10	.138-10	.138-10	.138-10	.138-10	.138-10
2	Co-58	.156-05	.281-13	.507-21	.915-29	.165-36	.000	.000	.000
3	Co-58m	.206-06	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.152-06	.276-14	.499-22	.900-30	.163-37	.000	.000	.000
4	Co-60	.101-07	.523-08	.271-08	.140-08	.726-09	.140-10	.522-12	.140-14
5	Ni-63	.872-07	.847-07	.823-07	.799-07	.777-07	.653-07	.565-07	.436-07
6	Fe-55	.623-07	.172-07	.474-08	.131-08	.360-09	.158-12	.251-15	.231-20
7	Mn-54	.312-06	.403-08	.520-10	.672-12	.867-14	.402-25	.144-34	.000
8	Co-60	.153-05	.793-06	.411-06	.213-06	.110-06	.213-08	.792-10	.212-12
9	Co-60m	.354-05	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.117-05	.604-06	.313-06	.162-06	.839-07	.162-08	.603-10	.162-12
10	Mn-54	.150-09	.193-11	.249-13	.322-15	.415-17	.192-28	.690-38	.000
TOTAL		.863-05	.151-05	.813-06	.457-06	.273-06	.691-07	.567-07	.436-07

ITEM 14 - ROD DRIVE BOX AND MISC. MECH. - 304 STAINLESS STEEL

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
		ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
1	Ni-59	.129-11	.129-11	.129-11	.129-11	.129-11	.129-11	.129-11	.129-11
2	Co-58	.508-07	.917-15	.166-22	.299-30	.540-38	.000	.000	.000
3	Co-58m	.674-08	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.496-08	.903-16	.163-23	.294-31	.000	.000	.000	.000
4	Co-60	.330-09	.171-09	.884-10	.458-10	.237-10	.458-12	.170-13	.457-16
5	Ni-63	.286-08	.278-08	.270-08	.262-08	.255-08	.214-08	.185-08	.143-08
6	Fe-55	.582-08	.160-08	.442-09	.122-09	.336-10	.147-13	.235-16	.216-21
7	Mn-54	.102-07	.132-09	.170-11	.219-13	.283-15	.131-26	.471-36	.000
8	Co-60	.506-07	.262-07	.136-07	.703-08	.364-08	.702-10	.262-11	.701-14
9	Co-60m	.117-06	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.385-07	.200-07	.103-07	.535-08	.277-08	.535-10	.199-11	.534-14
10	Mn-54	.488-11	.631-13	.814-15	.105-16	.136-18	.629-30	.000	.000
TOTAL		.288-06	.509-07	.271-07	.152-07	.902-08	.227-08	.186-08	.143-08

ITEM 15 - TANK BOTTOM - 304 STAINLESS STEEL

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
		ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
1	Ni-59	.499-01	.499-01	.499-01	.499-01	.499-01	.498-01	.498-01	.498-01
2	Co-58	.131+02	.236-06	.426-14	.769-22	.139-29	.000	.000	.000
3	Co-58m	.174+01	.000	.000	.000	.000	.000	.000	.000
3D	Co-58	.128+01	.232-07	.419-15	.757-23	.137-30	.000	.000	.000
4	Co-60	.848-01	.439-01	.228-01	.118-01	.610-02	.118-03	.439-05	.118-07
5	Ni-63	.984+00	.956+00	.929+00	.902+00	.877+00	.737+00	.638+00	.492+00
6	Fe-55	.225+03	.619+02	.171+02	.471+01	.130+01	.569-03	.906-06	.832-11
7	Mn-54	.262+01	.339-01	.438-03	.565-05	.729-07	.338-18	.121-27	.000
8	Co-60	.365+02	.189+02	.979+01	.507+01	.262+01	.506-01	.189-02	.506-05
9	Co-60m	.844+02	.000	.000	.000	.000	.000	.000	.000
9D	Co-60	.278+02	.144+02	.746+01	.386+01	.200+01	.386-01	.144-02	.385-05
10	Mn-54	.126-02	.162-04	.210-06	.271-08	.349-10	.162-21	.580-31	.000
TOTAL		.393+03	.963+02	.353+02	.146+02	.685+01	.877+00	.691+00	.542+00

ITEM 16 - METERING PLATE - 304 STAINLESS STEEL

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Fe-55	.199+03	.549+02	.151+02	.416+01	.114+01	.502-03	.800-06	.737-11
2	Mn-54	.581+00	.749-02	.968-04	.125-05	.161-07	.746-19	.268-28	.000
3	H-3	.543+04	.413+04	.315+04	.239+04	.181+04	.352+03	.896+02	.766+01
4	Al-26	.253-04	.253-04	.253-04	.253-04	.253-04	.253-04	.253-04	.253-04
5	Cd-113m	.289-02	.226-02	.177-02	.138-02	.108-02	.244-03	.708-04	.760-05
6	Cd-115m	.644-04	.107-16	.177-29	.000	.000	.000	.000	.000
7	Co-60	.734+02	.381+02	.197+02	.102+02	.529+01	.102+00	.381-02	.102-04
8	Co-60m	.170+03	.000	.000	.000	.000	.000	.000	.000
8D	Co-60	.561+02	.289+02	.150+02	.777+01	.402+01	.777-01	.289-02	.777-05
TOTAL (Excluding H-3)		.500+03	.122+03	.497+02	.221+02	.105+02	.181+00	.679-02	.509-04

ITEM 17 - NORTH CORE BOX PLATE - BERYLLIUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Fe-55	.891+02	.245+02	.677+01	.187+01	.514+00	.226-03	.359-06	.330-11
2	Mn-54	.234-01	.302-03	.390-05	.504-07	.651-09	.301-20	.108-29	.000
3	H-3	.219+03	.166+03	.127+03	.963+02	.733+02	.142+02	.362+01	.308+00
4	Al-26	.102-05	.102-05	.102-05	.102-05	.102-05	.102-05	.102-05	.102-05
5	Cd-113m	.103-02	.807-03	.630-03	.492-03	.384-03	.870-04	.252-04	.272-05
6	Cd-115m	.285-04	.474-17	.786-30	.000	.000	.000	.000	.000
7	Co-60	.314+02	.163+02	.842+01	.436+01	.226+01	.436-01	.162-02	.435-05
8	Co-60m	.726+02	.000	.000	.000	.000	.000	.000	.000
8D	Co-60	.239+02	.124+02	.641+01	.132+01	.172+01	.332-01	.124-02	.331-05
TOTAL (Excluding H-3)		.217+03	.532+02	.216+02	.955+01	.449+01	.771-01	.289-02	.114-04

ITEM 18 - RD PIECES WITH PLUGS (8) - BERYLLIUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.312+03	.859+02	.237+02	.653+01	.180+01	.790-03	.126-05	.115-10
2	Mn-54	.156+00	.202-02	.260-04	.336-06	.434-08	.201-19	.721-29	.000
3	H-3	.146+04	.111+04	.844+03	.642+03	.488+03	.946+02	.241+02	.206+01
4	Al-26	.680-05	.680-05	.680-05	.680-05	.680-05	.680-05	.680-05	.680-05
5	Cd-113m	.370-05	.289-02	.226-02	.176-02	.138-02	.311-03	.903-04	.973-05
6	Cd-115m	.100-03	.166-16	.275-29	.000	.000	.000	.000	.000
7	Co-60	.110+03	.572+02	.296+02	.153+02	.795+01	.153+00	.572-02	.153-04
8	Co-60m	.256+03	.000	.000	.000	.000	.000	.000	.000
8D	Co-60	.842+02	.436+02	.226+02	.117+02	.606+01	.117+00	.435-02	.117-04
TOTAL (Excluding H-3)		.762+03	.187+03	.759+02	.336+02	.158+02	.271+00	.102-01	.435-04

ITEM 19 - RC PIECES WITH PLUGS (8) - BERYLLIUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.927+03	.255+03	.704+02	.194+02	.535+01	.235-02	.374-05	.343-10
2	Mn-54	.108+01	.140-01	.180-03	.233-05	.301-07	.139-18	.500-28	.000
3	H-3	.101+05	.769+04	.585+04	.445+04	.339+04	.656+03	.167+03	.143+02
4	Al-26	.472-04	.472-04	.472-04	.472-04	.472-04	.472-04	.472-04	.472-04
5	Cd-113m	.117-01	.913-02	.713-02	.556-02	.434-02	.983-03	.285-03	.307-04
6	Cd-115m	.298-03	.494-16	.820-29	.000	.000	.000	.000	.000
7	Co-60	.332+03	.172+03	.889+02	.461+02	.239+02	.460+00	.172-01	.460-04
8	Co-60m	.767+03	.000	.000	.000	.000	.000	.000	.000
8D	Co-60	.253+03	.131+03	.678+02	.351+02	.182+02	.351+00	.131-01	.350-04
TOTAL (Excluding H-3)		.228+04	.558+03	.227+03	.101+03	.474+02	.814+00	.306-01	.159-03

ITEM 20 - RB PIECES WITH PLUGS (8) - BERYLLIUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
		ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
1	Fe-55	.154+04	.426+03	.117+03	.323+02	.892+01	.391-02	.623-05	.572-10
2	Mn-54	.541+01	.699-01	.902-03	.117-04	.150-06	.697-18	.250-27	.000
3	H-3	.506+05	.385+05	.293+05	.223+05	.169+05	.328+04	.836+03	.713+02
4	Al-26	.236-03	.236-03	.236-03	.236-03	.236-03	.236-03	.236-03	.236-03
5	Cd-113m	.785-01	.613-01	.479-01	.374-01	.292-01	.660-02	.192-02	.206-03
6	Cd-115m	.574-03	.952-16	.158-28	.000	.000	.000	.000	.000
7	Co-60	.981+03	.508+03	.263+03	.136+03	.706+02	.136+01	.508-01	.136-03
8	Co-60m	.227+04	.000	.000	.000	.000	.000	.000	.000
8D	Co-60	.748+03	.387+03	.201+03	.104+03	.538+02	.104+01	.387-01	.104-03
TOTAL (Excluding H-3)		.554+04	.132+04	.581+03	.272+03	.133+03	.240+01	.092+00	.476-03

ITEM 21 - RA PIECES WITH PLUGS (8) - BERYLLIUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
		ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL							
1	Fe-55	.594+03	.164+03	.451+02	.124+02	.343+01	.150-02	.239-05	.220-10
2	Mn-54	.416+01	.537-01	.694-03	.896-05	.116-06	.536-18	.192-27	.000
3	H-3	.389+05	.296+05	.225+05	.171+05	.130+05	.252+04	.643+03	.548+02
4	Al-26	.181-03	.181-03	.181-03	.181-03	.181-03	.181-03	.181-03	.181-03
5	Cd-113m	.113-01	.883-02	.689-02	.538-02	.920-02	.951-03	.276-03	.297-04
6	Cd-115m	.193-03	.321-16	.532-29	.000	.000	.000	.000	.000
7	Co-60	.225+03	.117+03	.605+02	.313+02	.162+02	.313+00	.117-01	.313-04
8	Co-60m	.522+03	.000	.000	.000	.000	.000	.000	.000
8D	Co-60	.172+03	.840+02	.461+02	.239+02	.124+02	.238+00	.888-02	.238-04
TOTAL (Excluding H-3)		.152+04	.369+03	.152+03	.676+02	.320+02	.554+00	.210-01	.266-03

ITEM 22 - LI, II TYPE PIECES WITHOUT PLUGS (8) - BERYLLIUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Fe-55	.100+04	.276+03	.761+02	.210+02	.579+01	.254-02	.404-05	.371-10
2	Mn-54	.878+01	.113+00	.146-02	.189-04	.244-06	.113-17	.405-27	.000
3	H-3	.820+05	.624+05	.475+05	.361+05	.275+05	.532+04	.136+04	.116+03
4	Al-26	.382-03	.382-03	.382-03	.382-03	.382-03	.382-03	.382-03	.382-03
5	Cd-113m	.210-01	.164-01	.121-01	.100-01	.781-02	.177-02	.513-03	.553-04
6	Cd-115m	.328-03	.544-16	.902-29	.000	.000	.000	.000	.000
7	Co-60	.390+03	.202+03	.105+03	.542+02	.281+02	.542+00	.202-01	.541-04
8	Co-60m	.903+03	.000	.000	.000	.000	.000	.000	.000
8D	Co-60	.297+03	.54+03	.798+02	.413+02	.214+02	.413+00	.154-01	.412-04
TOTAL (Excluding H-3)		.260+04	.633+03	.261+03	.117+03	.553+02	.960+00	.365-01	.533-03

ITEM 23 - LA-2 THRU LA-10 PIECES WITHOUT PLUGS (9) - BERYLLIUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Al-26	.534-01	.534-01	.534-01	.534-01	.534-01	.534-01	.534-01	.534-01
2	Fe-55	.249+03	.684+02	.189+02	.520+01	.144+01	.630-03	.100-05	.922-11
3	Mn-54	.387+01	.500-01	.647-03	.835-05	.108-06	.500-18	.179-27	.000
4	Co-60	.477+00	.247+00	.128+00	.662-01	.344-01	.662-03	.247-04	.662-07
5	Ni-63	.118+00	.115+00	.112+00	.108+00	.105+00	.884-01	.766-01	.590-01
6	H-3	.173+05	.132+05	.100+05	.762+04	.581+04	.112+04	.287+03	.244+02
TOTAL (Excluding H-3)		.253+03	.069+03	.192+02	.543+01	.163+01	.143+00	.130+00	.112+00

ITEM 24 - FLOW DIVIDER PLATE - LOCKALLOY

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.192+04	.529+03	.146+03	.402+02	.111+02	.486-02	.773-05	.701-10
2	Mn-54	.269+02	.347+00	.448-02	.579-04	.747-06	.346-17	.124-26	.000
3	Co-60	.944+00	.489+00	.253+00	.131+00	.679-01	.131-02	.488-04	.131-06
4	Ni-63	.234+00	.227+00	.221+00	.215+00	.209+00	.175+00	.152+00	.117+00
5	Mn-54	.895-01	.116-02	.149-04	.193-06	.249-08	.115-19	.413-29	.000
6	Zn-65	.195+04	.111+02	.632-01	.360-03	.205-05	.703-19	.422-30	.000
7	Sc-46	.680+00	.196-06	.561-13	.160-19	.458-26	.000	.000	.000
8	Al-26	.249+00	.249+00	.249+00	.249+00	.249+00	.249+00	.249+00	.249+00
TOTAL		.389+04	.541+03	.146+03	.408+02	.116+02	.431+00	.401+00	.366+00

ITEM 25 - UPPER GRID - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.205+03	.564+02	.155+02	.429+01	.118+01	.518-03	.835-06	.758-11
2	Mn-54	.717+00	.926-02	.120-03	.154-05	.199-07	.923-19	.331-28	.000
3	Co-60	.252-01	.130-01	.676-02	.350-02	.181-02	.350-04	.130-05	.349-08
4	Ni-63	.625-02	.607-02	.590-02	.573-02	.556-02	.468-02	.405-02	.312-02
5	Mn-54	.239-02	.308-04	.398-06	.514-08	.664-10	.307-21	.110-30	.000
6	Zn-65	.164+03	.933+00	.532-02	.303-04	.173-06	.591-20	.355-31	.000
7	Sc-46	.184-01	.524-08	.150-14	.428-21	.122-27	.000	.000	.000
8	Al-26	.666-02	.666-02	.666-02	.666-02	.666-02	.666-02	.666-02	.666-02
TOTAL		.369+03	.574+02	.156+02	.430+01	.120+01	.119-01	.107-01	.978-02

ITEM 26 - V-2 "NEAR" CORE - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.190-01	.523-02	.144-02	.397-03	.109-03	.480-07	.765-10	.703-15
2	Mn-54	.665-02	.858-04	.111-05	.143-07	.185-09	.855-21	.307-30	.000
3	Co-60	.233-03	.121-03	.626-04	.324-04	.168-04	.324-06	.121-07	.324-10
4	Ni-63	.579-04	.562-04	.546-04	.531-04	.516-04	.434-04	.375-04	.289-04
5	Mn-54	.221-04	.206-06	.369-08	.476-10	.615-12	.285-23	.102-32	.000
6	Zn-65	.301-01	.172-03	.979-06	.558-08	.318-10	.109-23	.654-35	.000
7	Sc-46	.170-03	.486-10	.139-16	.396-23	.113-29	.000	.000	.000
8	Al-26	.617-04	.617-04	.617-04	.617-04	.617-04	.617-04	.617-04	.617-04
TOTAL		.563-01	.572-02	.162-02	.544-03	.240-03	.105-03	.992-04	.906-04

ITEM 27 - V-2 "ABOVE" CORE - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.704-01	.194-01	.535-02	.147-02	.406-03	.178-06	.284-09	.261-14
2	Mn-54	.823-04	.106-05	.137-07	.177-09	.229-11	.106-22	.380-32	.000
3	Co-60	.289-05	.150-05	.775-06	.401-06	.208-06	.401-08	.149-09	.400-12
4	Ni-63	.716-06	.696-06	.676-06	.657-06	.638-06	.537-06	.464-06	.358-06
5	Mn-54	.274-06	.354-08	.457-10	.590-12	.761-14	.353-25	.126-34	.000
6	Zn-65	.585-01	.334-03	.190-05	.108-07	.617-10	.211-23	.127-34	.000
7	Sc-46	.210-05	.601-12	.172-18	.490-25	.140-31	.000	.000	.000
8	Al-26	.763-06	.763-06	.763-06	.763-06	.763-06	.763-06	.763-06	.763-06
TOTAL		.129+00	.197-01	.535-02	.148-02	.408-03	.148-05	.123-05	.112-05

ITEM 28 - HB-6 (FIRST 28") - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.693-01	.191-01	.527-02	.145-02	.400-03	.176-06	.280-09	.257-14
2	Mn-54	.810-04	.105-05	.135-07	.174-09	.225-11	.104-22	.374-32	.000
3	Co-60	.285-05	.147-05	.763-06	.395-06	.205-06	.395-08	.147-09	.394-12
4	Ni-63	.705-06	.685-06	.666-06	.647-06	.628-06	.528-06	.457-06	.353-06
5	Mn-54	.270-06	.348-08	.450-10	.581-12	.750-14	.347-25	.125-34	.000
6	Zn-65	.577-01	.329-03	.187-05	.107-07	.608-10	.208-23	.125-34	.000
7	Sc-46	.207-05	.592-12	.169-18	.483-25	.138-31	.000	.000	.000
8	Al-26	.752-06	.752-06	.752-06	.752-06	.752-06	.752-06	.752-06	.752-06
TOTAL		.127+00	.194-01	.527-02	.145-02	.402-03	.146-05	.121-05	.110-05

ITEM 29 - HB-4 & -5 (FIRST 28") - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.135+04	.372+03	.102+03	.282+02	.778+01	.341-02	.543-05	.499-10
2	Mn-54	.354+01	.457-01	.591-03	.763-05	.985-07	.456-18	.164-27	.000
3	Co-60	.124+00	.645-01	.334-01	.173-01	.895-02	.173-03	.644-05	.173-07
4	Ni-63	.309-01	.300-01	.291-01	.283-01	.275-01	.231-01	.200-01	.154-01
5	Mn-54	.118-01	.152-03	.197-05	.254-07	.328-09	.152-20	.545-30	.000
6	Zn-65	.106+04	.604+01	.344-01	.196-03	.112-05	.383-19	.230-30	.000
7	Sc-46	.907-01	.259-07	.740-14	.211-20	.603-27	.000	.000	.000
8	Al-26	.329-01	.329-01	.329-01	.329-01	.329-01	.329-01	.329-01	.329-01
TOTAL		.241+04	.378+03	.103+03	.283+02	.785+01	.596-01	.529-01	.483-01

ITEM 30 - HT-1 IN CORE PORTION - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.118+03	.325+02	.896+01	.247+01	.681+00	.299-03	.475-06	.437-11
2	Mn-54	.207+00	.267-02	.344-04	.445-06	.574-08	.266-19	.954-29	.000
3	Co-60	.726-02	.376-02	.195-02	.101-02	.522-03	.101-04	.375-06	.101-08
4	Ni-63	.180-02	.175-02	.170-02	.165-02	.160-02	.135-02	.117-02	.900-03
5	Mn-54	.688-03	.888-05	.115-06	.148-08	.191-10	.885-22	.318-31	.000
6	Zn-65	.924+02	.526+00	.300-02	.171-04	.974-07	.333-20	.200-31	.000
7	Sc-46	.529-02	.151-08	.431-15	.123-21	.352-28	.000	.000	.000
8	Al-26	.192-02	.192-02	.192-02	.192-02	.192-02	.192-02	.192-02	.192-02
TOTAL		.210+03	.330+02	.897+01	.247+01	.685+00	.357-02	.308-02	.282-02

ITEM 31 - HT-1 (ENDS OUTSIDE CORE BOX) - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.428+03	.118+03	.326+02	.897+01	.247+01	.109-02	.173-05	.159-10
2	Mn-54	.450+00	.582-02	.751-04	.969-06	.125-07	.580-19	.208-28	.000
3	Co-60	.158-01	.819-02	.424-02	.220-02	.114-02	.220-04	.818-06	.219-08
4	Ni-63	.392-02	.381-02	.370-02	.360-02	.349-02	.294-02	.254-02	.196-02
5	Mn-54	.150-02	.194-04	.250-06	.323-08	.417-10	.193-21	.693-31	.000
6	Zn-65	.322+03	.184+01	.105-01	.596-04	.340-06	.116-19	.699-31	.000
7	Sc-46	.115-01	.329-08	.940-15	.268-21	.767-28	.000	.000	.000
8	Al-26	.418-02	.418-02	.418-02	.418-02	.418-02	.418-02	.418-02	.418-02
TOTAL		.751+03	.120+03	.326+02	.898+01	.248+01	.823-02	.673-02	.614-02

ITEM 32 - HT-2 "IN" CORE PORTION - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.742+01	.205+01	.564+00	.155+00	.429-01	.188-04	.299-07	.275-12
2	Mn-54	.260-01	.336-03	.434-05	.560-07	.723-09	.335-20	.120-29	.000
3	Co-60	.914-03	.473-03	.245-03	.127-03	.657-04	.127-05	.473-07	.127-09
4	Ni-63	.227-03	.220-03	.214-03	.208-03	.202-03	.170-03	.147-03	.113-03
5	Mn-54	.866-04	.112-05	.144-07	.186-09	.241-11	.112-22	.400-32	.000
6	Zn-65	.584+01	.333-01	.190-03	.108-05	.616-08	.211-21	.127-32	.000
7	Sc-46	.666-03	.190-09	.543-16	.155-22	.443-29	.000	.000	.000
8	Al-26	.241-03	.241-03	.241-03	.241-03	.241-03	.241-03	.241-03	.241-03
TOTAL		.133+02	.208+01	.565+00	.156+00	.434-01	.431-03	.388-03	.355-03

ITEM 33 - HT-2 "OUTSIDE" CORE BOX - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
				ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL					
1	Fe-55	.462+00	.127+00	.351-01	.969-02	.267-02	.117-05	.186-08	.171-13
2	Mn-54	.162-02	.209-04	.270-06	.349-08	.450-10	.209-21	.748-31	.000
3	Co-60	.569-04	.295-04	.153-04	.791-05	.410-05	.790-07	.294-08	.789-11
4	Ni-63	.141-04	.137-04	.133-04	.129-04	.126-04	.106-04	.915-05	.706-05
5	Mn-54	.540-05	.697-07	.900-09	.116-10	.150-12	.695-24	.249-33	.000
6	Zn-65	.364+00	.207-02	.118-04	.673-07	.384-09	.131-22	.790-34	.000
7	Sc-46	.415-04	.118-10	.338-17	.966-24	.276-30	.000	.000	.000
8	Al-26	.150-04	.150-04	.150-04	.150-04	.150-04	.150-04	.150-04	.150-04
TOTAL		.828+00	.130+00	.352-01	.972-02	.270-02	.269-04	.242-04	.221-04

ITEM 34 - HB-1,-2,&-3(FIRST 2') - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Fe-55	.438-02	.121-02	.333-03	.917-04	.253-04	.111-07	.177-10	.162-15
2	Mn-54	.439-04	.567-06	.732-08	.945-10	.122-11	.565-23	.203-32	.000
3	Co-60	.154-05	.799-06	.414-06	.214-06	.111-06	.214-08	.797-10	.214-12
4	Ni-63	.382-06	.371-06	.361-06	.351-06	.341-06	.286-06	.248-06	.191-06
5	Mn-54	.146-06	.189-08	.244-10	.315-12	.406-14	.188-25	.675-35	.000
6	Zn-65	.394-02	.224-04	.128-06	.728-09	.415-11	.142-24	.854-36	.000
7	Sc-46	.112-05	.321-12	.916-19	.262-25	.747-32	.000	.000	.000
8	Al-26	.407-06	.407-06	.407-06	.407-06	.407-06	.407-06	.407-06	.407-06
TOTAL		.836-02	.123-02	.334-03	.927-04	.261-04	.707-06	.655-06	.598-06

ITEM 35 - HB-1,-2,&-3(>2') - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	JUNE 1973	5 YRS.	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL 10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Fe-55	.846+02	.233+02	.643+01	.177+01	.488+00	.214-03	.341-06	.313-11
2	Mn-54	.178-01	.230-03	.297-05	.383-07	.494-09	.229-20	.821-30	.000
3	Co-60	.625-03	.324-03	.168-03	.868-04	.449-04	.867-06	.323-07	.866-10
4	Ni-63	.155-03	.150-03	.146-03	.142-03	.138-03	.116-03	.100-03	.775-04
5	Mn-54	.592-04	.765-06	.988-08	.128-09	.165-11	.762-23	.274-32	.000
6	Zn-65	.621+02	.354+00	.202-02	.115-04	.655-07	.224-20	.135-31	.000
7	Sc-46	.455-03	.130-09	.371-16	.106-22	.303-29	.000	.000	.000
8	Al-26	.165-03	.165-03	.165-03	.165-03	.165-03	.165-03	.165-03	.165-03
TOTAL		.147+03	.237+02	.643+01	.177+01	.489+00	.496-03	.266-03	.243-03

ITEM 36 - FAR SOUTH CORE BOX PLATE - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Fe-55	.351+04	.967+03	.267+03	.735+02	.203+02	.889-02	.141-04	.130-09
2	Mn-54	.123+02	.159+00	.205-02	.265-04	.342-06	.158-17	.568-27	.000
3	Co-60	.252+00	.130+00	.676-01	.350-01	.181-01	.350-03	.130-04	.349-07
4	Ni-63	.625-01	.607-01	.590-01	.573-01	.556-01	.468-01	.405-01	.312-01
5	Mn-54	.956-01	.123-02	.159-04	.206-06	.266-08	.123-19	.441-29	.000
6	Zn-65	.391+04	.223+02	.127+00	.723-03	.412-05	.141-18	.848-30	.000
7	Sc-46	.489+00	.140-06	.399-13	.114-19	.326-26	.000	.000	.000
8	Al-26	.125+00	.125+00	.125+00	.125+00	.125+00	.125+00	.125+00	.125+00
TOTAL		.743+04	.990+03	.267+03	.737+02	.205+02	.182+00	.166+00	.157+00

ITEM 37 - CORE BOX SIDE PLATES (2) - 6061-T6 OR 356-T ALUMINUM

TABLE 2.6 PBR ACTIVITY LEVELS

REACTION NUMBER	ISOTOPE	ACTIVITIES (CURIES) AT INDICATED TIME INTERVAL JUNE 1973	5 YRS.	10 YRS.	15 YRS.	20 YRS.	50 YRS.	75 YRS.	120 YRS.
1	Fe-55	.982+04	.271+04	.746+03	.206+03	.567+02	.249-01	.396-04	.364-09
2	Mn-54	.103+03	.133+01	.172-01	.222-03	.287-05	.133-16	.447-26	.000
3	Co-60	.212+01	.110+01	.568+00	.294+00	.152+00	.294-02	.109-03	.293-06
4	Ni-63	.525+00	.510+00	.495+00	.481+00	.467+00	.393+00	.340+00	.262+00
5	Mn-54	.803+00	.104-01	.134-03	.173-05	.223-07	.103-18	.371-28	.000
6	Zn-65	.127+05	.721+02	.411+00	.234-02	.133-04	.457-18	.275-29	.000
7	Sc-46	.411+01	.117-05	.335-12	.958-19	.273-25	.000	.000	.000
8	Al-26	.105+01	.105+01	.105+01	.105+01	.105+01	.105+01	.105+01	.105+01
TOTAL		.226+05	.278+04	.749+03	.208+03	.584+02	.147+01	.139+01	.132+01

ITEM 38 - LOWER GRID - 6061-T6 OR 356-T ALUMINUM

APPENDIX A REFERENCES

A-1 Lynch, J.H.: Two Dimensional Flux and Criticality Calculations for the Plum Brook Reactor, NASA TN D-2210, October 1964

A-2 Lynch, J.H.: A Systematic Approach to Model Development by Comparison of Experimental and Analytical Regression Coefficients, NASA TM X-1797, May 1969

A-3 Ross, J.E., et. al.: An Evaluation of the Options for Further Decommissioning of the Plum Brook Reactor Facility, Teledyne Isotopes, Inc., 1978

TELEDYNE ISOTOPES

AN EVALUATION OF THE PLUM BROOK REACTOR FACILITY AND DOCUMENTATION OF EXISTING CONDITIONS

VOLUME 3 - PHYSICAL CHARACTERIZATION OF RADIOACTIVE/CONTAMINATED AREAS OF THE PBRF

VOLUME 3, PART 1 OF A 6 VOLUME SERIES

Prepared For

The National Aeronautics and Space Administration
Lewis Research Center
21000 Brookpark Road
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TELEDYNE ISOTOPES

This is Volume 3, Part 1 of a series titled. "An Evaluation of the Plum Brook Reactor Facility and Documentation of Existing Conditions." Appendices and data referred in this Part 1 appear in a separately bound Part 2 of this volume.

Following is a list of all titles in the series:

Study Organization

Volume 1 - Review of Existing PBRF Data and Pertinent Regulatory Changes Since 1978 Which Would Affect Documentation of Present Conditions at the Plum Brook Reactor Facility

Volume 2 - Items of Radiological Significance Addressed in the 1978 PBRF Options Study for Which Additional Information is Needed

Volume 3 - Part 1 - Physical Characterization of Radioactive/ Contaminated Areas at the PBRF

Part 2 - Appendices

Volume 4 - Update of the 1978 Cost Estimate for the Plum Brook Reactor Facility Dismantling Project

Volume 5 - Cost Estimates and Schedules to Maintain the Integrity of Barriers at the PBRF to Ensure Dry Safe Protective Storage for the Next 30 Years

Volume 6 - PBRF Systems/Equipment disposition Lists

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NOTICE

This report was prepared for the National Aeronautics and Space Administration for the purpose of documenting existing conditions at the Plum Brook Reactor Facility. Neither NASA, Teledyne Isotopes, or its subcontractors assumes liability for the use or accuracy of information contained herein for other than the above expressed purpose.

Requests for copies of this report must be submitted to:

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PREFACE

The National Aeronautics and Space Administration (NASA) owns the Plum Brook Reactor Facility (PBRF). This facility includes a 60 megawatt test reactor and a zero power pool type research reactor. The PBRF was mothballed in 1973 and placed in a dry safe configuration. NASA has made the decision to keep the PBRF in this safe storage configuration for an indefinite period. As a result of this decision it is important that NRC decommissioning regulations, methodology, technology, and activities be periodically tracked by NASA in order to optimize decision making and timing in the future. This report addresses further PBRF decommissioning in order to provide external feedback to NASA. The fact that PBRF decommissioning is discussed should in no way be interpreted to mean that such project plans are underway.

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(Continued)

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3.0 TASK PRIORITY #3: DETERMINE EXACT PHYSICAL CHARACTERIZATION OF RADIOACTIVE CONTAMINATED AREAS BY CONDUCTING RADIOLOGICAL SURVEYS AND MATERIAL SAMPLING

3.1 GENERAL

It was necessary to develop a comprehensive sampling plan to systematically classify all structures, systems, and grounds at the PBRF. This plan had to include sampling of all exposure pathways at PBRF, corresponding sampling of sites known to be radioactively clean with similar characteristics to PBRF monitored sites in order to define background radioactivity levels for purposes of comparison, a statement of appropriate release limits, laboratory analytical requirements and quality control, instrumentation specifications, and isotopic identification of those samples which contained significant activity. The plan used was an adaptation of the one utilized when Buildings 1121 and 1142 and structure 1156 were monitored, evaluated, and cleared for release from the PBRF along with approximately 2.7 acres of land in 1981. This Plan appears in Appendix 3.1.

3.1.1 Pathway Analysis

Pathway analysis refers to an evaluation of the mechanisms by which environmental contamination resulting from nuclear operations can contribute to human radiological exposure. It seems logical that a sampling plan for characterizing radioactive contamination should be broad enough to provide data for evaluating all avenues of possible exposure. The NRC requires that pathway analyses be performed to assess possible exposure due to unrestricted access. These exposures to maximally exposed individuals following de-licensing ultimately become the basis for risk assessment which in turn dictates the release limits that must be met before decommissioning can be considered complete. Although the NRC is moving to develop more uniform criteria for facility decommissioning, a site specific pathway analysis is still required. This is another reason why the PBRF sampling plan had to address all major pathways of exposure.

Figure 3.1 shows simplified pathways between radioactive materials released to atmosphere and man.

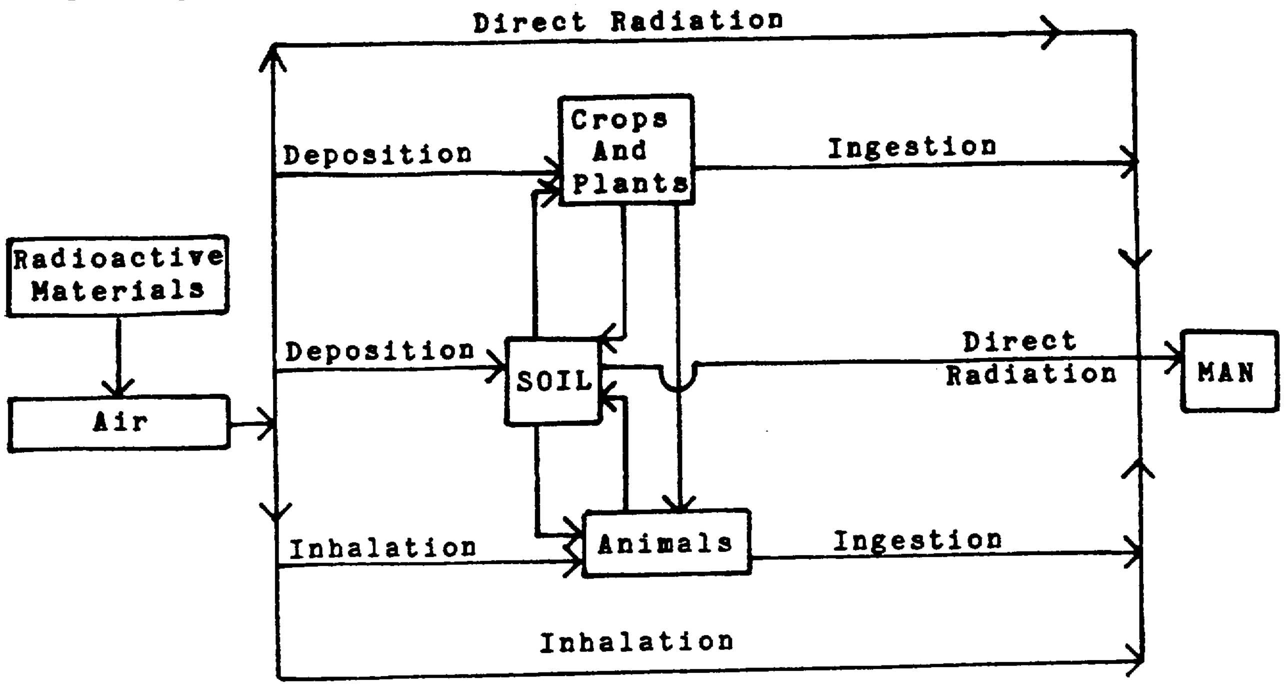

Figure 3.1 Simplified Pathways Between Radioactive Materials Released To Atmosphere And Man

Throughout the operating history at PBRF there were no major releases of airborne radioactive materials which resulted in detectable variances with background as verified by an extensive on-site and off-site environmental monitoring program. During Safe Storage since 1973, the only possible release has been trace quantities of tritium in the reactor tank nitrogen purge. (Sampling has shown no other isotopes to be present.) The N2 Purge flow has been approximately 10 liters per minute. For these reasons the only additional sampling necessary was to evaluate the nitrogen purge specifically for tritium. Any airborne depositions on site soil will be covered under the liquid pathway analyses following.

Figure 3.2 shows simplified pathways between radioactive materials released to ground or surface waters and man.

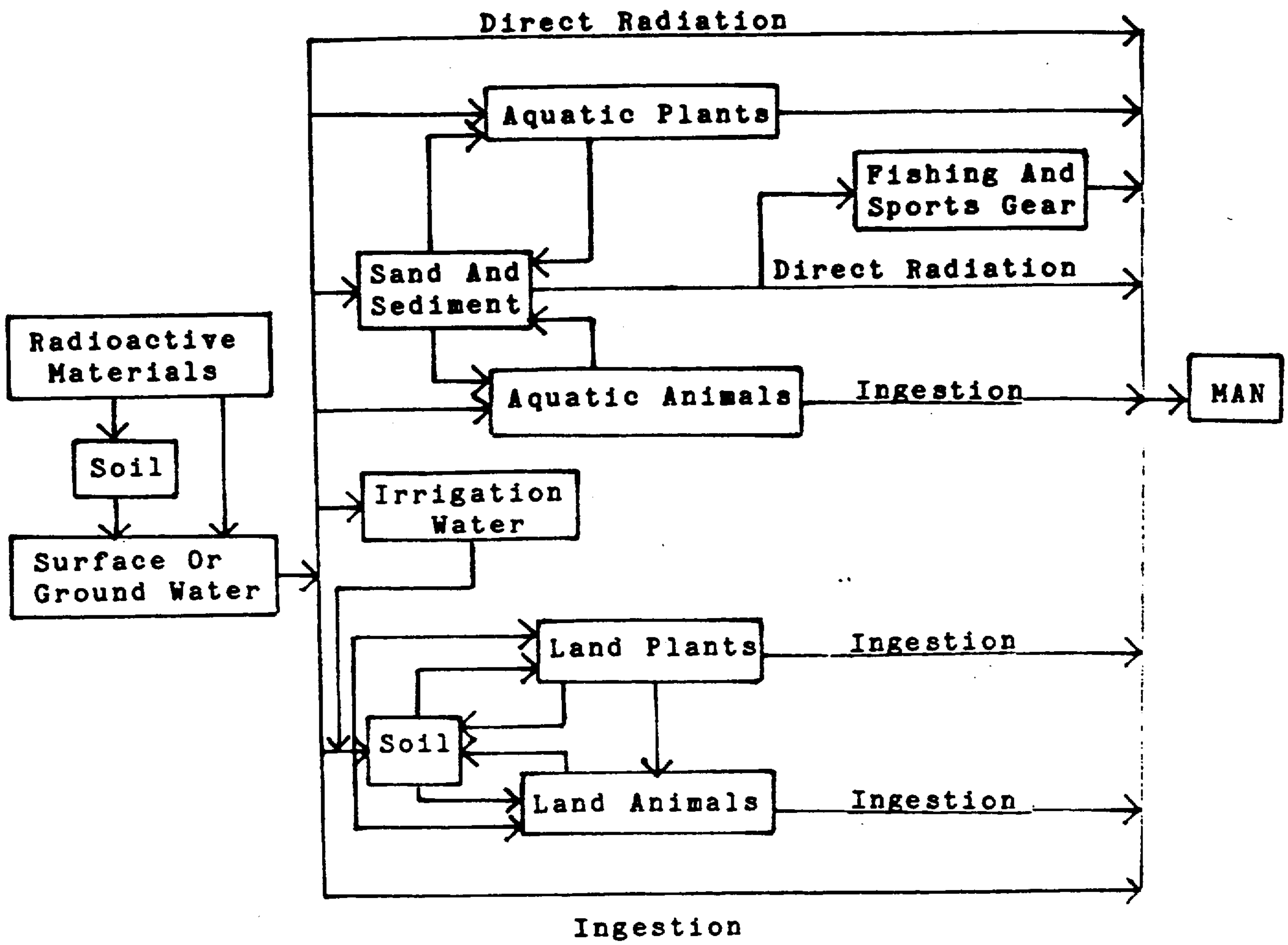

Figure 3.2 Simplified Pathways Between Radioactive Materials Released To Ground Or Surface Waters and Man

Liquid pathways of exposure represent those most likely to result from future unrestricted use of the facility. For this reason a comprehensive surface soil and deep soil sampling program was planned. A thorough sampling of all runoff and drainage systems was also planned. These included building roof tops, catch basins, buried drain pipes, the Water Effluent Monitoring System, ditches and basins, the Emergency Retention Basin, the Hot Retention Area, and the Cold Retention Area. Attention was focused on areas of known spills in the past as well as a comprehensive plan to cover all areas of the 27.3 acre facility. The full length of the Pentolite Ditch was also included in monitoring plans because it received liquid outfall from PBRF. Later, during the period of sampling, it became evident that two small animal species were active in the area and were included in sampling plans. One was the eastern groundhog (Marmota Monax), a shallow burrowing animal which feeds on surface vegetation during the growing season and hibernates during the winter months. The other was the mole (Scalopus Aquaticus), another small burrowing animal which feeds on insect larvae (grubs) attached to the shallow roots of grasses and other plants and goes deep for the winter.

When considering pathway analysis, the worst case scenario is considered. That is, an individual lives on the site, raises all his food on site, and consumes the food and local water supply. By far the most significant exposure is from external dose sources. At 5 uR/hr above background, the annual exposure would be about 44 mRem/year. Considering ingestion and inhalation, the total approximate dose to a person living on the site would be approximately 50 mRem/year. This value is about half the natural background of 100 mRem/year and about one-tenth the value of 500 mRem/year considered to be the maximum permissible exposure to the general public.

3.1.2 Background Interpretation

Control sampling was built into the monitoring/sampling plan by calling for background sampling approximately 1 mile away from PBRF. The numbers of control samples were specified at 5% of each of the total categories of samples. During sampling of the Pentolite Ditch one area of exposed shale showed a significantly higher background (3 x normal background) which was identified as Radium 226 and Thorium 228 by isotopic analyses. These are naturally occurring isotopes and not related to PBRF operations. Monitoring of the control background ditch along Fox Road revealed one area of similar exposed shale which also showed a higher than normal background. This high background shale also was discovered in two deep core background samples at deeper depths (18' and 22'). One of these locations was east of the station main gate near the north perimeter fence, and another was near the

Engineering Building #7141. In both of the deep core samples normal background levels were observed above and below the shale layers. All were verified to be naturally occurring isotopes from the uranium series.

It was decided not to include these high values in background determinations since corresponding release levels (2 x natural background exclusive of background) could have resulted in unrealistically high values which could reach 6 x normal background in those areas not having this shale. It should be noted that some high background shale was located during the deep and shallow core sampling within the PBRF fence, however. the maximum values were lower than those found in off site background shale samples. This phenomenon of high background shale deposits needs to be considered during future dismantling of PBRF structures because construction photographs taken in the 1957-59 era show what appear to be shale layers in excavations. If encountered in PBRF dismantling it could cause some confusion as to what was natural radiation and what resulted from PBRF operations.

3.1.3 Release Limits

The following release limits were used for purposes of determining whether or not various structures, equipment, systems, and areas qualify for release or will require decontamination or removal as rad waste. These limits are consistent with Table 1 of NRC Regulatory Guide 1.86 and are also shown in sections 3.2 and 3.3 of Appendix 3.1.

Direct Radiation	Less than 5 uR/hr above natural background
Transferable Contamination:	20 alpha d/m/100 sq. cm 1000 beta-gamma d/m/100 sq. cm
Fixed Contamination And Special Scrapings:	100 alpha d/m/100 sq. cm 5000 beta-gamma d/m/100 sq. cm
Silt And Soil:	Less than 2 times natural background exclusive of instrument background
90 Sr in ERB Soil:	Less than 5 pCi/gm of soil
Water And Air:	10CFR20-App. B Limits for Unrestricted Areas

3.1.4 Instrumentation and Procedures

All instrumentation used in performing the radiological characterization of the PBRF was calibrated at least quarterly to standards traceable to the National Bureau of Standards. Written procedures followed were those normally in effect at the Plum Brook Reactor Facility. Proprietary analytical procedures in effect at Teledyne Isotopes' Westwood Laboratory were utilized in sample handling and analyses there. All sampling and analyses were consistent with the Sampling Plan shown in Appendix 3.1. Portable instrument surveys were performed utilizing instruments available at PBRF. Laboratory analyses of samples collected were performed at the Teledyne Isotopes Radiological Environmental Laboratory in Westwood, New Jersey. This facility is a state-of-the-art commercial lab which performs environmental analyses for approximately 2/3 of the power reactors in the United States.

3.1.5 Isotopic Identification

Isotopic analyses were performed on all samples containing significant quantities of radioactive material when those samples were representative of the systems or structures they came from . As a result of this evaluation several conditions were noted which were contrary to what was previously believed.
The first condition encountered involved the widespread presence of low level fission products. Irradiated fueled specimens were processed in the Hot Laboratory, and therefore, fission products were expected to be in the hot cells, drains, etc. 137 Cesium and 90 Strontium were in fact identified in cell drains and sumps. What was unexpected was the fact that 134 Cesium, 137 Cesium, and 90 Strontium was also found in quadrant and canal drains, all hot sumps, resin pits, HRA, and in the ERB surfaces.

Another condition encountered was the presence of 152 Europium, 154 Europium, and 155 Europium in the primary system piping. These resulted from neutron activation of trace quantities of Gadolinium Nitrate persisting after the accidental triggering of the poison injection system on several occasions during operations and subsequent flushing of the primary cooling water system.

The half lives for these various isotopes found are as follows:

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Isotope	T 1/2 (years)
152 Eu	12.8
154 Eu	16.0
137 Cs	30.0
90 Sr	28.0

Until the time of this study 60 Cobalt was considered to be the predominant isotope in piping systems contributing to occupational exposures. 60 Cobalt with its 5.2 year half life could be expected to decay within 100 years, and in fact, after 30 years would decay to a point where minimal shielding would be required. After that time the longer lived remaining stainless steel activation products, 63 Nickel and 59 Nickel, would be the predominant isotopes. The longer half lives of Europium, Cesium, and Strontium isotopes present mean that there are likely to be less advantages to be gained from letting the facility decay naturally before attempting further decommissioning. More detailed information regarding the presence and quantities of these isotopes appears later in this section where specific systems and structures are discussed.

A third condition encountered centered around Tritium in the reactor tank and hot dry storage area. Tritium was known through activation calculations to be present in large quantities in beryllium pieces and beryllium alloys. It was thought to be totally contained within the metal matrices. Special sampling of the reactor tank nitrogen purge and vent system and the hot dry storage area verified this to be true for the most part. It was discovered, however, that small concentrations of tritium are offgassing and venting through the PBRF stack at levels within the maximum permissible concentration to the general public. Further tests showed that if the nitrogen purge system is shut off for a period of 10 days that the in-tank tritium concentration tripled. Thus, continuation of the nitrogen purge appears to be desirable in order to minimize build up of tritium in the reactor tank atmosphere. Tritium concentrations present in the hot dry storage atmosphere were somewhat lower than that found in the reactor tank. The Nitrogen purge through the stack is now being sampled on a quarterly basis for evaluation of Tritium concentrations.

A more detailed discussion of the tritium evaluation is presented later in this section where these systems and structures are discussed.

3.2 OUTDOOR RADIOLOGICAL CLASSIFICATION

3.2.1 Surface Soil

The outdoor area within the PBRF fence line was indexed in accordance with Appendix 3.1 by placing surveyor stakes at the northeast corner of each 50' grid. West to east indexing utilized letters "A" thru "U". South to north indexing utilized numbers 1 thru 32. This was done in order to perform a more comprehensive radiological evaluation and to determine the extent of contamination of the facility grounds resulting from stack fallout, spills, or tracking. The Emergency Retention Basin was also indexed; however, each 50' grid within the ERB was subdivided into four 25' grids using the same basic index with further subdivision indexed as northeast, southeast, southwest, and northwest sections. For example, Grid A-5 would be a 50' grid outside the ERB Grid. Grid R-6 NE would be the 25' grid in the northeast section of Grid R6 within the ERB. These smaller grids within the Emergency Retention Basin permitted a greater number of observations (20 vs 5) in an area known to be mildly contaminated. Figure 3.3 illustrates the PBRF Outdoor Monitoring Grid Index.

Each grid was monitored at near contact in five locations with an NMC-GS-3W GM instrument. Figure 3.4 illustrates the location of the monitoring points within each grid.

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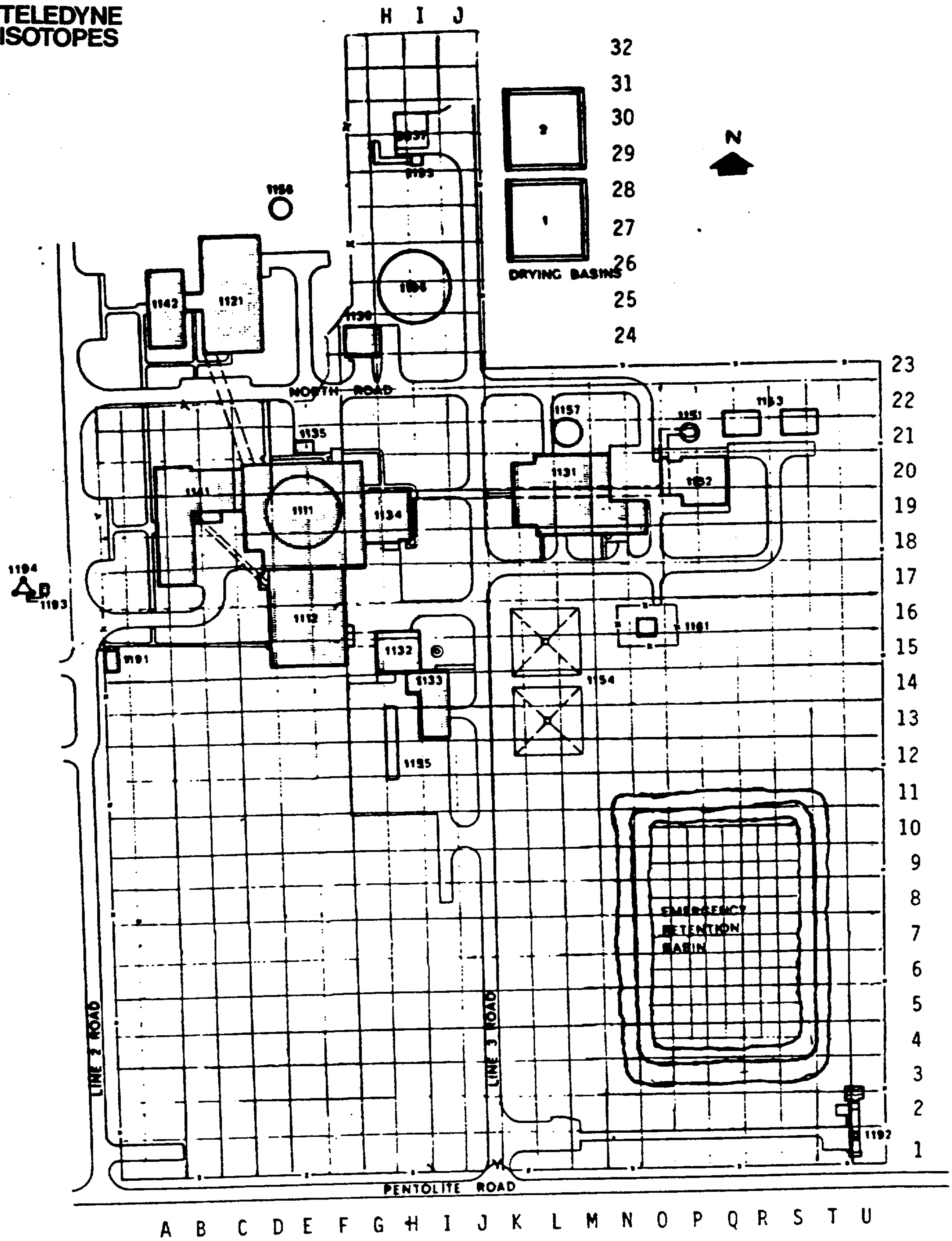

Figure 3.3 - PBRF Outdoor Monitoring Grid Index

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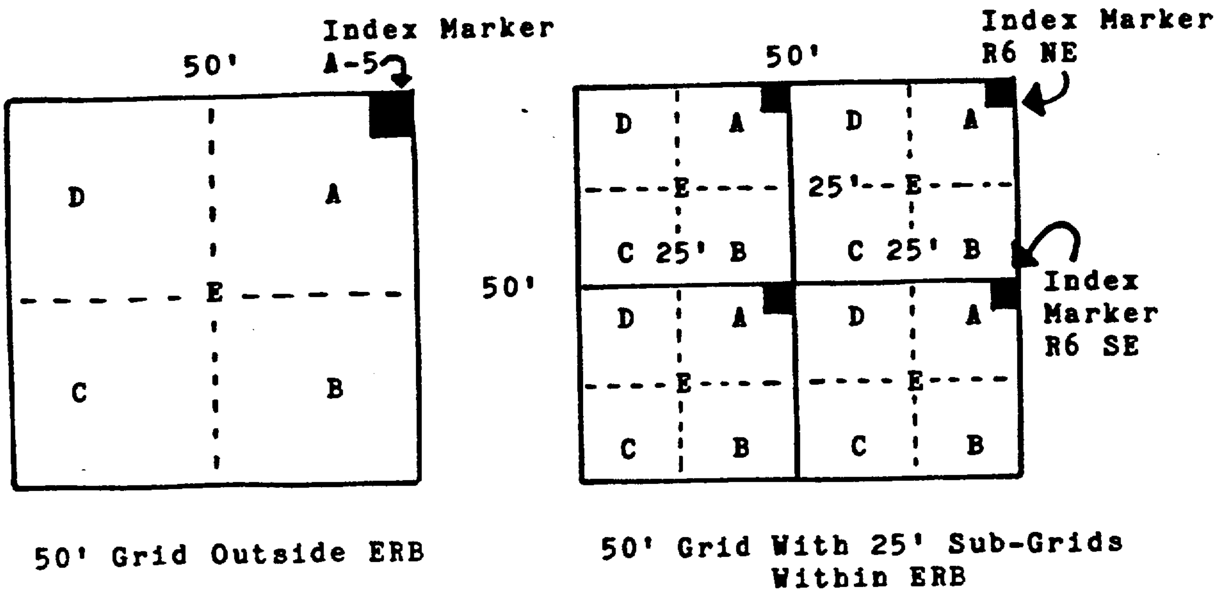

Figure 3.4 - Monitoring Points Within A Typical PBRF Outdoor Surface Grid

At the point of highest GS-3W beta-gamma reading, within each grid, a direct radiation reading was taken with an Eberline PRM-7 micro R meter held at a distance of 1 meter above the surface of the soil. At this same location a surface soil sample was also collected. Where possible, a direct reading of alpha radioactivity was taken on smooth surfaces with an Eberline PRS-1.

The soil sampling tool was fabricated from a 3" hole saw and included an ejection plunger for removing the sample from the tool. Each sample was placed in a one pint pre-numbered container, sealed, and sent to the laboratory for analysis. The tool was wire brushed and washed after each sample to minimize cross contamination of samples.

3.2.1.1 Surface Monitoring Results - Other Than ERB

Following is the summary of results of the surface monitoring data. Appendix 3.2 contains all data from surface soil sampling and monitoring.

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TABLE 3.1 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT - SURFACE SOIL SAMPLING OTHER THAN ERB

	Sample Data (pCi/g)		Background Data* (pCi/g)	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
Maximum	16	150	14	36
Minimum	LT 3	4	LT 5	24
Average	6	31	7	30
No. Samples	412	412	20	20
No. GT 2 x Background	0	3	-	-
Areas Over Release		H18D I9D U3B		

*Background Data Obtained From The Vicinity Of Engineering Building #7141

TABLE 3.2 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT - DIRECT RADIATION MONITORING OTHER THAN ERB

	Sample Data (Beta-Gamma)		Background Data* (Beta-Gamma)	
	End Window GM(c/m)	uR/hr	End Window GM(c/m)	uR/hr
Maximum	200	34	125	20
Minimum	25	4	25	4
Average	56	7	63	6
No. Grids	451	451	20	20
No. Readings	2163	451	100	20
No. GT 2 x Background	3**	3***	-	-
Areas Over Release	H18D I10C N8E	U3B I9D I10C		

*Background Data Obtained From The Vicinity of Engineering Building #7141

**Grid Areas H12D And H13D Were Also Over Release Limits; However, This Was Due To Interference Of High Backgrounds In The HRA & WHB.

***Grid Areas H12D, H13D, H14C, And I12D Were Also Over Release Limits; However, This Was Due To Interference Of High Backgrounds In the HRA & WHB.

Based on surface monitoring and soil sampling, there were 3 areas within the PBRF fence line (but outside of the ERB) which do not meet release criteria. One small area is in the vicinity of the Primary Pump House Resin Pits (Grid H18D) where low level activity was spilled during spent resin pumping. Another is adjacent to the Waste Handling Building outdoor concrete pad (Grid I9D and I10C). The third area was adjacent to the Water Effluent Monitoring trench near Grid U3B.

3.2.1.2 Surface Monitoring Results Within The ERB

Following is the summary of results of the surface monitoring data within the ERB. Appendix 3.2 contains all data from surface soil sampling and monitoring including the ERB. Note that 65% of all samples were also analyzed for 90 Strontium

TABLE 3.3 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT - SURFACE SOIL SAMPLING IN THE ERB

	Sample Data (pCi/g)			Background Data* (pCi/g)		
	Gross Alpha	Gross Beta	90 Sr	Gross Alpha	Gross Beta	90 Sr
Maximum	37	740	17	14	44	.24
Minimum	LT 4	15	LT 1	LT 7	34	.10
Average	10	78	2	10	39	.18
No. Samples	92	92	60	6	6	3
No. GT 2 X BKGD	3	22	4**	-	-	-

*Background Data Obtained From The Vicinity Of The Engineering Building #7141

**Number Exceeding 5 pCi/g 90 Sr

TABLE 3.4 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT - EMERGENCY RETENTION BASIN DIRECT RADIATION MONITORING

	Sample Data (Beta-Gamma)		Background Data* (Beta-Gamma)	
	End Window GM(c/m)	uR/hr	End Window GM(c/m)	uR/hr
Maximum	400	90	125	7
Minimum	25	10	50	6
Average	113	30	76	6
No. Grids	97	97	8	8
No. Readings	468	97	40	8
No. GT 2 x Background	59	96	-	-

*Background Data Obtained From The Vicinity Of The Engineering Building #7141

From the data in Tables 3.3 and 3.4, it can be seen that virtually all areas of the ERB flat basin fail to meet the release levels predominantly because of the direct radiation level. this will be discussed further in Section 3.2.3.4.

3.2.2 Deep Soil Samples

In addition to the surface soil samples, sub-surface core drilling was performed to obtain samples located at depths up to 30' below the surface. Shallow core samples were taken to a depth of 10' while deep core samples extend to 30' below the surface. A standard ASTM D-1586 split barrel sampler was driven to a depth of 24" and the sample removed. The hole was then reamed to the 24" depth to provide access for the next sampling. After reaming, the split barrel sampler was driven to a depth of 24" and the sample removed. This procedure was repeated until the desired depth was reached or rock was encountered. When rock was encountered the split barrel sampler was replaced with a 2" diamond core drill. Diamond core drilling continued until the desired depth was reached. The top 2' sample was split into four 6" sections to determine near surface migration and penetration patterns into the soil A 6" sample was split off the bottom of each successively deeper 2' core sample. Drilling logs were maintained to characterize the types of soils encountered.

The thirty-six 10' shallow core holes were located to be adjacent to the buried WEMS drainage pipes and to penetrate the original open asphalt lined drainage ditches. They were also located to randomly cover all areas of the PBRF grounds. Eight were within the ERB. Some were also focused in areas of suspected spills (such as the concrete waste handling pad and the field north of the ERB north dike break which occurred during operation).

The twenty-three deep 30' core holes were located adjacent to deep underground structures to verify that they did not leak contaminated water into the ground. These structures included the HRA, CRA, Canal G, and Canal K. Canal G and K were taken within Buildings #1111 and #1112, respectively. Figure 3.6 illustrates the location of the underground soil core samples.

Data for the shallow core (10') and deep core (30') sub-surface soil samples appears in Appendix 3.3 and 3.4. Following is a summary presentation of that data.

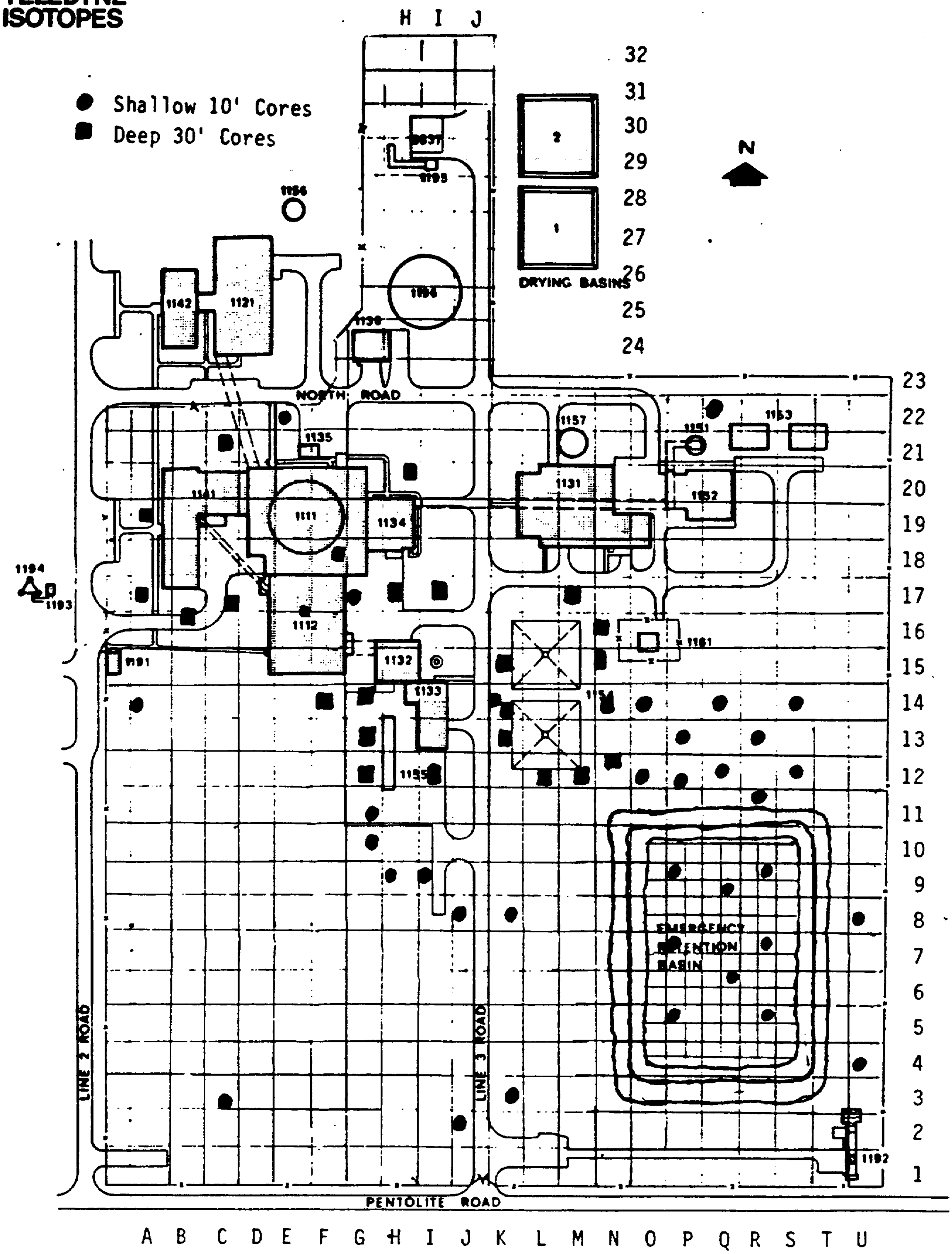

Figure 3.6 - Location Of Sub-Surface Core Soil Samples Within The PBRF

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TABLE 3.5 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT - SHALLOW CORE SOIL SAMPLING (10') OTHER THAN ERB

	Sample Data (pCi/g)		Background Data* (pCi/g)	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
6" DEPTH-1				
Maximum	14.0	200	LT 6	26
Minimum	4.6	20	LT 6	25
Average	7.2	37	LT 6	26
No. Samples	29	29	2	2
No. GT 2 x Background	2	2	-	-
12" DEPTH-2				
Maximum	93.0	1500	10	32
Minimum	3.6	22	LT 6	26
Average	9.3	79	8	29
No. Samples	29	29	2	2
No. GT 2 x Background	1	2	-	-
18" DEPTH-3				
Maximum	19.0	300	LT 6	29
Minimum	LT 4.0	29	LT 6	26
Average	6.0	44	LT 6	27
No. Samples	29	29	2	2
No. GT 2 x Background	1	1	-	-
2' DEPTH-4				
Maximum	14.0	170	6.5	29
Minimum	LT 4.0	21	LT 6.0	23
Average	6.7	32	LT 6.2	26
No. Samples	29	29	2	2
No. GT 2 x Background	2	1	-	-
4' DEPTH-5				
Maximum	12.0	180	6.5	34
Minimum	LT 3.0	21	LT 6.0	25
Average	6.8	34	6.2	29
No. Samples	29	29	2	2
No. GT 2 x Background	1	1	-	-

TABLE 3.5 (CONTINUED)

	Sample Data (pCi/g)		Background Data* (pCi/g)	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
6' DEPTH-6				
Maximum	11.0	97	8.1	45
Minimum	4.1	22	LT 6.0	24
Average	7.2	35	7.0	34
No. Samples	29	29	2	2
No. GT 2 x Background	0	1	-	-
8' DEPTH-7				
Maximum	14.0	45	15.0	64**
Minimum	LT 5.0	22	LT 6.0	34
Average	7.2	33	10.0	49
No. Samples	29	29	2	2
No. GT 2 x Background	0	0	-	-
10' DEPTH-8				
Maximum	15.0	43	24.0	85**
Minimum	LT 5.0	23	LT 6.0	30
Average	8.8	35	15.0	57
No. Samples	29	29	2	2
No. GT 2 x Background	0	0	-	-

*Background Data Obtained From Vicinity Of Engineering Building #7141

**Naturally Occurring Radioactive Material In Shale Layers See Section 3.1.2 For Discussion Of This Phenomenon

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TABLE 3.6 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL CLASSIFICATION-EMERGENCY RETENTION BASIN, SHALLOW CORE (10') SOIL SAMPLING

	Sample Data (pCi/g)		Background Data*	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
6" DEPTH-1				
Maximum	8.1	78	LT 6.0	26
Minimum	LT 3.0	26	LT 6.0	25
Average	5.1	43	LT 6.0	26
No. Samples	8	8	2	2
No. GT 2 x Background	0	2	-	-
12" DEPTH-2				
Maximum	6.1	46	10.0	32
Minimum	LT 5.0	26	LT 6.0	26
Average	5.2	32	8.0	29
No. Samples	8	8	2	2
No. GT 2 x Background	0	0	-	-
18" DEPTH-3				
Maximum	7.6	37	LT 6.0	29
Minimum	LT 5.0	29	LT 6.0	26
Average	5.4	31	LT 6.0	27
No. Samples	8	8	2	2
No. GT 2 x Background	0	0	-	-
2' DEPTH-4				
Maximum	9.7	36	6.5	29
Minimum	LT 5.0	24	LT 6.0	23
Average	5.9	29	6.2	26
No. Samples	8	8	2	2
No. GT 2 x Background	0	0	-	-
4' DEPTH-5				
Maximum	9.2	44	6.5	34
Minimum	LT 5.0	22	LT 6.0	25
Average	6.6	33	6.2	29
No. Samples	8	8	2	2
No. GT 2 x Background	0	0	-	-

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TABLE 3.6 (CONTINUED)

	Sample Data (pCi/g)		Background Data*	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
6' DEPTH-6				
Maximum	10.0	41	8.1	45
Minimum	LT 3.0	25	LT 6.0	24
Average	5.4	32	7.0	34
No. Samples	8	8	2	2
No. GT 2 x	0	0	-	-
8' DEPTH-7				
Maximum	8.1	42	15.0	64**
Minimum	LT 5.0	31	LT 6.0	34
Average	6.3	36	10.0	49
No. Samples	8	8	2	2
No. GT 2 x	0	0	-	-
10' DEPTH-8				
Maximum	13.0	44	24.0	85**
Minimum	LT 5.0	21	LT 6.0	30
Average	7.1	35	15.0	57
No. Samples	8	8	2	2
No. GT 2 x	0	0	-	-

*Background Data Obtained From Vicinity Of Engineering Building #7141

**Naturally Occurring Radioactive Materials In Shale Layers. See Section 3.1.2 For Discussion Of This Phenomenon.

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TABLE 3.7 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT, DEEP CORE (30') SOIL SAMPLING-Alpha

Depth/ Core Segment	Sample Data (pCi/g Alpha)					Background Data* (pCi/g Alpha)			
	MAX	MIN	AVG	NO SMPL	NO GT 2xBKGD	MAX	MIN	AVG	NO SMPL
6"-1	16	LT 4	6.5	25	1	LT 6	LT 6	LT 6	2
12"-2	10	LT 4	5.7	25	0	LT 6	LT 6	LT 6	2
18"-3	13	LT 4	6.6	25	1	LT 6	LT 6	LT 6	2
2'-4	14	LT 3	7.2	25	3	6.5	5.4	5.9	2
4'-5	11	LT 4	6.9	25	0	13.0	LT 6	9.5	2
6'-6	16	LT 4	7.4	25	0	17.0	LT 6	11.0	2
8'-7	16	4.9	7.7	25	0	16.0	15.0	15.0	2
10'-8	12	4.6	7.8	25	0	16.0	LT 6	11.0	2
12'-9	14	LT 4	8.7	25	0	12.0	11.0	12.0	2
14'-10	11	5.1	7.5	25	0	16.0	16.0	16.0	2
16'-11	17	3.6	8.1	25	1	14.0	13.0	14.0	2
18'-12	18	4.3	10	25	0	10.0	8.6	9.3	2
20'-13	16	4.4	10	25	0	12.0	8.6	10.0	2
22'-14	18	4.6	9.6	25	0	12.0	10.0	11.0	2
24'-15	17	3.6	9.0	25	0	11.0	11.0	11.0	2
26'-16	15	4.5	5.3	25	1	7.6	7.6	7.6	2
28'-17	18	LT 4	5.8	25	1	9.2	LT 6	7.6	2
30'-18	LT 6	LT 4	4.4	9	0	5.9	LT 6	6.0	2

*Background Data Obtained From Vicinity Of Engineering Building #7141

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TABLE 3.7 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT, DEEP CORE (30') SOIL SAMPLING-Beta

Depth/ Core Segment	Sample Data (pCi/g Beta)					Background Data* (pCi/g Beta)			
	MAX	MIN	AVG	NO SMPL	NO GT 2xBKGD	MAX	MIN	AVG	NO SMPL
6"-1	33	6.1	22	25	0	28	28	28	2
12"-2	75	8.9	24	25	1	30	23	27	2
18"-3	30	16	25	25	0	22	19	20	2
2'-4	37	22	27	25	0	27	25	26	2
4'-5	36	21	28	25	0	49	24	36	2
6'-6	43	18	28	25	0	50	24	37	2
8'-7	37	20	30	25	0	41	38	40	2
10'-8	40	24	31	25	0	39	29	34	2
12'-9	46	25	45	25	0	53	39	46	2
14'-10	37	19	31	25	0	44	40	42	2
16'-11	47	26	35	25	0	47	46	47	2
18'-12	58	24	39	25	0	51	37	44	2
20'-13	57	22	43	25	0	**570	47	300	2
22'-14	55	21	41	25	0	48	46	44	2
24'-15	60	5.6	32	25	0	54	44	49	2
26'-16	36	1.4	18	23	0	50	49	50	2
28'-17	52	4.4	20	15	0	49	45	47	2
30'-18	48	5.8	24	9	0	48	46	47	2

*Background Information Obtained From The Vicinity Of Engineering Building #7141

**Naturally Occurring Radioactive Materials In Shale Layers. See Section 3.1.2 Discussion Of This Phenomenon

The results of these core samplings indicate several things. First, the clay lined base of the ERB prevented penetration of low level radioactive material deeper than 6" below the surface. Second, the one area of a known low level spill in the vicinity of Grid index I9 (Waste Handling Building Pad) did penetrate sub-surface soils to approximately 6'. Third, there has been no other apparent leakage of any radioactive contamination into sub-surface soils from either surface infiltration or leakage from deep structures.

Figure 3.7 shows the depth profile and drilling log information relating to contamination within Grid index I9. Maximum activity is located at the 6"-12" depth. The drilling log shows that 4" of top soil is underlayed by gravel to a depth of 5.4'. The gravel is deposited on a strata of brown sandy clay. Percolation thru the gravel bed permitted the contamination to extend to a depth of 6'. Soil in this area will have to be removed to a depth of 8' amounting to approximately 185 cubic yards. Isotopic analyses identified the contamination to be predominantly 137 Cesium, although substantial quantities of naturally occurring 40 Potassium were present.

3.2.3 Drainage System

The PBRF surface grounds are graded so that no water runs off outside the fenceline. All runoff enters a series of surface catch basins leading to an underground drain system which flows to the Water Effluent Monitoring System trenches before leaving the facility at this single location. This system also receives building "cold" groundwater sump discharges as well as roof top runoffs. Controlled releases for low level radioactive liquid wastes within discharge limits were also made into this drain system through a release basin near the cold retention areas during PBRF operations. All water discharges to Pentolite Ditch and flows approximately 3000 feet before entering Plum Brook, where it then promptly leaves Plum Brook Station.

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GRID LOC / DEPTH	1-9 ALPHA PCI/GM DRY	1-9 BETA PCI/GM DRY	DRILLING LOG	
0			0	
6"	14 ± 6	200 ± 10	-4"	TOP SOIL
12"	93 ± 14	1500 ± 100		GRAVEL
18"	19 ± 7	300 ± 10		GRAVEL
24"	7 ± 5	170 ± 10		GRAVEL
	6 ± 4	180 ± 10		GRAVEL
4'				GRAVEL
	7 ± 5	97 ± 5	-5'4"	GRAVEL
6'				BROWN SANDY CLAY
	8 ± 5	33 ± 3		BROWN SANDY CLAY
8'			-8'	GRAY SANDY CLAY
	13 ± 6	35 ± 3		GRAY SANDY CLAY
10'			-10'	

Figure 3.7 - Depth Distribution Of Surface Radioactive Contamination In Soil Adjacent To The Waste Handling Building Concrete Storage Pad

3.2.3.1 Catch Basins

The Sampling Plan (Appendix 3.1) involved collection of silt and water samples from 42 catch basins and WEMS basin as well as surface water samples, where possible. Figure 3.8 shows the locations of catch basins within the PBRF fence line. Most catch basins had an accumulation of silt in them since they acted as settling chambers. Most were dry or nearly dry during periods of little or no precipitation. For this reason the silt samples were collected during periods of little or low flow and water samples were collected during periods of normal flow through the catch basins. Very little silt appeared to be in the drain lines although the catch basins had accumulations of silt. The detailed results of catch basin sampling appear in Appendix 3.5. Table 3.8 following is a summary of data obtained. No water samples exceeded the limits of 10CFR20 Appendix B for unrestricted release. About half of the silt samples exceeded 2 x background, the highest being in the catch basin receiving controlled low level liquid releases. When decommissioning is underway the small quantities of silt in these catch basins can be carefully removed during the dry season and disposed of as low level contaminated soil. Underground drainage pipes can be flushed with high pressure fire hoses and whatever small quantities of silt may exist would accumulate in the WEMS basin where it can be conveniently removed.

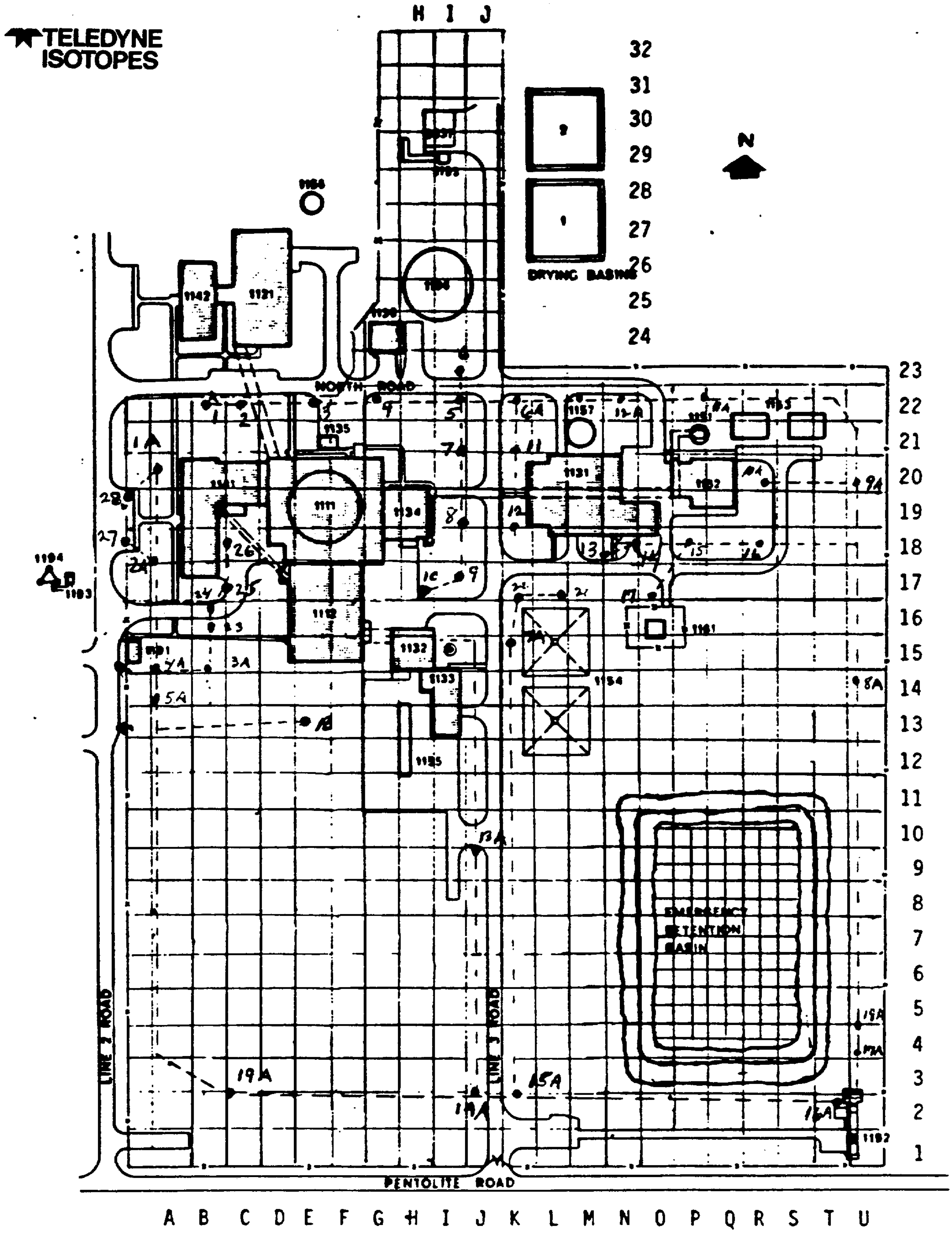

Figure 3.8 - PBRF Outdoor Radiological Classification
Facility Drainage Catch Basins

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TABLE 3.8 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT-CATCH BASINS AND WEMS BASIN, WATER AND SILT SAMPLES

	Sample Data (uCi/ml)		Background Data* (uCi/ml)	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
Water				
Maximum	LT 5.0 E-9	26.0 E-9	LT 6.0 E-9	4.8 E-9
Minimum	LT 0.8 E-9	1.8 E-9	LT 1.0 E-9	1.3 E-9
Average	LT 2.7 E-9	4.9 E-9	LT 3.5 E-9	3.0 E-9
No. Samples	47	47	2	2
No. GT 2 x Background	0	6**	-	-

	Sample Data (pCi/g)		Background Data* (pCi/g)	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
Silt				
Maximum	15.0	330***	6.9	15
Minimum	LT 5.0	7.3	5.0	15
Average	6.6	44.0	5.9	15
No. Samples	44	44	2	2
No. GT 2 x Background	3	18	-	-

*Background Data Obtained From Catch Basins In Vicinity Of Engineering Building #7141

**No Water Samples Exceeded The Limits Of 10CFR20 Appendix B For Unrestricted Access

***Catch Basin 7A Which Received Controlled Radiological Liquid Disposal Discharges Showed The Highest Level

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3.2.3.2 Water Effluent Monitoring Station Trench

All water from PBRF discharges through the Water Effluent Monitoring Station Trench. This area was monitored and found to have low level radioactivity tied up in small quantities of silt accumulated behind the flumes. The concrete base and walls of the trench plus the gates did not seem to be holding any low level radiological contamination. The highest reading obtained was .040 mR/hr directly under the WEMS Control Building #1192 along the west side of the trench. Four of twenty-four survey points monitored were in excess of 2 x background.

3.2.3.3 Emergency Retention Basin

During operation of PBRF the Emergency Retention Basin (ERB) was used for storage of slightly contaminated water in the event the facility effluent exceeded the allowable discharge criteria. The stored water could evaporate, percolate into the soil, decay off and be discharged, or be diluted and discharged.

The structure consists of an earth-diked basin approximately 350' by 250' with a capacity of approximately 10,000,000 gallons. Earth in the basin is mostly brown clay to a depth of at least ten feet.

A sampling procedure utilizing a 25' grid pattern was used to determine the extent of contamination. Each 25' grid was surveyed at contact in five locations with a GS-3 instrument. A direct radiation reading was taken at one meter with an Eberline PRM-7 instrument at the location of the highest GS-3 beta-gamma reading. At this same location a shallow soil plug sample was taken. This sample represented soil between 2" below the surface to 6" below the surface. The samples were sent to the laboratory for analysis. All samples were analyzed to determine gross alpha and gross beta. In addition, 65% of the samples were analyzed for 90 Sr. The results of this data was presented in Section 3.2.1 and 3.2.2 and

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indicated wide spread low level radioactive contamination.

Eight 10' deep core borings were taken in ERB. The results of this data was presented in Section 3.2.2 and indicate that contamination was contained at the surface of the ground.

Figure 3.9 is a presentation of the 8 shallow core samplings reported in Section 3.2.2 and graphically illustrates that the [illegible]ination has not penetrated the upper few inches of soil.

Two of the 10' holes from which the cores [illegible] removed collected sufficient ground [illegible] to be sampled. One hole was in the northeast section of ERB and the other one in the southwest section. Upon analysis, the activity of the northeast water was 0.23E-7 uCi/ml while the activity of the southwest water was 0.10E-7 uCi/ml. This represents 23% and 10% of MPC. A surface water sample collected in the ERB sump was [illegible]13E-7 uCi/ml. After completion of the core drilling all holes were grouted to comply with OEPA requirements.

Results of all sampling in the ERB indicate [illegible] cubic yards of soil must be removed from ERB to decontaminate the area to a release level. Figure 3.10 shows areas that must be removed to depths of 2" and 6". [illegible]ty of the removed soil will average [illegible]/gm.

[illegible]mpling shows that the soil selected [illegible]nstruction of ERB provided an efficient barrier material since contamination extended only a short distance into the soil. The clay provided a fairly impervious structure, good filtration, and ionic action to attract the various isotopes. This would not have been the case had a sandy or gravel type soil been used.

A special soil/vegetation sampling plan was undertaken in order to determine how much activity was retained in surface vegetation and shallow roots vs soil contamination.

GRID LOC / DEPTH	P5-NW-E PCI/GM DRY	P7-NW-E PCI/GM DRY	P9-NW-E PCI/GM DRY	O6-NE-E PCI/GM DRY	O9-SE-U PCI/GM DRY	R5-NE-E PCI/GM DRY	R7-NE-E PCI/GM DRY	R9-NE-B PCI/GM DRY	GRID LOC / DEPTH
6"	B 3.5 +- 0.3 E 01	B 3.4 +- 0.3 E 01	B 5.9 +- 0.4 E 01	B 4.2 +- 0.3 E 01	B 2.6 +- 0.3 E 01	B 7.8 +- 0.4 E 01	B 3.9 +- 0.3 E 01	B 3.5 +- 0.3 E 01	6"
12"	B 3.2 +- 0.3 E 01	B 3.6 +- 0.3 E 01	B 4.6 +- 0.3 E 01	B 2.7 +- 0.3 E 01	B 3.4 +- 0.3 E 01	B 3.3 +- 0.3 E 01	B 2.6 +- 0.2 E 01	B 2.9 +- 0.3 E 01	12"
18"	B 3.1 +- 0.3 E 01	B 3.3 +- 0.3 E 01	B 3.1 +- 0.3 E 01	B 3.1 +- 0.3 E 01	B 2.9 +- 0.3 E 01	B 3.1 +- 0.3 E 01	B 3.2 +- 0.3 E 01	B 3.7 +- 0.3 E 01	18"
24"	B 2.4 +- 0.3 E 01	B 3.6 +- 0.3 E 01	B 2.6 +- 0.3 E 01	B 3.1 +- 0.3 E 01	B 3.4 +- 0.3 E 01	B 3.1 +- 0.3 E 01	B 2.8 +- 0.3 E 01	B 2.9 +- 0.3 E 01	24"
4'	B 4.4 +- 0.3 E 01	B 3.8 +- 0.3 E 01	B 2.8 +- 0.3 E 01	B 3.2 +- 0.3 E 01	B 2.2 +- 0.2 E 01	B 3.8 +- 0.3 E 01	B 2.6 +- 0.2 E 01	B 3.6 +- 0.3 E 01	4'
6'	B 3.1 +- 0.3 E 01	B 3.0 +- 0.3 E 01	B 2.9 +- 0.3 E 01	E 2.5 +- 0.2 E 01	B 3.0 +- 0.3 E 01	B 4.1 +- 0.3 E 01	B 3.1 +- 0.3 E 01	B 3.9 +- 0.3 E 01	6'
8'	B 3.1 +- 0.3 E 01	E 3.8 +- 0.3 E 01	E 3.8 +- 0.3 E 01	E 3.5 +- 0.3 E 01	E 3.4 +- 0.3 E 01	E 4.2 +- 0.3 E 01	E 3.4 +- 0.3 E 01	E 3.7 +- 0.3 E 01	8'
10'	E 4.1 +- 0.3 E 01	E 3.0 +- 0.3 E 01	E 4.4 +- 0.2 E 01	E 2.1 +- 0.2 E 01	E 3.6 +- 0.3 E 01	E 4.3 +- 0.3 E 01	E 3.2 +- 0.3 E 01	E 3.7 +- 0.3 E 01	10'

Figure 3.9 - Radioactivity Depth Profiles In Shallow Core Soil Samples Taken In ERB

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Eight samples were collected in areas of highest contamination. Table 3.9 following summarizes this data. Complete data is found at the end of Appendix 3.2. The results of this data proved inconclusive. It could not be conclusively determined if the vegetation took up the low level radioactive contamination through its root system or was contaminated externally. One beneficial result occurred in that a concept for decontaminating the ERB was devised. It was concluded that since all contamination was within a few inches of the surface it would be desirable to kill off all weeds and woody growth, mow the basin closely, fertilize and develop a healthy turf for several years prior to decommissioning. Commercial sod cutting equipment could then cut, roll and remove the sod with substantial soil attached to the root structure. This would result in a bare basin which could then be re-monitored and remaining pockets of contamination removed. This technique would result in substantially lower volumes of waste since earth moving equipment would not be able to control the depth of cut to 2" as readily.

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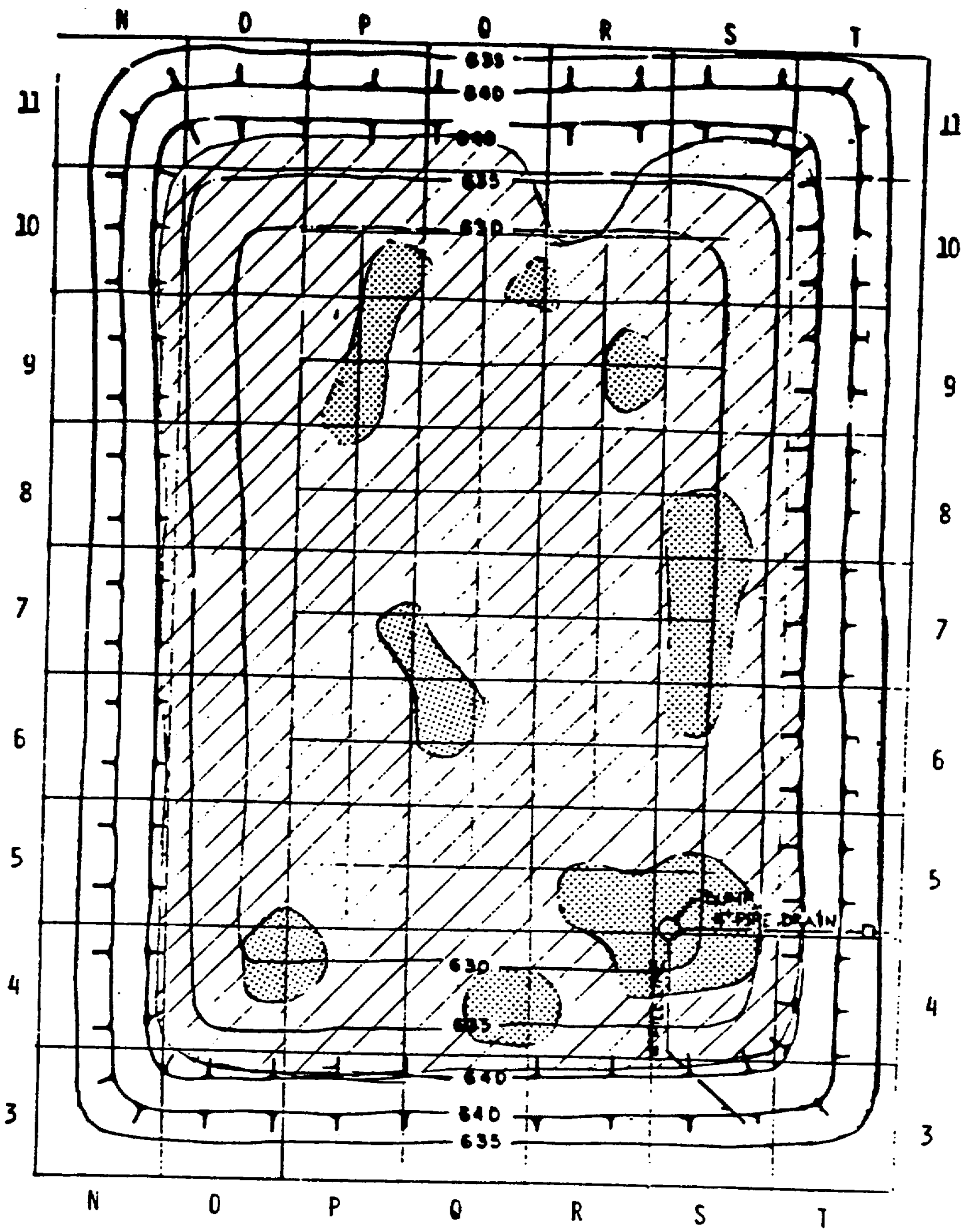

ERB CONTAMINATION PLOT

AREA TO BE REMOVED TO DEPTH OF 2"

AREA TO BE REMOVED TO DEPTH OF 6"

Figure 3.10 - Depth Distribution of Low Level Surface Contamination Within The PBRF Emergency Retention Basin

TABLE 3.9 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT-EMERGENCY RETENTION BASIN, SPECIAL SURFACE SOIL AND VEGETATION SAMPLING

	Sample Data (pCi/g)		Background Data* (pci/g)	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
Special Soil Samples				
Maximum	27.0	750	6.1	35.0
Minimum	LT 5.0	59	LT 5.0	30.0
Average	15.0	360	5.5	3.3
No. Samples	8	8	2	2
No. GT 2 x Background	6	8	-	-
Special Vegetation				
Maximum	8.3	180	2.6	1.4
Minimum	2.0	30	1.8	1.1
Average	4.6	100	2.2	1.3
No. Samples	8	8	2	2
No. GT 2 x Background	4	8	-	-

*Background Data Obtained From Vicinity Of Engineering Building #7141

3.2.3.4 Pentolite Ditch

The PBRF site was graded so that all of the surface water flow exited the facility at one location. All flow is through ditches, manholes, or culverts to the Water Effluent Monitoring System (WEMS). At the WEMS all effluent was continuously monitored, and where the activity levels exceeded a preset concentration limit, automatic sluice gates stopped the flow. Water would then be collected in the Emergency Retention Basin (ERB) until it could be released. All water discharged from the WEMS entered the Pentolite Ditch (PD) traveling some 2750' where it joined Plum Brook. Plum Brook eventually discharges to Lake Erie.

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Since all water, including the slightly contaminated water from ERB, discharged thru Pentolite Ditch, it was necessary to investigate this stream.

For this study earthen dams were constructed in three locations along the stream; one at the junction of Plum Brook, one at Grid 44, and one at Grid 32. These dams permitted pumping the ditch dry so direct radiation readings could be made and samples of soil and silt taken. The dams were later removed and normal flow returned.

A sampling procedure utilizing 30' grids (see Figure 3.11) was used to determine the extent of contamination. Grid 1 was at the WEMS discharge and Grid 90 was at Plum Brook. Each 30' grid was surveyed at contact in five locations; one at the center, and four at points equidistant from the center and corners with a NMC-GS-3 instrument. A direct radiation reading was taken with the Eberline PRM-7 instrument at the location of the highest NMC-GS-3 beta-gamma reading and center of the stream bottom.

A silt sample was taken from the stream bottom at the center of each grid. One soil sample was taken from the bank in the remaining survey location that had the highest direct radiation reading. Seven of these were submitted for analysis.

Tables 3.10 and 3.11 summarize data obtained from Pentolite Ditch sampling/monitoring. Complete data appears in Appendix 3.6. Results of the sampling indicate 168 cubic yards of material will have to be removed from the Pentolite Road ditch area. This material will average 47.5 pCi/g. Most of the soil/silt must be removed at the upper end of Pentolite Ditch from the WEMS outfall, Grid 1 thru Grid 38, and the lower end near the confluence with Plum Brook in Grids 80 to 88. Maximum depth that the soil must be removed is 12".

In addition, four 10' core samples were taken in accordance with the procedure previously described. Results of these core

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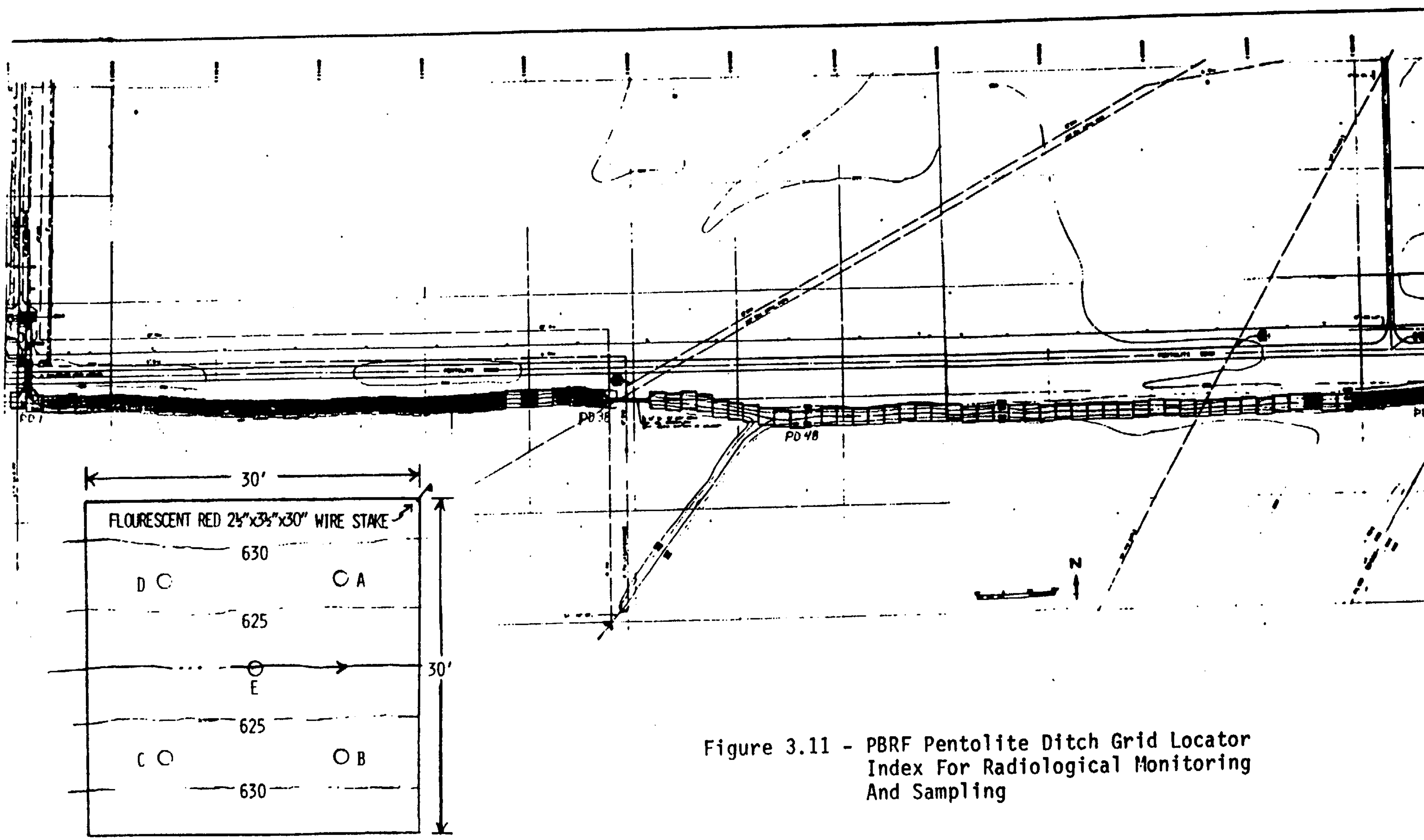

TYPICAL 30' PENTOLITE DITCH GRID

Figure 3.11 - PBRF Pentolite Ditch Grid Locator Index For Radiological Monitoring And Sampling

samples indicate there is no deep contamination of the earth in the Pentolite Ditch area. Contamination is within 12" of the surface. Table 3.12 and Figure 3.12 give the results of the 10' core sampling.

For control, five soil and five silt samples were collected along Fox Road ditch to obtain a background reading. Shallow shale deposits were found to have higher than normal backgrounds due to naturally occurring uranium/radium deposits within the shale layer. A similar high background shale reading was obtained along Pentolite Ditch. This will complicate the clean up of the Pentolite Ditch because the silt in the ditch bottom contains traces of 60 Cobalt and 137 Cesium (man-made isotopes) and the ditch banks contain shale with high background natural isotopes.

If the background data from Fox Road control samples were used, then only 2 of the Pentolite Ditch grid areas would require clean up. It was then decided to collect background comparison samples from a ditch along Taylor Road near Fox Road. These samples showed a more normal background and would indicate that about half of the Pentolite Ditch bottom requires decontamination. For this reason the Taylor Rd/ Fox Rd Ditch will be used as the background parameters.

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TABLE 3.10 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT-DIRECT RADIATION MONITORING OF PENTOLITE DITCH

	Sample Data-Ditch Bottom Beta-Gamma		Background Data Beta-Gamma			
	End Window GM c/m	uR/hr	End Window GM c/m		uR/hr	
Maximum	125	43	75*	100**	8*	25**
Minimum	25	6	50*	25**	7*	7**
Average	55	15	62*	65**	8*	17**
No. Grids	88	88	4*	5**	4*	5**
No. Readings	88	88	4*	5**	4*	5**
No. GT 2 x Background	2	42	-	-	-	-

	Sample Data-Ditch Bank Beta-Gamma		Background Data Beta-Gamma			
	End Window GM c/m	uR/hr	End Window GM c/m		uR/hr	
Maximum	300	40	100*	100**	9*	25**
Minimum	25	6	25*	25**	8*	7**
Average	57	11	64*	68**	7*	19**
No. Grids	90	90	4*	5**	4*	5**
No. Readings	360	79	16*	25**	4*	4**
No. GT 2 x Background	4	16	-	-	-	-

*Backgrounds Obtained From Taylor Road Ditch Near Fox Road
**Backgrounds Obtained From Fox Road Ditch Near Columbus Avenue

NOTE: The higher background at the Fox Road ditch was due to natural isotopes associated with a dark shale layer. Taylor Road backgrounds were then obtained to establish release criteria for Pentolite Ditch.

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TABLE 3.11 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT-PENTOLITE DITCH SURFACE SILT/SOIL SAMPLING

	Sample Data pCi/g		Background Data* pCi/g	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
Silt				
High	22.0	78	11.0	42
Low	LT 3.0	23	7.0	35
Average	8.7	40	8.7	37
No. Samples	90	90	4	4
No. GT 2 x Background	2	1	-	-
Soil Samples				
High	13.0	590	7.0	43
Low	5.6	29	LT 7.0	31
Average	9.6	110	7.0	35
No. Samples	7	7	4	4
No. GT 2 x Background	0	1	-	-

*Background Data Obtained From Taylor Road Ditch Near Intersection Of Fox Road

TELEDYNE ISOTOPES

TABLE 3.12 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT-PENTOLITE DITCH, SHALLOW CORE (10') SAMPLING

	Sample Data pCi/g		Background Data* pCi/g	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
6" DEPTH-1				
Maximum	12.0	39	-	-
Minimum	LT 5.0	24	-	-
Average	7.5	29	27	72
No. Samples	4	4	1	1
No. GT 2 x Background	0	0	-	-
12" DEPTH-2				
Maximum	8.1	31	-	-
Minimum	LT 5.0	29	-	-
Average	6.5	28	22	81
No. Samples	4	4	1	1
No. GT 2 x Background	0	0	-	-
18" DEPTH-3				
Maximum	12.0	48	-	-
Minimum	LT 5.0	24	-	-
Average	7.2	33	32	100
No. Samples	4	4	1	1
No. GT 2 x Background	0	0	-	-
2' DEPTH-4				
Maximum	15.0	53	-	-
Minimum	7.6	25	-	-
Average	10.0	35	36	99
No. Samples	4	4	1	1
No. GT 2 x Background	0	0	-	-
4' DEPTH-5				
Maximum	7.6	43	-	-
Minimum	LT 5.0	24	-	-
Average	6.9	33	42	110
No. Samples	4	4	1	1
No. GT 2 x Background	0	0	-	-

TELEDYNE ISOTOPES

TABLE 3.12 (CONTINUED)

	Sample Data pCi/g		Background Data*pCi/g	
	Gross Alpha	Gross Beta	Gross Alpha	Gross Beta
6' DEPTH-6				
Maximum	11.0	42	-	-
Minimum	LT 5.0	32	-	-
Average	7.2	35	30	94
No. Samples	4	4	1	1
No. GT 2 x Background	0	0	1	1
8' DEPTH-7				
Maximum	360.0	41		
Minimum	6.2	34		
Average	97.0	37	UNABLE TO OBTAIN SAMPLE	
No. Samples	4	4		
No. GT 2 x Background	0	0		
10' DEPTH-8				
Maximum	12.0	43		
Minimum	7.4	31		
Average	8.8	37	UNABLE TO OBTAIN SAMPLE	
No. Samples	4	4		
No. GT 2 x Background	9	0		

*Background Data Obtained From Fox Road Ditch About 300 Yards West Of Columbus Avenue

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DEPTH \ GRID LOC	PD 1 PCI/GM DRY	PD 38 PCI/GM DRY	PD 48 PCI/GM DRY	PD 88 PCI/GM DRY
6"	B 2.7 + - 0.3 E 01	B 2.4 + - 0.3 E 01	B 2.8 + - 0.3 E 01	B 3.9 + - 0.3 E 01
12"	B 2.8 + - 0.3 E 01	B 2.9 + - 0.3 E 01	B 2.4 + - 0.2 E 01	B 3.1 + - 0.3 E 01
18"	B 3.0 + - 0.3 E 01	B 2.4 + - 0.3 E 01	B 3.0 + - 0.3 E 01	B 4.8 + - 0.3 E 01
24"	B 3.0 + - 0.3 E 01	B 3.2 + - 0.3 E 01	B 2.5 + - 0.2 E 01	B 5.3 + - 0.3 E 01
4'	B 4.3 + - 0.3 E 01	B 2.4 + - 0.3 E 01	B 3.0 + - 0.3 E 01	B 3.8 + - 0.3 [illegible]
6'	B 3.2 + - 0.3 E 01	B 3.2 + - 0.3 E 01	B 3.6 + - 0.3 E 01	B 4.2 + - 0.3 E 01
8'	B 8.4 + - 0.3 E 01	B 3.8 + - 0.3 E 01	B 4.1 + - 0.3 E 01	B 3.5 + - 0.3 E 01
10'	B 4.3 + - 0.3 E-01	B 3.5 + - 0.3 E 01	B 3.1 + - 0.3 E 01	B 4.1 + - 0.3 E 01

Figure 3.12 - Gross Beta Radioactivity In Shallow Core Soil Samples Collected Along Pentolite Ditch

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3.2.4 Rooftops

Building rooftops within the PBRF were monitored to verify that no radiological contamination was present as a result of stack fallout, tracking or spills during operations. Rooftop water runoff travels via the enclosed shallow underground drain pipes to the WEMS discharge and was part of the controlled effluent system.

Various roofs have been re-coated since the facility was placed in shutdown status in 1973. These roofs were comprehensively monitored just prior to recoating to verify that no contamination was present. Records showed that the Reactor Building (#1111), Reactor Office and Lab Building (#1141), Fan House (#1132), and Waste Handling Buildings (#1133) were previously monitored and re-coated and were therefore not surveyed as part of the current verification.

Radiological monitoring was performed on the Hot Lab roof (#1112), Service Equipment Building (#1131), and the Primary Pump House (#1134). No contamination was found on any PBRF rooftops. Hot Lab roof Grids #70, 71, and 72 indicated slightly higher radiation levels; however, this was due to indoor radiation levels (beneath the roofs) in the Hot Lab Decon Room, Machine Shop, and Sample Storage Room. Appendix 3.7 presents all data in detail.

3.2.5 Surface Water

The Plum Brook Reactor Facility has no standing surface water within the facility fence line. Surface water monitoring therefore consisted of collecting samples from temporary standing puddles after heavy rainfall. This was very difficult because the facility is well drained by the various catch basin systems described in Section 3.2.3.1 and surface water runs off quickly. Two areas were selected as being representative of PBRF surface water. One area was the two sludge settling basins at the north end of the PBRF, and the other was the ERB outdoor sump at the north end of the facility. A third area, the Fan House stack base, was later discovered to have collected about 1'-2' of water in the base over an unknown period of time and this structure was also sampled. All surface water samples collected were less than the permissible discharge limit of 1E-7 uCi/ml (100 pCi/l). Table 3.13 following presents data on surface water radioactivity.

TABLE 3.13 - PBRF OUTDOOR RADIOLOGICAL ASSESSMENT
SURFACE WATER RADIOACTIVITY LEVELS

Date	Location	uCi/ml x E-9 Alpha	Beta-Gamma
3/85	ERB Sump	LT 1	13
8/85	West Sludge Basin	NSO	12
8/85	East Sludge Basin	NSO	8
7/85	Rainwater	2	9
5/85	Fan House Stack	3	100

3.2.6 Groundwater

The Plum Brook Reactor Facility has many locations for monitoring groundwater. These include the 6 deep wells in the facility plus various building and structure cold sumps. In addition, the Cold Retention Basins were opened by plan at shutdown to permit groundwater to enter these structures under controlled conditions and neutralize floata- tion. Another source of groundwater sampling be- came evident during shallow core soil sampling. Two shallow core soil samples taken in the ERB hit shallow groundwater pockets at 5'-6' deep. This water, which was directly beneath the Emergency Retention Basin, was also sampled. Table 3.14 following presents data on groundwater radioactiv- ity.

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TABLE 3.14 - PBRF OUTDOOR RADIOLOGICAL ASSESSMENT
GROUNDWATER RADIOACTIVITY LEVELS

		uCi/ml x E-9	
Date	Location	Alpha	Beta-Gamma
-	Bkgd. - 7141 Sump	LT 5	6.2
3/85	Deep Well - RB-25'	LT 5	9.1
3/85	Deep Well - RB-15'	LT 5	5.4
3/85	Deep Well No. 1	LT 1	LT 0.9
3/85	Deep Well No. 2	LT 2	12.0
3/85	Deep Well No. 3	LT 2	5.8
3/85	Deep Well No. 4	LT 4	11.0
3/85	Bldg. 1132 Sump	LT 5	2.3
3/85	Bldg. 1133 Sump	LT 4	4.8
3/85	Bldg. 1141 Sump #1	LT 1	5.3
3/85	Bldg. 1141 Sump #2	LT 4	330.0*
3/85	Bldg. 1111 Sump -25'	LT 4	7.2
3/85	Bldg. 1111 Sump -15'	LT 4	3.6
3/85	Bldg. 1131 Sump	LT 6	17.0
3/85	CRA 1 - North	LT 4	13.0
3/85	CRA 2 - South	LT 4	9.5
5/85	ERB Sh. Core R9-NE	3	23.0
5/85	ERB Sh. Core P5-NW	3	10.0

*This sump may have received overflow discharge from the radiochemistry labs during operations. This sump received indoor runoff flow groundwater infiltrating the Hot Pipe Tunnel. It does not pump to the outdoor drainage system except by controlled releases.

3.2.7 Biospecimens

During the PBRF outdoor radiological monitoring program, it became evident that two small mammalian species were active in the area. One species was the eastern groundhog (marmota monax), a shallow burrowing animal which feeds on surface vegetation during the growing season and hibernates during the winter months. The second species was the mole (scalopus aquaticus), another small burrowing animal which feeds on insect larvae (grubs) attached to the shallow roots of grasses and other vegetation, and goes deep below the frost line for winter.

Both of these species were active throughout the PBRF area including the Emergency Retention Basin. It was decided to collect a limited number of these specimens in the area of the ERB and have them radioassayed. Results were compared with those from con-

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trol samples collected approximately 1 mile away in the vicinity of the Engineering Building #7141. The results of this sampling indicate that both species within the PBRF area showed barely detectable increases in radioactivity above the control samples. Table 3.15 following summarizes the results of this sampling.

TABLE 3.15 - SUMMARY OF PBRF OUTDOOR RADIOLOGICAL ASSESSMENT - BIOSPECIMENS

	Test Samples (pCi/g Wet)		Control Samples (pCi/g Wet)	
	GA	GB	GA	GB
Eastern Groundhog (Marmota Monax)				
No. of Samples	4	4	2	2
Soft Tissue				
High	LT .3	5.0 ± .3	.092 ± .056	3.4 ± .1
Low	.039 ± .020	1.3 ± .1	LT .09	2.8 ± .1
Average	.11 ± .03	3.1 ± .2	.091 ± 3.5	3.1 ± .1
Organ Tissue				
High	.23 ± .11	6.2 ± .2	LT .04	4.4 ± .2
Low	LT .10	3.7 ± .1	LT .10	3.3 ± .1
Average	LT .13	4.7 ± .2	LT .07	3.9 ± .2
Bone Tissue				
High	LT 3	12 ± 1.0	LT 3.0	7.6 ± 1.2
Low	LT 2	3.2 ± .7	LT 2.0	5.5 ± 1.1
Average	LT 2.2	6.6 ± 1.0	LT 3.0	6.6 ± 1.2
Eastern Mole (Scalopus Aquaticus)				
No. of Samples	5	5	2	2
Combined Tissue				
High	.92 ± .44	8.4 ± .4	LT .48	3.4 ± .3
Low	LT .4	3.3 ± .3	LT .3	3.3 ± .3
Average	.64 ± .45	6.1 ± .4	LT .39	3.3 ± .3

GA = Gross Alpha
GB = Gross Beta

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3.3 INDOOR RADIOLOGICAL CLASSIFICATION OF SYSTEMS

3.3.1 Reactor Tank, Reactor Core and Bioshield

The reactor tank, core and bioshield were considered as one system because of the relationship of each to the other for purposes of maintaining the integrity of enclosure and for future removal activities. In order to radiologically characterize these systems it was necessary to:

a. obtain dosimetry data inside the tank in the near core region to substantiate the calculated inventory of radioactivity in the core,

b. obtain air samples from inside the reactor tank to determine if airborne radioactivity (tritium) is present, and

c. obtain concrete core samples from the bioshield to verify that concrete activation was minimal as predicted.

A procedure was developed for collecting the above samples in a safe manner. This procedure appears in Appendix 3.8.

3.3.1.1 Tritium Air Sampling

During reactor operations, Tritium (3H) was produced in the various beryllium components of the reactor core. It is calculated that 100,000 curies of 3H is contained in these components at the time of this report.

Tritium outgassing must be considered as a possibility even though it is contained within the metal matrix of the beryllium components.

Preliminary investigation for tritium outgassing involved sampling the reactor tank nitrogen purge bubbler oil. All purge nitrogen, after leaving the reactor tank, passes through a bubbler filled with mineral oil. This bubbler is located in Bldg. 1132. This oil, after being used since 1973, was analyzed for tritium content and found to contain 7.5E-5 uCiH3/ml.

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All oil was drained from the bubbler, the bubbler cleaned with solvent (NA500), and refilled with clean mineral oil. The purge system was then placed in normal operating condition for a two week period. Following the two week period a sample of the oil was sent for analysis. The oil was found to contain 2.3E-4 uCiH3/ml.

Although sampling the bubbler oil confirmed the offgassing of tritium, it did not give a quantitative value of the amount. The relatively large nitrogen flow, large size bubbles, and the short contact time contributed to a low collection efficiency in the purge bubbler.

To improve the collection efficiency, a cascade of three Greenburgh/Smith impingers with fritted gas sampling tips were connected to an evacuated 16 liter tritium sampling flask. Each impinger bottle was filled with 400 ml mineral oil and the valve to the sampling flask adjusted to admit the mixture of nitrogen and tritium gas at a rate of 16 liters per hour. Gas flowed in series through the first, second, and third impingers and then to the sample flask. Oil in each of the impingers was analyzed for tritium as was the contents of the sampling flask. At a flow rate of 16 liters per hour, and the concentration that normally exists in the purge gas, we found the efficiency of each impinger in the cascade to be 27%. The impingers removed 62% of the tritium from the stream while 38% carried over to the sampling flask. Input to the system was calculated to contain 2.48E-7 uCiH3/cc.

Immediately after the impinger test, a sample of the purge gas was taken directly into an evacuated 16 liter tritium sampling flask. This sample was analyzed and found to contain 2.3E-7 uCiH3/cc. This compares to the 2.48E-7 uCiH3/cc value obtained with the impinger cascade. The two tests averaged 2.4E-7 uCiH3/cc and showed good agreement.

The occupational MPC in air for tritium is 5E-6 uCi/cc. The MPC for release to the public is 2E-7 uCi/cc air. Since the N2 reactor tank purge is further diluted by at least a factor of 10 (probably 100) in the PBRF stack, it is reasonable to conclude that releases from the stack are well within the MPC.

From April 29, 1985 to June 20, 1985, a 85,622 cu. ft. nitrogen tuber was used to purge the reactor tank. For this period the average flow rate was 66.2 cu. ft./hr. or 1874 liters/hr. Using the average concentration of 2.4E-7 uCiH3/cc of purge gas, the outgassing of the beryllium components was calculated to be .45 uCiH3/hr. or 3.9E3 uCiH3/yr. as measured at the purge line in Bldg. 1132.

It was decided to determine if tritium buildup in the reactor tank occurs under no purge conditions. The nitrogen purge was suspended and a sample of the purge gas was taken from inside the reactor tank near the top by teeing into a sampling line at the 0' level of the "lily pad" area. After purging the nitrogen feed line, to obtain a representative sample, a 16 liter evacuated sample flask was filled with purge gas. This sample was analyzed and found to contain 8.87E-8 uCiH3/cc.

The reactor tank purge system remained shut down for a ten day period and the tank again sampled. After the ten days with no flow, the purge gas was found to contain 2.7E-7 uCiH3/cc. This agreed closely with the samples collected earlier from the purge line in Bldg. 1132. Using the volume of the primary systems as 26,000 gallons or 9.793E7cc, the tritium build-up for the ten day period amounted to 17.75 uCi.

The above information leads to some observations.

(1) The rate of offgassing does not vary significantly. The data seems to indicate that within a short period of time (several weeks) the concentration in the tank and

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offgas purge remained relatively constant at approximately 2.4E-7 uCi/H3/cc. Some variations might be expected due to system pressure changes and temperature changes. Follow up monitoring should confirm this.

(2) Some **tritium** build-up occurs if the N2 purge is discontinued. The purpose of the nitrogen purge was based on minimizing corrosion damage to the reactor tank, primary system, and core components. The purge is actually performing another function, that of **purging accumulated** tritium from the tank and preventing its build-up to levels which would be difficult to handle.

(3) The above confirmation of tritium offgassing gives rise to a speculative safety question. The beryllium components of the reactor core have been exposed to an estimated E10 to E11 rads of mixed gamma and neutron irradiation, which can cause embrittlement. If embrittlement occurs to the point where cracking or crumbling of the beryllium pieces can result in the accelerated release of tritium, then what control measures can be implemented to control the release? The simplest prompt control would be to cover the core with water and use the hydrogen atoms in water to exchange with the H3 atoms and slow down their rate of release to air. Ultimately the tritiated water would have to be evaluated and disposed of. Such questions may stimulate additional contingency planning during the current indefinite period of PBRF mothballing.

3.3.1.2 PBRF Reactor Tank Dosimetry

The Plum Brook Reactor has a number of components removed and placed in Hot Dry Storage in the Hot Lab. Nevertheless, the remaining inventory of items still in the reactor tank is substantial based on calculated values in 1973, 1978, and 1985. These values were discussed in Section 1.1.1 of Volume I, however, they are included again below for convenience.

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TABLE 3.16 - INVENTORY OF PBRF RADIONUCLIDES
(Quantity in Curies)

REACTOR TANK

Nuclide	6/1/73	6/1/78	6/1/88	2003	2015	2073
3H (12.3y)	206,300	156,800	90,944	37,632	18,980	681
60 Co (5.2y)	5,077	2,640	713	103	22	<1
55 Fe (2.4y)	26,214	7,340	558	13	<1	<1
63 Ni (92y)	47	45	41	35	33	22
59 Ni (8xE4y)	0.5	0.5	0.5	0.5	0.5	0.5
65 Zn (0.7y)	14,720	115	<1	-	-	-
26 Al (7.4xE5y)	1.4	1.4	1.4	1.4	1.4	1.4
113m Cd (14y)	1	0.8	0.5	0.2	0.1	-

It was necessary to obtain in-tank dosimetry data to verify that the above inventory was accurate, and also to predict what dose rates might be encountered when bioshield core sampling occurred.

The first step in determining the in-tank dose rate was to obtain a contact reading at the center of the shrapnel shields. This reading was 14 uR/hr. By back extrapolating thru the 13.8 inches of steel shielding in the shrapnel shields and reactor tank dome, this translates tc approximately a 2.3 R/hr air dose rate at the top of the reactor tank if the lid and shields were removed. Based on this reading one might expect to find a several thousand R/hr air dose rate at or near the top of the reactor about 16 feet below.

The air dose rate at the top of the tank was also confirmed by inserting thermoluminescent dosimeters under the shrapnel shields but on top of the reactor tank cover dome. These insertions were made thru 1-1/2" diameter instrument cabling penetrations at the "lily pad" 0' level. These dosimeters showed a 2 R/hr reading, which agreed well with the 2.3 R/hr calculation above.

The final procedure then involved insertion of dosimeters via a modified rabbit/cable assembly thru the RA-8 flange in Quadrant A. This permitted accurate readings in the core and at varying distances above the

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core. Results indicate an in-core dose rate of 8700 R/hr and a dose rate of 3100 R/hr at the top of the core. The field drops off to 220 R/hr at four feet above the core. Complete results are shown in the following Table 3.17 and Figure 3.13. Radiation exposures encountered by the team in collecting these samples was less than 10 mRem. Tritium air monitoring indicated no detectable airborne tritium escaped during the sampling via RA-8. (The procedure presented in Appendix 3.8 called for shut off of the N2 purge and allowing the reactor tank N2 pressure to bleed to ambient pressure before opening RA-8.)

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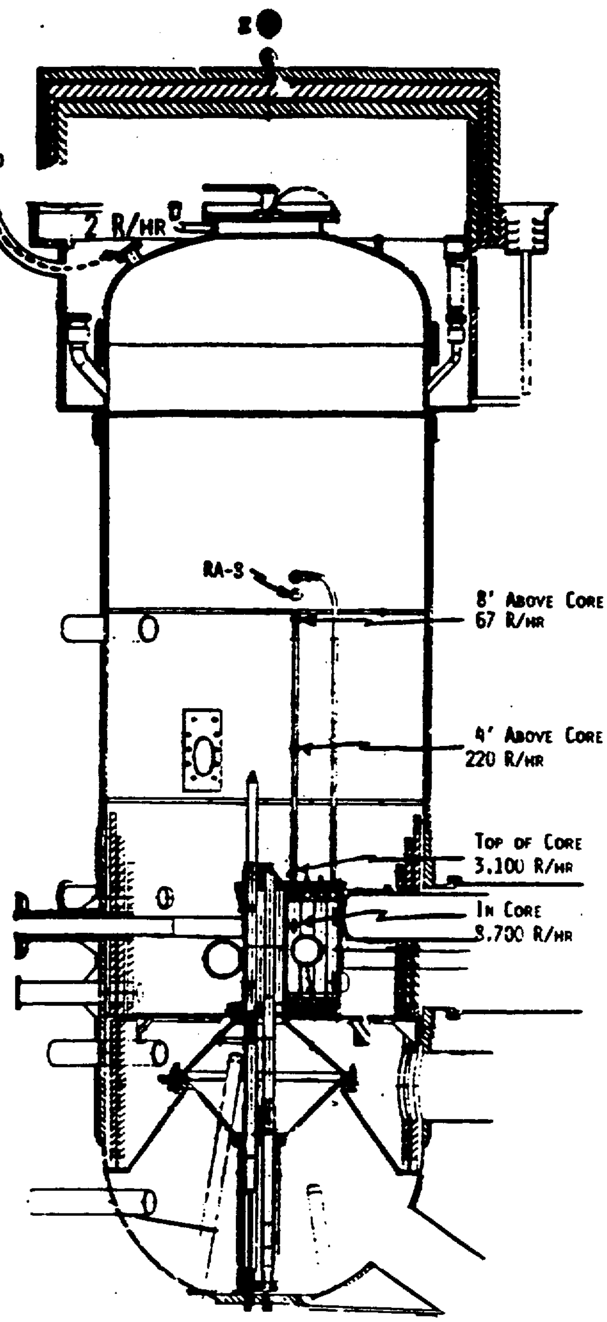
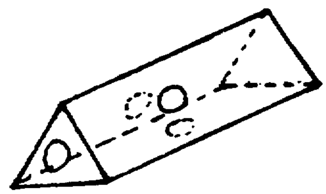


FIGURE 3.13 - PBRF IN-TANK DOSIMETRY VIA RA-8

TABLE 3.17 - PBRF IN-TANK DOSIMETRY

USING LITHIUM FLUORIDE TEFLON DISC DOSIMETER IN AN ALUMINUM
RABBIT CAPSULE ORIENTED ON 4 PLANES
USING LOW 2 (BALSA) FIXTURE

BALSA FIXTURE



ONE DOSIMETER MOUNTED ON EACH OF 3 SIDES OF BALSA FIXTURE AND 1 MOUNTED ON THE END

DOSIMETER NUMBER	TIME EXPOSED MIN/SEC	RAW DOSE (MR)	DOSE RATE (R/HR)	LOCATION
21	2M,5S	305,464	8,797	IN CORE-E*
22	2M,5S	302,528	8,713	IN CORE-S**
23	2M,5S	284,356	8,189	IN CORE-S
24	2M,5S	300,080	8,642	IN CORE-S
25	2M,4S	148,368	4,307	TOP OF CORE-E
26	2M,4S	107,300	3,115	TOP OF CORE-S
27	2M,4S	97,890	2,842	TOP OF CORE-S
28	2M,4S	109,322	3,174	TOP OF CORE-S
29	2M,3S	7,740	223	4' ABOVE CORE-E
30	2M,3S	7,248	212	4' ABOVE CORE-S
31	2M,3S	7,040	206	4' ABOVE CORE-S
32	2M,3S	7,096	208	4' ABOVE CORE-S
36	2M,2S	2,258	67	8' ABOVE CORE-E
37	2M,2S	2,314	68	8' ABOVE CORE-S
38	2M,2S	2,304	70	8' ABOVE CORE-S
39	2M,2S	2,176	64	8' ABOVE CORE-S
40	2M,1S	1,168	35	RA-8 TANK FLANGE-E
41	2M,1S	1,166	35	RA-8 TANK FLANGE-S
42	2M,1S	1,152	34	RA-8 TANK FLANGE-S
43	2M,1S	974	29	RA-8 TANK FLANGE-S

*E = END
**S = SIDE

3.3.1.3 Concrete Core Sampling From The Bioshield

The reactor tank, located in the center of the containment vessel, is encased in a high density concrete structure. The concrete is 2' thick in the area of Quadrants A, C, and D and 8' thick in the Quadrant B area. Reason for the thicker section in the Quadrant B area is for shielding purpose in the dry quadrant. Surrounding the concrete structure is a steel shell. Concrete was placed by the prepacked process using barytes as aggregate. The procedure produced a concrete density of 220 pounds per cubic foot.

The "lily pad" is the floor area surrounding the reactor at the 0' level. This area provides working space for the operating personnel.

Three concentric shrapnel shields cover the reactor tank hatch area. These shields are carbon steel with a combined top thickness of 13-3/4" and a combined wall thickness of 9-1/4".

An important aspect of this study was to determine the extent of concrete activation in the near tank area. To obtain this information the concrete was core drilled horizontally from Quadrant A at core elevation. Three different locations were chosen. One to sample the general area behind the thermal shields, one to determine the effect of fast neutrons in the vicinity of HB-3, and the other to determine the effect of thermal neutrons in the vicinity of the thermal column.

A contract was awarded to Dot Drilling of Elyria, Ohio, to obtain the cores. Cores of 1-1/4" diameter were taken. During the drilling operation cores were retrieved at 6" intervals. Figure 3.14 shows the location of the holes. All samples were sent to the Teledyne Isotopes Laboratory in Westwood, New Jersey, for pulse height analysis and isotope identification. Special attention was given to looking for europium isotopes. Concrete was crushed prior to

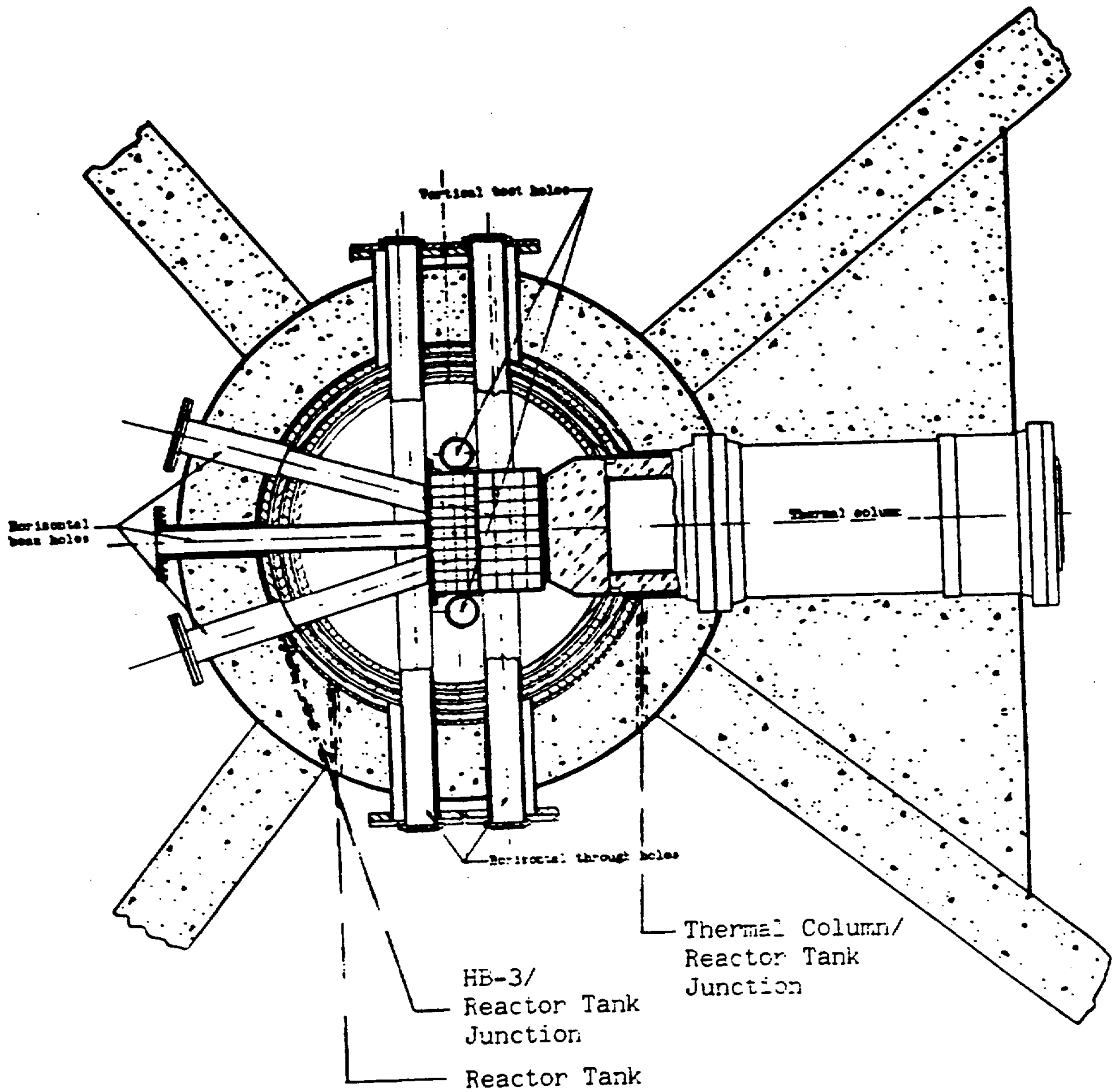


FIGURE 3.14 - LOCATION OF CONCRETE BIOSHIELD CORE SAMPLES AT CENTERLINE ELEVATION OF THE PLUM BROOK REACTOR CORE

analyzing and the reinforcing steel removed with the cores was dissolved in acid prior to analyzing. The results of the concrete core analysis are tabulated in Table 3.18. In addition, a sample of reinforcing steel removed from the thermal column core at a distance of 22" from the tank was analyzed. Gross alpha was 16 pCi/gm, gross beta was 560 pCi/gm, and the 60 Co was 325 pCi/gm.

Results in the general area are as expected - more activity closer to the reactor tank. Except for one sample taken 16" from the tank, correlation was as expected in the beam tube area. This discrepancy could be due to the sample containing different aggregate/cement ratios, presence of a voided instrument tube in the area, or localized neutron scattering during operation.

Results obtained in the thermal column area were not as expected. The data indicated higher activity at a further distance from the reactor tank. Reason for the discrepancy could be due to the presence of a voided instrument tube in the area, variation of the aggregate/cement ratios, or possible contamination of the sample with reinforcing steel.

While no europium was found, the data indicates some concrete must be removed from the near core area surrounding the reactor tank before the facility can be released for unrestricted use. This confirms assumptions made in the 1978 Study.

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TABLE 3.18

ANALYSIS OF BIOLOGICAL SHIELD CONCRETE CORES

DISTANCE TO REACTOR TANK	GROSS ALPHA PCI/GM	GROSS BETA PCI/GM	60 CO PCI/GM
General Area Between HB-3 And HT-2			
4"	4	52	26
10"	<4	26	<1
16"	<4	20	-*
22"	<4	2	-
28"	<4	7	-
Thermal Column			
4"	<4	44	30
10"	<4	53	33
16"	<4	34	-
22"	<4	120	-
28"	<4	130	-
34"	<4	140	-
40"	<4	430	-
46"	7	390	
HB-3 Beam Tube Area (Fast)			
4"	<4	35	9
10"	<4	35	6
16"	6	120	-
22"	<4	23	-
28"	<4	9	-
34"	<4	2	-
40"	<4	6	-
46"	<4	3	-

*Indicates Not Analyzed

3.3.2 Primary Cooling System (1000) And Primary Cooling-Shutdown System (1100)

The Primary Cooling Water System was used to remove the heat from the Plum Brook Reactor Core during operations and to transfer this heat to the secondary cooling water loop. The system includes the reactor tank, 3 primary pumps, 2 main heat exchangers, a shutdown cooling loop to handle decay heat, interconnecting piping, and many auxiliary systems. The auxiliary systems include the bypass clean up system and the degassifier located in rooms 5 and 6 of the Primary Pump House. Most of the equipment is contaminated and some is highly contaminated. All must be removed and processed for radiological waste burial.

Except for the buried 24" diameter primary system supply and return lines, removal of most of the system outside of the reactor tank is relatively straightforward. Removal of the buried 24" primary piping is discussed in Appendix 2.1 of Volume II of this report series. Removal of the reactor tank is discussed and sequenced in Appendix 2.2 of Volume II along with the reactor tank internals.

Radiological monitoring and classification of these systems was difficult since they are all closed, sealed and relatively in-accessible. Radiological contamination was essentially internal to all systems and classification was based upon external monitoring of this internal contamination. Most of the internal contamination was in the form of a corrosion film deposit believed to be deposited throughout all the systems. In addition, there were several measured "hot spots" around the primary system strainer, heat exchanger inlets, bottom of the primary pumps, certain valves, etc. which seemed to indicate that loose crud and debris may have been trapped and held in these areas. The monitoring strategy therefore consisted of:

a. attempting to obtain internal corrosion film samples for analyses, and

b. thoroughly monitoring all accessible external surfaces of these systems.

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3.3.2.1 Corrosion Film Analyses

The relocation and deposition of metallic ions from activated stainless steel to non-activated internal areas of high temperature closed loop nuclear systems is a common and well studied phenomenon. The degree and rate of migration apparently depend on operating temperatures, pressures, and water chemistry. The PBR primary system operated at approximately 155 degrees F and about 180 psi. This is substantially lower than corresponding conditions of nuclear power plant operations. For this reason the amount of the deposited metallic ions was expected to be less for the PBR.

Two areas were selected to obtain corrosion film samples. Valve 10V01 is a 24" gate valve on the outlet end of the primary system strainer and is the last main valve between the pumps and the reactor tank. As such, it represents a "cold leg" condition in the PCW supply line. The second area selected to obtain samples was valve 11V02, an 8" diameter gate valve which is the first valve downstream of the reactor tank on the Primary Cooling Water Shutdown Loop. This valve represented a "hot leg" condition.

Both valves gave off a direct radiation field of from 3 to 5 mR/hr. Readily removable contamination was 256 beta gamma d/m/100 square centimeters for 10V01 and approximately 375 d/m/100 square centimeters for 11V02. Valve 11V02 was carefully scraped to obtain samples of the corrosion film. This film showed a fixed contamination level of 13,250 beta gamma d/m/100 square centimeters based on analyses of these scrapings at Plum Brook.

Isotope identification by gamma pulse height analysis gave the following results from the 11V02 scrapings:

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	T 1/2	Activity (pCi/100 sq. cm:)
Gross Alpha	-	5
Gross Beta	-	1400
60 Cobalt	5.3 YR	320
152 Europium	12.8 YR	129
154 Europium	16.0 YR	90
155 Europium	1.8 YR	20

The discovery of europium contamination in the primary system was unexpected. It is suspected to have occurred as a result of irradiation of high cross section gadolinium nitrate. The PBR had a poison injection safety system consisting of pressure injection of several gallons of gadolinium nitrate solution. This system was accidentally triggered on three occasions during operations of the PBR. At least one of these occurred during criticality while neutron fluxes existed. Operations promptly ceased and flushing and clean out of the primary system followed. Apparently enough trace contamination persisted to become irradiated under neutron activation. Gadolinium exists in nature in 5 isotopic mass forms. The atomic number (z number) for gadolinium is adjacent to the atomic number for europium. Several nuclear reactions could have transformed the stable gadolinium isotopes to the radio isotopes of europium.

These findings are revealing because two of the europium isotopes are present in significant quantities, and their half-lives are substantially longer than 60-Cobalt, which was previously thought to be the major isotope contributing to exposures during PBR decommissioning activities. This means that there may not be a significant advantage to delaying decommissioning beyond the 30 year post shutdown decay period.

It should be noted that the PBRF Study Team believes that the corrosion film analysis based on limited sampling is likely to be representative of internal corrosion film contamination throughout the primary cooling systems. Crud or debris deposits are

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discussed in the following section of this PCWS discussion.

3.3.2.2 <u>External Monitoring Of The PCWS & PCWSS</u>

Various major components of the PBRF Primary Cooling Water System (1000 Series) and Primary Cooling Water Shutdown System (1100 Series) were monitored in order to radiologically classify these components. All sealed rooms of the Primary Pump House (Bldg. 1134) were opened to obtain these readings. Figure 3.15 is a schematic of the 1000 System and shows that certain parts of the system have collected substantial radiological deposits internally.These areas tend to be associated with more complex geometries and/or low settling spots in the system and are suggestive of crud or debris deposits.

Figure 3.16 is a schematic of the 1100 System located primarily in Quadrant D and shows the several items monitored. Since this equipment was located in quadrants it was difficult to monitor accurately because of many other sources of radiation from loose and fixed equipment and systems.

Figure 3.17 is a schematic of the Primary Cooling Water Bypass Clean Up System located primarily in rooms 5 and 6 of the Primary Pump House. This survey shows that radiological levels in the degassifier equipment located in room 5 of the PPH are substantially less than those in the liquid clean up equipment in room 6 of the PPH.

Much of this same equipment was monitored in 1973 prior to securing these areas as part of the shutdown activities leading to the "possession only" phase of PBRF history. Table 3-19 presents the comparison of 1985 data with 1973 data and verifies that substantial natural decay of radioactivity has occurred during the 12 year interim.

3.3.2.3 <u>Summary Observations On The PCWS</u>

Radiological monitoring suggests that substantial radioactive contamination is deposited and/or trapped throughout the Primary Cooling System and it's auxiliary systems. The reactor tank itself is likely to have the same contamination coating internally. In addition there may be low level neutron activation of the reactor tank in the near core region. The levels of contamination are such that essentially all primary system waste is likely to be classified as low level radioactive waste, including the reactor tank, buried PCW supply and return lines, and special piping, components, pumps, tanks, etc. located in the Primary Pump House. Except for debris trapped in unusual locations of special equipment, the general dose rate from system piping, tanks, etc., is expected to be less than 30 mR/hr. After the reactor core, support structure and penetrations are removed (See Appendix 2.2, Volume II), it is likely the reactor tank sections will also give a comparable dose rate.

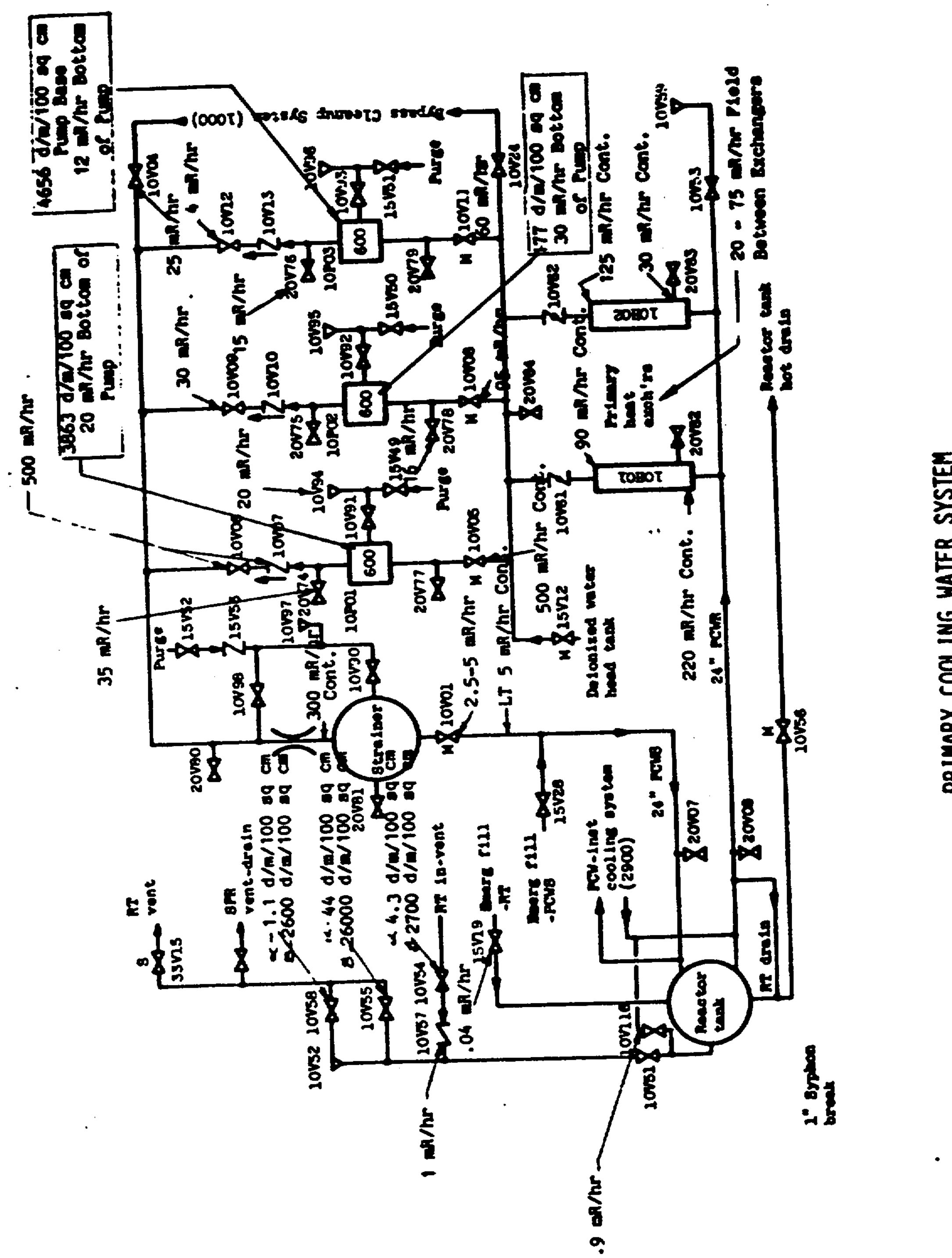

FIGURE 3.15 - PRIMARY COOLING WATER SYSTEM
RADIOLOGICAL CLASSIFICATION

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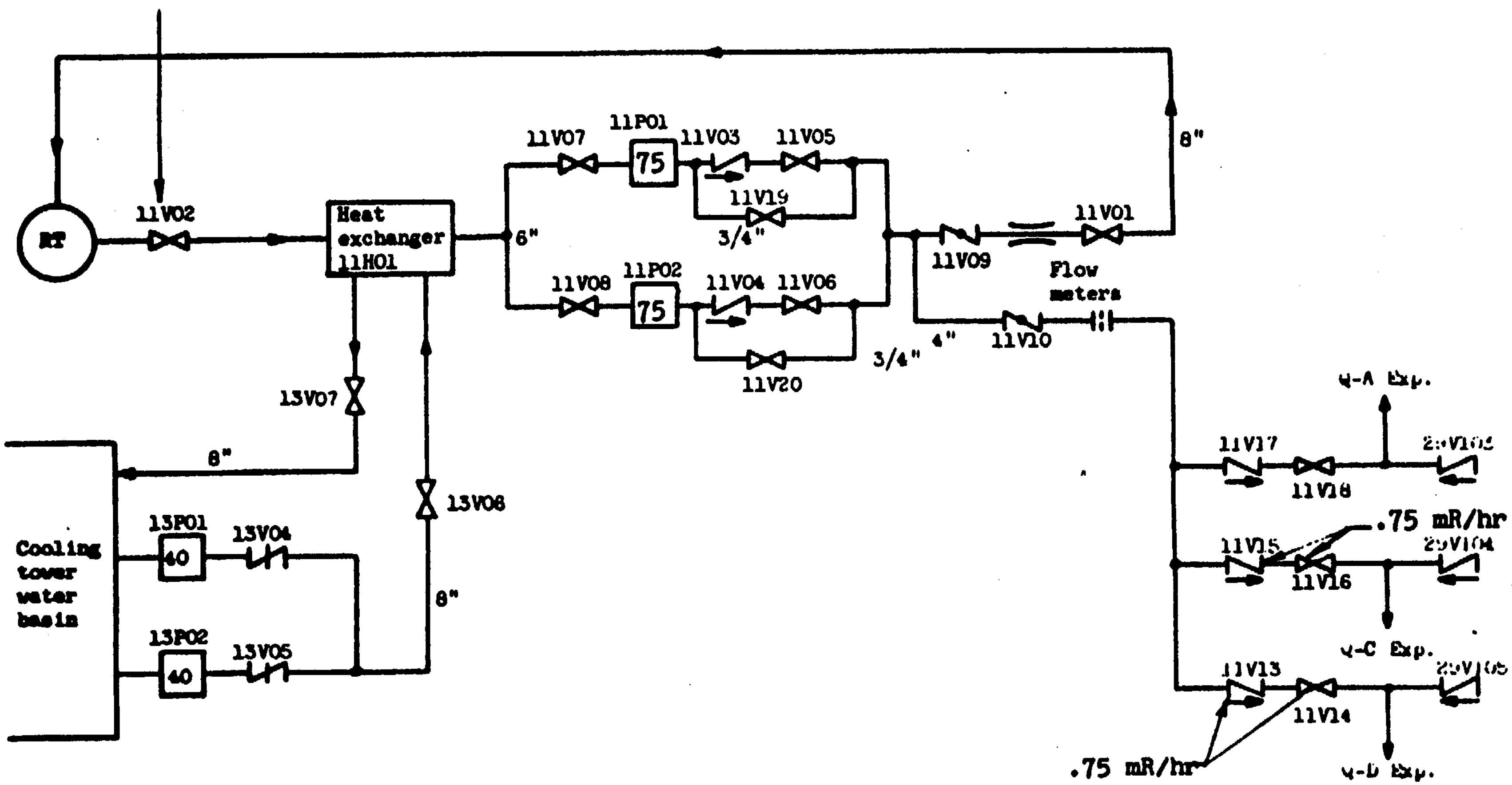
FIGURE 3.16 - PRIMARY COOLING WATER SHUTDOWN LOOP RADIOLOGICAL CLASSIFICATION

Alpha	- 5.4	pCi/100 sq cm
Beta	- 1400	pCi/100 sq cm
60 Co	- 320	pCi/100 sq cm
152 Eu	- 129	pCi/100 sq cm
154 Eu	- 89.8	pCi/100 sq cm
155 Eu	- 20.4	pCi/100 sq cm



PRIMARY COOLING WATER SHUTDOWN LOOP

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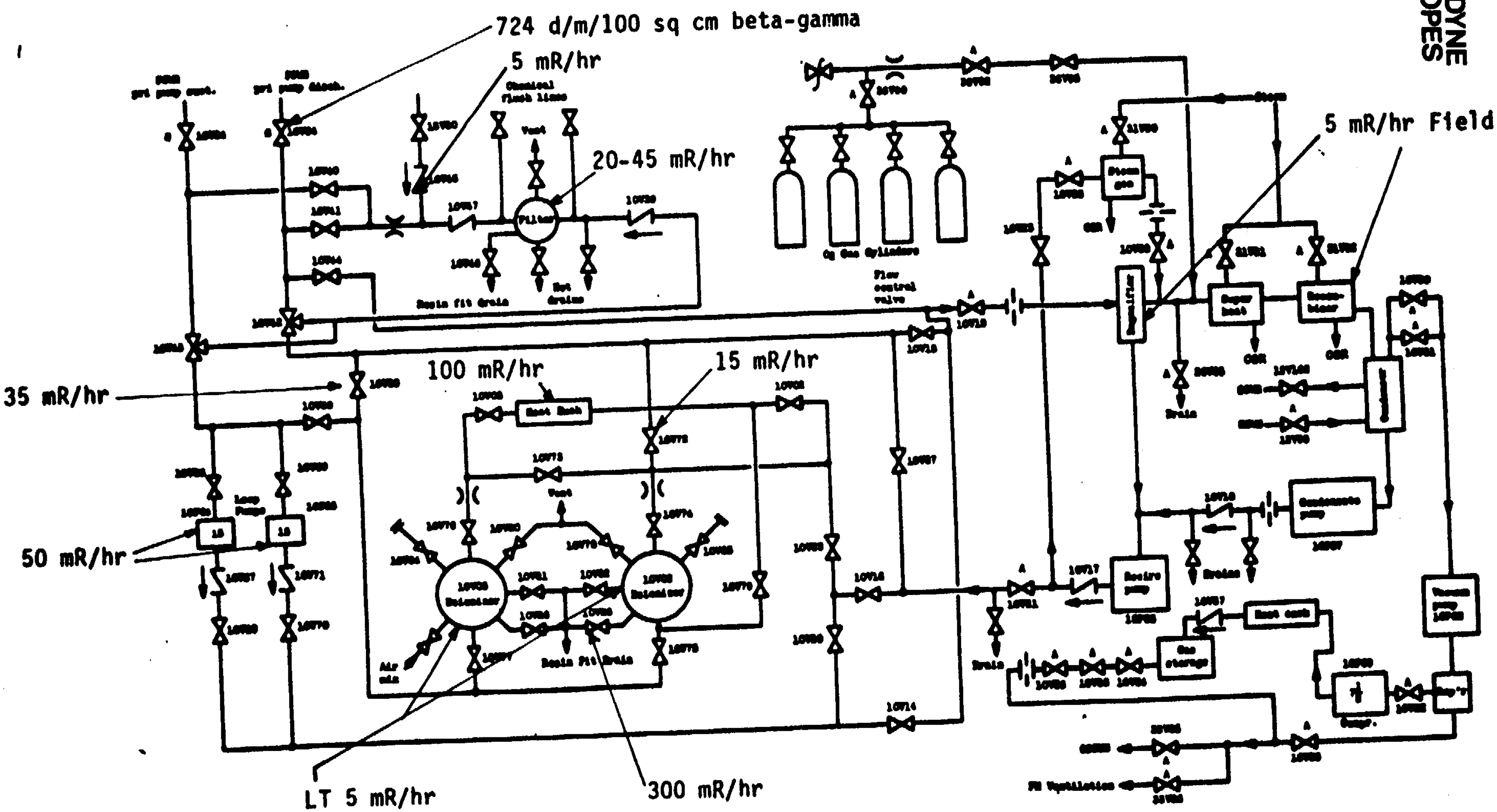

PCW BY-PASS CLEANUP SYSTEM

FIGURE 3.17 - PCW BYPASS CLEAN UP SYSTEM

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RADIOLOGICAL SURVEY OF PRIMARY PUMP HOUSE ROOMS 1-6

	1973	1985
Pump House Room #1:		
Field Center of Room	5 mR/hr	0.1 mR/hr
Gate Valve at Contact	1100 mR/hr	500 mR/hr
Bottom of Pump at Contact	190 mR/hr	20 mR/hr
Line to 20V74 at Contact	150 mR/hr	35 mR/hr
Line from Pump at Contact	1000 mR/hr	350 mR/hr
Pump House Room #2:		
Lower Gate Valve at Contact	450 mR/hr	95 mR/hr
Upper Gate Valve at Contact	250 mR/hr	30 mR/hr
Line Bottom of Pump at Contact	50 mR/hr	30 mR/hr
Line to 20V74 at Contact	15 mR/hr	3 mR/hr
Field Center of Room	5 mR/hr	0.1 mR/hr
Pump House Room #3:		
General Field Center of Room	5 mR/hr	0.3 mR/hr
Lower Gate Valve at Contact	450 mR/hr	60 mR/hr
Upper Gate Valve at Contact	30 mR/hr	4 mR/hr
Line Bottom of Pump at Contact	50 mR/hr	12 mR/hr
Line to 20V76 at Contact	200 mR/hr	15 mR/hr
Heat Exchanger Room #4:		
North End of East HX at Contact	400 mR/hr	125 mR/hr
South End of East HX at Contact	1000 mR/hr	25-30 mR/hr
North End of West HX at Contact	300 mR/hr	90 mR/hr
South End of West HX at Contact	5000 mR/hr	220 mR/hr
Field Between South Ends	200 mR/hr	20-75 mR/hr
Line North of Strainer at Bottom at Contact	1700 mR/hr	300 mR/hr
Line South of Strainer at Bottom at Contact	150 mR/hr	<5 mR/hr
General Field East of HX	5 mR/hr	<5 mR/hr
Degassifier Room #5:		
All Areas Clean, At Contact Anywhere	<5 mR/hr	0.006 mR/hr
Filter and Clean Up Room #6:		
Filter Housing Tank at Contact North	100 mR/hr	45 mR/hr
Filter Housing Tank at Contact South	35 mR/hr	20 mR/hr
Resin Tanks at Contact	10 mR/hr	<5 mR/hr
Valve 10V72 at Contact	30 mR/hr	15 mR/hr
Valve 10V85 at Contact	600 mR/hr	300 mR/hr
Valve 10V89 at Contact	100 mR/hr	35 mR/hr
Filters in Drum at Contact	30 mR/hr	<5 mR/hr
Field Center of Room	5 mR/hr	<5 mR/hr

TABLE 3.19 - RADIOLOGICAL SURVEY OF PRIMARY PUMP HOUSE ROOMS 1-6

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3.3.3 Quadrant & Canal Pump Out (1900) and Re-Circulation System (1800)

The PBRF Quadrant and Canal Re-circulation System (1800 System) is basically a closed loop re-circulation system. It's purpose was to re-circulate water from Quadrants A, C, and D by means of 2 pumps (18P07 and 18P08 in the CV dry annulus (-25' level) through two filter units (18U03 and 18U04) located in the Fan House basement, then through 2 mixed resin de-ionizers (18U01 and 18U02) in the Fan House 0' level. This was done in order to maintain cleanliness and optical clarity of the quadrant water. Valve 18V164 controlled flow through the two de-ionizers.

The PBRF Quadrant & Canal Pump Out System (1900 System) was used to pump water from Quadrants A, C, and D and Canals E thru K into the cold retention area for storage. This water could be returned through a filter in the Fan House basement back to the quadrants and canals. Quadrants A, C, D and Canal E were pumped via 2 pumps (19P03 and 19P04) located in the -25' dry annulus of the CV. Canals F, J, K, G, and H were pumped via pumps 19P01 and 19P02 located in the PPP room of the Reactor Building -25' area.

The Quadrant and Canal Re-circulation and Pump Out Systems also had certain interconnects to each other as well as permit valving to dump to the HRA. Because of the many options for routing quadrant and canal water to and from the CRA and HRA, it was expected that internal contamination in these systems would be somewhat similar in isotopic composition although the quadrant and canal re-circulation system would be expected to have somewhat lower levels of contamination. In reality both systems are extensively contaminated internally with low level radioactive waste and externally have little or no radiological contamination. The relationship of these systems with each other and the Cold Retention Area and Hot Retention Area are shown in Figure 3.18.

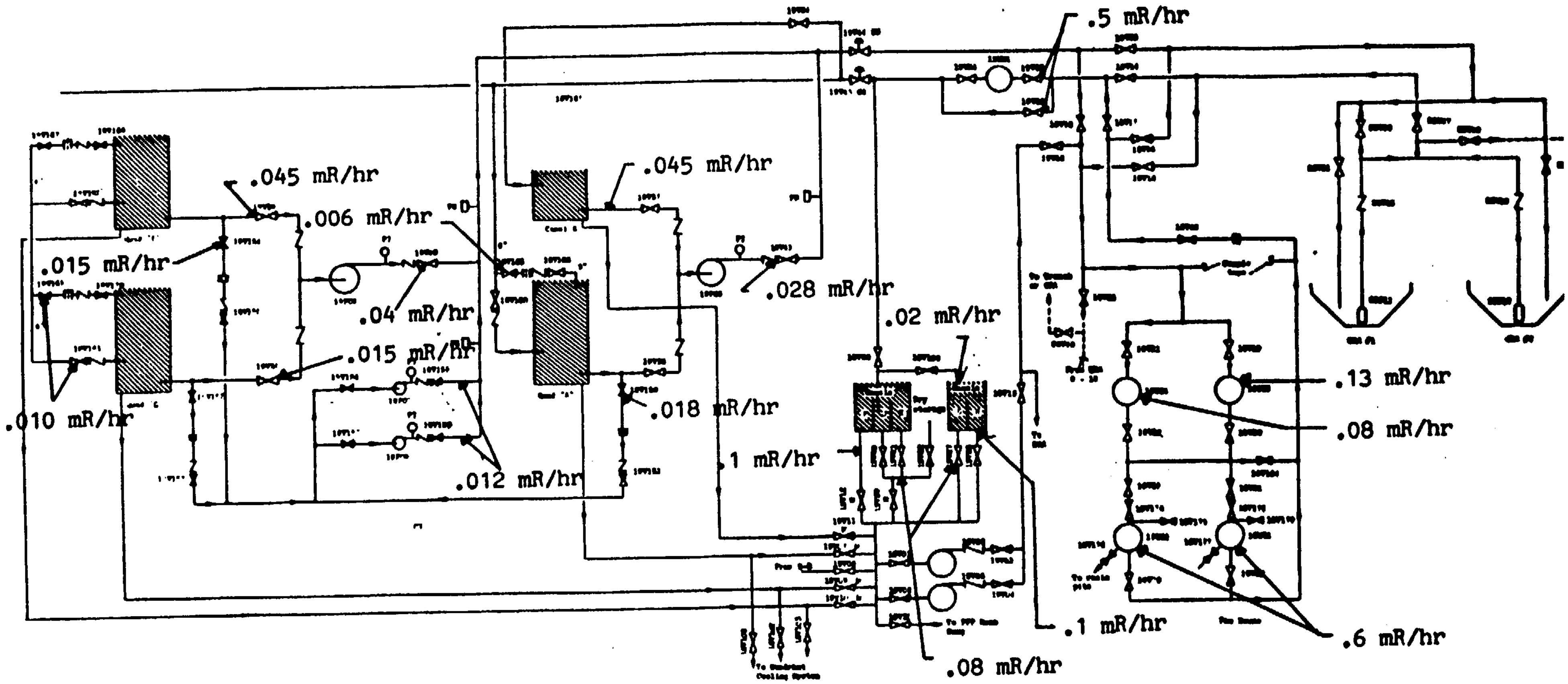

FIGURE 3.18 - RADIOLOGICAL CLASSIFICATION OF Q&C RE-CIRCULATION AND PUMP OUT SYSTEM

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The approach to classifying the Q&C Re-circulating System 1800 was to externally monitor accessible valves, filter housings and resin housings since this system was a closed system. The following Table 3.20 summarizes these observations.

TABLE 3.20
RADIOLOGICAL CLASSIFICATION OF COMPONENTS OF THE QUADRANT & CANAL RE-CIRCULATION SYSTEM (1800)

Component	External Radiation Level (Near Contact)
18V106	.02 mR/hr
18V150	.018 mR/hr
18V158	.012 mR/hr
18V159	.012 mR/hr
18V161	.010 mR/hr
18V165	.006 mR/hr
18V169	.010 mR/hr
18V03 Filter	.13 mR/hr
18V04 Filter	.08 mR/hr
18V01 De-Ionizer	.6 mR/hr
18V02 De-Ionizer	.6 mR/hr

A similar evaluation was performed on the 1900 System, Quadrant and Canal Pump Out. **TABLE** 3.21 following summarizes these observations based on external radiation monitoring of major accessible hardware.

TABLE 3.21
RADIOLOGICAL CLASSIFICATION OF COMPONENTS OF THE QUADRANT & CANAL PUMP OUT SYSTEM (1900)

Component	External Radiation Level (Non-Contact)
19V33	.500 mR/hr
19V35	.500 mR/hr
19V38	.015 mR/hr
19V39	.045 mR/hr
19V40	.040 mR/hr
19V41	.028 mR/hr
Drain Headers For F,J,K	.08 mR/hr
Drain Headers for G,H	.08 mR/hr

In order to determine internal contamination levels and perform isotopic identification it was decided to monitor and sample the Q&C drains at the floor levels of the respective quadrants and canals.

These had been sealed shut at the time the PBRF was placed in protective storage. Drain covers were removed and monitoring was performed. Small quantities of water was found in the drains which were originally dry at shut down. This water is believed to be condensation from the containment dome and reactor building roof which drops into the Q&C floor areas and gradually seeps into the drains following drying and cracking of the once pliable mastic seal. Table 3.22 presents the quantities of water found in various drains and the radiological classification. Figure 3.19 shows the location of these drains.

TABLE 3.22
RADIOLOGICAL CLASSIFICATION OF QUADRANT AND CANAL DRAIN SAMPLES - WATER

Drain No.	Location	Quantity (Gallon)	uCi/ml Alpha	uCi/ml Beta
5&6	Quad C	3	6E-10	1E-8
17	Canal E	35	2E-8	4E-7
13	Canal F	1	1.2E-7	3E-5
14	Canal J	50	2.4E-8	3.1E-5
11	Canal H	2	5E-8	1.4E-5

All drains were dried out and crud samples were obtained from each for isotopic analysis. Drains were then re-sealed with RTV mastic after monitoring was completed. Table 3.23 presents the results of the drain crud sample analysis.

TABLE 3.23
RADIOLOGICAL CLASSIFICATION OF QUADRANT AND CANAL DRAIN CRUD SAMPLES

Location	pCi/gm Wet Gross Alpha	Gross Beta	CO 60	CS 137
Quad A	LT 1E-1	2.1E4	1.5E3	LT 4E1
Quad B	LT 1E-1	4.4E2	1.8E2	LT 2E1
Quad C	LT 1E1	9.1E3	2.3E4	2.8E3
Quad D	LT 1E-1	6.2E3	1.4E4	LT 1E2
Canal E	LT 1E1	1.9E4	2.4E4	LT 1E2

From this data it is evident that the predominant isotopes distributed throughout the Q&C system are 60 Cobalt and, to a lesser extent, 137 Cesium. These observations agree with similar findings in other PBRF systems.

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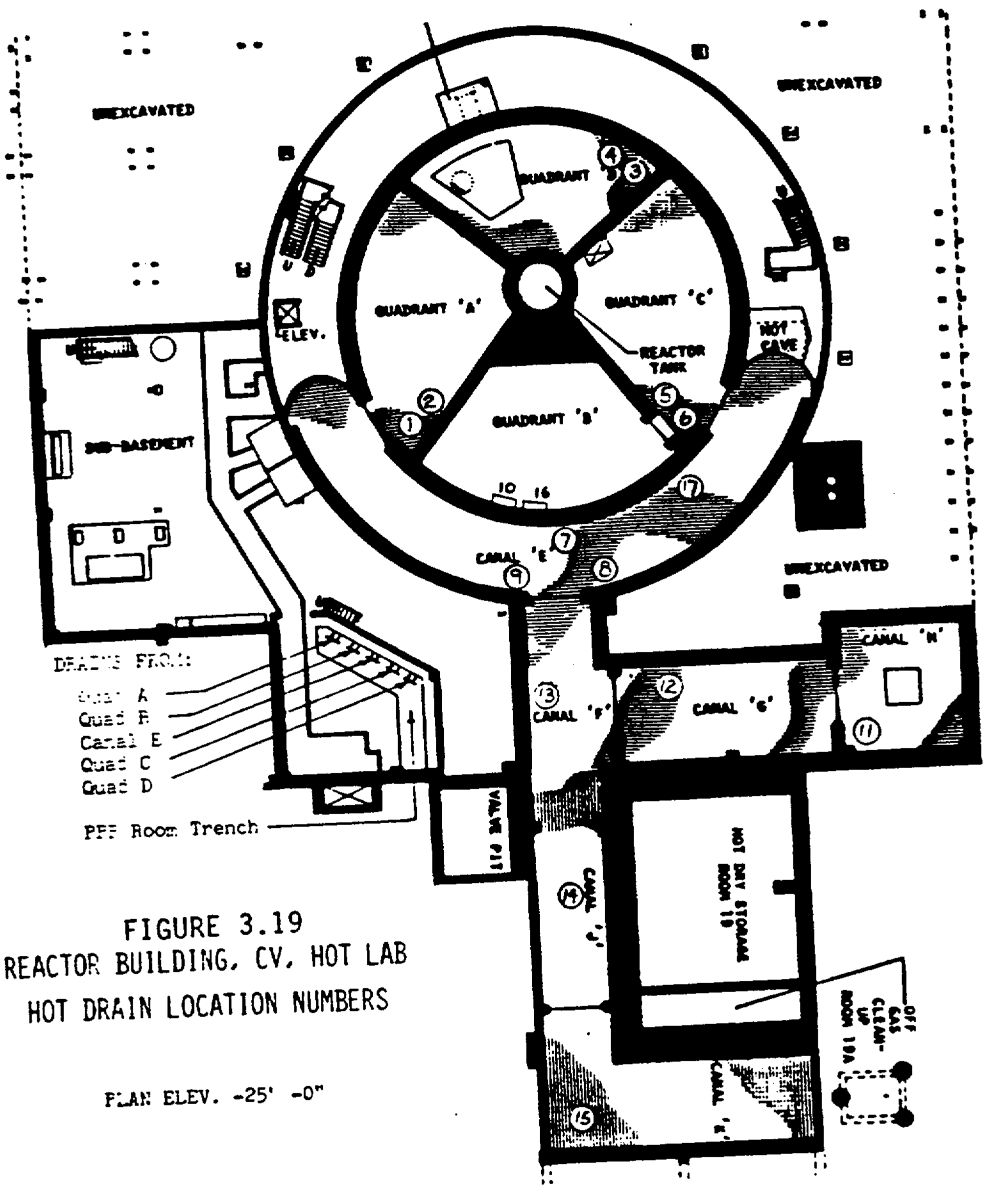

FIGURE 3.19
REACTOR BUILDING, CV, HOT LAB
HOT DRAIN LOCATION NUMBERS

PLAN ELEV. -25' -0"

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Table 3.24 presents the radiological monitoring observations taken in the open drains when the sealed drains were opened on the Q&C floors. Generally, the highest activity was trapped in the strainers and strainer housings with lesser radiation noted in the open drains themselves.

TABLE 3.24
RADIATION LEVELS FROM QUADRANT AND CANAL FLOOR DRAINS

Drain No.	Area	Description	Beta mR/hr	Gamma mR/hr
1	Quad A	Strainer	150	10
		Strainer Housing	90	20
		Drain Pipe	-	0.5
2	Quad A	Strainer	300	45
		Strainer Housing	150	10
		Drain Pipe		1.1
10	Quad B	Basin		1.5
		Pipe		.8
16	Quad B	Basin		1.3
		Pipe		1.8
5	Quad C	Strainer		15
		Strainer Housing		0.5
		Drain Pipe		2
6	Quad C	Strainer		15
		Strainer Housing		1.5
		Drain Pipe		2
3	Quad D	Strainer	30	10
		Strainer Housing	150	10
		Drain Pipe		0.2
4	Quad D	Strainer		10
		Strainer Housing		20
		Drain Pipe		0.2
9	Canal E	Strainer	48	15
		Strainer Housing		40
		Drain Pipe		15
17	Canal E	Strainer		35
		Strainer Housing		3.5
		Strainer		10

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TABLE 3.24
RADIATION LEVELS FROM QUADRANT AND CANAL FLOOR DRAINS
(Continued)

Drain No.	Area	Description	Beta mR/hr	Gamma mR/hr
7	Canal E	Strainer	240	25
		Strainer Housing	300	45
		Drain Pipe		4.5
8	Canal E	Strainer		5
		Strainer Housing		10
		Drain Pipe		10
13	Canal F	Strainer		15
		Strainer Housing		30
		Pipe	18	10
12	Canal G	Strainer	-	-
		Strainer Housing	18	12
		Pipe		5
11	Canal H	Strainer		0.5
		Strainer Housing		1.2
		Drain Pipe		0.5
14	Canal J	Strainer		20
		Strainer Housing		1.2
		Drain Pipe		2.5
15	Canal K	Strainer	7.5	5
		Strainer Housing		4
		Drain Pipe		3

NOTE: General background in the areas of the above drains varied from 0.2 to 0.5 mR/hr.

3.3.4 Hot Drains, Sumps, Pumps, Valves

The hot drain system can be described as the drain collection system for all waste water drainage which originates directly or indirectly from a radioactively contaminated area. There are twelve collection sumps, two each in the Fan House (FH) and Office and Lab Building (OLB), one each in the Pump House (PH) and Hot Lab (HL), two each in the Containment Vessel (CV), two each in the Reactor Building (RB), and two in the Waste Handling Building (WHB). All of the connecting lines of this system are doubly contained as a leakage precaution. This is accomplished by pipe tunnels, sheath piping and drains and dual walled tanks. Location of the sumps is shown on Figure 3.20. Following is a brief description of the drainage sources to each sump in the PBRF.

Containment Vessel
In the CV there are two sumps which collect drainage from the hot drain system. The first is the Sub-Pile Room sump which is a 100 gallon well at the base of the reactor containment vessel at the -40' level. The following is a list of the drains and overflows to this sump:

Primary Water Supply Drain
Primary Water Return Drain
Primary Water Sheath Drain
Sub-Pile Sump Pump Relief
Valve Pit Drain
Shrapnel Shield Area Drain
Containment Vessel Floor Drains
Flushing Line
Shutdown Cooling Water Pump Seals

In addition to the above there will be drainage from the seals and control equipment in the Sub-Pile Room. This drainage will overflow to the sump or pass directly through the grate floor to the sump. There are three Sub-Pile sump pumps. All of these discharge to a 12" diameter drain collector which leads to the Process Piping Pump (PPP) Room sump.

The other sump in the CV is located in the dry annulus -25' east. This sump receives waste from the elevator pit, underwater beam room, CV floor drains, HVAC condensate, and drinking fountain. Two 40 gpm pumps on this sump discharge the waste to the reactor sump in the PPP Room -25'.

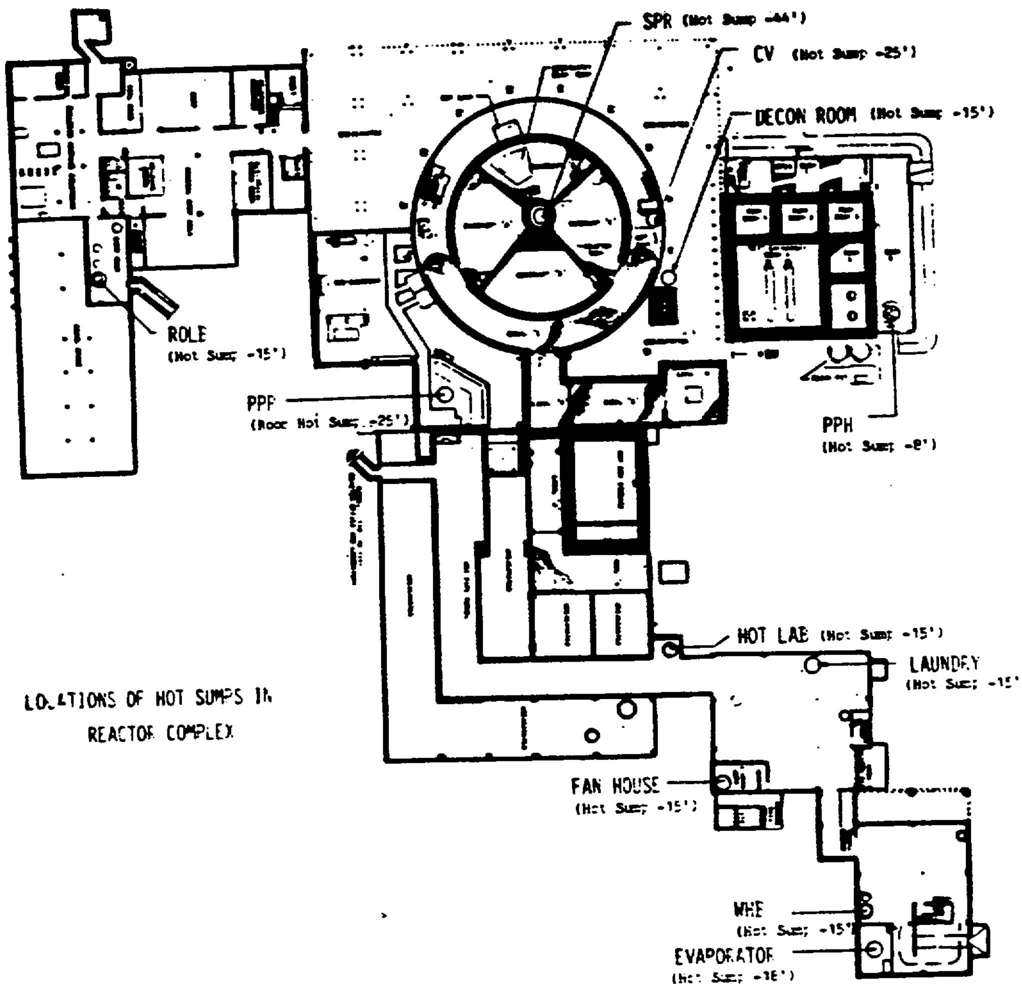

FIGURE 3.20 - LOCATION OF RADIOLOGICAL (HOT) SUMPS IN THE PLUM BROOK REACTOR FACILITY

TELEDYNE ISOTOPES

Reactor Building (1111)

All of the floor drainage from three working levels of the RB (outside the containment vessel) collects and enters the drain header. The 12" diameter drain collector runs from the reactor containment vessel wall to the PPP Room at the -25' SW level in the RB and drainage is to the reactor sump.

The reactor sump is located in the PPP Room -25' in the RB. The sump is 7' inside diameter and 7-1/2' deep. The following is a list of the drains and overflows to the sump:

Reactor Tank Drain
Overflow Canal F-G-H-J-K
Drain Dry Storage
Canal Waste Drain
Drain Collector
PPP Floor Drain

There are two reactor sump pumps, a 200 gallon per minute and a 500 gallon per minute pump. Both pumps discharge to the reactor tank drain which is an 8" diameter line to the Hot Retention Area (HRA). There is a bypass check valve around the sump on this reactor tank drain to allow the reactor sump to act as a storage tank in the event that this drain line is closed at the HRA.

The decontamination sump in the RB -15' East collects waste water from the decontamination room, the personnel decontamination shower room and the floor drains in the PH Rooms 7 & 8. This sump has two 50 gallon per minute pumps.

Reactor Office & Lab Building (1141)

Two hot sumps are located in the basement of the OLB. The first sump collects drainage from 18 laboratory sinks designed for handling radioactive materials. The second handles waste which normally is not radioactive. Both sumps have two 50 gallon per minute pumps.

Fan House (1132)

In the FH there are two sumps, the FH hot sump and the FH laundry sump. The first collects regeneration drainage from the Q&C recirculation drainage and liquid drainage from the waste clean up resin pit. There are two 50 gallon per minute pumps on this sump. The waste water pumps to the reactor tank drain. The second sump collects waste drainage from the laundry unit drains and has two 50 gallon per minute pumps and a 50 gallon per minute water filter on the discharge to the reactor tank drain.

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Reactor Pump House (1134)
The PH hot sump, which is 7' inside diameter and 7-1/2' deep, collects drainage from the following list of drains:

Bypass Clean Up Resin Pit
11-Floor Drains Rms. 1 Thru 6
PCW Pump Header Drain
PCW Strainer Drain
PCW Heat Exchanger Drain
PCW Valve Drains
PCW Pump Drains

The PH sump pumps discharge is through an 8" diameter line which enters the reactor tank drain in the basement of the FH. Both of the pumps are Deming Co. vertical shaft, one is rated at 100 gallons per minute and the other is 200 gallons per minute.

Waste Handling Building (1133)
There are two hot sumps in the Waste Handling Building. The WHB laundry drains into one and the floor drains in the WHB flow into the other (evaporator). The laundry sump has two 50 gallon per minute pumps which discharge to the HRA. The WHB sump has one 100 gallon per minute which discharges to the HRA.

Hot Laboratory (1112)
The last sump in the hot drain system is the HL sump which collects all drains and overflows from the Hot Laboratory Building. The drainage from the 14 floor drains in the hot cells, hot work areas and the decontamination room is collected through a 4" diameter polystyrene line. Fan House basement floor drains are also connected to this sump.

There are two pumps on this sump which discharge directly to the HRA through a 4" diameter HL drain. Both pumps are 50 gallon per minute pump units.

Figure 3.21 shows the flow schematic for pump out of the PBRF radiological (hot) sumps. Also shown on this schematic are the summary results of radiological surveys performed where access to the respective areas permitted sampling/monitoring. Four of the facility sumps were not opened because their covers were welded. These were the:

Decontamination Sump, -15' RB
Pump House Hot Sump, Room 8
Waste Handling Bldg., Evaporator Sump
Process Piping Pump Room, -25' RB

TELEDYNE ISOTOPES

HOT DRAINS (SUMPS)

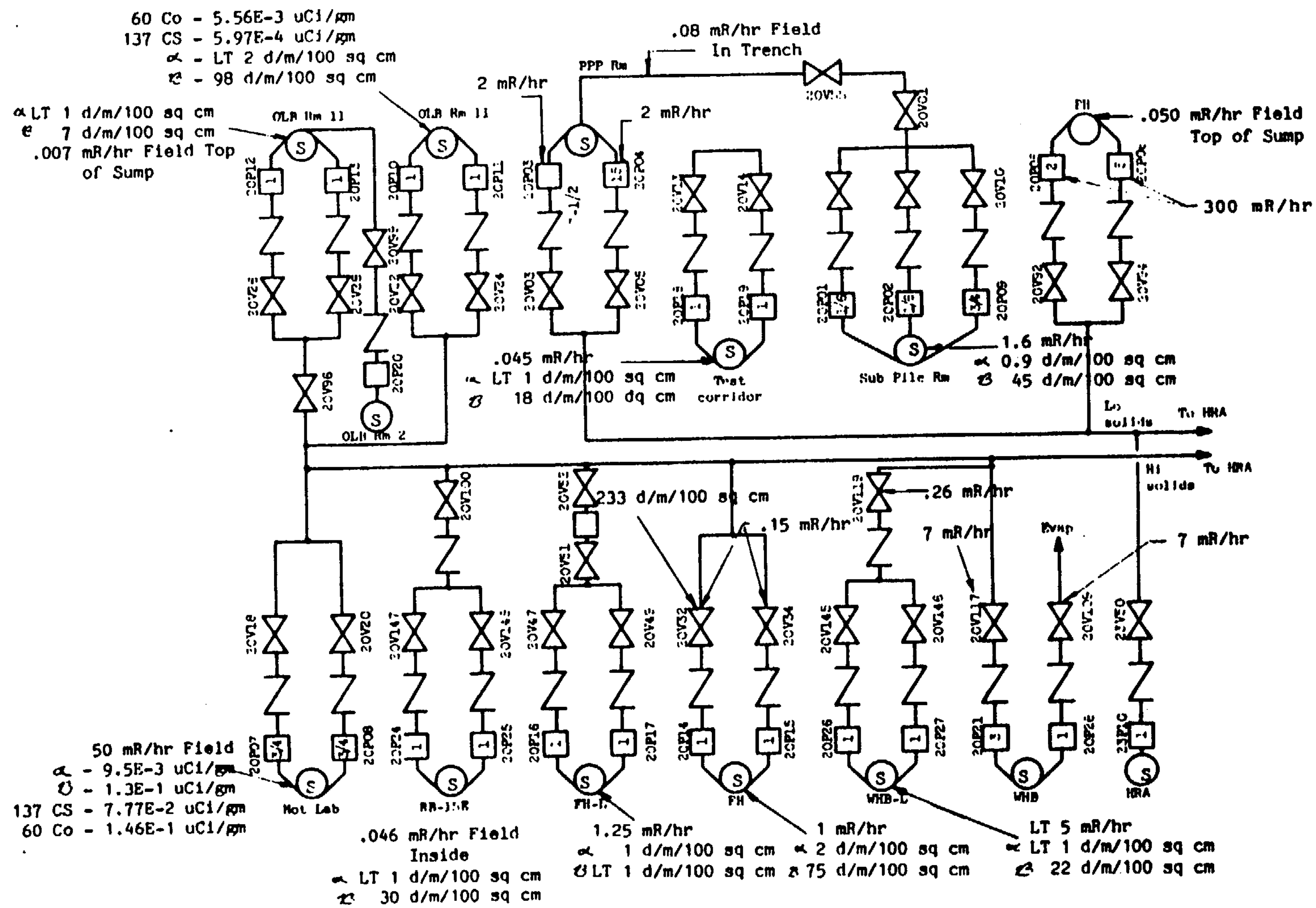

FIGURE 3.21 - FLOW SCHEMATIC FOR PBRF HOT SUMP PUMP OUTS AND RADIOLOGICAL CLASSIFICATION

TELEDYNE ISOTOPES

When the sumps were not opened and entered for monitoring, then monitoring was performed from accessible exterior piping, pumps, valves, etc. to obtain some indication of the radiological conditions. Where possible water samples were also collected. Table 3.25 following summarizes the results of this monitoring.

TABLE 3.25
RADIOLOGICAL CLASSIFICATION OF PBRF HOT SUMPS

LOCATION & CONDITION		LOOSE CONTAMINATION d/m/100 sq cm ALPHA	BETA-GAMMA	DIRECT RADIATION GS3 C/M	PRM-7 mR/Hr
1. Sub-Pile Room CV (1111) Dry-Clean	Average	1	45	-	.007
	Maximum	2	87	-	.007
	Minimum	0	27	-	.007
	No. Samples	4	4	0	1
2. CV Sump - 25' Annulus (1111) Dry-Some Rust	Average	1	16	1500	.05
	Maximum	4	42	1500	.05
	Minimum	0	1	1500	.05
	No. Samples	4	4	1	1
3. PPP Room -25' RB (1111) Seal Welded Shut, Could Not Sample	Average	-	-	-	2.
	Maximum	-	-	-	2.
	Minimum	-	-	-	2.
	No. Samples	0	0	0	2
4. -15' Decon Sump RB (1111) SS Clean, 1/2" Water & Crud(1)	Average	2	33	-	.05
	Maximum	4	46	-	.05
	Minimum	0	18	-	.05
	No. Samples	3	3	0	1
5. Hot Sump - Rm. 11 ROLB (1141) Dry, Rusty	Average	1	4	800	.08
	Maximum	2	7	2000	.18
	Minimum	0	0	200	.02
	No. Samples	4	4	3	3
Pump Base 20P10		5	52	-	-
6. Cold/Hot Sump - Rm. 11 ROLB (1141) Water In Sump/ Rusty	Average	2	7	-	-
	Maximum	4	10	-	-
	Minimum	0	5	-	-
	No. Samples	3	3	0	0
Pump Base 20P11		5	80	-	-

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TABLE 3.25
RADIOLOGICAL CLASSIFICATION OF PBRF HOT SUMPS
(Continued)

LOCATION & CONDITION		LOOSE CONTAMINATION d/m/100 sq cm ALPHA	BETA-GAMMA	DIRECT RADIATION GS3 C/M	PRM-7 mR/Hr
7. Fan House Hot Sump (1132) 2" Water/ Rusty (2)	Average	1	64	-	.66
	Maximum	2	75	-	1.
	Minimum	0	42	-	.32
	No. Samples	3	3	-	2
8. Fan House Laundry Sump (1132) Dry/ Rusty	Average	1	1	1750	1.3
	Maximum	1	1	2500	1.3
	Minimum	1	1	1000	1.3
	No. Samples	1	1	2	1
9. Reactor Pump House Sump (1134) Seal Welded Closed- Water in Sump Could Not Sample(3)	Average	-	-	-	.05
	Maximum	-	-	-	.05
	Minimum	-	-	-	.05
	No. Samples	0	0	0	1
10. Waste Handling Evap. Sump (1133) Dry/ Rusty	Average	LT 1	22	42000	3.
	Maximum	1	35	42000	5.
	Minimum	0	15	42000	.9
	No. Samples	4	4	1	2
11. Waste Handling Laundry Sump (1133) Dry/ Rusty	Average	LT 1	247	-	LT 5
	Maximum	LT 1	406	-	LT 5
	Minimum	LT 1	88	-	LT 5
	No. Samples	2	2	0	1
12. Hot Lab Sump (1112) Dry/ Heavy Rust	Average	-	-	-	50.
	Maximum	-	-	-	50.
	Minimum	-	-	-	50.
	No. Samples	0	0	0	1

(1) Water sampled showed 2.9 E-6 uCi/ml.
(2) Water sampled showed 1.1 E-5 uCi/ml.
(3) Water sampled showed 0.8 E-6 uCi/ml. Water believed to have infiltrated via electrical conduit from resin storage pits (2.4 E-6 uCi/ml).

Crud samples were also obtained from two sumps and submitted for radioisotopic identification. Following are the results.

TABLE 3.26
PBRF HOT SUMPS - CRUD SAMPLE RADIOLOGICAL ANALYSIS

	GROSS ACTIVITY pCi/gm		ISOTOPIC IDENTITY pCi/gm		
SUMP LOCATION	ALPHA	GAMMA	CO60	CS137	CS134
ROLB Room 11	-	-	5.6E+3	6.0E+2	-
Fan House Laundry	5.0E+1	2.5E+3	5.9E+4	7.4E+3	-
Fan House	1.5E+1	2.3E+3	6.7E+3	1.9E+4	9.7E+1
Waste Handling	5.2E+1	5.8E+2	3.8E+2	1.0E+3	5.3E+0
Hot Lab	9.5E+3	1.3E+5	1.5E+5	7.8E+4	-

Unusual conditions were noted in several of the sumps. The PPH sump in Room 8 was found to have water in it. This water was believed to have entered as a result of the outdoor resin pits filling with water from surface/ground water run off. When the resin pits filled then electrical conduit piping common to the two areas was under water and this permitted flow of water from the resin storage pits to the sump.

The hot sump in ROLB Room 11 had water in it also. This resulted from clogged footer drains in the ROLB which caused ground water to enter Room 11 and flow across the floor to the hot sump.

The HL sump was found to have substantial corrosion. This corrosion resulted in some internal surface scale flaking off and falling to the bottom of the sump. The thickness of the walls of this sump will be tested ultrasonically in the near future to insure that sufficient metal remains in the sump liner so as not to leak contamination into the concrete pit surrounding it.

3.3.5 Hot Retention Area

The Hot Retention Area (HRA) consists of eight 22' diameter by 23' high, carbon steel tanks each holding 60,000 gallons. These tanks are located in an underground concrete room measuring 45' x 90'. Four 7,500 gallon buried stainless steel hold tanks are also part of the HRA facility. The large tanks receive all flow from the hot drain system. During normal operations, the discharge from the eight 60,000 gallon tanks flowed through a clean-up system and back to one of the 60,000 gallon tanks or to one of the hold tanks. After monitoring, water in the hold tanks was discharged to either the Cold Retention Area (CRA), Q&C recirculating system, or off-site through the WEMS.

For this study, entry was made into the HRA structure annulus area around the 60,000 gallon tanks to evaluate conditions. It was found that ground water had entered the annulus around the eight tanks to a depth of 34-3/4". This water was analyzed for gross alpha and beta contamination in the Plum Brook Laboratory and at the Teledyne Isotopes Laboratory, in Westwood, New Jersey. Isotopic analysis was made at the Westwood Facility with particular attention to 90 Strontium content. The water was found to meet release requirements (0.14 MPCF) and approximately 33,000 gallons was discharged to Pentolite Ditch, which flows into Plum Brook. During the release period, both the effluent and Plum Brook composite were monitored to ensure that all released water was below the MPC. After the annulus was pumped dry, it was determined that ground water is entering the annulus at a rate of 41 gallons per day. The HRA indoor sump had been secured during shutdown and operations continued with the external sump pump at the south end of the HRA structure. Apparently the depth of this sump well was not sufficient to prevent ground water infiltration during the wet season.

While investigating the HRA, Tanks 2, 5, and 7 were also found to contain water. Tank 2 contained 474 gallons; Tank 5 contained 1,659 gallons; and Tank 7 contained between 948 and 1,422 gallons. Water in the tanks collected as rain water leaked through the roof of the HRA pipe chase and flowed by gravity into the tank access hatches. Water in the tanks was analyzed and found to be above MPC for release. Since water continues to enter the tanks at a slow rate during periods of rain, it is felt that release at this time would not be made until plans to re-seal the roof are underway. Table 3.27 Summarizes In-Tank activity.

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Detailed information regarding the HRA findings can be found in Appendix 3.9, "Teledyne Isotopes Correspondence of May 16, 1985 and August 9, 1985, to E. C. Boitel."

Results of the wipe tests and direct radiation survey that were taken indicate the concrete structure housing the eight tanks is within release criteria for unrestricted use.

Survey results of the eight 60,000 gallon carbon steel tanks indicate they are contaminated and must be removed. It may be possible to decontaminate some of the tank sections while others must be disposed of as rad waste. Figure 3.22 shows the schematic of the HRA piping and pumping systems and radiological monitoring data taken in the annulus.

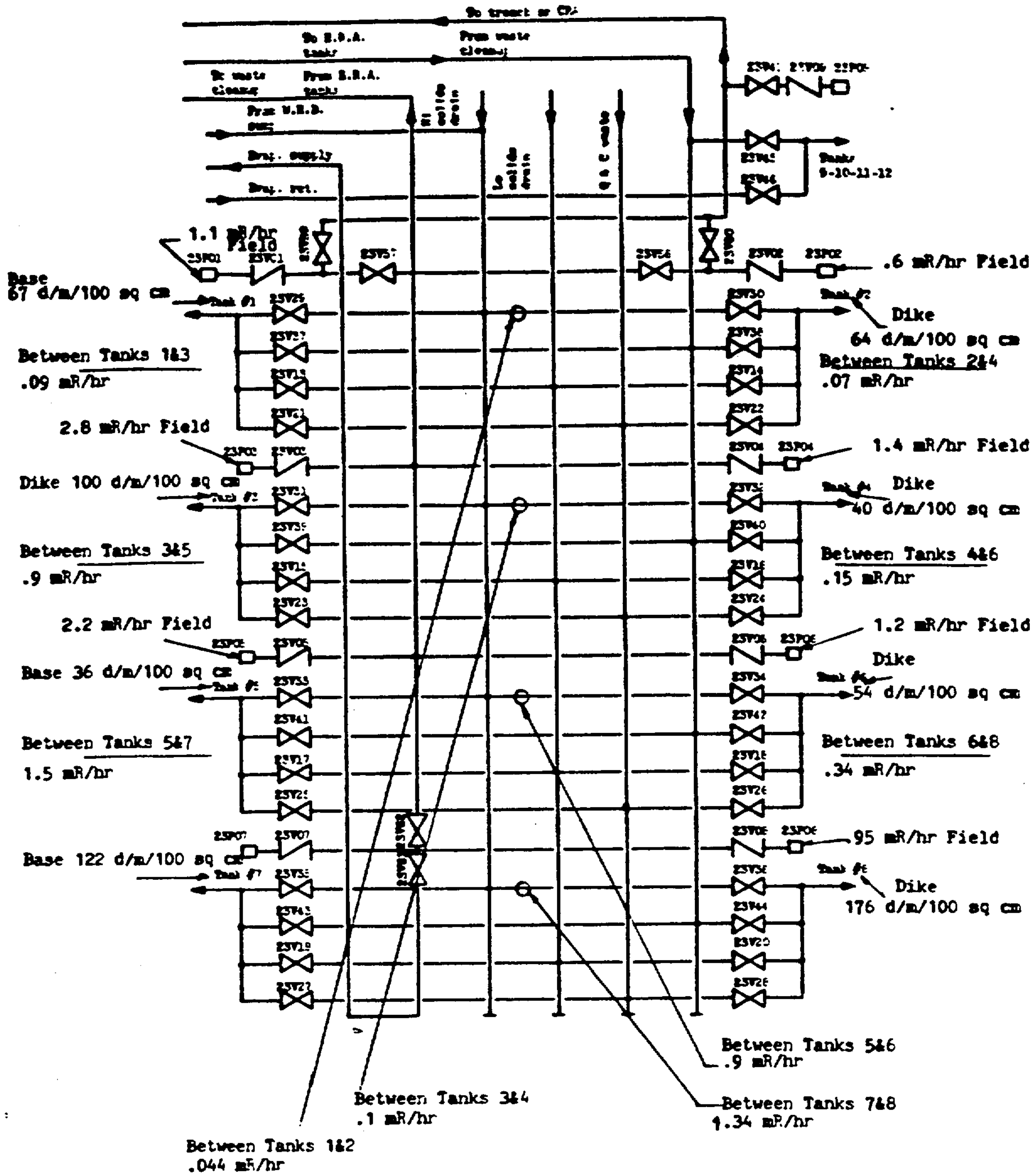
For removal of the tanks, the original approach in the 1978 Study was to excavate the south end of the stucture to -12' elevation. The end wall would then be removed to give access to the tanks. Results of the deep drilling, conducted in 1985 during the study, show the water table above the floor level of the structure. This water condition may make removal difficult and could increase the chance of spreading contamination.

As the results of this study, the approach on the removal of the tanks may need to be re-examined. One current approach is to remove a portion of the HRA structureroof at the south end. This opening would be large enough to remove 8' wide tank sections by crane. The tank sides should be cut into 9 vertical sections while the bottoms should be parallel cut into 3 sections. The sides should be cut with a torch from the outside to minimize the spread of contamination. Tank bottoms can be moved into another tank for cutting to contain contamination.

Surveys indicate the HRA pumps and all the piping in the HRA pipe chase are contaminated. All this piping and equipment must be removed and shipped as contaminated waste.

The four 7,500 gallon buried stainless steel hold tanks are only slightly contaminated and can be decontaminated for salvage.

To control the ground water entering the HRA tank annulus, the sump pump discharge piping was rearranged and reactivated to permit pumping the annulus to the CRA. Facility change 85-01 was written to describe this modification.



HOT RETENTION AREA

FIGURE 3.22 - RADIOLOGICAL CLASSIFICATION OF THE PBRF HOT RETENTION AREA STORAGE AND PUMPING SYSTEM

TELEDYNE ISOTOPES

To eliminate the rain water entering the HRA tanks, the roof of the pipe chase must be replaced. Detailed information regarding these repairs are given in Volume 5, Section 5.1.11, pages 5-19 thru 5-21. Plans are underway to correct the problem.

Additional monitoring performed in the pipe chase of the HRA above the openings to the eight tanks showed a dose rate range of from 0.6 to 2.8 mR/Hr with an average of 1.4 mR/Hr. General fields elsewhere in the HRA pipe chase varied from .45 MR/Hr to 2.2 mR/Hr as a maximum dose rate. Removable contamination levels in the pipe chase ranged from 27 to 1,135 Beta-Gamma d/m/100 sq. cm. The average of the 16 wipe samples was 268 Beta-Gamma d/m/100 sq. cm. No significant alpha contamination was detected.

Water samples were collected from Tanks 2, 5, and 7. Although the source of this water was rain water leakage through the pipe chase roof, the residual contamination in the HRA tanks resulted in contaminated water. Table 3.27 presents this data along with data from water samples collected in the annulus from ground water infiltration.

TABLE 3.27
RADIOLOGICAL CLASSIFICATION OF WATER IN PBRF
HOT RETENTION AREA TANKS 2, 5, & 7

	uCi/ml					
LOCATION	GROSS ALPHA	GROSS BETA-GAMMA	SR90	CO60	CS137	CS134
HRA TANK 2	9.8E-9	4.4E-6	1.5E-7	1.8E-7	2.6E-6	1.3E-8
HRA TANK 5	LT 2E-9	4.2E-6	1.4E-7	3.8E-6	1.4E-6	-
HRA TANK 7	LT 4E-9	3.2E-4	9.6E-6	5.3E-6	2.9E-4	1.3E-6
HRA ANNULUS	LT 5E-9	4.1E-7	4.9E-9	-	9.6E-8	-
HRA ANNULUS	LT 5E-9	3.4E-7	-	1.3E-8	4.3E-8	-

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3.3.6 Cold Retention Basins

The Cold Retention Area (CRA) consists of two basins for storage of low level contaminated water primarily from quadrants and canals. The basins are in the shape of inverted pyramids 94' x 94' square at the surface and 18' deep. Each basin can hold 500,000 gallons.

During facility operations it was suspected that the basins leaked so a plastic liner was installed in 1969.

At the time of shutdown in 1973, the ground water equalizing lines were secured opened to permit the level of the basin water to seek the level of the ground water table. This was done to prevent the basins from floating in the event of a high ground water table.

In order to perform a comprehensive evaluation of the two CRA basins the water was sampled to ensure that it could safely be released. The empty basins were then comprehensively monitored and silt samples on the liner and in the basin bottoms were collected. The pumping out of each basin required a total of approximately 3 weeks. During this period daily composite samples were collected at the pump discharge, and at either the WEMS catch basin or at the Plum Brook Water Sampling Station at the intersection of Pentolite Ditch with Plum Brook (about 0.5 miles downstream of the PBRF-WEMS catch basin). This was done in order to ensure that no silt was being stirred up. When both basins were near empty pump out was discontinued. Dilution at the pump out point was estimated at 50% and achieved by use of fire water. Table 3.28 following details the results of the water discharge monitoring.

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TABLE 3.28
RADIOLOGICAL CLASSIFICATION OF PBRF COLD RETENTION AREA
WATER AND DOWNSTREAM SAMPLING POINTS

DATE	SAMPLE ACTIVITY uCi/ml (BETA-GAMMA)			
	CRA-1	CRA-2	WEMS BASIN	PLUM BROOK
5/9/85	0.4E-7	0.6E-7	(PRIOR TO PUMPING)	
5/31/85	0.1E-7	-	0.1E-7	-
6/4/85	0.2E-7	-	0.2E-7	-
6/5/85	0.2E-7	0.3E-7	-	-
6/6/85	0.2E-7	-	0.2E-7	0.1E-7
6/7/85	0.2E-7	-	0.2E-7	0.1E-7
6/8/85	0.2E-7	0.1E-7	*	-
6/9/85	0.2E-7	0.1E-7	*	-
6/10/85	0.1E-7	0.2E-7	*	0.1E-7
6/11/85	-	0.6E-7	*	0.1E-7
6/12/85	-	0.1E-7	*	0.1E-7
6/13/85	-	0.2E-7	*	0.1E-7
6/14/85	-	0.3E-7	*	0.1E-7
6/15/85	-	0.3E-7	*	-
6/16/85	-	-	*	-
6/17/85	-	0.2E-7	*	0.1E-7
6/18/85	0.3E-7	2.3E-7	*	0.1E-7
6/19/85	1.2E-7	-	*	0.1E-7
6/20/85	-	-	*	0.1E-7

*Discontinued after dilution was verified.

Silt or sludge samples were collected from the top, middle and bottom of each CRA basin wall and from the center bottom of each basin. Table 3.29 following shows this sampling data.

TABLE 3.29
RADIOLOGICAL CLASSIFICATION OF SLUDGE SAMPLES
COLLECTED FROM THE COLD RETENTION AREA

LOCATION		pCi/g DRY			
		GROSS ALPHA	GROSS BETA-GAMMA	CO60*	CS137*
CRA-1, NORTH	TOP	3.1E+1	1.3E+3		
	MIDDLE	7.1E+0	1.7E+2		
	BOTTOM	9.7E+0	1.5E+2		
CRA-1, EAST	TOP	1.4E+1	5.0E+2		
	MIDDLE	1.0E+1	1.3E+2		
	BOTTOM	1.4E+1	2.4E+2		

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TABLE 3.29
RADIOLOGICAL CLASSIFICATION OF SLUDGE SAMPLES
COLLECTED FROM THE COLD RETENTION AREA
(Continued)

LOCATION		pCi/g DRY GROSS ALPHA	GROSS BETA-GAMMA	CO60*	CS137*
CRA-1, SOUTH	TOP	1.2E+1	5.0E+2		
	MIDDLE	1.2E+1	3.0E+2		
	BOTTOM	1.5E+1	1.8E+2		
CRA-1, WEST	TOP	2.1E+1	1.1E+3		
	MIDDLE	2.2E+1	4.8E+2		
	BOTTOM	1.7E+1	2.5E+2		
CRA-1, SUMP		1.0E+1	1.7E+2	9.7E+2	7.5E+1
CRA-1, BOTTOM PLATE		1.6E+1	3.7E+2		
CRA-2, NORTH	TOP	1.2E+2	4.0E+3		
	MIDDLE	2.7E+1	4.7E+2		
	BOTTOM	1.2E+2	4.8E+3	1.7E+4	9.5E+2
CRA-2, EAST	TOP	4.0E+1	3.5E+3		
	MIDDLE	- NO SAMPLE TAKEN -			
	BOTTOM	2.1E+1	4.4E+2		
CRA-2, SOUTH	TOP	4.3E+1	2.2E+3		
	MIDDLE	2.1E+4	2.2E+3		
	BOTTOM	5.0E+1	2.2E+3		
CRA-2, WEST	TOP	6.0E+1	2.2E+3		
	MIDDLE	6.4E+1	3.2E+3		
	BOTTOM	2.4E+1	6.3E+2		
CRA-2, SUMP		6.1E+0	1.6E+2		

*Isotopic analysis was performed on one representative sample from each basin.

After each basin was pumped dry the basin surfaces were monitored. Figures 3.23 and 3.24 present the summary results of the data collected. In general low level contamination is relatively uniformly spread throughout the basins. Most contamination seems to be associated with silt deposits. This is probably because the silt acts like an ion exchange media and gradually gathers trace isotopes from the liquids which have bathed the silt over the years. As would be expected most silt is accummulated in

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the bottoms of the basins. It is expected that if the contaminated liners with the silt are removed, that the remaining contamination on concrete structures may be removed with high pressure water jets of low volume. The concrete structures would have to be removed to verify that adjacent underlying soil is free of contamination. The 10 foot deep core soil samples taken around the periphery of CRA basins indicates background levels of radioactivity. If contamination has migrated into the soil it has probably not penetrated more than a few inches from the structures based on the soil sampling experience in the ERB. For purposes of this study, it was felt prudent to allow for surrounding soil, gravel, crushed rock, etc., to be removed to a distance of 18" around the structures. This translates into approximately 1,000 cubic yards of material to be removed. The data from soil core samples was presented in Section 3.2.2 of this volume beginning on page 3-14.

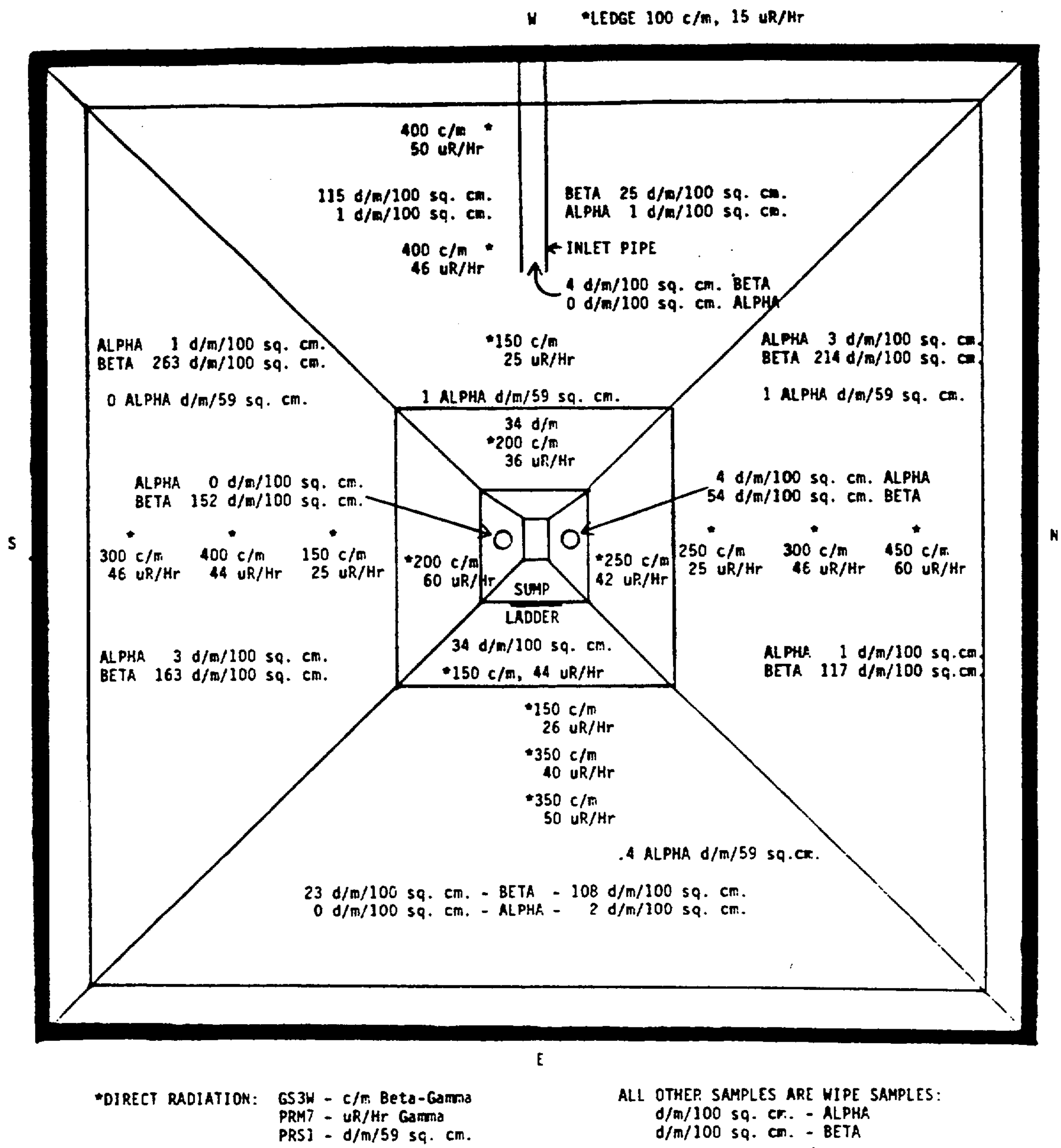
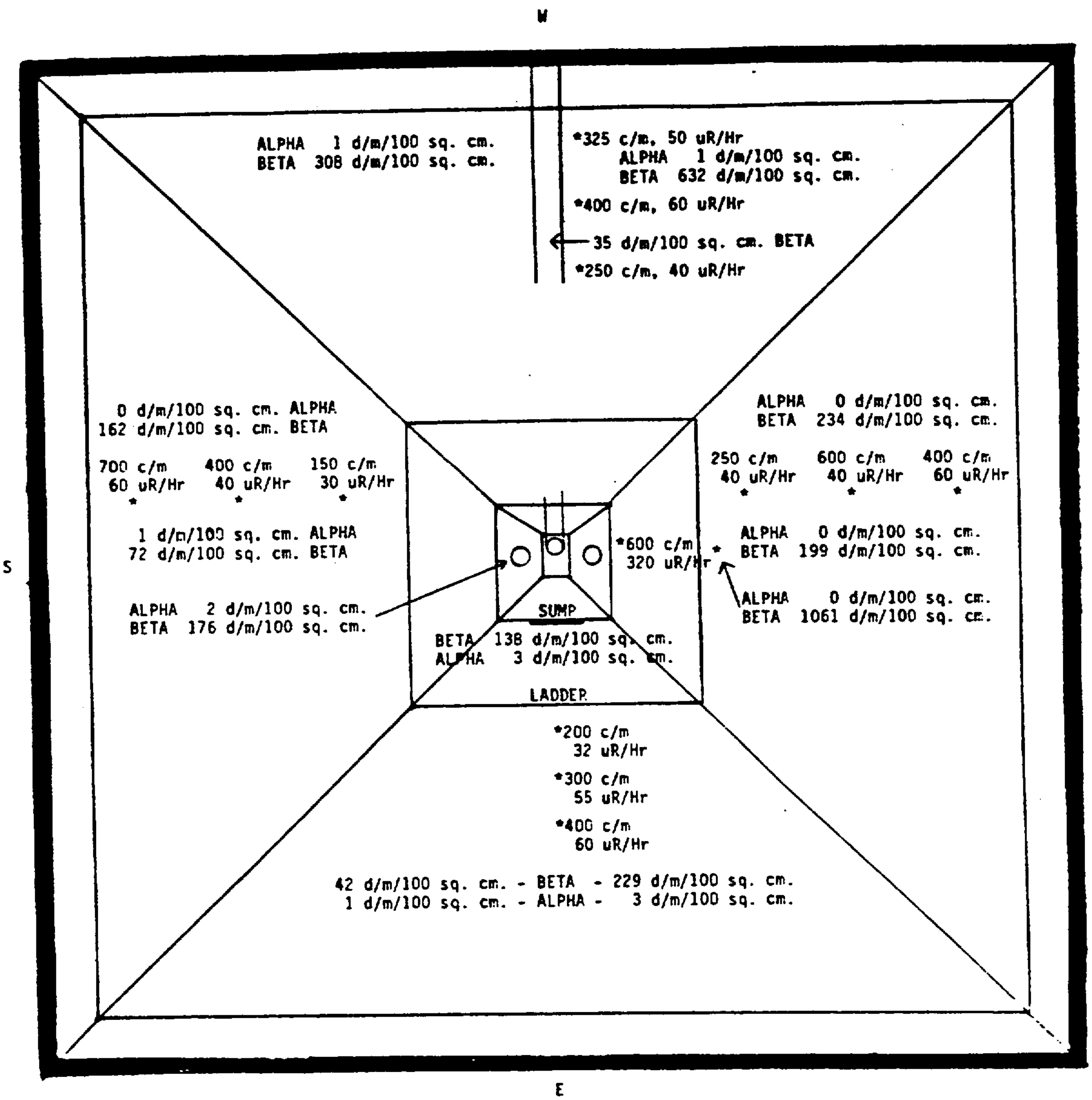


FIGURE 3.23 - RADIOLOGICAL CLASSIFICATION OF COLD RETENTION AREA BASIN 1 (NORTH) AT THE PLUM BROOK REACTOR FACILITY



*DIRECT RADIATION: GS3W - c/m Beta-Gamma
PRM7 - uR/Hr Gamma
PRS1 - d/m/50 sq. cm. - ALPHA

ALL OTHER SAMPLES ARE WIPE SAMPLES:
d/m/100 sq. cm. - ALPHA
d/m/100 sq. cm. - BETA

FIGURE 3.24 - RADIOLOGICAL CLASSIFICATION OF COLD RETENTION AREA BASIN 2 (SOUTH) AT THE PLUM BROOK REACTOR FACILITY

3.3.7 Exhaust Air System

The contaminated air systems for the PBRF exhausted through filtration/control systems located in the Fan House into the PBRF Stack. This stack is a 100′ high, 5′ diameter vertical steel pipe with a concrete support stand and a vortex plenum at the base. All exhausted air was monitored by means of the Stack Effluent Monitoring System.

Air flowed into the stack through several headers. Room air from seven buildings or areas flowed thru nine separate lines into the Fan House and after filtering were collected into a 54" diameter header and then discharged to the stack. Following are the areas collected by this header.

- Waste Handling Building
- Reactor Building & Hot Pipe Tunnel
- Primary Pump House Rooms 1 thru 6, Plus The Primary Cooling Water Degassifier Storage Tank
- Hot Lab Hood Vent Exhaust
- Hot Lab Cells 3-7 Normal Exhaust
- Hot Lab Cells 3-7 Door Open Exhaust
- Hot Lab Cells 1 & 2 Normal Exhaust
- Hot Cell Vacuum System
- Hot Retention Area & PPP Room Sump Vents

Another system releasing to the stack was the Experimental Waste Air Header. Two 10" diameter connections in Quadrants A & C and one 8" diameter header from the ROLB basement are collected in a 16" diameter header which passes thru the Hot Pipe Tunnel and then into the Fan House basement for filtration before release to the stack.

A third system releasing to the PBRF stack collected air from the containment vessel thru a 6" diameter line passing thru the Hot Pipe Tunnel to the Fan House basement where it was filtered and then entered the Bottle Monitoring System. This system consisted of two each two-stage compressors, an after cooler and a 20 cubic foot receiver. The air at 300 psi then passed into four each 50 cubic foot tanks on the Air Tank Monitoring System. The system was so designed that each tank filled with system air to the full pressure, holds during a radioactivity monitoring period, and exhausts to the stack on a cycle time of 20 to 60 seconds. In the event that one of the monitored tanks indicated a high level of radioactivity, the tank exhaust valve remained closed and the system operated on the remaining 3 tanks. This system was also interconnected to receive exhaust

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air from the primary system degassifier, reactor tank 2" vent line, and Canal H rabbit tube if necessary.

A fourth header releasing to the PBRF stack received exhaust air from the following sources.

Hot Cells 1 & 2 Special Vents via The Off Gas Clean Up System (OGCUS)
The Reactor Tank 2" Vent Line
Canal H Rabbit Tube Exhaust Vents

This OGCUS also could receive exhaust air from the previously described CV ventilation system.

At first it was thought that the radiological monitoring of the PBRF ventilation systems would be simple and straightforward. The relatively thin walled ductwork, etc., would permit external monitoring to be indicative of internal ductwork contamination. In reality it was found that ambient radiation backgrounds in most control zones, where this ductwork is located, were high enough to preclude differential classification of ducts, dampers, etc. Effort was then focused on obtaining wipe samples in filter housings and direct radiation readings in the several areas of each system where this could be performed reliably. It should be noted that the general radiation background in the Hot Pipe Tunnel was heavily influenced by the hot cell drain line so it was not possible to classify ductwork in that area. Also, the OGCUS was separated from the Hot Dry Storage Area by only 18" of concrete shielding, therefore, the radiation levels observed in the OGCUS areas did not truly represent the status of that system, but rather, resulted from the high radiation levels in the Hot Dry Storage Area.

Despite these problems, a good indication of the relative radiation levels was obtained. In general the systems were moderately contaminated and it is probable that some larger ductwork may be decontaminated successfully. As might be expected, higher levels of internal contamination were associated with hot cell operations.

Figure 3.25 shows a simplified flow diagram of the PBRF contaminated air systems along with the direct radiation readings taken at the exterior of the respective ducts, valves, etc., for the respective systems. Figure 3.26 provides additional monitoring data for the Auxiliary Ventilation System. This data also includes internal hot cell contamination levels because they are related to the potential for ductwork and vent system contamination from those areas

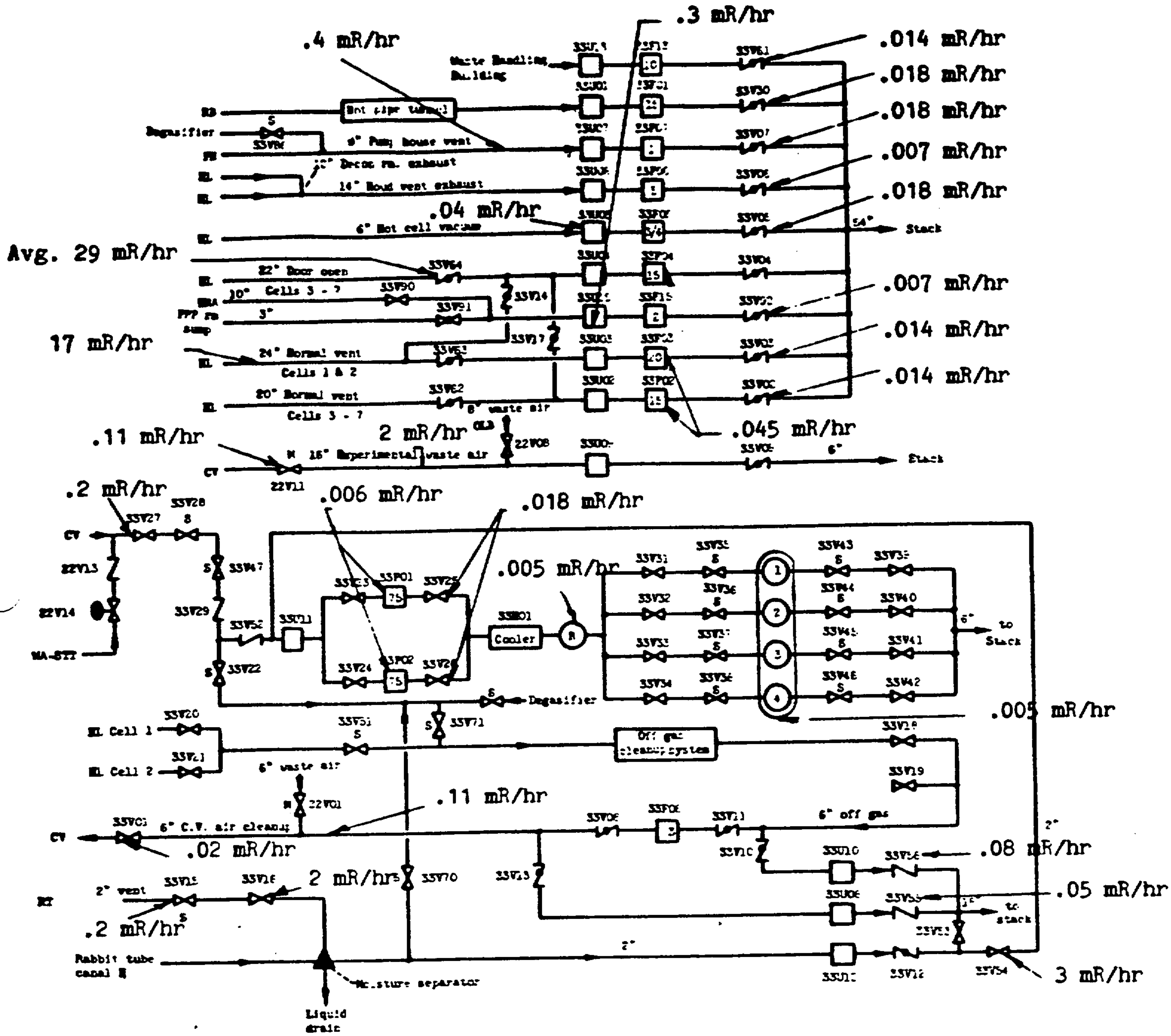

FIGURE 3.25 - RADIOLOGICAL CLASSIFICATION OF PBRF CONTAMINATED AIR SYSTEMS

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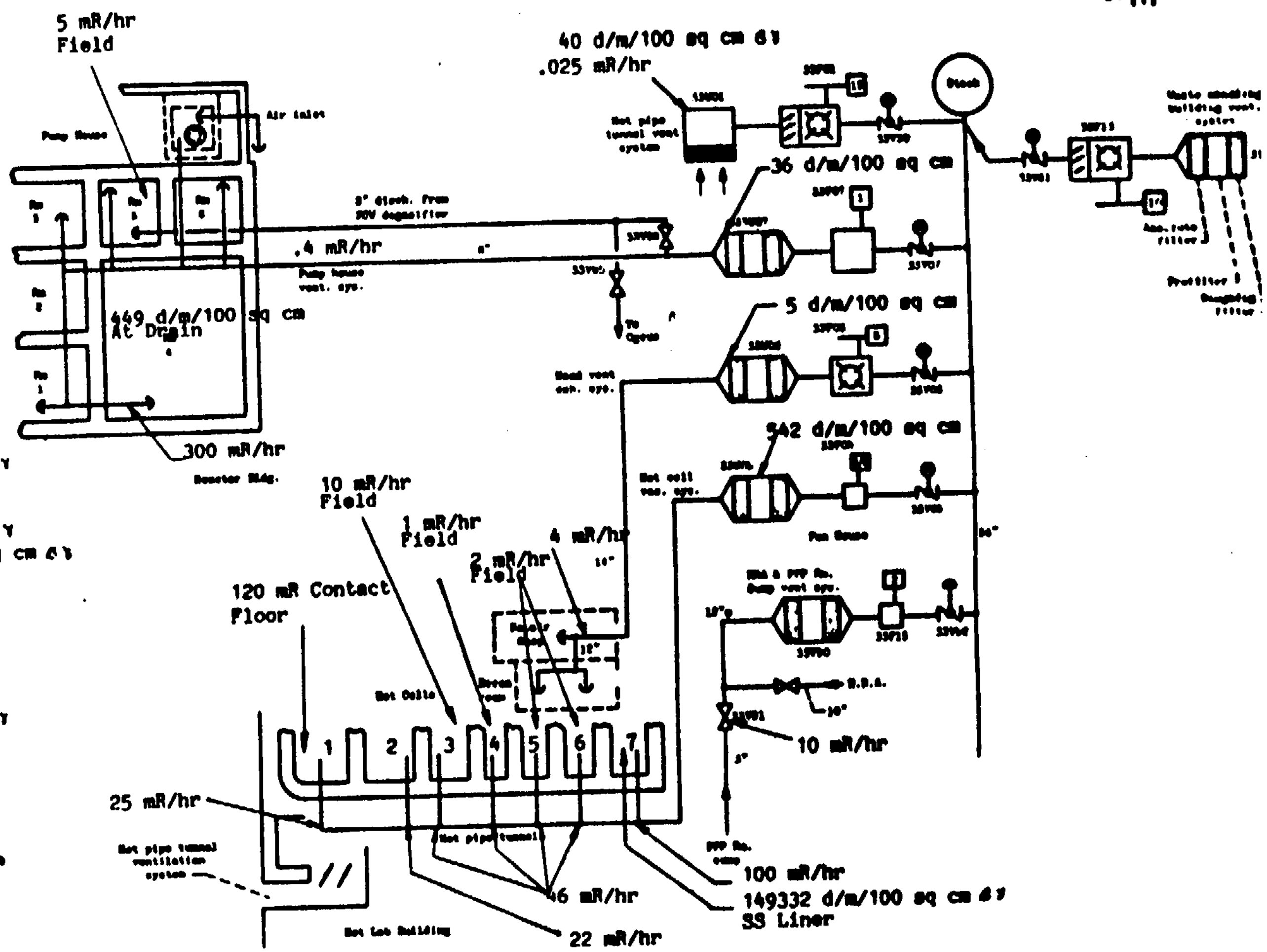


Cell 1 West Wall, 370 d/m/100 sq cm α
Cell 1 Floor, 129417 d/m/100 sq cm βγ
Cell 1 Inside Door, 165955 d/m/100 sq cm βγ

Cell 2 Floor, 173189 d/m/100 sq cm βγ
Cell 2 Inside Door, 150467 d/m/100 sq cm βγ
Cell 2 Inside Glove Box, 130203 d/m/100 sq cm βγ

Cell 3 North Wall, 9447 d/m/100 sq cm βγ
Cell 3 South Wall, 13184 d/m/100 sq cm βγ

Cell 4 East Wall, 4637 d/m/100 sq cm βγ
Cell 4 Inside Door, 189 d/m/100 sq cm α
Cell 4 Inside Door, 37862 d/m/100 sq cm βγ

Cell 5 Floor, 1787 d/m/100 sq cm βγ
Cell 5 Inside Door, 1355 d/m/100 sq cm βγ

Cell 6 West Wall, 33226 d/m/100 sq cm βγ
Cell 6 Inside Door, 40126 d/m/100 sq cm βγ

Cell 7 Floor, 149332 d/m/100 sq cm βγ
Cell 7 North Wall, 6367 d/m/100 sq cm βγ

FIGURE 3.26 - RADIOLOGICAL CLASSIFICATION OF THE PBRF AUXILIARY VENTILATION SYSTEM

despite the fact that exhaust air was filtered at the cells before entering the system.

Figure 3.27 presents a flow diagram of the OGCUS and Storage System along with some limited radiation survey data.

The OGCUS is located adjacent to the south of the Hot Dry Storage Area. This area is behind Cells 1 & 2 in the Hot Laboratory.

The storage portion of the facility consists of two vacuum pumps, two compressors, and five storage tanks. This equipment is located within a 66" diameter by 40′-6" high containment tank. In use, the output of the compressors is stored in one of the five 72 cubic foot storage tanks at pressures to 250 psig.

The clean up portion of the facility consists of a liquid gas scrubber and two activated carbon bed absorbers. Output from the storage tanks is monitored, flows through the clean up section, and an absolute filter to the exhaust stack. If the output does not meet release criteria, it is returned to the storage tanks.

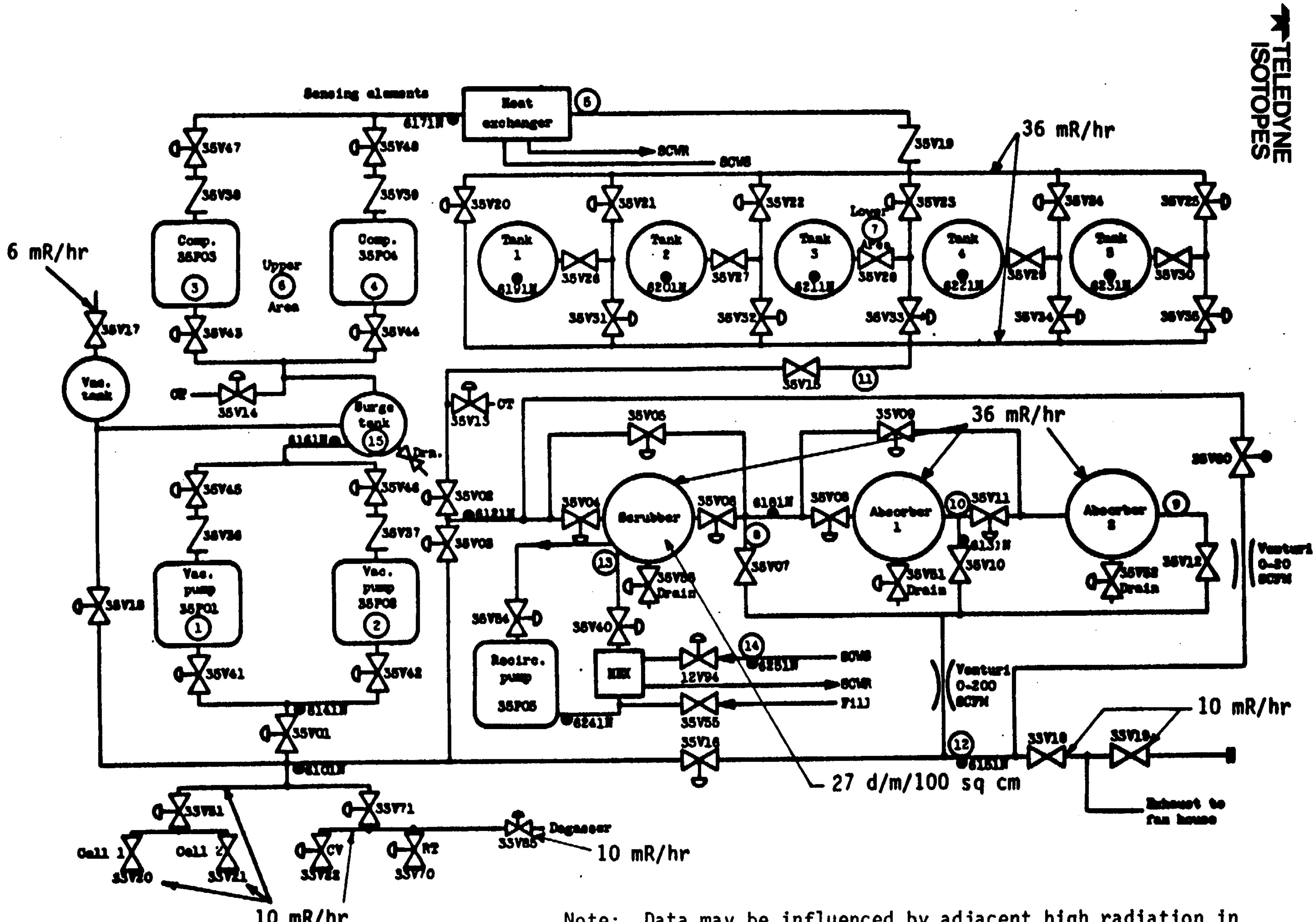
In the event the containment vessel ventilating system indicated high level of activity in the ventilating exhaust, the containment vessel would be isolated from access and a purge would have been drawn from the vessel, through the clean up system, and returned to the containment vessel.

During this study a survey of the area around the upper portion of the containment tank was made. The floor surface ranged from 750 to 1000 c/min. using a GM instrument. The highest point had an alpha reading of 2.9 D/min. using a PRS-1 scintillation meter. A PRM-7 (Rascal) instrument was used to obtain a direct reading at one meter. The highest level obtained was 390 uR/hr.

Two floor plugs were pulled to gain access to the lower level portions of the containment tank, the carbon bed absorbers, and the liquid gas scrubbers.

Prior to entering the area, an oxygen and combustible gas measurement was made. Portable lights were used to provide illumination.

To enter the lower area, a technician was lowered on a sling attached to the overhead crane. The floor plug opening limited the lowering depth since the crane hook would not pass through the opening.



<u>Note</u>: Data may be influenced by adjacent high radiation in the Hot Dry Storage areas.

FIGURE 2-27 RADIOLOGICAL CLASSIFICATION OF THE PRPF

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e technician could reach the top of the scrubber tank.

The area was surveyed with a portable ionization chamber giving the following results:

Scrubber Tank Top (Contact)	5 mR/hr
Absorber #1 (Contact)	8 mR/hr
Absorber #2 (Contact)	7 mR/hr
Main Containment Tank (Contact)	5 mR/hr
Floor Area	5 mR/hr
General Field	5 mR/hr

north wall of the OGCUS and Storage Area showed eld of 22 mR/hr. This higher reading was due to ighly activated materials stored in Hot Dry Storage. The concrete wall between the two areas is hick.

s for transferable contamination were also taken in the area. Results of this survey are as s:

crubber Tank, Beta-Gamma	27 d/m/100 sq cm
North Wall, Beta-Gamma	6 d/m/100 sq cm
South Wall, Beta-Gamma	4 d/m/100 sq cm
Scrubber Tank, Alpha	<1 d/m/100 sq cm
North Wall, Alpha	-0-
outh Wall, Alpha	-0-

n containment tank is constructed in three s that are flanged together. The size of the assembled tank is 66" diameter x 40′-6" long. Four storage tanks are 24" diameter x 23′ long, he other storage tank is 22" diameter x 23′ If decommissioning occurs, these tanks may be red as shipping containers for LSA material.

3.30 shows the summary data on the internal removable contamination present in the accessible portions of the contaminated air systems in the Fan House, and the interior of the Fan House Stack Base. It should be noted that many of these filter housings were partially decontaminated when filters were removed and systems secured at the time of facility shutdown. For this reason it is possible that data obtained at these locations may not be indicative of contamination elsewhere in the systems.

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TABLE 3.30
REMOVABLE CONTAMINATION ON ACCESSIBLE INTERIOR SURFACES OF ACCESSIBLE PBRF CONTAMINATED AIR SYSTEMS, FILTER HOUSINGS, DAMPERS, FANS, ETC.

		GROSS ALPHA d/m/100 sq cm	GROSS BETA d/m/100 sq cm
Fan House 0′	Average	LT 1	10
	Maximum	2	94
	Minimum	0	0
	No. Samples	18	18
Fan House -15′	Average	2	695
	Maximum	5	4572
	Minimum	0	0
	No. Samples	27	27
Fan House Stack Base	Average	LT 1	216
	Maximum	2	1192
	Minimum	0	0
	No. Samples	6	6
Fan House Stack +30′ (Wall & Sample Probe)	Average	LT 2	50
	Maximum	2	80
	Minimum	LT 1	21
	No. Samples	2	2

When the base of the Fan House Stack was evaluated it was noted that approximately 15" of water had accumulated in it. This had obviously been rain water collecting there gradually over a long period of time. Substantial corrosion of the metal access door was noted along with substantial concrete spalling. This water was sampled and found to contain 1E-7 uCi/ml of beta and 3E-10 uCi/ml of alpha activity which was within release limits. After release, samples of silt at the base of the stack were evaluated. Following are the results of laboratory evaluation:

Gross Alpha Radioactivity	4.7E+2 pCi/g
Gross Beta Radioactivity	3.5E+4 pCi/g
60 Cobalt Radioactivity	1.2E+4 pCi/g
137 Cesium Radioactivity	2.6E+2 pCi/g

During facility operations the radiochemistry lab hood on the second floor of the Reactor Office and Laboratory Building (ROLB) had the potential for handling low level radioactive air contamination. These hoods were not part of the contaminated air systems previously described. These radiochemistry hoods were equipped with separate high efficiency filter units atop each hood and powered by separate exhaust fans located on the roof of the ROLB. Prior to roof repairs performed on the building in 1982, these exhaust fans were removed and the exhaust ducts were capped off and a foam roofing sealant was applied. Just prior to this application, the fans and interior ductwork were monitored and found to be free of contamination. It is possible that some of the filter housings and short ductwork upstream of these housings may have low level internal contamination; however, this could not be confirmed by monitoring.

3.3.8 Hot Dry Storage

The Hot Dry Storage area contains an inventory of radiological items comparable to that in the Plum Brook Reactor Tank. The facility is designed to permit remote retrieving, packaging and shipment of such items, therefore, their handling and disposal represents no unusual problems. Evaluation of the current radiological levels present was necessary to ensure that the integrity of this storage area remains high.

The Hot Dry Storage Facility is located behind Cells 1 & 2 in the Hot Laboratory, Building #1112. The area is a concrete structure approximately 23′x32′ with a floor elevation of -25′. The top is covered with removable, high density concrete shielding slabs and removable plugs. The thickness of these slabs is 30". Elevation of the top of the slabs is +6′-6".

A remotely controlled bridge crane is located in the Hot Dry Storage area. Control for the crane is from a control station in the Reactor Building on the south side of Canal G. A shielding window next to the control station provides a view of the area.

Several stackable metal hoppers, 53"x60"x60" high, are located in Hot Dry Storage. These hoppers are designed to be loaded and moved remotely. At the present time, experimental hardware, reactor beryllium pieces, core fuel element handling tools, and end box cut off equipment are stored in the hopper or on the floor of the Hot Dry Storage area.

Materials stored in Hot Dry Storage fall into one of two categories. One category is contaminated material which must be controlled, but does not require item-by-item accountability. The other category is irradiated materials which require item-by-item accountability of isotope inventory. A copy of the by-product accountability inventory of materials stored in Hot Dry Storage is shown in Table 3.31.

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INV #	ITEM	ISO	CURIE	ISO	CURIE	ISO	CURIE	ISO	CURIE
12000-1171	North Beryllium Plate	46Sc	.952E-22	60Co	.474E+00	3H	.149E+04		
12000-1227	MUR Cadmium Section	60Co	.551E-03						
12000-1228	MUR Cadmium Section	60Co	.551E-03						
12000-1229	MUR Cadmium Section	60Co	.551E-03						
12000-1230	MUR Cadmium Section	60Co	.551E-03						
12000-1231	MUR Cadmium Section	60Co	.551E-03						
12000-1233	LC-1 Beryllium Plug	55Fe	.175E+02	3H	.799E+03				
12000-1234	LA-5 Beryllium Plug	55Fe	.175E+02	3H	.799E+03				
12000-1235	LA-11 Beryllium Plug	55Fe	.175E+02	3H	.799E+03				
12000-1236	LD-11 Beryllium Plug	55Fe	.175E+02	3H	.799E+03				
12000-1237	LC-11 Beryllium Plug	55Fe	.175E+02	3H	.799E+03				
12000-1238	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1239	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1240	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1241	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1242	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1243	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1244	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1245	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1246	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1247	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1248	Beryllium R Piece Plug	54Mn	.180E-04	60Co	.566E+01	3H	.277E+03	65Zn	.125E-05
12000-1241I	Taft Lower Section	54Mn	.231E-01	59Fe	.357E-30	60Co	.306E+03		
12000-1244I	Taft Lower Section	65Zn	.446E-05						
12000-1245I	EE-6 Taft Lower Section	65Zn	.314E-05						
12000-1248I	Taft Lower Section	60Co	.121E+02						
12000-1250	68-03 Taft	59Fe	.531E-31						
12000-1255	Beryllium Cont. Rod Sect.	51Cr	.000E+00	55Fe	.353E+03	59Fe	.164E-28	3H	.125E+04
12000-1256	Beryllium Cont. Rod Sect.	51Cr	.000E+00	55Fe	.353E+03	59Fe	.164E-28	3H	.125E+04
12000-1257	Beryllium Cont. Rod Sect.	51Cr	.000E+00	55Fe	.353E+03	59Fe	.166E-28	3H	.125E+04
12000-1258	Beryllium Cont. Rod Sect.	51Cr	.000E+00	55Fe	.353E+03	59Fe	.166E-28	3H	.125E+04
12000-1259	Beryllium Cont. Rod Sect.	51Cr	.000E+00	55Fe	.353E+03	59Fe	.166E-28	3H	.125E+04
12000-1264	65-01-003 Taft	59Fe	.185E-30						
12000-1272	LC-6 Fast Flux Facility	51Cr	.000E+00	59Fe	.489E-28	60Co	.851E+02	55Fe	.553E+00
12000-1273	LC-6 Lower Shim Section	59Fe	.727E-29	60Co	.413E+03				
12000-1274	LC-1 Beryllium Section	55Fe	.155E+02	3H	.749E+03				
12000-1275	LD-1 Beryllium Section	55Fe	.155E+02	3H	.648E+03				
12000-1276	LA-1 Beryllium Section	55Fe	.155E+02	3H	.500E+03				
12000-1277	LB-1 Beryllium Section	55Fe	.155E+02	3H	.623E+03				
12000-1278	Type 2 Beryllium L Piece	55Fe	.195E+02	60Co	.166E+02	3H	.113E+04		
12000-1279	Type 2 Beryllium L Piece	55Fe	.195E+02	60Co	.166E+02	3H	.113E+04		
12000-1280	Type 2 Beryllium L Piece	55Fe	.195E+02	60Co	.166E+02	3H	.113E+04		
12000-1281	Type 2 Beryllium L Piece	55Fe	.195E+02	60Co	.166E+02	3H	.113E+04		
12000-1282	LC-11 Beryllium Section	55Fe	.155E+02	3H	.749E+03				
12000-1283	LD-11 Beryllium Section	55Fe	.155E+02	3H	.648E+03				
12000-1284	LA-11 Beryllium Section	55Fe	.155E+02	3H	.500E+03				
12000-1285	LB-11 Beryllium Section	55Fe	.155E+02	3H	.623E+03				
12000-1286	One Piece Upper Grid	65Zn	.264E-03						
12000-1289	IT1A Inst. Thimble	59Fe	.378E-33						
12000-1290	IT2I Inst. Thimble	59Fe	.268E-28	60Co	.118E+04				
12000-1291	IT3I Inst. Thimble	59Fe	.268E-28	60Co	.118E+04				
12000-1292	IT4I Inst. Thimble	59Fe	.268E-28	60Co	.118E+04				
12000-1293	IT5I Inst. Thimble	59Fe	.268E-28	60Co	.118E+04				
12000-1541	Cadmium Control Sect.	60Co	.293E-01						
12000-1542	Cadmium Control Sect.	60Co	.293E-01						
12000-1543	Cadmium Control Sect.	60Co	.293E-01						

Total Inventory of Byproduct Materials Stored in Hot Dry Storage by Isotopes

ISOTOPE	CURIES
3H	.243E+05
46Sc	.952E-22
51Cr	.000E+00
54Mn	.233E-01
55Fe	.205E+04
56Co	.000E-00
59Fe	.247E-27
60Co	.568E+04
65Zn	.264E-03

TABLE 3.31 - INVENTORY OF RADIOLOGICAL MATERIALS STORED IN THE PBRF HOT DRY STORAGE AREA AS OF 12/31/85

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During November 1984, a preliminary radiation survey of the Hot Dry Storage roof slabs was obtained using a PRM-7 Rascal at the surface of the slabs. The following information was obtained regarding dose rates on top of the shielded Hot Dry Storage area:

Removable Plug Area	.14 to 1.8 mR/hr
North Side	.34 to .7 mR/hr
South Side	.25 to 1.0 mR/hr

The storage area light bulbs are burned out, so a portable light was lowered through one of the shield plug holes to provide light for photographic documentation.

The radiation survey consisted of determining the beta-gamma field within the storage area and the amount of airborne tritium present. Tritium is of concern since irradiated beryllium plate and core components are stored in the area and the rate of tritium offgassing (if any) required verification.

A radiation profile of the storage area was taken by lowering unshielded TLD dosimeters on a string. Two dosimeters were placed at each of three elevations on the string. One dosimeter in each set was oriented in the vertical plane while the other was oriented horizontally. The strings were lowered through the removable plug holes. This arrangement produced a profile of a vertical plane 16′ south of the north storage area wall. Figure 3.28 shows the results of this investigation. Depending on elevation and location the dose rates varied from 0.35 R/hr to 66.5 R/hr.

It should be recognized that contact dose rates with individual pieces could be in the range of hundreds to thousands of R/hr, as expected. The profile dose rates beneath the circular shield plugs do indicate that the shield plugs can be removed, under a safe work permit, in order to obtain additional information from within the Hot Dry Storage area. Maximum dose rates observed on top of the storage area with the circular shield plugs removed ranged from 0.5 to 1.5 R/hr and were somewhat directional in origin. Although dose rates within the Hot Dry Storage area are very high, personnel exposures can be controlled to verv low levels (10-20 mRem). when shield plugs are removed.

A weighted piece of tygon tubing was lowered through the removable plug holes to obtain airborne tritium samples within the Hot Dry Storage area. Samples were taken at 4′ above the floor and 2′ below the roof slabs. The tubing was attached to a gas sampling pump to permit purging the tubing. By manip-

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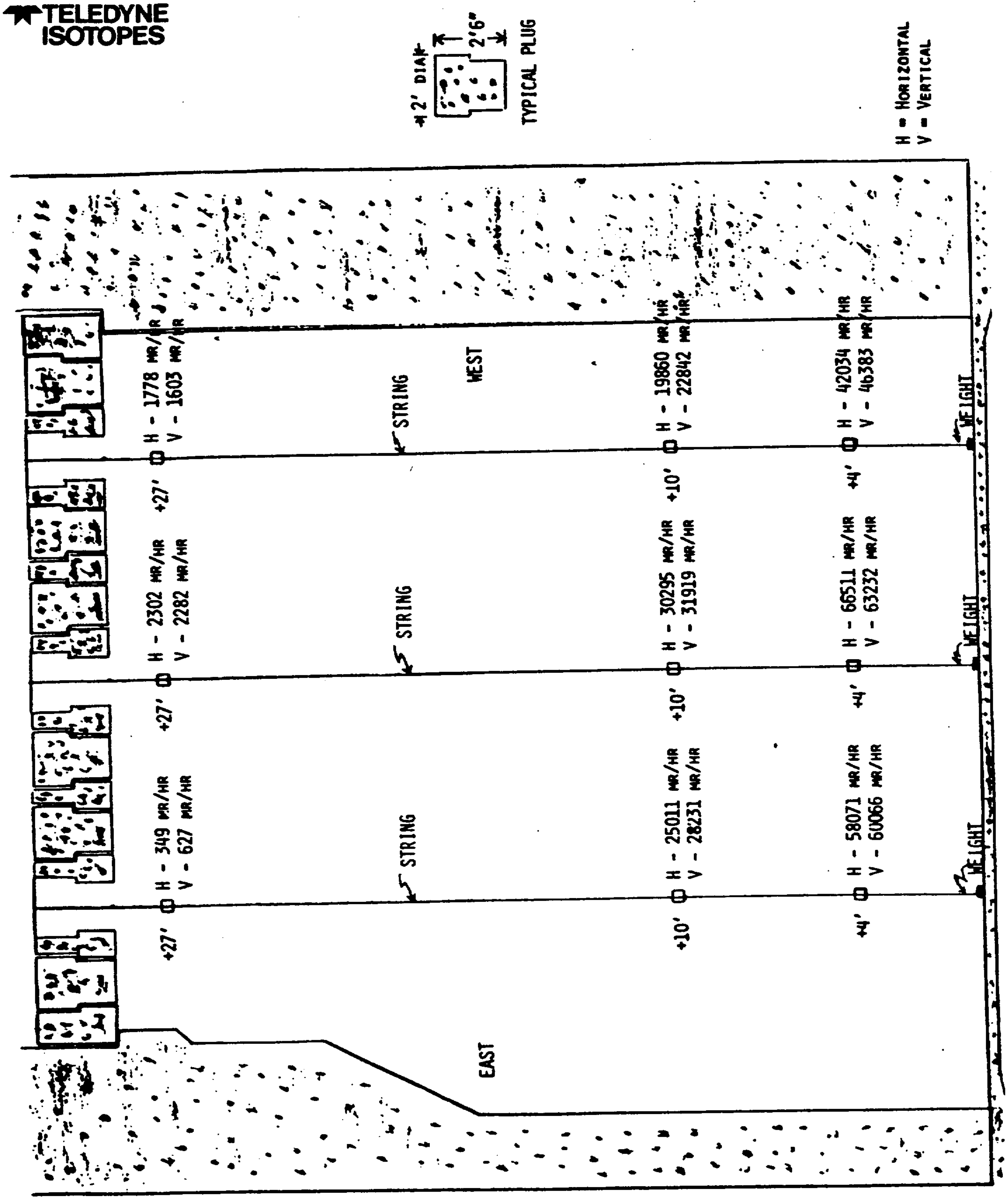

FIGURE 3.28 - RADIOLOGICAL DOSE RATES ON A PLANE 16' FROM THE NORTH WALL OF THE HOT DRY STORAGE AREA OF THE PBRF (AS DETERMINED BY UNSHIELDED TLD MEASUREMENTS)

ulating valves, the flow was diverted into an evacuated 16,000 cc tritium sampling flask.

Results of the airborne tritium sampling are as follows:

4′ Above Floor	2.96E-08 uCi/cc
2′ Below Roof Slab	2.73E-08 uCi/cc
Occupational MPC	5E-06 uCi/cc
General Public MPC	2E-07 uCi/cc

Values for the Maximum Permissible Concentration (MPC) were obtained from Part 10CFR 20, Appendix B, Tables 1 and 2.

From the samples, we found that the airborne concentration is approximately 0.6% of the Occupational MPC and 15% of the MPC for the General Public. These concentrations should present no problems if further work is to be performed in these areas.

3.3.9 Hot Lab

Most of the radiological contamination in the PBRF Hot Lab air handling and liquid drain systems as well as contamination of various equipment and building surfaces directly resulted from operational tasks performed in the seven Hot Cells. Representative monitoring was performed in the Hot Cells by unlocking and removing the cell door plugs and carefully entering with a portable ionization chamber instrument and a more sensitive portable GM instrument. Wipe samples were also collected and a photographic record obtained from within each hot cell. Interpretation of the data obtained will be somewhat indicative of what could exist in liquid drain systems as well as contaminated cell ventilation systems. Table 3.32 presents the summary results of radioactive contamination and radiation dose rates in each of the seven cells. The highest wipe samples from each cell were submitted for isotopic analyses and the results appear in Table 3.33. The major isotopes are Cobalt 60 and Cesium 137. These isotopes have also been confirmed to be present in many other systems, equipment, and facilities at PBRF. The source of the trace levels of K40 and Radium 226 in Cells 6 and 7, respectively, are unknown. Both of these are naturally occurring isotopes and may have been present in natural materials although both may also be resulting from other chemical or calibration standards used in these cells.

A more detailed evaluation of the entire Hot Laboratory is presented in Section 3.4.3. The major purpose of presenting Hot Laboratory data in this section is to relate the data to the contaminated air and liquid systems discussed previously in Sections 3.3.3 thru 3.3.7.

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TABLE 3.32
SUMMARY RADIOLOGICAL CLASSIFICATION
OF THE PBRF HOT CELLS

		LOOSE CONTAMINATION d/m/100 sq cm		FIXED* CONTAMINATION	DIRECT RADIATION
		ALPHA	BETA-GAMMA	c/m	mR/hr
Cell 1	Average	82	70,900	-	40
	Maximum	370	166,000	-	120
	Minimum	8	5,500	-	10
	No. Samples	6	6	0	7
Cell 2	Average	35	87,400	-	124
	Maximum	77	173,200	-	450
	Minimum	14	4,400	-	8
	No. Samples	8	8	0	4
Cell 3	Average	5	5,800	3,000	39
	Maximum	13	13,200	3,000	250
	Minimum	0	1,600	3,000	1
	No. Samples	6	6	1	8
Cell 4	Average	33	8,400	1,000	2
	Maximum	189	37,900	1,000	3
	Minimum	0	570	1,000	1
	No. Samples	6	6	1	4
Cell 5	Average	1	930	-	5
	Maximum	2	1,800	-	13
	Minimum	0	200	-	1
	No. Samples	6	6	0	3
Cell 6	Average	8	18,500	-	39
	Maximum	19	40,100	-	75
	Minimum	2	6,600	-	2
	No. Samples	1	6	0	2
Cell 7	Average	LT 1	26,700	1,000	9
	Maximum	4	149,300	2,000	40
	Minimum	0	1,040	400	1
	No. Samples	6	6	3	6

*Fixed Contamination was difficult to estimate in some cells due to the general radiation field in the cells.

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TABLE 3.33
ISOTOPIC ANALYSIS OF PBRF
HOT CELL WIPE SAMPLES

	pCi/gm					
	GROSS ALPHA	GROSS BETA-GAMMA	CO 60	CS 137	K 40	RA 226
Cell 1	1.7E0	1.7E+3	1.0E+3	7.1E+2	-	-
Cell 2	1.5E+1	1.4E+4	2.4E+4	2.7E+3	-	-
Cell 3	8.1E0	3.7E+3	2.2E+3	7.9E+2	-	-
Cell 4	1.6E0	1.8E+3	2.4E+2	8.5E+2	-	-
Cell 5	1.1E0	6.8E+2	3.0E+1	5.3E+2	-	-
Cell 6	2.3E0	3.4E+3	2.4E+2	2.4E+3	6.4E+1	-
Cell 7	1.2E0	2.4E+3	3.6E+2	2.4E+3	-	1.4E+2

	AIR SAMPLES uCi/cc		% MPC	
	GROSS ALPHA	GROSS BETA-GAMMA	GROSS ALPHA	GROSS BETA-GAMMA
Cell 1	1.0E-12	2.5E-10	33.3	8.5
Cell 2	0.9E-12	2.0E-10	29.4	6.6
Cell 3	3.9E-13	0.9E-10	12.8	3.0
Cell 4				
Cell 5	ND	0.9E-10	-	3.0
Cell 6	5.6E-13	2.1E-10	18.5	7.0
Cell 7	5.0E-13	0.8E-10	16.7	2.7

3.3.10 Mock Up Reactor (MUR)

The MUR is a near identical configuration of the Plum Brook Reactor, however, it was operated essentially as a zero power critical assembly in Canal H to obtain fuel element and experiment calibration data. Cooling occurred by convection as in a "swimming pool" reactor. The MUR was secured and mothballed at the same time the entire PBRF was shutdown and placed in a "possess but do not operate" mode.

During this study the MUR assembly was monitored using a portable ionization chamber as well as a PRM-7 micro-R-meter. Readings ranged from about 1.5 mR/hr to a maximum of 13 mR/hr at the northwest corner of the core box with an average approximately 5 mR/hr. No significant alpha activity was detected, the maximum being 4 alpha d/m/59 sq cm at one

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spot on the northeast corner of the core box. Figure 3.29 shows the summary results of the MUR monitoring. See Table 3.39 on page 3-122 for survey results for Canal H itself.

Several standing water samples were collected from Canal H and analyzed. This small amount of water was presumed to result from either roof leaks or condensation from the steel roof deck during cold weather. Following are the results of these analyses.

	uCi/ml	
	GROSS ALPHA	GROSS BETA-GAMMA
Average	LT 3E-9	2.3E-8
Maximum	5E-9	5.0E-8
Minimum	1E-9	0.6E-8
No. Samples	5	5

3.3.11 Deep Core Sampling Adjacent To Indoor Canals At PBRF

After the outdoor deep soil sampling was completed the drilling rigs were utilized to obtain deep core soil samples adjacent to Canal G midway along the north wall to determine if low level contaminated water leaked from Canal G fuel storage area to adjacent sub-soil areas. The area selected was in an area where some visual settling of the surface had occurred. It was hypothesized that any leakage would most likely occur in an area of structural failure and the most likely area of structural failure would occur where most soil settling or compaction occurred. In reality the core samples showed that Canal G footers and concrete were actually settling on top of a gray limestone substrate.

The techniques for drilling and obtaining core soil samples were identical to those previously described in Section 3.2.2, page 3-14, of this volume. A diamond core drill was used to break through the top layer of concrete which was observed to be 6.5" thick. The 20-ton crane over Canals F, G, and H was utilized to place and remove the drilling rig.

The results of the sample analyses and soil characterization are shown in Table 3.34, following. The data shows that sub-surface soil radioactivity is at background levels and that no contamination of sub-surface soils has occurred in the vicinity of Canal G.

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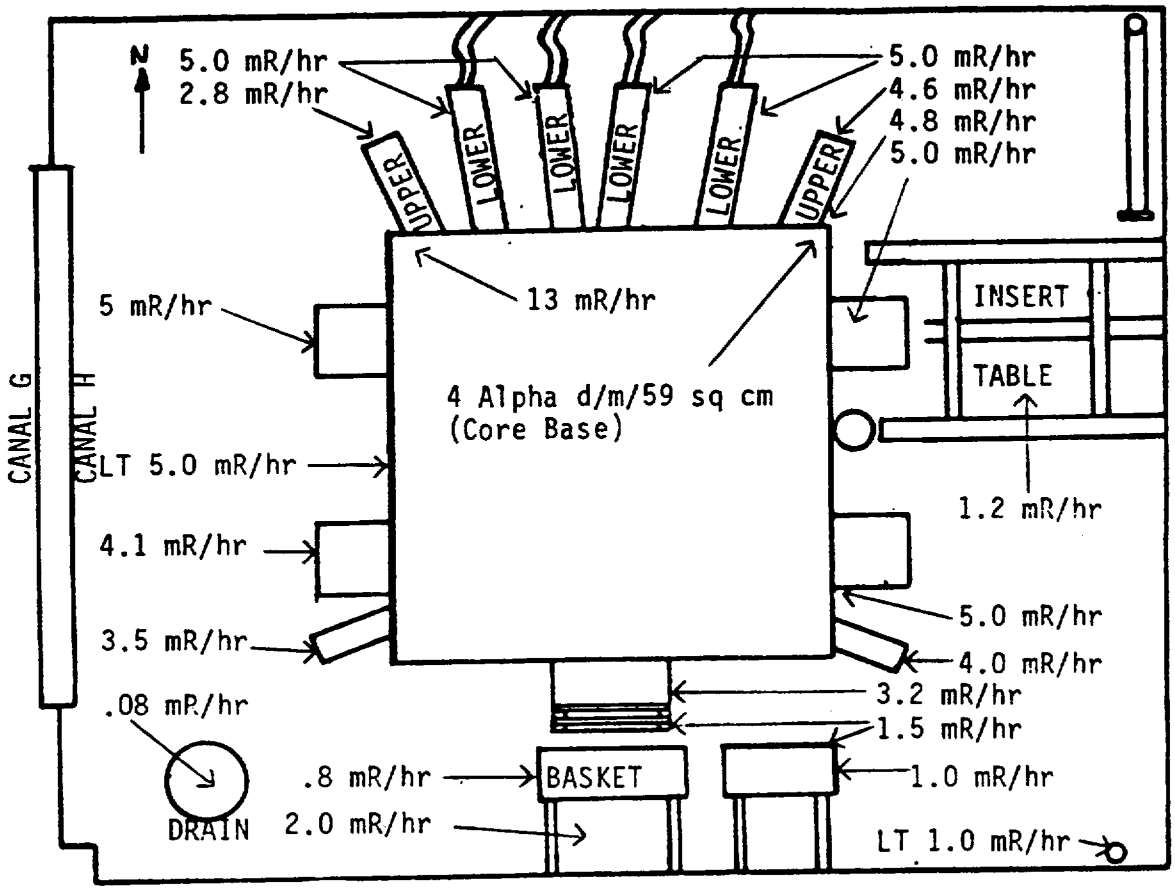

FIGURE 3.29 - RADIOLOGICAL CLASSIFICATION OF THE MOCK UP REACTOR AT PBRF (BETA-GAMMA RADIATION UNLESS OTHERWISE NOTED)

TABLE 3.34

RADIOLOGICAL CLASSIFICATION OF SUB-SURFACE SOIL SAMPLES TAKEN ALONG NORTH CENTRAL WALL OF CANAL G

			CONCENTRATION pCi/g			
DEPTH	SAMPLE NUMBER	SAMPLE TYPE	GROSS ALPHA	GROSS BETA-GAMMA	uR/hr	SOIL TYPE
0"	NONE	-	-	-	-	CONCRETE
6"	1	CONCRETE	LT 7E0	2.2E+1	7.0	CONCRETE*
12"	2	SOIL	LT 7E0	2.5E+1	7.0	
18"	3	SOIL	LT 7E0	2.7E+1	7.5	
24"	4	SOIL	LT 7E0	2.9E+1	7.0	
4'	5	SOIL	LT 7E0	2.4E+1	7.0	
6'	6	SOIL	LT 7E0	2.4E+1	6.5	BROWN SAND
8'	7	SOIL	LT 7E0	2.0E+1	6.0	&
10'	8	SOIL	LT 7E0	2.4E+1	6.0	SILT
12'	9	SOIL	LT 7E0	2.5E+1	6.0	
14'	10	SOIL	LT 7E0	2.4E+1	6.5	
16'	11	SOIL	3.6E0	2.7E+1	6.5	
18'	12	SOIL	5.1E0	2.4E+1	6.5	
20'	13	SOIL	4.6E0	2.2E+1	6.5	
22'	14	SOIL	4.6E0	3.0E+1	6.0	
24'	15	SOIL	3.6E0	2.4E+1	6.0	GRAY SAND
26'	16	SOIL	6.6E0	2.7E+1	7.5	& SILT
28'	17	LIMESTONE	6.1E0	2.4E+1	6.5	GRAY LIME-STONE
30'		NONE				

*6.5" of concrete noted.

A similar group of samples were also obtained inside the hot work area of the Hot Lab at the southwest intersection of Canals J and K. Techniques were again identical to those previously described. The top layer of concrete in this area was found to be 16.5" thick. This is consistent with the facility drawings and was planned in order to handle the weight of lead shielded containers, fork lifts, etc.

The results of the sample analyses and soil characterization are shown in Table 3.35. This data agrees closely with that obtained in the vicinity of Canal G and also shows that sub-surface soil radioactivity is at background levels and that no contamination of sub-surface soils has occurred in the vicinity of Canals J and K.

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TABLE 3.35
RADIOLOGICAL CLASSIFICATION OF SUB-SOIL SAMPLES TAKEN AT SOUTHWEST INTERSECTION OF CANALS J & K IN THE HOT LAB WORK AREA

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	CONCENTRATION pCi/g GROSS ALPHA	GROSS BETA-GAMMA	uR/hr	SOIL TYPE
0"	19	SURFACE CONCRETE	LT 6E0	1.2E+1	5.0	CONCRETE*
6"	1	CONCRETE	8.6E0	2.6E+1	4.5	CONCRETE*
12"	2	CONCRETE	LT 6E0	2.2E+1	4.5	CONCRETE*
18"	3	SOIL	6.6E0	2.0E+1	4.0	GRAVEL
24"	4	SOIL	LT 6E0	2.6E+1	4.0	GRAVEL
4'	5	SOIL	6.1E0	2.8E+1	4.5	
6'	6	SOIL	LT 6E0	1.8E+1	5.0	
8'	7	SOIL	8.1E0	2.7E+1	5.0	BROWN FINE
10'	8	SOIL	LT 6E0	3.1E+1	5.0	SANDY SILT
12'	9	SOIL	LT 6E0	2.8E+1	4.5	
14'	10	SOIL	LT 6E0	2.6E+1	4.5	
16'	11	SOIL	LT 6E0	2.6E+1	4.5	
18'	12	SOIL	LT 6E0	2.4E+1	4.5	GRAY SANDY
20'	13	SOIL	LT 6E0	2.5E+1	5.0	SILT
22'	14	SOIL	LT 6E0	2.8E+1	4.5	
24'	15	SOIL	6.1E0	2.4E+1	5.0	FILL
26'	16	SOIL	LT 6E0	7.9E0	4.5	SOME WOOD**
26'	20	FOOTER CONCRETE	LT 6E0	2.8E+1	5.0	CONCRETE**
28'	17	LIMESTONE	LT 6E0	2.9E+1	4.5	GRAY
30'	18	NONE	-	-	-	LIMESTONE

*16.5" of concrete noted.
**Wood forms and concrete footer for Canal G noted.

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3.4 INDOOR RADIOLOGICAL CLASSIFICATION OF BUILDINGS AND STRUCTURES

Background radiological monitoring was performed in several buildings at Plum Brook Station in order to establish normal background levels as a basis for interpreting sampling data obtained from various buildings and structures at the Plum Brook Reactor Facility. Care was taken to select background areas similar to those conditions encountered within PBRF. These included type of construction, materials used, elevations, etc. Table 3.36 summarizes background monitoring at these selected areas outside of the PBRF but within Plum Brook Station.

Most background data was consistent; however, one difference was noted. Steel roof decking and metal tank walls emitted a lower gamma background than concrete or plastered surfaces.

3.4.1 Building #1111 - Reactor Building

3.4.1.1 Containment Vessel

The Containment Vessel (CV) is a circular vessel 100′ in diameter and extending from 56′ below grade to 53′ above grade. The vessel was fabricated from 3/4" steel plate. Personnel access to the CV is through one of the two air locks. It lies within the Reactor Building (#1111).

During operations, the CV was maintained at a slight negative pressure to assure flow of air into, rather than out of, the vessel during entry. Since shutdown in 1973 no forced ventilation has been operated and the vessel has been at ambient pressures. The CV atmosphere breathes to the outside through a filter housing which is left open.

Direct alpha and beta-gamma surveys were made of the CV utilizing twenty pie-shaped grids at the 0′ level and above. Smears were taken to determine the extent of removable alpha and beta-gamma contamination. Vertically the grids were divided into three sections. The lower section represented the area from 0′ floor level to +10′ level. The middle section represented the area from the +10′ level to +20′ level. The upper section represented area from the +20′ level to +30′ level.

Similar surveys were taken at the -7′, -15′, and -25′ levels. Surveys were also taken in the Sub-pile Room and in the areas leading to the Sub-pile Room.

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TABLE 3.36 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BACKGROUND SAMPLES

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	LOOSE CONTAMINATION (d/m/100 sq cm) BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	FIXED CONTAMINATION c/m (GS-3) BETA	DIRECT RADIATION mR/hr
FLOOR (SEALED CONCRETE) BLDG. #3211 (B-2)	Average	LT 1	11	LT 1	30	.004
	Maximum	1	19	3	50	.006
	Minimum	0	0	0	LT 25	.003
	No. Samples	15	15	15	75	15
CONCRETE FLOOR BLDG. #7141 (EB)	Average	LT 1	12	3	42	.005
	Maximum	1	26	6	125	.005
	Minimum	0	0	0	LT 25	.005
	No. Samples	5	5	5	25	5
TILE FLOOR BLDG. #7141 (EB)	Average	LT 1	3	7	LT 25	.004
	Maximum	1	6	10	25	.004
	Minimum	0	1	4	LT 25	.004
	No. Samples	2	2	2	10	2
HALLWAY BLDG. #1142 (ROB)	Average	1	13	4	33	.006
	Maximum	1	13	4	50	.006
	Minimum	1	13	4	LT 25	.006
	No. Samples	1	1	1	3	1
METAL TANK WALL BLDG. #3211 (B-2)	Average	0	11	1	25	.002
	Maximum	0	18	3	25	.002
	Minimum	0	5	0	25	.001
	No. Samples	6	6	6	30	6
ROOF (ASPHALT STEEL DECK) BLDG. #8531 (PH-1)	Average	0	0	0	30	.005
	Maximum	0	0	0	50	.005
	Minimum	0	0	0	LT 25	.005
	No. Samples	2	2	2	10	2
WALLS-CONCRETE BLDG. #3211 (B-2)	Average	LT 1	8	3	31	.004
	Maximum	1	12	9	50	.005
	Minimum	0	3	0	25	.004
	No. Samples	5	5	5	25	5

TABLE 3.36 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BACKGROUND SAMPLES (Continued)

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
WALLS-STEEL BLDG. #1121 (ATS)	Average	LT 1	11	2	27	.005
	Maximum	1	22	7	50	.009
	Minimum	0	1	0	LT 25	.004
	No. Samples	6	6	6	30	6
WALLS-CONCRETE BLOCK (FIRE STATION) BLDG. #7233	Average	0	13	LT 1	28	.004
	Maximum	0	14	1	50	.004
	Minimum	0	12	0	LT 25	.004
	No. Samples	2	2	2	10	2
WALLS-PLASTERED BLDG. #7141 (EB)	Average	2	12	9	26	.004
	Maximum	19	18	18	50	.004
	Minimum	0	5	1	LT 25	.003
	No. Samples	8	8	8	40	8
CEILINGS-METAL BLDG. #1121 (ATS)	Average	LT 1	8	2	27	.003
	Maximum	1	9	4	50	.003
	Minimum	0	6	0	LT 25	.002
	No. Samples	3	3	3	15	3
CEILINGS-CONCRETE BLDG. #8531 (PH-1)	Average	0	3	0	25	.005
	Maximum	0	3	0	25	.005
	Minimum	0	3	0	25	.005
	No. Samples	1	1	1	5	1

Quadrants A, B, C, and D could not be evaluated because of the many sources of radiation present in piping, hardware and the reactor bioshield penetrations. These resulted in elevated backgrounds which made it impractical to obtain meaningful indications of structural contamination.

The polar crane was monitored to determine the extent of contamination. Smear surveys indicate a maximum beta-gamma contamination of 173 d/m/100 sq cm with an average of 54 d/m/100 sq cm. The alpha smear survey indicates a maximum of 5 d/m/100 sq cm with the average less than 2 d/m/100 sq cm. Direct radiation readings were influenced by the broad field emanating from the quadrant hardware.

The results of the radiological monitoring in the CV appear in Table 3.37. Appendix 3.11, Part 2, provides the exact locations and total radiological monitoring data for the CV.

The elevated fixed alpha contamination results from the accumulation of naturally occurring Radon 222 and its daughter Polonium 210 emanating from the stone aggregate in the concrete structure. This is discussed in more detail in Section 3.6 of this volume.

As a general observation contamination levels indicate that the white zone areas of the CV structure presently meet release levels providing the various sources of direct radiation are removed. These sources would be the contaminated drains, piping, systems, reactor tank and bioshield.

The Sub-pile Room has one very small narrow beam of high radiation streaming through the control rod drive penetrations in the ceiling. This beam shows a dose rate of 500 mR/hr. Compared to readings taken in 1973 and 1978 this area has decreased similarly to Cobalt 60 decay and apparently is related to reactor tank activity.

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TABLE 3.37 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1111 - CONTAINMENT VESSEL ABOVE GRADE

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
FLOOR 0´ LEVEL	Average	1	29	57	169	.036
	Maximum	5	104	82	1000	.210
	Minimum	0	0	24	0	.010
	No. Samples	20	20	20	500	20
LOWER WALL +10´	Average	LT 1	4	30	142	.013
	Maximum	3	28	48	250	.020
	Minimum	0	0	12	0	.009
	No. Samples	20	20	20	500	20
MIDDLE WALL +20´	Average	LT 1	5	37	78	.025
	Maximum	2	31	68	175	.042
	Minimum	0	0	12	25	.012
	No. Samples	20	20	20	500	20
UPPER WALL +30´	Average	LT 1	0	42	68	.013
	Maximum	2	0	85	150	.017
	Minimum	0	0	21	50	.009
	No. Samples	20	20	20	500	20
FLOORS	Average	LT 1	30	42	291	.045
	Maximum	3	189	206	3000	.450
	Minimum	0	5	15	75	.006
	No. Samples	22	22	22	110	22
WALLS	Average	LT 1	10	36	218	.035
	Maximum	2	185	65	4000	.380
	Minimum	0	0	12	75	.005
	No. Samples	41	41	41	205	41
CEILINGS	Average	0	LT 1	41	193	.026
	Maximum	0	2	53	250	.050
	Minimum	0	0	26	100	.009
	No. Samples	4	4	4	20	4
SUB-PILE ROOM	Average	LT 1	30	17	2696	73.7
	Maximum	2	45	38	12000	500
	Minimum	0	12	6	500	2
	No. Samples	7	7	7	35	7

3.4.1.2 Outside The Containment Vessel

A comprehensive radiological evaluation was performed in 1985 throughout the Reactor Building, external to the CV. The detailed results of this data are presented in Appendix 3.11, Part 2. A summary presentation of the data appears in Table 3.38 following. The data for Canals F, G, and H are presented along with all canal data in Section 3.4.2.

Based on this data it appears that no significant contamination would prevent the release of Building #1111 following removal of the various contaminated piping systems, MUR, fuel racks, and other sources of external radiation in the Reactor Building.

3.4.2 Quadrants And Canals

The Plum Brook Reactor Facility was designed with a series of quadrants and canals to be used for shielding and underwater transfer of radioactive materials. With this system it was possible to transfer materials or fuel assemblies to or from the reactor tank, to/from the fuel storage area, or to/from the Hot Laboratory. Figure 3.30 shows the relationship of the various canals.

The reactor tank is surrounded by four quadrants, A, B, C, and D. Quadrants A, C, and D were water-filled and 25′ deep. Quadrant B is a dry area 27′ deep. Quadrants A and C connect with Canal E inside the containment vessel. When open, the E-F door permits transfer of materials to and from the containment vessel. Canal D contains the Underwater Beam Room. Canal G was used for spent fuel storage and contains the spent fuel storage racks. Canal H contains the swimming pool type MUR reactor. Canals J and K are located in the Hot Laboratory. All canals were water-filled and 25' deep.
Meaningful monitoring of the four quadrants could not be accomplished due to the general radiation field from the reactor tank and bioshield penetrations, systems piping and experiment hardware present. All canals were comprehensively monitored. The walls and floors of each were indexed into 15′ grids with an upper and lower section for each wall grid.

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TABLE 3.38 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1111 - OUTSIDE THE CONTAINMENT VESSEL

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
-25´ FLOORS	Average	LT 1	31	11	148	.009
	Maximum	2	352	22	5000	.019
	Minimum	0	0	3	50	.005
	No. Samples	14	14	14	70	14
-25´ WALLS	Average	LT 1	13	6	84	.010
	Maximum	1	30	8	125	.014
	Minimum	0	2	0	50	.006
	No. Samples	6	6	6	30	6
PPP ROOM	Average	0	43	9	137	.079
	Maximum	0	147	15	1000	.230
	Minimum	0	4	3	0	.015
	No. Samples	16	16	16	80	16
-15´ FLOORS	Average	LT 1	4	6	52	.007
	Maximum	2	14	14	200	.040
	Minimum	0	0	0	0	.004
	No. Samples	44	44	44	220	44
-15´ WALLS	Average	0	5	3	84	.010
	Maximum	0	8	6	125	.023
	Minimum	0	0	0	50	.005
	No. Samples	7	7	7	35	7
0´ FLOORS	Average	LT 1	7	3	49	.008
	Maximum	5	145	11	250	.030
	Minimum	0	0	0	0	.004
	No. Samples	79	79	79	395	79
0´ WALLS	Average	0	7	5	67	.008
	Maximum	0	17	8	100	.011
	Minimum	0	0	0	0	.005
	No. Samples	12	12	12	60	12

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TABLE 3.38 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1111 - OUTSIDE THE CONTAINMENT VESSEL (Continued)

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
PENTHOUSE	Average	0	7	0	LT 100	.005
	Maximum	0	24	0	100	.006
	Minimum	0	0	0	LT 100	.004
	No. Samples	5	5	5	5	5
0´ AIRLOCKS	Average	0	9	6	53	.005
	Maximum	0	20	8	100	.007
	Minimum	0	3	0	25	.003
	No. Samples	12	12	12	60	12
MEZZANINE	Average	LT 1	5	4	36	.006
	Maximum	2	17	14	100	.010
	Minimum	0	0	0	0	.003
	No. Samples	30	30	30	150	30

UNDER WATER BEAM ROOM

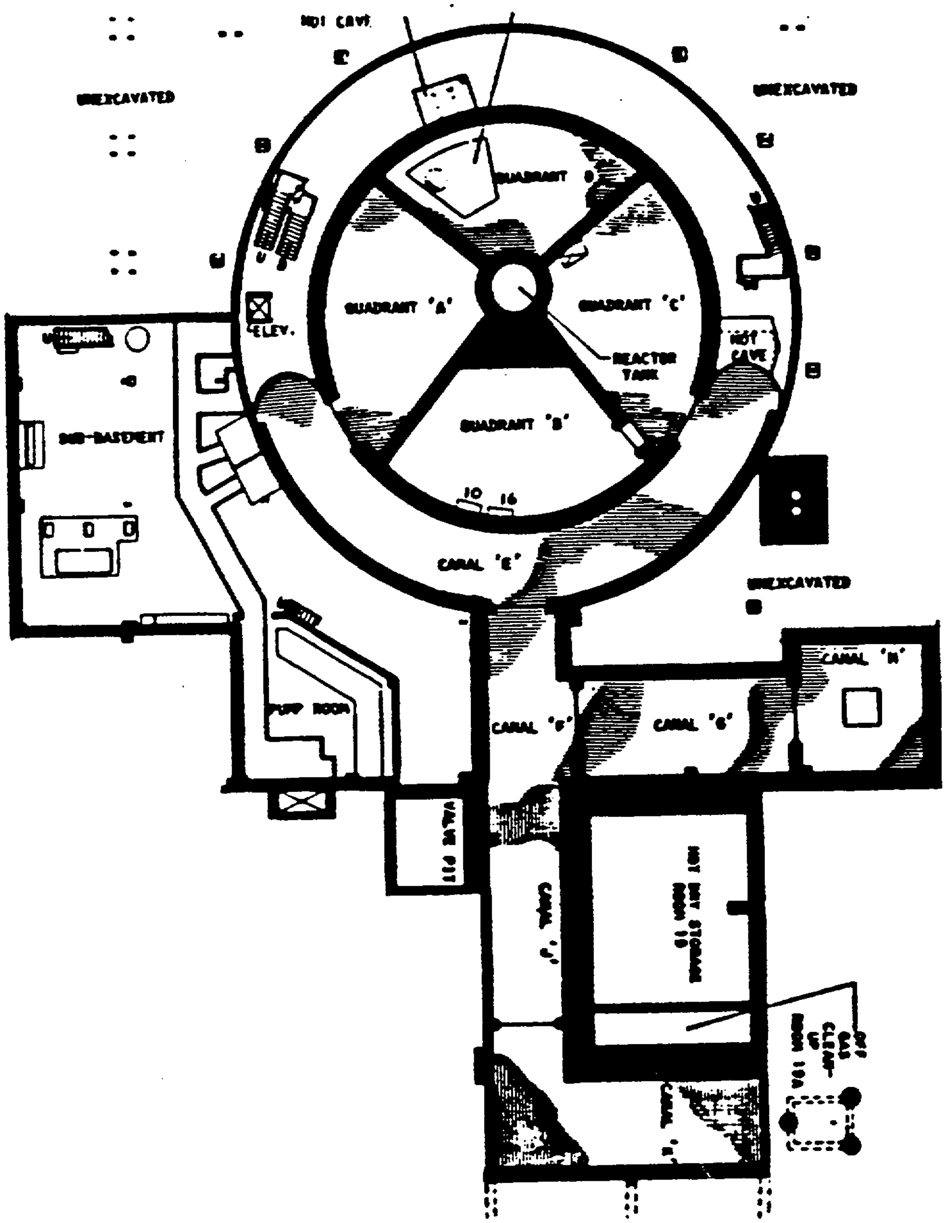

FIGURE 3.30 - PBRF QUADRANT & CANAL SYSTEM

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Table 3.39 presents the summary data for each canal. The results indicate some low level contamination to be present. Hardware present in Canals E and G and the MUR in Canal H influenced some measurements; nevertheless, the conclusion was not altered. This is, removal of contaminated systems and hardware present with modest decontamination effort should enable the canal structures to meet release levels. This conclusion will likely apply to Quadrants A thru D also. Fiqure 3.31 indicates radiation levels present in the Canal G spent fuel storage systems in micro-rads/hour.

Complete data are present in Appendix 3.12 for all canal floor and wall structures.

3.4.3 Building #1112 - Hot Laboratory

The Hot Laboratory, located south of and abutting the Reactor Building, provides facilities for working with radioactive materials. Underwater transfer of materials from the reactor is possible through a series of canals. Figure 3.32 shows the layout of the facility.

Located behind Cells #1 and #2 are the Hot Dry Storage Area and the Off Gas Cleanup and Storage Facility. These facilities were previously described in Section 3.3.8.

Seven hot cells equipped with remote manipulators are located in the laboratory. Behind Cells #1 and #2 is a hot handling room where materials can be remotely transferred from the canal to the hot cells or the Hot Dry Storage Area. This room is separated from the other hot work areas by an 80-ton lead filled door and also contains the Off Gas Cleanup System previously described in Section 3.3.7.

Behind Cells #3 through #7 are a decontamination room, a repair shop, and a storage room.

The cold side consists of an area to control the manipulators while observing operations through shielding windows, a manipulator repair shop and a change room.

For this study all rooms were divided into grids and surveyed for radiological monitoring. Walls and floors were indexed with 15′ by 15′ grids, while 30′ by 30′ grids were used on the ceilings. Summary results of the surveys are tabulated in Table 3.40. The survey indicated that most of the area can be decontaminated with thorough scrubbing. In a few places, particularly near the cell doors, door tracks and some adjacent concrete must be removed. Appendix 3.13 contains the total results of the Hot Lab radiological classification.

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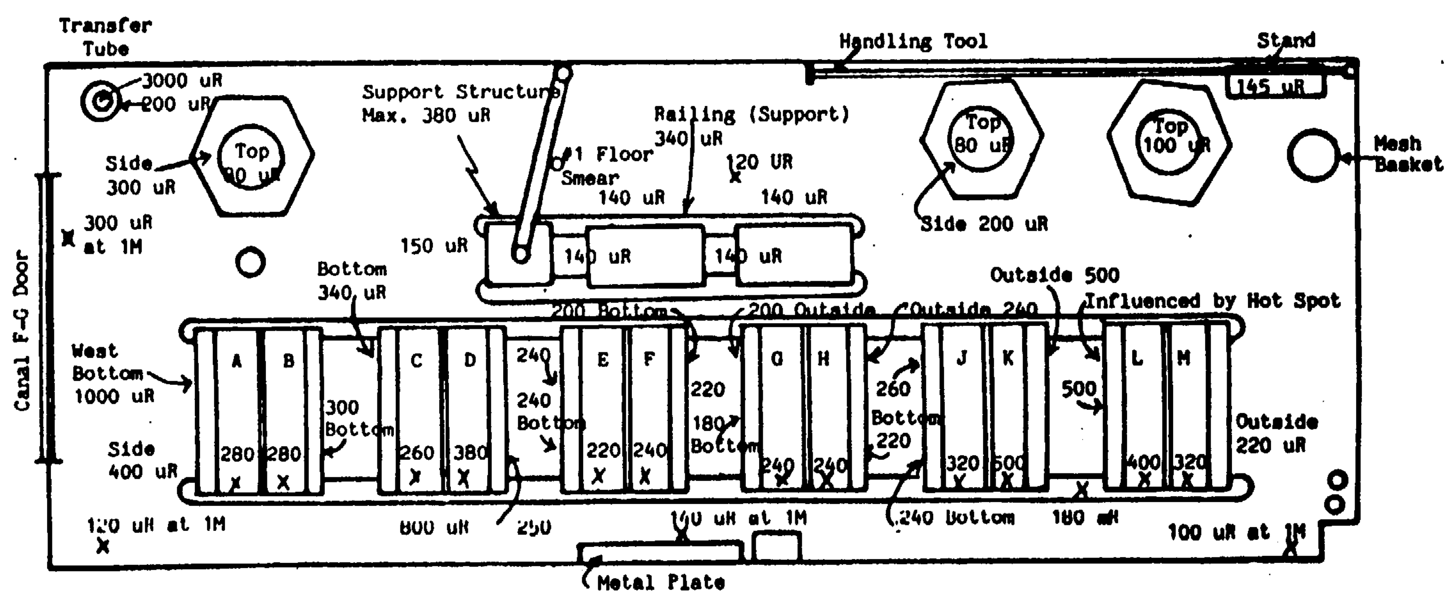
TABLE 3.39 - RADIOLOGICAL CLASSIFICATION OF THE PBRF CANALS E THRU K

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
CANAL E	Average	2	1173	43	386	.081
	Maximum	7	9443	79	3500	.310
	Minimum	0	28	15	100	.019
	No. Samples	44	44	44	220	44
CANAL F-J	Average	1	695	29	612	.106
	Maximum	2	4030	429	10000	.700
	Minimum	0	88	0	50	.040
	No. Samples	29	29	29	145	29
CANAL G	Average	2	1319	17	424	.113
	Maximum	5	4869	106	1500	.300
	Minimum	0	153	0	150	.006
	No. Samples	19	19	19	95	19
CANAL H	Average	1	16	1	188	.105
	Maximum	3	28	6	450	.280
	Minimum	0	2	0	75	.004
	No. Samples	14	14	14	70	14
CANAL K	Average	2	733	14	333	.045
	Maximum	5	1868	44	1800	.300
	Minimum	0	97	6	125	.001
	No. Samples	19	19	19	95	19



*All readings are in micro-Rads/hour.

FIGURE 3.31 - GAMMA RADIATION DOSE RATES FROM CANAL G
SPENT FUEL STORAGE FACILITY

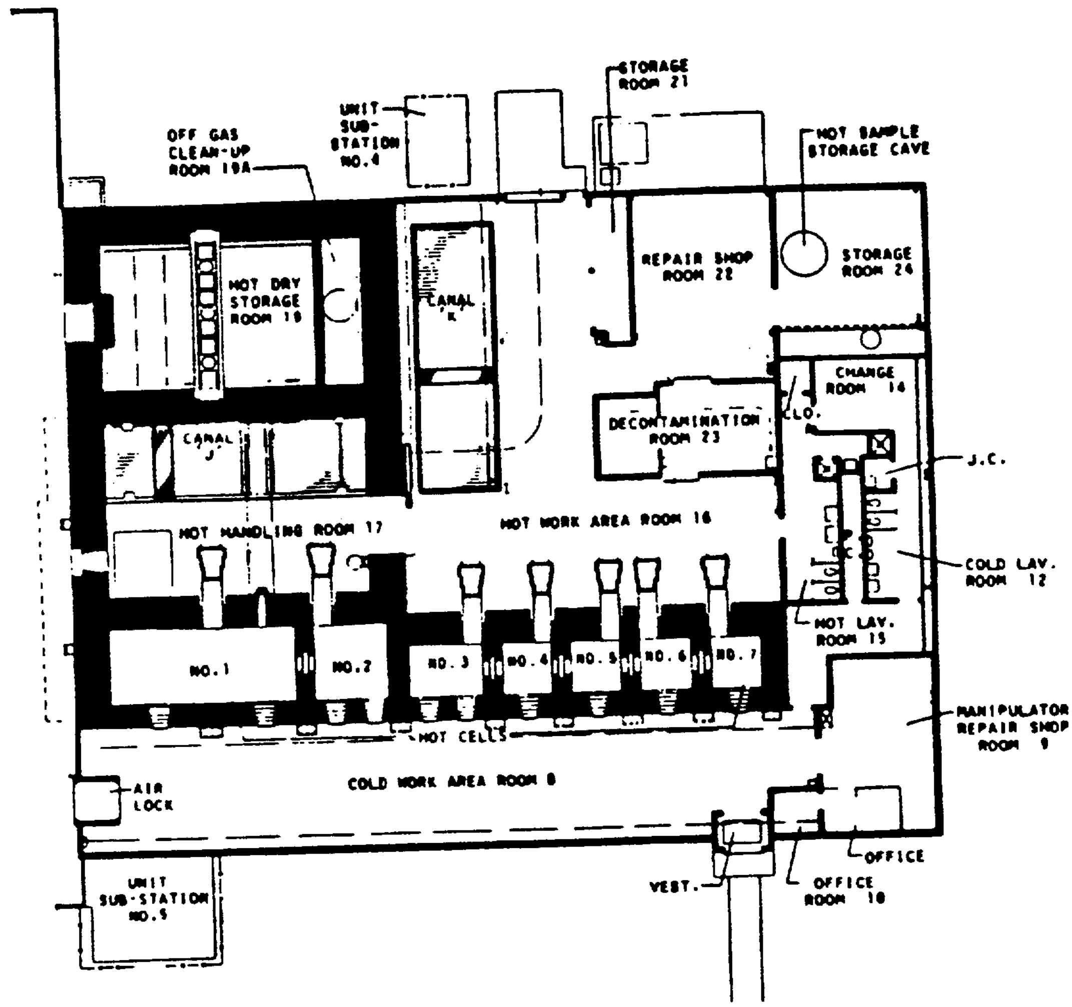


FIGURE 3.32 - BUILDING #1112 PLAN VIEW PBRF HOT LABORATORY

TELEDYNE ISOTOPES

TABLE 3.40 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BLDG. #1112 - HOT LABORATORY

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
COLD WORK AREA FLOOR	Average	LT 1	9	8	65	.007
	Maximum	2	27	15	125	.010
	Minimum	0	0	0	25	.050
	No. Samples	14	14	14	70	14
COLD WORK AREA WALLS	Average	LT 1	9	8	63	.008
	Maximum	3	186	21	125	.022
	Minimum	0	0	0	25	.005
	No. Samples	34	34	34	170	34
COLD WORK AREA CEILINGS	Average	0	2	14	50	.009
	Maximum	0	5	21	125	.012
	Minimum	0	0	9	25	.006
	No. Samples	4	4	4	20	4
HOT WORK AREA FLOOR	Average	LT 1	206	107	2133	.034
	Maximum	1	764	388	50000	.127
	Minimum	0	0	6	100	.012
	No. Samples	15	15	15	75	15
HOT WORK AREA WALLS	Average	LT 1	64	10	98	.019
	Maximum	8	717	38	200	.080
	Minimum	0	0	0	25	.006
	No. Samples	33	33	33	165	33
HOT WORK AREA CEILINGS	Average	0	6	10	85	.014
	Maximum	0	15	15	200	.017
	Minimum	0	0	6	25	.010
	No. Samples	5	5	5	25	5
DECON RM. FLOORS	Average	2	2096	279993*	GT 10760	4426
	Maximum	4	4191	558824*	GT 50000	8850
	Minimum	0	0	1162*	200	1.1
	No. Samples	2	2	2	10	2
DECON RM. WALLS	Average	17	25269	24	1750	.174
	Maximum	208	337638	50	40000	.375
	Minimum	0	376	0	150	.038
	No. Samples	14	14	6	34	9

*Suspected false alpha indications because of the very high beta/gamma levels causing interference with the PRS-1 alpha monitor.

TABLE 3.40 - RADIOLOGICAL CLASSIFICATION OF THE PBRF
BLDG. #1112 - HOT LABORATORY (Continued)

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
DECON RM. CEILINGS	Average	2	262	18	215	.055
	Maximum	3	510	18	350	.080
	Minimum	0	13	18	100	.030
	No. Samples	2	2	2	10	2
REPAIR SHOP FLOOR	Average	LT 1	116	29	176	.020
	Maximum	2	192	65	1000	.030
	Minimum	0	67	9	100	.012
	No. Samples	4	4	4	20	4
REPAIR SHOP WALLS	Average	LT 1	190	7	93	.017
	Maximum	4	1687	21	300	.060
	Minimum	0	12	0	50	.004
	No. Samples	14	14	14	70	14
REPAIR SHOP CEILING	Average	0	270	9	85	.009
	Maximum	0	270	9	100	.009
	Minimum	0	270	9	75	.009
	No. Samples	1	1	1	5	1
STORAGE ROOM FLOOR	Average	0	78	14	115	.014
	Maximum	0	122	24	200	.025
	Minimum	0	15	6	100	.008
	No. Samples	4	4	4	20	4
STORAGE ROOM WALLS	Average	LT 1	31	10	80	.009
	Maximum	2	205	18	150	.015
	Minimum	0	0	0	50	.007
	No. Samples	13	13	13	65	13
STORAGE ROOM CEILINGS	Average	0	12	0	80	.006
	Maximum	0	12	0	125	.006
	Minimum	0	12	0	25	.006
	No. Samples	1	1	1	5	1
MEZZANINE FLOOR	Average	LT 1	421	14	365	.017
	Maximum	2	1540	35	2000	.060
	Minimum	0	48	3	100	.005
	No. Samples	10	10	10	50	10
MEZZANINE WALLS	Average	LT 1	49	8	147	.010
	Maximum	2	169	18	200	.070
	Minimum	0	0	0	25	.003
	No. Samples	27	27	27	135	27

TELEDYNE ISOTOPES

TABLE 3.40 - RADIOLOGICAL CLASSIFICATION OF THE PBRF
BLDG. #1112 - HOT LABORATORY (Continued)

LOCATION	RANGE & NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
MEZZANINE	Average	LT 1	69	4	65	.006
CEILING	Maximum	1	97	6	100	.008
	Minimum	0	47	3	25	.004
	No. Samples	5	5	5	25	5
HOT	Average	2	3755	6	551	.309
HANDLING	Maximum	8	18852	15	2000	1.000
FLOORS	Minimum	0	172	0	75	.026
	No. Samples	12	12	12	60	12
HOT	Average	LT 1	109	4	220	.088
HANDLING	Maximum	2	573	12	1000	.220
WALLS	Minimum	0	0	0	100	.016
	No. Samples	30	30	30	142	30
HOT	Average	LT 1	32	6	191	.050
HANDLING	Maximum	1	54	9	325	.070
CEILING	Minimum	0	23	3	100	.038
	No. Samples	4	4	4	20	4
HOT PIPE	Average	3	5314	-	GT 21100	19
TUNNEL	Maximum	17	47363	-	GT 50000	85
GENERAL	Minimum	0	0	-	1500	2
BKGD.	No. Samples	15	15	-	45	15

TELEDYNE ISOTOPES

In addition to the radiological survey conducted in the general hot and cold areas of the Hot Laboratory, a survey was made in the hot cells. Each of the seven hot cells was opened to allow the study team to enter. Both ionization chamber and GM instruments were used in obtaining the field and contact readings.

All cells contained a large number of items in storage, some of which were locally shielded. This prevented comprehensive radiological classification of the cell structures themselves; nevertheless, a general radiological evaluation was obtained. These data were presented earlier in this volume in Section 3.3.9, Tables 3.32 and 3.33.

3.4.3.1 Hot Pipe Tunnel

The Reactor Office and Lab Building (ROLB), Hot Lab (HL), Reactor Building (RB), and Fan House (FH) are connected by the hot pipe tunnels. These tunnels contain piping handling liquid and airborne materials that were radiologically contaminated.

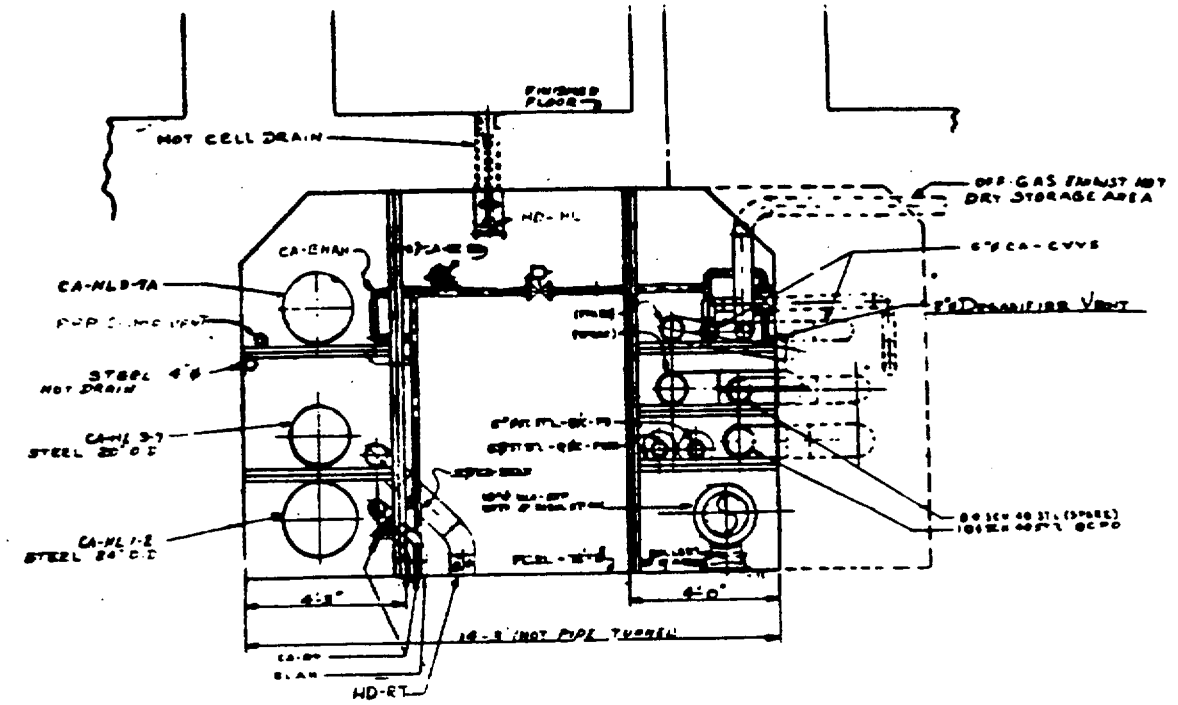
The tunnel between the ROLB and the HL is a corrugated steel pipe 6′ in diameter. It starts from Sump Room #11 in the ROLB and joins the tunnel located under the HL. This tunnel carries the discharge lines from Sump Room #11 hot sumps.

The main section of the Hot Pipe Tunnel is a concrete structure built in an "L" configuration. The north-south section is 108′ long starting at the junction of the RB and the HL. The east-west section is 89′ long and terminates at a gate in the basement of the FH. Each leg of the tunnel is 14′-3" wide by 10′-0" high with a floor elevation of -12′-0". Near the ceiling the sides slope at 45 degrees to form an arch.

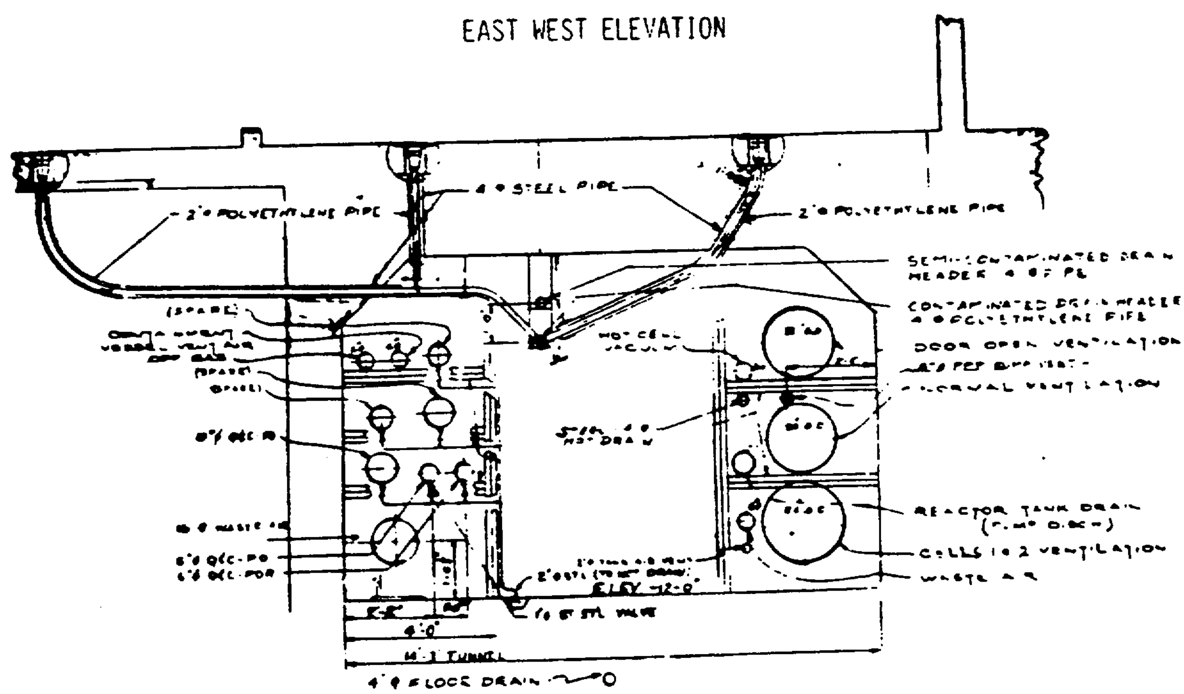
To ventilate the tunnel, a 32200 CFM blower located in the Fan House drew air from the Fan House basement, discharging through a roughing and absolute filter to the stack. Supply air enteredfrom Sump Room #11 in ROLB, or through an automatic louver located in the northwest end of the Hot Pipe Tunnel. This louver is set to regulate pressure at 1/8" W.G. This ventilation system has been secured during shutdown.

Figure 3.33 shows cross sections of the concrete tunnel.

TELEDYNE ISOTOPES



EAST WEST ELEVATION



NORTH SOUTH ELEVATION
HOT PIPE TUNNEL PIPING LOCATIONS

FIGURE 3.33 - CROSS SECTION OF PBRF HOT PIPE TUNNEL

A radiological survey of the tunnel was made. Fifteen-foot grids were used for indexing. Three readings were taken from the floor in each grid. One reading was taken from the center of each grid at the ceiling. A side wall survey was not made because of the pipes located in the racks in this area. The floor and ceiling were smeared for transferable contamination. One smear was taken from the ceiling at the center of the grid. A smear was also taken from the floor at the location of the highest contact reading. Summary results of the Hot Pipe Tunnel survey are presented at the end of Table 3.40.

Surveys of individual pipes in the tunnel indicate the majority of the activity is from the 4" polyethylene line from the hot cell drains. Figure 3.34 shows the results of this survey by illustrating contact gamma dose rates at the outside surface of the pipe.

All other pipes in the tunnel were monitored for direct radiation and wipe samples taken at 5′ intervals.

During the study we found the 4" polyethylene hot cell drain line had broken, leaking contamination on the floor. It is believed the expansion/contraction due to temperature difference together with possible failure due to radiation damage is the cause of failure.

The fracture was repaired by wrapping the pipe with adhesive backed aluminum repair tape and then covering the joint with "Bondo" body filler. A wipe sample of the floor area was then taken. Isotopic analysis of the smear indicates 60 Co of 8.93E+04 pCi/100 sq cm and 137 CS of 2.49E+03 pCi/100 sq cm.

A strippable coating formulated to remove contamination from concrete and metal surfaces was applied to an area of 25 sq ft. The material, Alara 1146, was only partially successful in removing the contamination. The material was applied to the surface and allowed to cure. The coating was then stripped from the floor and bagged. After a one week interval, the process was repeated. Results of the decontamination effort are as follows.

TELEDYNE ISOTOPES

APPLICATION	SURVEY BEFORE TREATMENT	SURVEY AFTER TREATMENT	DECON FACTOR
First	3600 mR/hr Beta	2100 mR/hr Beta	1.7
	400 mR/hr Gamma	400 mR/hr Gamma	-
Second	2100 mR/hr Beta	2100 mR/hr Beta	-
	400 mR/hr Gamma	400 mR/hr Gamma	-
Total (1&2)	3600 mR/hr Beta	2100 mR/hr Beta	1.7
	400 mR/hr Gamma	400 mR/hr Gamma	-

To obtain acceptable decontamination in this area it will be necessary to remove approximately 1/4" of the concrete surface. It should be noted that the concrete was not sealed or coated in this area.

TELEDYNE ISOTOPES

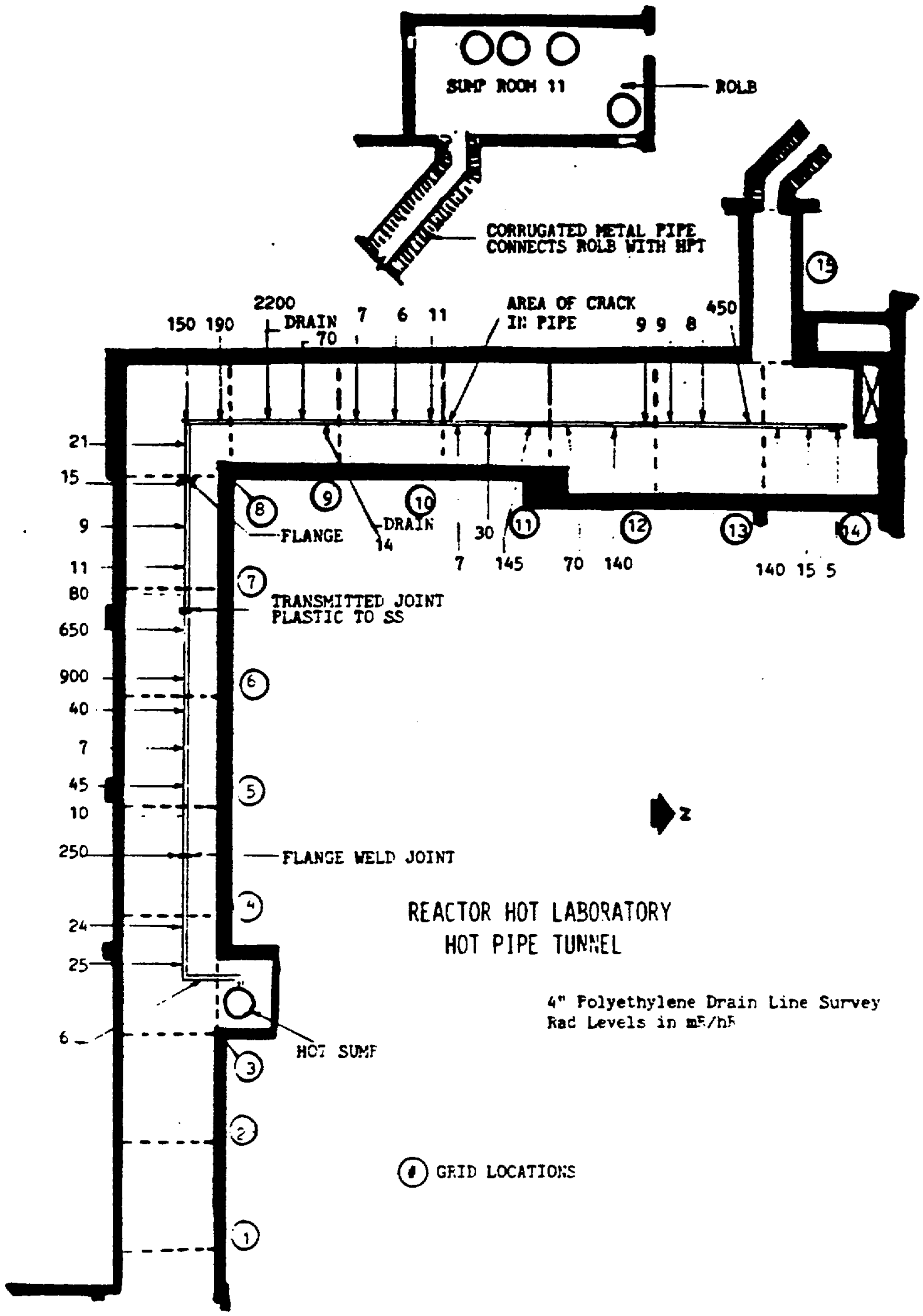


FIGURE 3.34 - GAMMA RADIATION LEVELS EMITTED FROM HOT CELL DRAIN LINE IN THE PBRF HOT PIPE TUNNEL

TELEDYNE ISOTOPES

3.4.4 Building #1132 - Fan House

A radiological evaluation of the Fan House was performed utilizing a 15′ square grid indexing system to accurately identify locations for monitoring. This evaluation indicates that the Building #1132 structure itself is not contaminated. The various ducts, pipes, equipment, etc., used in the contaminated air and water systems are internally contaminated and therefore do emit low level gamma radiation which causes background radiation to be in excess of release levels in many areas of the building. When these contaminated systems are carefully removed it should require relatively little effort to further decontaminate the Fan House structure itself. The contamination in these air and water systems was discussed previously in Section 3.3 in detail. The summary results of the Fan House radiological classification are presented in Table 3.41. Complete data are presented in Appendix 3.14.

The Fan House stack was also monitored when the structure evaluation was performed. This stack is a 100′ high 5′ diameter vertical steel pipe mounted on a concrete support stand with a vortex plenum at the base. Data from this monitoring was presented previously in this volume in Section 3.3.7, Table 3.30 and elsewhere on page 3-99. The data shows that the structure itself has minimal contamination with only one localized spot on the access hatch interior being in excess of release limits. There is a collection of silt at the base of the concrete support structure which does show levels of radioactive contamination of 3.5 E+4 pCi/g. This silt was removed as low level waste and the concrete base floor was partially decontaminated to permit repairs to the spalled concrete and corroded metal access door. A metal cap ("Chinese hat") was also placed at the top of the stack to prevent rain water from collecting at the stack base and accelerating corrosion and spalling during freeze/thaw cycles.

3.4.5 Building #1133 - Waste Handling Building

The radiological evaluation of the Waste Handling Building was performed in a similar fashion to that performed in the Fan House. The general radiation level in the Waste Handling Building is influenced by the contaminated waste evaporator and other contaminated systems as well as the small quantity of low level waste in storage. There is some low level radioactive contamination in the basement evaporator room that will require removal during future decontamination efforts. Most of the remainder of the building structure will require little decontamination effort once the contaminated systems piping and equipment is removed. Table 3.42 summarizes the data from the radiological evaluation of Building #1133. Complete data are presented in Appendix 3.15.

TELEDYNE ISOTOPES

TABLE 3.41 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1132 - FAN HOUSE

LOCATION	RANGE NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
FIRST FLOOR FLOORS	Average	LT 1	18	4	131	.066
	Maximum	1	89	14	1500	.360
	Minimum	0	0	0	50	.006
	No. Samples	19	19	19	90	19
FIRST FLOOR WALLS	Average	LT 1	5	5	72	.021
	Maximum	2	16	17	200	.036
	Minimum	0	0	0	25	.003
	No. Samples	33	33	33	145	33
FIRST FLOOR CEILINGS	Average	LT 1	4	5	70	.016
	Maximum	1	11	14	150	.022
	Minimum	0	0	0	25	.006
	No. Samples	6	6	6	28	6
BASEMENT FLOORS	Average	LT 1	37	5	1040	.398
	Maximum	1	88	14	12000	2.200
	Minimum	0	0	0	50	.005
	No. Samples	16	16	16	75	16
BASEMENT WALLS	Average	LT 1	13	9	449	.220
	Maximum	1	102	22	12000	.950
	Minimum	0	0	0	50	.004
	No. Samples	24	24	24	116	24
BASEMENT CEILING	Average	0	10	8	555	.167
	Maximum	0	51	14	2000	.280
	Minimum	0	0	3	50	.008
	No. Samples	5	5	5	24	5

TELEDYNE ISOTOPES

TABLE 3.42 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1133 - WASTE HANDLING BUILDING

LOCATION	RANGE NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
1ST FLOOR FLOOR (WHITE)	Average	LT 1	22	4	105	.020
	Maximum	1	50	27	1500	.050
	Minimum	0	0	0	50	.001
	No. Samples	18	18	18	76	18
1ST FLOOR WALLS (WHITE)	Average	LT 1	8	4	90	.019
	Maximum	1	50	14	250	.080
	Minimum	0	0	0	25	.004
	No. Samples	50	50	50	218	50
1ST FLOOR CEILINGS (WHITE)	Average	LT 1	6	4	72	.025
	Maximum	1	24	14	300	.085
	Minimum	0	0	0	25	.004
	No. Samples	13	13	13	61	13
1ST FLOOR FLOOR (CONTROLLED)	Average	LT 1	80	3	464	.393
	Maximum	2	274	9	2000	2.000
	Minimum	0	15	0	50	.035
	No. Samples	11	11	11	46	11
1ST FLOOR WALLS (CONTROLLED)	Average	LT 1	8	2	130	.167
	Maximum	2	41	9	1000	.700
	Minimum	0	0	0	25	.012
	No. Samples	37	37	37	141	37
1ST FLOOR CEILINGS (CONTROLLED)	Average	LT 1	12	LT 1	154	.036
	Maximum	1	29	3	250	.046
	Minimum	0	0	0	75	.025
	No. Samples	5	5	5	23	5

TELEDYNE ISOTOPES

TABLE 3.42 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1133 - WASTE HANDLING BUILDING (Continued)

LOCATION	RANGE NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	LOOSE CONTAMINATION (d/m/100 sq cm) BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	FIXED CONTAMINATION c/m (GS-3) BETA	DIRECT RADIATION mR/hr
BASEMENT FLOORS (WHITE)	Average	LT 1	105	11	267	.160
	Maximum	1	267	25	1800	.700
	Minimum	0	19	6	75	.050
	No. Samples	10	10	10	50	10
BASEMENT WALLS (WHITE)	Average	LT 1	11	11	284	.125
	Maximum	5	100	19	1800	.700
	Minimum	0	0	0	50	.007
	No. Samples	18	18	18	87	18
BASEMENT CEILINGS (WHITE)	Average	LT 1	3	10	405	.471
	Maximum	1	9	14	1500	.800
	Minimum	0	0	6	50	.012
	No. Samples	3	3	3	13	3
BASEMENT FLOORS (CONTROLLED)	Average	1	6107	35	1735	3.0
	Maximum	2	11797	63	3500	5.0
	Minimum	0	416	6	350	1.0
	No. Samples	2	2	2	10	2
BASEMENT WALLS (CONTROLLED)	Average	LT 1	224	9	1544	1.0
	Maximum	1	928	14	5000	2.5
	Minimum	0	29	3	125	0.1
	No. Samples	8	8	8	35	8
BASEMENT CEILINGS (CONTROLLED)	Average	0	75	3	1140	1.5
	Maximum	0	75	3	2800	1.5
	Minimum	0	75	3	300	1.5
	No. Samples	1	1	1	5	1

TELEDYNE ISOTOPES

3.4.6 Building #1134 - Primary Pump House

The reactor Primary Pump House was radiologically monitored in a similar fashion to other PBRF buildings and areas. The six shielded equipment rooms containing the three reactor primary pumps in Rooms 1 thru 3; the heat exchangers and strainers in Room 4; the degassifier system in Room 5 and the mixed bed deionizers in Room 6 were entered by removing the shielded roof hatches with a hydraulic crane. Major equipment in these rooms was monitored and the results were compared with similar data obtained in 1973 at the time the facility was shut down and secured for a possession only license. This data was previously presented in Table 3.19 on page 3-66 of this volume.

The walls, floors and ceilings of these rooms were also monitored to determine structure contamination. Additional monitoring was also performed in Rooms 7 and 8 and the mezzanine of Room 7. These data are summarized in Table 3.43. Complete data are presented in Appendix 3.16. The results of this data indicate that the Building #1134 structure has but minimal contamination. Once the primary system piping and components are removed, final clean up of the structure itself should be straightforward with few complications. Decontamination or removal of the contaminated resin storage pit, pump pit and Room 8 hot sump will most likely be necessary whenever future decommissioning occurs.

3.4.7 Building #1141 - Reactor Office And Laboratory Building

The Reactor Office and Laboratory Building (ROLB) #1141 housed engineering personnel, drafting, laboratory analysis, metallurgical, photography processing, health physics, and electronic services. The Nurse's Station and RAMS, WEMS, SEMS and Meteorological Readout equipment were also located in the building. At shutdown in 1973, the building was cleared of the majority of the equipment in the Offices and some of the laboratory equipment. Services to the building were terminated with the exception of electricity and the cold and hot-cold sumps, which remain active. Sanitary systems and water were cut off. The heating system was secured. Presently heat is provided by a gas-fired unit heater located in the basement shop area to keep the building above freezing.

A comprehensive radiological survey was performed in the laboratory, metallurgical, health physics, and basement areas of the building. The floors and walls were indexed in 15'x15' grids. The ceilings were on a 30'x30' grid. Radiation levels were within release levels with the exception of a small location on the floor in Room #212, and a small location on the floor in Room #214. These

TELEDYNE ISOTOPES

TABLE 3.43 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1134 - PRIMARY PUMP HOUSE

LOCATION	RANGE NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
FLOORS ROOMS 1 - 6	Average	LT 1	5	8	161	.007
	Maximum	2	15	18	300	.007
	Minimum	0	0	3	100	.006
	No. Samples	11	11	11	55	11
WALLS ROOMS 1 - 6	Average	LT 1	5	12	99	.007
	Maximum	2	29	30	150	.015
	Minimum	0	0	0	50	.005
	No. Samples	24	24	24	120	24
CEILINGS ROOMS 1 - 6	Average	LT 1	4	10	115	.007
	Maximum	LT 1	6	15	175	.007
	Minimum	LT 1	2	6	75	.006
	No. Samples	2	2	2	10	2
FLOORS ROOMS 7 & 8	Average	LT 1	10	7	174	.007
	Maximum	2	15	9	250	.007
	Minimum	0	5	6	50	.006
	No. Samples	4	4	4	20	4
WALLS ROOMS 7 & 8	Average	LT 1	5	12	106	.007
	Maximum	2	29	29	20	.015
	Minimum	0	0	0	25	.005
	No. Samples	24	24	24	120	24
CEILINGS ROOMS 7 & 8	Average	LT 1	4	10	115	.007
	Maximum	LT 1	6	15	175	.007
	Minimum	LT 1	2	6	75	.006
	No. Samples	2	2	2	10	2

TELEDYNE ISOTOPES

TABLE 3.44 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1141 - REACTOR OFFICE & LAB BUILDING

LOCATION	RANGE NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
BASEMENT	Average	LT 1	5	18	70	.007
	Maximum	3	16	94	200	.028
	Minimum	0	0	0	25	.003
	No. Samples	40	40	40	200	40
1ST & 2ND FLOOR HALLWAYS	Average	LT 1	10	11	59	.006
	Maximum	2	49	44	125	.007
	Minimum	0	0	0	25	.005
	No. Samples	15	15	15	49	15
LABORATORIES	Average	LT 1	15	17	67	.006
	Maximum	4	137	336	500	.017
	Minimum	0	0	0	25	.004
	No. Samples	67	67	67	316	67
LAB HOODS	Average	-	-	3742	2090	.049
	Maximum	-	-	43356	20000	.36
	Minimum	-	-	0	100	.005
	No. Samples	-	-	14	26	18
LAB HOOD FILTER HOUSINGS	Average	-	-	0	3429	.020
	Maximum	-	-	0	45000	.100
	Minimum	-	-	0	100	.005
	No. Samples	-	-	14	14	12

areas had a spill which penetrated the cracks between the floor tiles. These areas can be decontaminated by removing the tile and cleaning the substrate. The remainder of the areas were at, or very near, background levels.

Laboratory hoods in the 2nd floor laboratory were monitored for contamination. At shutdown the hoods were cabled shut to prevent entry. For this study the cables were cut to gain access for monitoring inside the hoods, filter housings, and in drawers, shelves, and base cabinet sections. After the survey was complete, new 1/4" cables were installed and sealed using crimp sleeves and a "micro press" compression tool.

The survey showed that the laboratory hoods are the main source of activity in these areas. When the hoods, filter housings, base cabinets, and sinks are removed, only minor decontamination of the facilities will be required to meet release criteria.

Table 3.44 presents a summary of the data obtained. Complete data is included in Appendix 3.17.

3.4.8 Building #1192 - Effluent Control Station

The Effluent Control Station consists of a concrete trench with metal gates and flumes and served as the single point of release for all liquid effluents leaving the PBRF. A small metal shed was mounted on top of the trench and served as a station for collecting proportionate water effluent samples and continuous monitoring of that effluent. At the present time only "cold" building sumps are discharging thru this point. All radioactive liquid systems are secured. A radiological survey showed that these areas had only minimal contamination. A small amount of clay-like silt entrapped behind the weirs indicated a low level of contamination. This silt most likely acted similar to an ion exchange media and gradually accumulated low quantities of contamination prior to shut down. Another possible source might be from material lodged in the ditch system which was loosened during extended wet season sump discharge. Once this silt is removed from its entrapment the structure of the Effluent Control Station should meet release criteria with but minimal additional effort.

The summary results of the Effluent Control Station monitoring tasks are presented in Table 3.45. Total data are presented in Appendix 3.18.

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TABLE 3.45 - RADIOLOGICAL CLASSIFICATION OF THE PBRF BUILDING #1192 - Effluent Control Station

LOCATION	RANGE NO. OF SAMPLES	LOOSE CONTAMINATION (d/m/100 sq cm) ALPHA	BETA GAMMA	FIXED CONTAMINATION c/m (PRS-1) ALPHA	c/m (GS-3) BETA	DIRECT RADIATION mR/hr
FLOOR	Average	0	10	8	98	.012
	Maximum	0	18	12	175	.026
	Minimum	0	4	3	50	.006
	No. Samples	5	5	5	20	5
WALLS	Average	LT 1	18	7	83	.011
	Maximum	2	48	15	150	.040
	Minimum	0	0	0	25	.004
	No. Samples	14	14	14	70	14
CEILINGS	Average	0	3	2	57	.007
	Maximum	0	12	6	100	.009
	Minimum	0	0	0	25	.004
	No. Samples	5	5	5	25	5

3.4.9 Other Buildings At PBRF

The two Cold Retention Areas (Structure #1154) and the Hot Retention Area (Structure #1155) were monitored and reported previously along with their respective systems in Sections 3.3.6 and 3.3.5 respectively of this volume. The remaining facilities within the PBRF fence were not monitored because they were clean areas previously verified to be in an uncontaminated condition. These included:

Building #1131 - Service Equipment Building
Building #1135 - Gas Services Building
Building #1136 - Compressor Building
Building #1161 - Substation E
Building #1191 - Reactor Security And Control Building

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3.5 ASBESTOS

It was necessary to determine the impact which asbestos insulation products might have on future PBRF activities. A preliminary investigation was made by the study group to determine the extent of asbestos in the facility. Core samples of insulation were extracted and sent to the Lewis Research Center for laboratory analysis.

The PBRF systems include some asbestos and fiberglass/asbestos insulation on various pipes, tanks, vents, etc. Radiological classification shows that some of these systems are externally contaminated and internally clean. Others are both internally and externally contaminated. Some, notably in the SEB and ROLB, are internally and externally free of radioactive contamination. Generally, the asbestos insulation is in relatively good condition with only minimal areas of exposed friable asbestos. This permits the outside of the asbestos insulation to be lightly wiped with damp cloths to remove the low level radioactive contamination prior to removing the asbestos and treating it as non-radioactive contaminated asbestos waste. The asbestos abated piping systems could then be disposed of solely on the basis of radiological classification.

An asbestos abatement contractor was then requested to provide an estimate of costs to remove and dispose of asbestos and fiberglass/asbestos insulation. This report by the Affiliated Environmental Services, Inc., of Sandusky, Ohio, is included as Appendix 3.19 to this volume. They estimated that total abatement would cost $130,228 and require about 6 weeks to complete. Their report also details procedures and notification requirements, and also lists disposal sites in northern Ohio approved to receive non-radioactively contaminated asbestos waste.

Table 3.46 identifies the type and quantity of insulation at the PBRF by building.

It should be noted that early design and construction drawings indicated that the Reactor Tank was wrapped with an asbestos insulation. Later drawings did not show this. It could not be determined positively, during the course of this study, if the Reactor Tank had an external asbestos insulation. Removal of this asbestos could be coordinated during the Reactor Tank disassembly utilizing usual abatement techniques.

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TABLE 3.46 - AMOUNT OF ASBESTOS BY BUILDING

BLDG	ELEVATION	TYPE	FIBERGLASS/ ASBESTOS UNITS (FEET)*	ASBESTOS UNITS (FEET)*
ROLB	-15′	P	2100	605
(1141)	-15′	V	1100	
	-15′	T		210
	0′ PIPE	P	170	180
	+10′ HEATING	P	700	
RB	+12′	P	1650	
(1111)	0′	P	800	60
	-15′	(10") P-HPS	500 (190)	50 (20)
	-15′	(12") P-CAR		180 (60)
	-15′	(24") P-EXHAUST AIR		720 (120)
	-15′	P-MIX	800	80
	-25′	V	640	
	-25′	CHILLER		250
HL	BACK SIDE	P	1625	40
(1112)	BACK SIDE	V	1250	
	FRONT SIDE	P	560	
	PIPE TUNNEL	EXHAUST AIR	60 (20)	1470 (245)
CV	0′	P	520	50
(1111)	MINUS LEVELS	P		500
	MINUS LEVELS	P-WASTE AIR		1170 (195)
FH	0′	P	175	45
(1132)	-15′	P-MISC	120	
		P-EXHAUST AIR INCL PIPE & FILTER UNIT	750 (50)	
WHB	0′	P-BOILER ROOM	140	50
(1133)	0′	T-BOILER ROOM		300
	0′	P	830	
	+12′	P	950	
	+12′	V	1200	
	-15′	P	390	

P = PIPE; V = VENT; T = TANKS

*NOTE: Units are in square feet for pipe larger than 8" diameter and for tanks and vents. Units are in linear feet for pipe less than 8" diameter. For larger pipe the number of linear feet is listed in parentheses ().

TELEDYNE ISOTOPES

TABLE 3.46 - AMOUNT OF ASBESTOS BY BUILDING (Continued)

BLDG	ELEVATION	TYPE	FIBERGLASS/ ASBESTOS UNITS (FEET)*	ASBESTOS UNITS (FEET)*
WHB - PROBABLY CONTAMINATED - NOT INCLUDED ABOVE				
(1133)	EVAP SYSTEM	P	100	260
	EVAP SYSTEM	T	370	
SEB	INSIDE	P	960	130
(1131)	OUTSIDE	P	70	
	TUNNEL	P	480	

UNITS OF ASBESTOS AND FIBERGLASS/ASBESTOS

BUILDING	FIBERGLASS/ ASBESTOS UNITS (FEET)*	ASBESTOS UNITS (FEET)*
ROLB (1141)	4,070	995
RB (1111)	4,390	1,090
HL (1112)	3,495	1,510
CV (1111)	520	1,720
FH (1132)	1,045	45
WHB (1133)		
NON-CONTAMINATED	3,010	350
CONTAMINATED	470	260
SEB (1131)	1,510	130
TOTAL	18,510	6,100
SUBSYSTEMS INCLUDED ABOVE:		
EXHAUST AIR	810	2,190
CONT. AIR RETURN		300
WASTE AIR		1,170
HPS	500	305
VENTS	4,190	

P = PIPE; V = VENT; T = TANKS

*NOTE: Units are in square feet for pipe larger than 8" diameter and for tanks and vents. Units are in linear feet for pipe less than 8" diameter. For larger pipe the number of linear feet is listed in parentheses ().

TELEDYNE ISOTOPES

3.6 RADON

During the radiological monitoring surveys conducted in the Containment Vessel at PBRF in 1985 it was noted that during the course of the day the alpha background on the Eberline PRS-1 portable alpha count rate meter continued to rise. At the beginning of each day the instrument background would be normal at or near zero counts per minute. By noon background would consistently rise to higher levels of from 15 to 50 counts per minute. Decontamination of the instrument would restore background once again only to have the background again creep upwards by the end of the day. Along with this increase in background low level <u>fixed</u> alpha contamination was noted to be relatively widespread on all surfaces in the CV, particularly concrete surfaces. <u>Loose</u> alpha contamination was determined to be relatively non-existent as verified by wipe sampling. Alpha radioactivity was never observed during normal PBRF operations except in certain radiochemistry laboratories where calibration standards were prepared.

The above phenomenon was also noted in the fuel storage vault in the basement of the ROLB. Elevated fixed alpha activity was noted to be widespread to a lesser degree in other portions of Buildings #1141, #1133, #1134, and both the hot and cold work areas of Building #1112. Elevated levels were also found in the canals with Canal E in The CV being the highest.

This low level fixed alpha contamination was hypothesized to have resulted from the accumulation of the radioactive daughters formed by the decay of Radon 222 gas, a naturally occurring isotope emitted from the decay of Radium 226 within the stone aggregate in concrete. Since 1973 all ventilation systems in the PBRF have been secured and not operated. Normal air turnover by either natural or forced ventilation was non-existent in locked and secured areas. This lack of ventilation prevented the normal purging of the short half-lived Radon 222 gas and consequently it permeated as a gas into minute areas where decay occurred to longer lived solid daughters. The following simplified decay scheme illustrates this point.

Uranium 238 (4.5 E9 years) → x → x → x → Uranium 234 (2.5 E5 years)

↓

Alpha Radon 222 (3.8 days) ← Alpha Radium 226 (1602 years) ← Thorium 230 (8 E4 years)

↓

Polonium 218 (3 minutes) → Lead 214 (27 minutes) → Bismuth 214 (20 minutes) → Polonium 214 (LT 1 second)

↓

Lead 206 (Stable) ← Alpha Polonium 210 (138 days) ← Bismuth 210 (5 days) ← Beta Lead 210 (21 years)

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From the above it can be seen in all likelihood the alpha decay of Radon 222 is contributing to a build up of Lead 210 and its alpha emitting daughter, Polonium 210.

Discussions with a geologist revealed that a shale deposit with elevated uranium present underlies southwestern New York, northwestern Pennsylvania and northeastern Ohio with its western most portion being around Erie County, Ohio, the location of Plum Brook Station. It is possible that some of the local stone quarried for use as aggregate in the large quantities of concrete used to construct PBRF contain these natural isotopes causing this phenomenon.

A Radon sampling program was conducted in 1985 and repeated in 1986 to determine if Radon was present at levels greater than background in the areas of concern. Chemical etching radon detectors manufactured by Terradex Corporation were utilized in 1985 to determine radon levels over a two month period. These dosimeters were again placed in identical locations in 1986 for two months. Charcoal cannisters supplied by Teledyne Isotopes were also placed at identical locations for 5 days in the second test. Both techniques are reliable and provide dual confirmation of the hypothesis. The chemical etching dosimeters must be exposed for a long period of time and therefore provide good long term integration of dose rate. The charcoal cannisters are more sensitive for short periods of exposure and therefore provide a highly reliable basis for dose measurement over a shorter time interval. The results of these tests appear in Table 3.47.

Agreement between the 1985 and 1986 tests are good as well as general agreement between the two methods in 1986. The U.S. EPA has recently recommended a limit of 4 pico-Curies of Radon 222 per liter of air in residential dwellings. Seven of ten tests in 1985 exceeded this level and eight of the combined twenty tests in 1986 exceeded this level. It should be noted that several areas outside the PBRF were utilized as background information. Several of these areas showed elevated radon levels due to their poor ventilation and major use of concrete with stone aggregate in this construction. The Engineering Building #7141 essentially has been made energy efficient with no outside air turnover except by infiltration and the two rooms tested on the first floor each showed elevated Radon concentrations. Warehouse #9199, a concrete igloo like structure with earth overburden, also showed the same result. The Firehouse Building #7233 and HTF Building #3411 were well ventilated and showed normal background radon levels. It should be recognized, however, that radon levels do fluctuate with seasonal, climatic, temperature, and geographic influences.

The results of these tests confirm that Radon 222 and its daughter decay products are the principal source of low level fixed alpha contamination in certain areas of the PBRF which have massive concrete structures and relatively poor ventilation. This observation also relates to the verification of high natural

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TABLE 3.47 - RADON 222 CONCENTRATIONS IN SELECTED PLUM BROOK FACILITIES

LOCATION	TERRADEX TYPE SF - 1985 EXPOSURE PERIOD	TERRADEX TYPE SF - 1985 pCi/l	TERRADEX TYPE SF - 1986 EXPOSURE PERIOD	TERRADEX TYPE SF - 1986 pCi/l	TELEDYNE CHARCOAL 1986 EXPOSURE PERIOD	TELEDYNE CHARCOAL 1986 pCi/l
Bldg. #1111 - 0' CV Canal E Railing	7/2-9/5	4.64	3/14-5/19	4.58	3/14-3/19	7.0 ± 1.4
Bldg. #1111 - -25' CV Center Dry Annulus	7/2-9/5	8.14	3/14-5/19	10.81	3/14-3/19	10.9 ± 1.7
Bldg. #1111 - 25' Door of PPP Room	7/2-9/5	4.75	3/14-5/19	1.7	3/14-3/19	2.6 + 1.4
Bldg. #1111 - 15' Entrance to CPT	7/2-9/5	4.05	3/14-5/19	1.93	-	-
Bldg. #1112 - Hot Handling Room 80-T Door	7/2-9/5	3.24	3/14-5/19	2.74	3/14-3/19	3.4 + 1.0
Bldg. #1132 - 15' Entrance to HPT	7/2-9/5	4.40	3/14-5/19	2.89	3/14-3/19	LT 4
Warehouse #9199	7/2-9/5	9.66	3/20-5-19	3.66	3/20-3/24	8.4 ± 0.8
Bldg. #7141 - Room 105	7/2-9/5	5.22	3/14-5/19	7.12	3/14-3/19	5.1 ± 1.0
Bldg. #7141 - Room 114	-	-	3/14-5/19	5.74	-	-
Bldg. #3211 - 60' (B-2)	7/2-9/5	2.18	3/17-5/19	0.94	-	-
Bldg. #3411 - 15' (HTF)	-	-	3/17-5/19	1.11	-	-
Bldg. #7233, Mail Desk (Background)	7/2-9/5	1.02	3/14-5/19	0.32	3/14-3/19	LT 2

radiation background noted during sub-surface soil sampling and cut bank exposed shale stream bank monitoring performed at Plum Brook and described in Section 3.1.2 of this volume.

The quantities of alpha contamination do not exceed the release levels of 100 alpha d/m/100 sq cm for fixed contamination or the levels of 20 alpha d/m/100 sq cm for loose contamination.

It is recommended that sealed areas be ventilated extensively twice yearly to minimize the rate of build up of Radon daughters. It would also seem prudent to monitor future trends in Radon 222 emanation to verify effectiveness of ventilation and to ensure that build up is not continuing to unmanageable levels.

3.7 RADIOISOTOPE IDENTIFICATION

Radioisotope identification was made on various samples collected during the radiological classification of the PBRF. Identification was performed by gamma pulse height analysis utilizing Germanium/Lithium detectors networked in Multi-Channel Analyzer systems. Strontium 90 was analyzed by chemical separation of Strontium, holding for ingrowth of the Yttrium daughter and subsequent counting/analysis.

Samples were obtained from all systems in the PBRF and selected samples outdoors and in the drainage system. Samples showing the highest gross activity were generally selected in order to meet the sensitivity requirements of the instrumental methods for isotope identification. A broad range of naturally occurring isotopes and man-made fission products and activation products were scanned.

As would be expected from the characteristics of the PBR and a 13 year decay period since last neutron irradiation occurred, 60 Cobalt was the major activation product present. Also true to expectations 226 Radium and 40 Potassium were the most prevalent natural radioisotopes present. No attempts were made to confirm the presence of low energy gamma or pure beta emitters such as 55 Iron or 63 Nickel due to the expense and difficulty of such analyses. The known presence of 60 Cobalt can be used to accurately estimate the quantities of other activation products in proportional abundance. Likewise, no attempts were made to perform the more difficult and expensive 90 Strontium analyses on all samples since the presence of 137 Cesium as a fission product can be used to approximate the presence of 90 Strontium in proportional amounts.

The most significant unexpected information was the presence of three Europium isotopes (Eu 152, Eu 154, and Eu 155) in the primary system and on fuel storage racks in Canal G. The origin of these isotopes and their impact were discussed previously in Section 3.3.2.1 (pages 3.59 and 3.60) of this report. To a lesser extent, the widespread presence of fission products, namely 137 Cesium and 90 Strontium, was somewhat unexpected.
22 Sodium was detected in minute amounts on 4 samples; however, its origin in the PBRF is unknown.

As a general observation the indicated isotopes accounted for most of the gross activity detected on the respective samples. Tables 3.48 thru 3.51 identify the quantities and types of isotopes verified in the respective PBRF samples. Table 3.48 indicates that Co 60 and Cs 137 are the predominant isotopes present in the Q&C drain, facility hot sumps, CRA sump and stack silt crud samples. These systems collected or handled a large portion of PBRF liquids and air effluents. As expected, no natural isotopes were present in these systems, only reactor-made isotopes. Table 3.49 shows those isotopes present in liquid samples. Note that Co 60 and Cs 137 are again present as major contributors of the activity. Cs 134 is also present at quantities approximately 2 orders of magnitude less than Cs 137. Sr 90 is present at levels approximately 1 order of magnitude less than Cs 137. The presence of the natural isotope K 40 in these liquid samples is logical. The water which entered the HRA tanks was precipitation which leaked slowly through concrete prior to entering the tanks and probably picked up some potassium salts prior to entering the HRA tanks. Groundwater with some potassium in solution was the source of infiltration into the HRA annulus and the PPH resin pits. All of these observations have been described elsewhere. By way of maintaining perspective, the K 40 concentrations present in these liquid samples at PBRF are perhaps a little less than the concentrations usually found in human urine samples.

Table 3.50 presents those isotopes present in various high activity wipe samples taken at PBRF. These data again confirms that Co 60 and Cs 137 are the principal isotopes present. It also shows the presence of Europium isotopes in the primary systems and the Canal G fuel storage areas. It should be recognized that data in Table 3.50 is qualitative, or at best semi-quantitative, because wipe samples are not highly quantitative techniques.

Table 3.51 presents the isotopic data for the PBRF outdoor sediment and soil samples. As expected, all of the isotopes present in-plant were also detected in the drainage system outdoor samples, as well as the various natural isotopes, particularly K 40, Ra 226 and Th 228. Radium 226 is the sixth daughter in the decay of Uranium 238. Thorium 228 is the third daughter in the decay of Thorium 232. Both are universally distributed at varying levels with northeast Ohio having somewhat higher quantities of Ra 226 present than most other areas.

TABLE 3.48 - RADIOISOTOPES IDENTIFIED TO BE PRESENT IN PBRF SOLIDS SAMPLES

		NATURAL ISOTOPES pCi/g			ACTIVATION PRODUCTS pCig					FISSION PRODUCTS pCi/g		
LOCATION	RANGE	K 40	Ra226	Th 228	Co 60	Eu 152	Eu 154	Eu 155	Na 22	Sr 90	Cs 137	Cs 134
Quadrant & Canal Drain Crud	Average				1.2E4						2.8E3	
	Maximum				2.4E4							
	Minimum				1.8E2							
	No. Samples				5						1	
Hot Sump Crud	Average				4.3E4						2.1E4	5.1E1
	Maximum				1.5E5						7.8E4	9.7E1
	Minimum				3.8E2						6.0E2	5.3E0
	No. Samples				5						5	2
CRA No. 1 Sump	Average				9.7E2				4.1E0		7.5E1	
	No.				1				1		1	
Stack Silt	Average				1.2E4						2.6E2	
	No.				1						1	

TABLE 3.49 - RADIOISOTOPES IDENTIFIED TO BE PRESENT
IN PBRF LIQUID SAMPLES

LOCATION	RANGE	NATURAL ISOTOPES pCi/l			ACTIVATION PRODUCTS pCi/l					FISSION PRODUCTS pCi/l		
		K 40	Ra 226	Th 228	Co 60	Eu 152	Eu 154	Eu 155	Na 22	Sr 90	Cs 137	Cs 134
HRA Tanks (#1155)	**Average**	1.6E2			3.3E3					3.3E3	9.8E4	6.5E2
	Maximum				5.3E3					9.6E3	2.9E5	1.3E3
	Minimum				1.8E2					1.4E2	1.4E3	1.3E1
	No. Sam.	1			3					3	3	
HRA Annulus (#1155)	**Average**	1.5E2			1.3E1					4.9E0	6.9E1	
	Maximum	1.6E2									9.6E1	
	Minimum	1.4E2									4.3E1	
	No. Sam.	2			1					1	2	
PPH Resin Pit (#1134)	1	4.7E2			1.9E2					1.6E1	3.9E2	
Fan House Resin Pit (#1132)	1									3.3E1	9.0E1	
Background (B-2)	1	6.9E1										

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TABLE 3.50 - RADIOISOTOPES IDENTIFIED TO BE PRESENT IN PBRF WIPE SAMPLES

		NATURAL ISOTOPES pCi/100 sq cm			ACTIVIATION PRODUCTS pCi/100 sq cm					FISSION PRODUCTS pCi/100 sq cm		
LOCATION	RANGE	K 40	Ra 226	Th 228	Co 60	Eu 152	Eu 154	Eu 155	Na 22	Sr 90	Cs 137	Cs 134
Canal Wipes	**Average**	7.2E1			2.7E3	1.3E1	9.2E1	2.2E1			4.6E2	
	Maximum				6.5E3						8.8E2	
	Minimum				9.7E1						4.0E1	
	No. Samples	1			3	1	1	1			2	
Hot Cells	1				1.0E3						7.1E2	
	2				2.4E4						2.7E3	
	3				2.2E3						7.9E2	
	4				2.4E2						8.5E2	
	5				3.0E1						5.3E2	
	6	6.4E1			2.4E2						2.4E3	
	7		1.4E2		3.6E2						2.4E3	
Hot Lab Decon Sink					5.9E2				1.4E1		8.1E3	1.2E1
Hot Pipe Tunnel					8.9E4						2.5E3	
Waste Evaporator					2.4E2						3.1E3	2.6E1
Primary Valve 11V02					3.2E2	1.2E2	9.0E1		2.0E1			
ROLB Hood			1.3E3		6.9E0							

TABLE 3.51 - RADIOISOTOPES IDENTIFIED TO BE PRESENT IN PBRF OUTDOOR SAMPLES

LOCATION	RANGE	NATURAL ISOTOPES pCi/g			ACTIVATION PRODUCTS pCi/g					FISSION PRODUCTS pCi/g		
		K 40	Ra 226	Th 228	Co 60	Eu 152	Eu 154	Eu 155	Na 22	Sr 90	Cs 137	Cs 134
Emergency Retention Basin (Surface Soil)	Average	1.6E1	2.6E0	7.3E-1	2.2E1				7.5E-1	2.4E0	3.2E1	3.7E-1
	Maximum	1.9E1	3.2E0	8.9E-1	1.3E2				-	2.4E1	1.1E2	5.5E-1
	Minimum	1.3E1	2.3E0	5.4E-1	3.5E0				-	0.1E-2	5.4E0	1.9E-1
	No. Samp.	9	7	7	8				1	64	9	2
Background (Surface Soil)	Average									2.0E-1		
	Maximum									2.4E-1		
	Minimum									1.4E-1		
	No. Samp.									3		
Sub-Surface Soil (Grid I-9-2)	Average	7.7E0									1.9E2	
	No.	1									1	
Pentolite Ditch - Sediment	Average	2.2E1		1.4E0	4.9E-1						5.0E1	1.1E0
	Maximum	2.8E1		2.6E0							9.6E1	
	Minimum	1.7E1		7.1E-1							4.0E1	
	No. Samp.	2		2	1						2	1
Background Sediment	Average	2.4E1	2.0E1	1.1E0							1.9E-1	
Background Surface Soil	Average	2.8E1	2.6E1	1.7E0							1.7E-1	
Pentolite Ditch - Surface Soil	Average	1.5E1	2.8E0	7.7E-1	9.1E						3.9E2	4.7E0
	Maximum	1.5E1			1.8E2						7.6E2	9.1E0
	Minimum	1.4E1			2.4E0						1.4E1	1[illegible]-1
	No. Samp.	2	1	1	2						2	

TELEDYNE ISOTOPES

AN EVALUATION OF THE PLUM BROOK REACTOR FACILITY AND DOCUMENTATION OF EXISTING CONDITIONS

VOLUME 3 - PHYSICAL CHARACTERIZATION OF RADIOACTIVE/CONTAMINATED AREAS OF THE PBRF
PART 2 - APPENDICES

VOLUME 3, PART 2 OF A 6 VOLUME SERIES

Prepared For

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TELEDYNE ISOTOPES

This is Volume 3, Part 2 of a series titled. "An Evaluation of th Plum Brook Reactor Facility and Documentation of Existing Conditions." This Part 2 contains the Appendices and data referenced in Part 1 of Volume 3.

Following is a list of all titles in the series:

Study Organization

Volume 1 - Review of Existing PBRF Data and Pertinent Regulatory Changes Since 1978 Which Would Affect Documentation of Present Conditions at the Plum Brook Reactor Facility

Volume 2 - Items of Radiological Significance Addressed in the 1978 PBRF Options Study for Which Additional Information is Needed

Volume 3 - Part 1 - Physical Characterization of Radioactive/ Contaminated Areas at the PBRF

Part 2 - Appendices

Volume 4 - Update of the 1978 Cost Estimate for the Plum Brook Reactor Facility Dismantling Project

Volume 5 - Cost Estimates and Schedules to Maintain the Integrit of Barriers at the PBRF to Ensure Dry Safe Protective Storage for the Next 30 Years

Volume 6 - PBRF Systems/Equipment disposition Lists

NOTICE

This report was prepared for the National Aeronautics and Space Administration for the purpose of documenting existing conditions at the Plum Brook Reactor Facility. Neither NASA, Teledyne Isotopes, or its subcontractors assumes liability for the use or accuracy of information contained herein for other than the above expressed purpose.

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PREFACE

The National Aeronautics and Space Administration (NASA) owns the Plum Brook Reactor Facility (PBRF). This facility includes a 60 megawatt test reactor and a zero power pool type research reactor. The PBRF was mothballed in 1978 and placed in a dry safe configuration. NASA has made the decision to keep the PBRF in this safe storage configuration for an indefinite period. As a result of this decision it is important that decommissioning regulations, methodology, technology, and activities be periodically tracked by NASA in order to optimize decision making and timing in the future. This report addresses PBRF decommissioning in several sections in order to provide external feedback to NASA. The fact that PBRF decommissioning is discussed should in no way be interpreted to mean that such project plans are underway.

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APPENDIX 3.1

Procedure for Performing a Comprehensive Radiological Survey For The Purpose Of Characterizing Radioactive Contamination At The PBRF

PROCEDURE FOR PERFORMING A COMPREHENSIVE RADIOLOGICAL SURVEY FOR THE PURPOSE OF CHARACTERIZING RADIOACTIVE CONTAMINATION AT THE PBRF

1.0 INTRODUCTION

This procedure sets forth the requirements and methods for performing a radiological survey of the Plum Brook Reactor Facility. The purpose of the survey is to characterize radioactive contamination at the PBRF.

2.0 GENERAL INFORMATION

2.1 The radiological survey parameters to be measured include direct external radiation at one meter from surfaces, surface fixed and transferable contamination, soil, (surface, shallow core and deep core) water and concrete boring sample radioactivity. Limited air sampling for tritium will be performed at selected locations or systems. Silt samples from PBRF selected catch basins, WEMS ditches, Pentolite ditch, and deep wells will also be collected and analyzed.

2.2 For purposes of the survey, the areas to be monitored include, but are not necessarily limited to:

2.2.1 The floor and inside wall surfaces at all elevations of all radiological control zones of all buildings including the basements. (The ceilings and roof surfaces of these buildings will be monitored using a larger grid.) See Section 3.5.

<u>NOTE</u>: The outside surface of the CV dome along with recently re-surfaced roofs such as the ROLB, RB, WHB, and the FH will not be monitored.

2.2.2 Representative monitoring of the equipment and furniture, piping, window sills, inside building girders, and other miscellaneous facilities in these zones.

2.2.3 All grounds within the fence line including soil surfaces and paved areas.

2.2.4 Pentolite Road Ditch from PBRF to Plum Brook.

2.2.5 Air samples for tritium will be collected from the Reactor Vessel Purge System and the Hot Lab hot handling room areas.

2.3 The types of monitoring required to accomplish the objectives listed above include the following:

2.3.1 Measurement of direct beta-gamma radiation levels due to fixed contamination at specified distances from structural and other surfaces (generally at one centimeter and/or one meter), using portable survey instruments. (Note: When the general radiation field is sufficiently high to interfere with accurate determination of fixed or loose surface contamination then scrapings of paint, coatings, etc. will be analyzed to indicate the presence of surface contamination.)

2.3.2 Measurement of radiation levels of fixed alpha emitters at not greater than one centimeter from structural and other surfaces using portable survey instruments. (Survey to be as close to the surface as is practical.) If scrapings are taken as in Section 2.3.1 above, then such scrapings will also be analyzed for alpha activity.

2.3.3 Measurement of loose alpha and beta-gamma emitting contaminants on structural and other surfaces using the smear technique and sensitive laboratory counting equipment.

2.3.4 Measurement of radioactivity in silt, surface soil, deep coring, and shallow coring samples, analyzing for alpha and beta-gamma radioactivity using sampling and laboratory analysis techniques.

2.3.5 Measurement of standing or contained water volumes for gross alpha and beta-gamma radioactivity using grab sampling and laboratory analysis techniques.

2.3.6 Measurement of tritium in reactor tank purge lines by shutting off purge for short time and then taking a sample for analysis. Tritium samples will also be measured from the hot-dry storage area of the Hot Lab.

2.4 The appropriate procedures and survey forms found in the Health-Safety Operations Procedure Manual will be used in performing this survey. Since these procedures were originally written to be performed during operation of the PBRF, many aspects of the procedures will not apply. It is the intent here to follow the appropriate and applicable techniques and methods representative of sound health physics practices set forth in the procedures rather than following them in cook-book fashion. Any questions relative to compliance with these procedures will be resolved by the PBRF Radiation Safety Officer. These procedures and associated forms include, but are not limited to the following:

2.4.1 FM-3 Facility Monitoring - Contamination Surveys, Form CR HP-11.

2.4.2 FM-2 Facility Monitoring - Water Sampling, Form NASA-P2045.

2.4.3 FM-4 Facility Monitoring - Portable Instrument Surveys, Form CR-HP-1, NASA-P-2146

2.4.4 G-2 Health Safety Use of Signs, Tags, Labels, and Placecards, Forms NASA-C-928-C, and NASA-C-928-D.

2.4.5 D-1 Facility and Equipment Decontamination.

2.4.6 LAB-7 Radiometric Analysis of Smear Samples, Form - Smear Survey Record.

2.4.7 LAB-8 Radiometric Analysis of Soil or Silt Samples, Form CR-L-X or Equivalent.

2.4.8 LAB-10 Radiometric Analysis of Water Samples, Form NASA-P2045.

2.4.9 Off-site analysis for special samples, i.e., soil, concrete, tritium, etc. will be in accordance with the contractor's established procedures, copies of which will be made available for review.

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Equipment, materials, structures, and surfaces shall be within the levels of radioactivity specified below before the site is considered to be qualified for release from the NRC licenses and controls. Any areas, structures, systems or equipment not meeting these specified levels of radioactivity shall be considered to require additional decontamination or disposal through rad waste procedures for the purpose of dismantling planning.

3.2 For purpose of this report it is assumed that in order for the PBRF to be released for unrestricted use, the radioactivity levels must not exceed the following criteria:

3.2.1 Direct radiation: less than 5 uR/hr above natural background.

3.2.2 Transferable (removable) contamination: alpha 20 d/m/100 sq. cm; beta-gamma 1000 d/m/100 sq. cm.

3.2.3 Fixed contamination and special scrapings: alpha 100 d/m/100 sq. cm; beta-gamma 5000 d/m/100 sq. cm.

<u>NOTE</u>: The limits of 3.2.2 and 3.2.3 are exclusive of instrument background and are consistent with Table 1 of Regulator Guide 1.86.

3.3. The limit for silt and soil samples shall be assumed to be two times natural background for silt and soil, exclusive of instrument background; however, soil samples from ERB must have Sr 90 concentrations less than 5 pCi/gm of soil. The limit for water shall be the appropriate unrestricted area MPC value for water in Title 10CFR Part 20 regulations. Limits for airborne tritium shall be the appropriate unrestricted area MPC value for air in Title 10CPR Part 20 regulations.

3.4 Background determinations for direct radiation, transferable contamination, soil, silt, coring, and water samples shall be determined by appropriate measurement of these parameters under similar conditions of building structure and environs in the vicinity of the Engineering Building and/or the PBS Communications Center. These levels shall be documented using the appropriate report forms cited in 2.4 above.

3.5 The survey locations for transferable contaminations and direct radiation shall generally be determined by overlaying on a plot plan, a rectangular grid (see Attachments A, B, and C for typical grid systems). The grid lines for building floor and wall areas shall be approximately fifteen foot (15′) spacings (Attachment A), except office walls may be used to define areas rather than grids, provided the same number of surveys are performed. The building roof and interior ceiling surfaces shall be at approximately thirty foot (30′) spacings (see Attachment B). The grid lines for the surrounding outdoor areas shall be fifty foot (50') (see Attachment C) except for areas known to be contaminated, e.g., the ERB shall have twenty-five foot (25') spacings and Pentolite Road Ditch shall have thirty foot (30') spacings. Surface soil samples shall be collected from each grid at the location of the highest beta-gamma reading. Surface sampling within the CV will utilize a polar coordinate grid system of equivalent area to that of a fifteen foot (15') rectangular grid.

3.6 No covering will be applied to surface of equipment, structures, or other surfaces by paint or other covering material until it has been determined by documented survey results that the radioactivity levels are below the limits specified.

3.7 The radioactivity on the interior surface of the pipes, drain lines, duct work, or other equipment with inaccessible areas shall be determined by making measurements at traps, cut lines or other appropriate access points provided that contamination at these locations is likely to be representative of contamination on the interior of the item being surveyed. Wherever sampling calls for opening a closed system, a special procedure will be developed and submitted to the PBRF Safety Committee.

3.8 All survey results shall be reviewed by the contractor health physicist for accuracy and compliance with this procedure. Anomalies shall be investigated and reported. All survey results shall be reported in the final engineering study report. The NASA Radiation Safety Officer shall be notified of any unusual instances of radioactive contamination or radiation that was heretofore not known or discovered.

3.9 In documenting survey results, floor, roof, and ground plan sketches and maps shall be used to clarify reporting the survey locations in addition to using the survey forms.

3.10 When radiation and/or contamination levels are detected in excess of posted limits, the affected area shall be barricaded and posted in accordance with Procedure G-2.

3.11 All survey and counting equipment must be currently calibrated and in good operating condition. Daily source response checks shall be made prior to use. Records of all calibrations and response checks shall be maintained for quality assurance. Calibrations shall be made utilizing standards traceable to the NBS.

3.12 Since not all surveys called for in this procedure may be practical (for example, a one cm distance survey of soil surfaces on which high vegetation is growing) the PBRF Radiation Safety Officer may grant variances.

3.13 Due to NRC licensing limitations and limited decontamination facilities and capabilities, equipment and materials which cannot be readily decontaminated with the generation of manageable levels of radioactive waste must be transferred to a radiological control zone within PBRF, for storage, if they are not presently in a proper control zone.

3.14 The survey report will: identify the facility, include a summary and discussion of survey methods, a table of contents, and the individual survey results for each area listed in the table of contents. The survey findings must be expressed in the units of measurement specified in limits (Item 3.2). The survey results will include the following information for each survey performed: the location of the survey, the name of the person performing the survey, the instruments used, the date and time of survey, the results of the survey, and any laboratory counting data generated. In the case of surveys for transferable contamination, a plot plan must be included showing the smear sample locations by number. Plot plans may be useful for other types of surveys as well.

4.0 PROCEDURE

4.1 Determine natural background radioactivity levels for the following parameters from similar and representative structures, paved surfaces, soil surfaces and water sources at the PBS Plant Protection Building #7231 and/or Engineering Building #7141. Use the same, appropriate instruments that will be used in performing the survey of the PBRF.

4.1.1 Direct beta-gamma radiation (fixed contamination) at one centimeter from all types of surface.

4.1.2 Alpha radiation at less than one centimeter from all paved floor and roof surfaces.

4.1.3 Direct beta-gamma radiation in uR/hr at one meter from all surfaces.

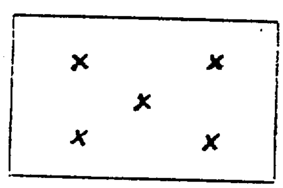
4.1.4 Transferable alpha and beta-gamma emitters using smear survey techniques from all paved, floor and roof surfaces.

4.1.5 Alpha and beta-gamma radioactivity in silt, soil and water samples.

The number of background measurements and samples shall be at least 5% of the total number of actual recorded measurements and representative of the surfaces to be monitored, in the survey itself, and for water samples at least representative of each source of water monitored (4.9).

4.2 Using the gridded plans in Appendices A, B, and C of this procedure, determine the location of the survey and sampling points.

4.3 Perform a fixed beta-gamma surface contamination survey of each grid block at a distance of one centimeter from the surface. The survey of each block shall consist of five readings, one at the center and four at points equidistant from the center and the corners in this pattern.



4.3.1 Survey all inside surfaces within the limitations of 2.2 and all horizontal ground and roof paved surfaces. Note: If contamination exceeds specified limits on paved surfaces, penetrate the surface and obtain sub-surface soil sample and analyze for radioactivity (Item 4.7).

4.3.2 Record the single maximum beta-gamma reading in each block, in units of disintegrations per minute (d/m). Note and record the location of that reading in each block.

4.3.3 Use an NMC GS-3W survey instrument in the open-window mode or an Eberline "Rascal" Model PRS-1 with beta probe.

4.3.4 If the general radiation background interferes with accurate estimation of fixed beta-gamma contamination then surface paint scrapings, etc. will be collected from a 100 sq. cm area and submitted for laboratory analysis (gross alpha and beta-gamma).

4.4 Perform a single fixed alpha surface contamination survey in each grid location surveyed in 4.3.1 at the point of highest beta-gamma reading.

4.4.1 Record the reading in units of disintegrations per minute (d/m).

4.4.2 Use an Eberline PAC-4S survey instrument or Eberline "Rascal" Model PRS-1 with alpha probe.

4.5 Perform a direct external gamma radiation survey at a distance of one meter from the maximum beta-gamma value obtained for each block in 4.3 above.

4.5.1 Measure and record the gamma radiation levels in units of micro roentgen per hour (uR/hr).

4.5.2 Use an Eberline PRM-7.

4.6 Excepting soil or ground surfaces, perform a transferable contamination survey (swipe samples) at the point of maximum reading for each block measured in 4.3.2 above. Survey the same floor, wall, and paved area locations (not ground areas).

4.6.1 Use the standard smear survey technique by wiping 100 sq. cm of surface area with a dry filter paper, using moderate pressure.

4.6.2 Count all smears for alpha and beta-gamma activity using appropriate laboratory counting equipment (LAB-7 procedure).

4.6.3 Report results in units of d/m/100 sq. cm.

<u>NOTE</u>: If contamination on a paved area exceeds specified limits, penetrate the surface and obtain a sub-surface soil sample and analyze for radioactivity (Item 4.7).

4.7 For soil-covered (ground) surfaces, perform a soil radioactivity sample survey for the grid block point of maximum reading obtained in 4.3.2. Sample each block marked with an ◣ .

4.7.1 Collect representative samples of surface soil by gathering at least 25 grams of soil (removing rocks, vegetation and debris).

4.7.2 Analyze for alpha and beta-gamma emitters (LAB-8). If results exceed the limits specified in 3.3, then isotopic identification utilizing a Ge-Li system should be made. Note: Specific analysis for Sr 90 is required for ERB samples.

4.7.3 Report results in units of pCi/gm of sample. Note: If any soil sample exceeds the specified limit, a stratified core sample must be obtained in that location to determine the depth and degree of radioactivity.

4.7.4 Collect silts from the six deep wells, the Pentolite Road Ditch and the forty-three area outdoor catch basins and analyze for alpha and beta-gamma emitters.

4.8 For additional soil stratified core sampling, the location of the samples are marked on the grid map with a "0" indicating a shallow core (10′) and a " □ " indicating a deep core (30′).

4.8.1 The shallow soil core sample locations were chosen in areas where known surface contamination existed or was suspected. These areas include the Emergency Retention Basin, around the concrete pad at the rear of the Waste Handling Building, and near selected catch basins.

4.8.2 The deep soil core sample locations were chosen in areas where there was a possibility of leakage from underground structures such as the area around the reactor, ROLB, Hot Lab, and the Primary Pump House Buildings, around the HRA tanks, and around the cold retention area.

4.8.3 Collect representative samples of at least 25 grams of soil from split spoon fractions every six inches (6") for the first two feet (2′) and one sample every two feet (2′) thereafter.

4.8.4 Analyze for alpha and beta-gamma emitters. If results exceed the limits specified in 3.3, then isotopic identification shall be made utilizing a Ge-Li system.

4.8.5 Report results in units of pCi/gm of sample.

4.9 Collect a representative sample of water from any standing surface water, from each building sump, and any other contained water, e.g., deep wells, the storm drains, catch basins, any other known sources of water (FM-2).

4.9.1 Analyze for alpha and beta-gamma emitters (LAB-10).

4.9.2 Report results in units of uCi/ml of sample.

4.10 In radiological control zones monitor other equipment, furniture, piping, sills, internal girders, and miscellaneous facilities not included above for fixed and transferable contamination. Select representative items such that not less than 25 percent of all items are surveyed.

4.11 Prepare a survey report in accordance with Item 3.14.

APPENDIX 3.2

PBRF Outdoor Radiological Classification

Surface Soil Sampling and Monitoring Data

Radiological Monitoring Outside of the Emergency Retention Basin

Soil Sampling Outside of the Emergency Retention Basin

Radiological Monitoring in the Emergency Retention Basin

Soil Sampling in the Emergency Retention Basin

Please note that Column Headings, in all subsequent Appendix Sections, which include the term "LT" means that the individual sample concentration in those columns were found to be less that the statistical error at the 95% confidence level.

PBRF OUTDR RAD CLASS NOT ERB, APP. 3.2
05-14-86
11:46:08

GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
BG 01	12-17-84	White	50	75	50	100	100	Pt. 4	0.006	62522	36024	10-10-84	466	12-10-84	3
BG 02	12-17-84	White	50	100	75	75	75	Pt. 2	0.006	62522	36024	10-10-84	466	12-10-84	3
BG 03	12-17-84	White	50	50	50	75	100	Pt. 5	0.005	62523	36024	10-10-84	466	12-10-84	3
BG 04	12-17-84	White	125	75	75	50	100	Pt. 1	0.006	62523	36024	10-10-84	466	12-10-84	3
BG 05	12-18-84	White	75	50	50	100	50	Pt. 4	0.005	62556	36027	10-10-84	466	12-10-84	7
BG 06	12-18-84	White	50	75	50	50	50	Pt. 2	0.005	62556	36027	10-10-84	466	12-10-84	7
BG 07	12-18-84	White	50	75	50	75	100	Pt. 5	0.005	62557	36027	10-10-84	466	12-10-84	7
BG 08	12-18-84	White	25	75	100	50	25	Pt. 3	0.005	62557	36027	10-10-84	466	12-10-84	7
BG 09	12-18-84	White	50	75	100	50	100	Pt. 5	0.006	62558	36027	10-10-84	466	12-10-84	7
BG 10	12-18-84	White	50	50	25	50	50	Pt. 5	0.005	62558	36027	10-10-84	466	12-10-84	7
BG 11	12-18-84	White	50	50	50	75	100	Pt. 5	0.006	62559	36027	10-10-84	466	12-10-84	7
BG 12	12-18-84	White	125	50	100	75	100	Pt. 1	0.006	62559	36027	10-10-84	466	12-10-84	7
BG 13	12-18-84	White	50	75	75	50	75	Pt. 5	0.006	62560	36027	10-10-84	466	12-10-84	7
BG 14	12-18-84	White	100	75	50	50	50	Pt. 1	0.006	62560	36027	10-10-84	466	12-10-84	7
BG 15	12-20-84	White	75	75	100	50	75	Pt. 3	0.006	62620	36027	10-10-84	466	12-10-84	7
BG 16	12-20-84	White	100	75	100	50	100	Pt. 5	0.006	62620	36027	10-10-84	466	12-10-84	7
BG 17	12-20-84	White	100	75	125	75	125	Pt. 5	0.006	62621	36027	10-10-84	466	12-10-84	7
BG 18	12-20-84	White	50	75	75	75	100	Pt. 5	0.007	62621	36027	10-10-84	466	12-10-84	7
BG 19	12-20-84	White	75	50	75	75	100	Pt. 5	0.006	62622	36027	10-10-84	466	12-10-84	7
BG 20	12-20-84	White	75	75	75	75	50	Pt. 4	0.006	62622	36027	10-10-84	466	12-10-84	7
BG 21	12-20-84	White	50	50	100	50	75	Pt. 3	0.007	62623	36027	10-10-84	466	12-10-84	7
BG 22	12-20-84	White	50	50	50	100	75	Pt. 4	0.006	62623	36027	10-10-84	466	12-10-84	7
BG 23	1-2-85	White	50	75	75	50	50	Pt. 2	0.007	62757	36027	10-10-84	466	12-10-84	5
BG 24	1-2-85	White	50	100	50	50	50	Pt. 2	0.006	62757	36027	10-10-84	466	12-10-84	5
BG 25	1-2-85	White	50	50	50	25	50	Pt. 5	0.006	62758	36027	10-10-84	466	12-10-84	5
BG 26	1-2-85	White	25	50	50	25	50	Pt. 5	0.006	62758	36027	10-10-84	466	12-10-84	5
BG 27	1-3-85	White	25	50	25	50	50	Pt. 5	0.004	62759	36027	10-10-84	466	12-10-84	1
BG 28	1-3-85	White	50	50	50	50	75	Pt. 5	0.010	62759	36027	10-10-84	466	12-10-84	1
A 01	12-17-84	White	50	50	75	50	75	Pt. 5	0.005	62524	36024	10-10-84	466	12-10-84	3
A 02	12-17-84	White	50	75	100	50	50	Pt. 3	0.006	62534	36024	10-10-84	466	12-10-84	3
A 03	12-17-84	White	50	75	50	50	75	Pt. 5	0.007	62545	36024	10-10-84	466	12-10-84	3
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A 08	12-18-84	White	50	25	25	50	50	Pt. 5	0.007	62624	36027	10-10-84	466	12-10-84	7
A 09	12-18-84	White	50	75	75	50	50	Pt. 2	0.007	62640	36027	10-10-84	466	12-10-84	7
A 10	12-18-84	White	50	50	100	50	75	Pt. 3	0.007	62656	36027	10-10-84	466	12-10-84	7
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A 14	12-18-84	White	50	25	25	75	50	Pt. 4	0.005	62702	36027	10-10-84	466	12-10-84	7
A 15	1-2-85	White	25	75	50	75	50	Pt. 2	0.006	62713	36027	10-10-84	466	12-10-84	7
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A 19	1-2-85	White	50	50	50	25	50	Pt. 5	0.006	62751	36027	10-10-84	466	12-10-84	5
A 20	1-2-85	White	25	50	25	50	50	Pt. 5	0.006	62760	36027	10-10-84	466	12-10-84	5
A 21	1-2-85	White	50	25	50	50	25	Pt. 3	0.005	62766	36027	10-10-84	466	12-10-84	5
A 22	1-2-85	White	50	50	50	75	50	Pt. 4	0.005	62777	36027	10-10-84	466	12-10-84	5
B 01	12-17-84	White	75	50	50	75	75	Pt. 5	0.006	62524	36024	10-10-84	466	12-10-84	3
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FMPF OUTDR RAD CLASS NOT ERB, APP. 3.2
05-14-86
11:46:08

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B 05	12-18-84	White	75	25	25	75	50	Pt. 1	0.007	62572	36027	10-10-84	466	12-10-84	7
B 06	12-18-84	White	50	25	50	50	50	Pt. 5	0.007	62588	36027	10-10-84	466	12-10-84	7
B 07	12-18-84	White	50	25	25	50	50	Pt. 5	0.006	62604	36027	10-10-84	466	12-10-84	7
B 08	12-18-84	White	25	50	50	50	50	Pt. 5	0.007	62624	36027	10-10-84	466	12-10-84	7
B 09	12-18-84	White	75	50	50	100	100	Pt. 5	0.007	62640	36027	10-10-84	466	12-10-84	7
B 10	12-18-84	White	50	75	50	50	75	Pt. 5	0.006	62656	36027	10-10-84	466	12-10-84	7
B 11	12-18-84	White	50	75	50	75	50	Pt. 4	0.007	62670	36027	10-10-84	466	12-10-84	7
B 12	12-18-84	White	50	50	25	50	50	Pt. 5	0.007	62681	36027	10-10-84	466	12-10-84	7
B 13	12-18-84	White	50	25	25	50	50	Pt. 5	0.007	62692	36027	10-10-84	466	12-10-84	7
B 14	12-18-84	White	75	75	25	25	25	Pt. 2	0.006	62702	36027	10-10-84	466	12-10-84	7
B 15	1-2-85	White	50	50	50	50	50	Pt. 5	0.006	62713	36027	10-10-84	466	12-10-84	5
B 16	1-2-85	White	25	50	50	50	50	Pt. 5	0.005	62722	36027	10-10-84	466	12-10-84	5
B 17	1-2-85	White	0	50	50	0	100	Pt. 5	0.007	62732	36027	10-10-84	466	12-10-84	5
B 21	1-2-85	White	50	50	50	50	50	Pt. 5	0.006	62766	36027	10-10-84	466	12-10-84	5
B 22	1-2-85	White	50	25	75	50	25	Pt. 3	0.006	62777	36027	10-10-84	466	12-10-84	5
C 01	12-17-84	White	25	50	75	50	25	Pt. 3	0.006	62525	36024	10-10-84	466	12-10-84	3
C 02	12-17-84	White	75	50	50	50	50	Pt. 1	0.006	62535	36024	10-10-84	466	12-10-84	3
C 03	12-17-84	White	75	75	75	75	100	Pt. 5	0.008	62546	36024	10-10-84	466	12-10-84	3
C 04	12-17-84	White	75	50	125	75	75	Pt. 3	0.007	62562	36024	10-10-84	466	12-10-84	3
C 05	12-18-84	White	75	50	25	50	50	Pt. 1	0.006	62572	36027	10-10-84	466	12-10-84	7
C 06	12-18-84	White	50	25	75	100	100	Pt. 5	0.007	62588	36027	10-10-84	466	12-10-84	7
C 07	12-18-84	White	50	50	75	100	50	Pt. 4	0.007	62604	36027	10-10-84	466	12-10-84	7
C 08	12-18-84	White	50	25	50	50	25	Pt. 4	0.007	62625	36027	10-10-84	466	12-10-84	7
C 09	12-18-84	White	25	50	75	75	25	Pt. 3	0.007	62641	36027	10-10-84	466	12-10-84	7
C 10	12-18-84	White	50	75	50	50	75	Pt. 5	0.006	62657	36027	10-10-84	466	12-10-84	7
C 11	12-18-84	White	50	75	50	75	50	Pt. 2	0.006	62671	36027	10-10-84	466	12-10-84	7
C 12	12-18-84	White	100	75	50	50	50	Pt. 1	0.005	62682	36027	10-10-84	466	12-10-84	7
C 13	12-18-84	White	75	25	50	50	50	Pt. 5	0.006	62693	36027	10-10-84	466	12-10-84	7
C 14	12-18-84	White	50	50	25	50	50	Pt. 5	0.006	62703	36027	10-10-84	466	12-10-84	7
C 15	1-2-85	White	50	50	25	50	50	Pt. 5	0.006	62714	36027	10-10-84	466	12-10-84	5
C 16	1-2-85	White	50	25	25	50	25	Pt. 4	0.004	62723	36027	10-10-84	466	12-10-84	5
C 17	1-2-85	White	50	25	50	50	50	Pt. 5	0.005	62733	36027	10-10-84	466	12-10-84	5
C 18	1-2-85	White	50	100	50	50	50	Pt. 2	0.005	62742	36027	10-10-84	466	12-10-84	5
C 19	1-2-85	White	50	50	50	50	50	Pt. 5	0.006	62751	36027	10-10-84	466	12-10-84	5
C 21	1-2-85	White	25	50	50	50	75	Pt. 5	0.006	62767	36027	10-10-84	466	12-10-84	5
C 22	1-2-85	White	75	75	25	50	50	Pt. 2	0.005	62778	36027	10-10-84	466	12-10-84	5
D 01	12-17-84	White	50	50	50	50	100	Pt. 5	0.006	62525	36024	10-10-84	466	12-10-84	3
D 02	12-17-84	White	75	75	75	75	100	Pt. 5	0.007	62536	36024	10-10-84	466	12-10-84	3
D 03	12-17-84	White	50	50	50	50	50	Pt. 3	0.007	62546	36024	10-10-84	466	12-10-84	3
D 03	12-17-84	White	50	50	50	50	50	Pt. 3	0.007	62547	36024	10-10-84	466	12-10-84	3
D 04	12-17-84	White	50	50	50	75	75	Pt. 4	0.006	62562	36024	10-10-84	466	12-10-84	3
D 05	12-18-84	White	50	50	50	75	100	Pt. 5	0.005	62573	36027	10-10-84	466	12-10-84	3
D 06	12-18-84	White	75	75	25	50	100	Pt. 5	0.007	62589	36027	10-10-84	466	12-10-84	7
D 07	12-18-84	White	50	75	25	100	75	Pt. 4	0.006	62605	36027	10-10-84	466	12-10-84	7
D 08	12-18-84	White	75	50	50	75	75	Pt. 5	0.007	62625	36027	10-10-84	466	12-10-84	7
D 09	12-18-84	White	50	50	75	50	50	Pt. 3	0.007	62641	36027	10-10-84	466	12-10-84	7
D 10	12-18-84	White	50	50	25	50	50	Pt. 5	0.007	62657	36027	10-10-84	466	12-10-84	7
D 11	12-18-84	White	50	75	25	75	25	Pt. 4	0.007	62671	36027	10-10-84	466	12-10-84	7
D 12	12-18-84	White	50	50	75	50	50	Pt. 3	0.006	62682	36027	10-10-84	466	12-10-84	7
D 13	12-18-84	White	25	25	25	50	50	Pt. 5	0.006	62693	36027	10-10-84	466	12-10-84	7
D 14	12-18-84	White	75	25	50	50	100	Pt. 5	0.006	62703	36027	10-10-84	466	12-10-84	7
D 15	1-2-85	White	75	75	75	100	50	Pt. 4	0.006	62714	36027	10-10-84	466	12-10-84	5
D 16	1-2-85	White	100	50	75	50	75	Pt. 1	0.006	62723	36027	10-10-84	466	12-10-84	5
D 17	1-2-85	White	0	50	50	50	75	Pt. 5	0.006	62733	36027	10-10-84	466	12-10-84	5

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GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
D 18	1-2-85	White	0	50	50	75	50	Pt. 4	0.006	62743	36027	10-10-84	466	12-10-84	5
D 19	1-2-85	White	0	0	50	50	0	Pt. 4	0.006	62752	36027	10-10-84	466	12-10-84	5
D 21	1-2-85	White	50	25	25	50	50	Pt. 5	0.006	62767	36027	10-10-84	466	12-10-84	5
D 22	1-2-85	White	25	50	50	50	50	Pt. 5	0.006	62778	36027	10-10-84	466	12-10-84	5
E 01	12-17-84	White	25	50	100	50	25	Pt. 3	0.006	62526	36024	10-10-84	466	12-10-84	3
E 02	12-17-84	White	75	75	100	100	125	Pt. 5	0.006	62536	36024	10-10-84	466	12-10-84	3
E 03	12-17-84	White	100	75	50	75	50	Pt. 1	0.006	62547	36024	10-10-84	466	12-10-84	3
E 04	12-17-84	White	50	50	50	75	50	Pt. 4	0.007	62563	36024	10-10-84	466	12-10-84	3
E 05	12-18-84	White	75	50	25	25	50	Pt. 1	0.006	62573	36027	10-10-84	466	12-10-84	3
E 06	12-18-84	White	50	75	25	50	75	Pt. 5	0.007	62589	36027	10-10-84	466	12-10-84	7
E 07	12-18-84	White	50	25	25	50	50	Pt. 5	0.007	62605	36027	10-10-84	466	12-10-84	7
E 08	12-18-84	White	50	25	50	25	50	Pt. 5	0.006	62626	36027	10-10-84	466	12-10-84	7
E 09	12-18-84	White	50	25	50	75	50	Pt. 4	0.007	62642	36027	10-10-84	466	12-10-84	7
E 10	12-18-84	White	75	50	75	50	100	Pt. 5	0.007	62658	36027	10-10-84	466	12-10-84	7
E 11	12-18-84	White	25	25	25	50	25	Pt. 4	0.007	62672	36027	10-10-84	466	12-10-84	7
E 12	12-18-84	White	50	50	50	25	50	Pt. 5	0.007	62683	36027	10-10-84	466	12-10-84	7
E 13	12-28-84	White	50	25	25	75	75	Pt. 5	0.007	62694	36027	10-10-84	466	12-10-84	7
E 14	12-18-84	White	50	25	25	50	50	Pt. 5	0.006	62704	36027	10-10-84	466	12-10-84	7
E 21	1-2-85	White	50	50	50	50	50	Pt. 5	0.006	62768	36027	10-10-84	466	12-10-84	5
E 22	1-2-85	White	50	50	50	50	50	Pt. 5	0.006	62779	36027	10-10-84	466	12-10-84	5
F 01	12-17-84	White	50	25	50	25	50	Pt. 5	0.006	62526	36024	10-10-84	466	12-10-84	3
F 02	12-17-84	White	75	50	50	100	125	Pt. 5	0.006	62537	36024	10-10-84	466	12-10-84	3
F 03	12-17-84	White	50	50	50	50	50	Pt. 5	0.007	62548	36024	10-10-84	466	12-10-84	3
F 04	12-17-84	White	100	50	50	75	50	Pt. 1	0.007	62563	36024	10-10-84	466	12-10-84	3
F 05	12-18-84	White	75	75	25	75	75	Pt. 5	0.005	62574	36027	10-10-84	466	12-10-84	7
F 06	12-18-84	White	50	25	50	75	50	Pt. 4	0.006	62590	36027	10-10-84	466	12-10-84	7
F 07	12-18-84	White	50	25	25	50	50	Pt. 5	0.006	62606	36027	10-10-84	466	12-10-84	7
F 08	12-18-84	White	50	50	75	50	50	Pt. 3	0.007	62626	36027	10-10-84	466	12-10-84	7
F 09	12-18-84	White	50	50	25	50	75	Pt. 5	0.006	62642	36027	10-10-84	466	12-10-84	7
F 10	12-18-84	White	100	75	75	50	50	Pt. 1	0.007	62658	36027	10-10-84	466	12-10-84	7
F 11	12-18-84	White	50	25	50	25	25	Pt. 1	0.007	62672	36027	10-10-84	466	12-10-84	7
F 12	12-18-84	White	75	75	25	25	25	Pt. 2	0.008	62683	36027	10-10-84	466	12-10-84	7
F 13	12-28-84	White	75	75	50	50	50	Pt. 1	0.007	62694	36027	10-10-84	466	12-10-84	7
F 14	12-18-84	White	50	25	50	50	75	Pt. 5	0.008	62704	36027	10-10-84	466	12-10-84	7
F 21	1-2-85	White	50	50	0	75	75	Pt. 5	0.004	62768	36027	10-10-84	466	12-10-84	5
F 22	1-2-85	White	50	50	50	50	50	Pt. 5	0.005	62779	36027	10-10-84	466	12-10-84	5
G 01	12-17-84	White	50	25	75	50	50	Pt. 3	0.006	62527	36024	10-10-84	466	12-10-84	3
G 02	12-17-84	White	50	75	50	50	75	Pt. 5	0.006	62537	36024	10-10-84	466	12-10-84	3
G 03	12-17-84	White	50	50	50	100	75	Pt. 4	0.006	62548	36024	10-10-84	466	12-10-84	3
G 04	12-17-84	White	50	75	50	50	100	Pt. 5	0.006	62564	36024	10-10-84	466	12-10-84	3
G 05	12-18-84	White	50	25	25	75	100	Pt. 5	0.006	62574	36027	10-10-84	466	12-10-84	7
G 06	12-18-84	White	50	25	50	75	75	Pt. 5	0.006	62590	36027	10-10-84	466	12-10-84	7
G 07	12-18-84	White	50	25	75	75	75	Pt. 5	0.006	62606	36027	10-10-84	466	12-10-84	7
G 08	12-18-84	White	100	50	25	50	50	Pt. 1	0.006	62627	36027	10-10-84	466	12-10-84	7
G 09	12-18-84	White	100	75	75	75	50	Pt. 1	0.007	62643	36027	10-10-84	466	12-10-84	7
G 10	12-18-84	White	75	75	50	50	50	Pt. 2	0.007	62659	36027	10-10-84	466	12-10-84	7
G 11	1-2-85	White	100	25	50	50	50	Pt. 1	0.007	62673	36027	10-10-84	466	12-10-84	5
G 12	1-2-85	White	75	50	75	50	50	Pt. 1	0.009	62684	36027	10-10-84	466	12-10-84	5
G 13	1-2-85	White	75	75	50	50	75	Pt. 5	0.007	62695	36027	10-10-84	466	12-10-84	5
G 14	1-2-85	White	50	50	50	75	50	Pt. 4	0.006	62705	36027	10-10-84	466	12-10-84	7
G 15	1-2-85	White	75	75	100	75	75	Pt. 3	0.006	62715	36027	10-10-84	466	12-10-84	5
G 16	1-2-85	White	100	75	75	75	100	Pt. 5	0.007	62724	36027	10-10-84	466	12-10-84	5
G 17	1-2-85	White	50	50	50	75	75	Pt. 4	0.006	62734	36027	10-10-84	466	12-10-84	5
G 18	1-2-85	White	75	50	0	0	50	Pt. 1	0.005	62743	36027	10-10-84	466	12-10-84	5

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GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
G 21	1-2-85	White	50	50	75	50	50	Pt. 3	0.005	62769	36027	10-10-84	466	12-10-84	5
G 22	1-2-85	White	25	50	50	50	50	Pt. 5	0.006	62780	36027	10-10-84	466	12-10-84	5
G 23	1-2-85	White	50	25	50	25	50	Pt. 5	0.005	62788	36027	10-10-84	466	12-10-84	5
G 25	1-2-85	White	25	25	0	0	50	Pt. 5	0.005	62797	36027	10-10-84	466	12-10-84	5
G 26	1-2-85	White	50	50	0	0	50	Pt. 5	0.006	62799	36027	10-10-84	466	12-10-84	5
G 27	1-2-85	White	50	50	0	0	50	Pt. 5	0.006	62801	36027	10-10-84	466	12-10-84	5
G 28	1-2-85	White	50	75	0	0	25	Pt. 2	0.005	62803	36027	10-10-84	466	12-10-84	5
G 29	1-2-85	White	25	50	0	0	50	Pt. 5	0.007	62805	36027	10-10-84	466	12-10-84	5
G 30	1-2-85	White	50	25	0	0	25	Pt. 1	0.006	62807	36027	10-10-84	466	12-10-84	5
G 31	1-2-85	White	50	50	0	0	75	Pt. 5	0.006	62809	36027	10-10-84	466	12-10-84	5
G 32	1-2-85	White	25	50	0	0	50	Pt. 5	0.005	62811	36027	10-10-84	466	12-10-84	5
G 33	1-2-85	White	0	50	0	0	0	Pt. 2	0.005	62813	36027	10-10-84	466	12-10-84	5
H 01	12-17-84	White	50	50	50	50	75	Pt. 5	0.006	62527	36024	10-10-84	466	12-10-84	3
H 02	12-17-84	White	50	50	50	50	75	Pt. 5	0.006	62538	36024	10-10-84	466	12-10-84	3
H 03	12-17-84	White	50	50	50	75	100	Pt. 5	0.008	62549	36024	10-10-84	466	12-10-84	3
H 04	12-17-84	White	75	125	50	75	50	Pt. 2	0.007	62564	36024	10-10-84	466	12-10-84	3
H 05	12-18-84	White	75	75	50	75	75	Pt. 5	0.005	62575	36027	10-10-84	466	12-10-84	7
H 06	12-18-84	White	50	25	25	75	75	Pt. 5	0.007	62591	36027	10-10-84	466	12-10-84	7
H 07	12-18-84	White	50	50	50	50	50	Pt. 5	0.006	62607	36027	10-10-84	466	12-10-84	7
H 08	12-18-84	White	100	75	75	75	75	Pt. 1	0.007	62627	36027	10-10-84	466	12-10-84	7
H 09	12-18-84	White	75	75	50	100	50	Pt. 4	0.008	62643	36027	10-10-84	466	12-10-84	7
H 10	12-18-84	White	50	125	75	50	75	Pt. 2	0.008	62659	36027	10-10-84	466	12-10-84	7
H 11	1-2-85	White	50	75	75	50	50	Pt. 2	0.007	62673	36027	10-10-84	466	12-10-84	5
H 12	1-2-85	White	75	75	100	200	75	Pt. 4	0.032	62684	36027	10-10-84	466	12-10-84	5
H 13	1-2-85	White	75	100	100	150	125	Pt. 4	0.034	62695	36027	10-10-84	466	12-10-84	5
H 14	1-2-85	White	0	75	100	75	100	Pt. 3	0.012	62705	36027	10-10-84	466	12-10-84	7
H 16	1-2-85	White	50	100	75	75	75	Pt. 2	0.006	62724	36027	10-10-84	466	12-10-84	5
H 17	1-2-85	White	50	75	50	50	100	Pt. 5	0.007	62734	36027	10-10-84	466	12-10-84	5
H 18	1-2-85	White	100	125	50	150	50	Pt. 4	0.010	62744	36027	10-10-84	466	12-10-84	5
H 20	1-2-85	White	75	75	50	50	75	Pt. 5	0.006	62760	36027	10-10-84	466	12-10-84	5
H 21	1-2-85	White	50	25	50	25	25	Pt. 3	0.006	62769	36027	10-10-84	466	12-10-84	5
H 22	1-2-85	White	50	50	50	50	75	Pt. 5	0.006	62780	36027	10-10-84	466	12-10-84	5
H 23	1-2-85	White	25	25	25	50	50	Pt. 5	0.004	62788	36027	10-10-84	466	12-10-84	5
H 24	1-2-85	White	25	50	0	0	25	Pt. 2	0.004	62796	36027	10-10-84	466	12-10-84	5
H 25	1-2-85	White	50	25	25	25	50	Pt. 1	0.005	62798	36027	10-10-84	466	12-10-84	5
H 26	1-2-85	White	50	25	25	25	50	Pt. 5	0.006	62800	36027	10-10-84	466	12-10-84	5
H 27	1-2-85	White	50	75	75	50	50	Pt. 2	0.006	62802	36027	10-10-84	466	12-10-84	5
H 28	1-2-85	White	50	50	50	25	25	Pt. 2	0.006	62804	36027	10-10-84	466	12-10-84	5
H 29	1-2-85	White	25	25	25	25	25	Pt. 5	0.006	62806	36027	10-10-84	466	12-10-84	5
H 30	1-2-85	White	75	50	50	50	50	Pt. 1	0.005	62808	36027	10-10-84	466	12-10-84	5
H 31	1-2-85	White	100	50	25	50	50	Pt. 1	0.006	62810	36027	10-10-84	466	12-10-84	5
H 32	1-2-85	White	50	25	25	25	25	Pt. 1	0.006	62812	36027	10-10-84	466	12-10-84	5
H 33	1-2-85	White	0	25	25	0	50	Pt. 5	0.006	62814	36027	10-10-84	466	12-10-84	5
I 01	12-17-84	White	50	50	50	50	50	Pt. 5	0.007	62528	36024	10-10-84	466	12-10-84	3
I 02	12-17-84	White	100	75	75	50	100	Pt. 5	0.006	62538	36024	10-10-84	466	12-10-84	3
I 03	12-17-84	White	75	25	100	50	125	Pt. 5	0.007	62549	36024	10-10-84	466	12-10-84	3
I 04	12-17-84	White	50	50	50	50	75	Pt. 5	0.007	62565	36024	10-10-84	466	12-10-84	3
I 05	12-18-84	White	100	50	50	50	75	Pt. 1	0.006	62575	36027	10-10-84	466	12-10-84	7
I 06	12-18-84	White	50	25	50	50	50	Pt. 5	0.006	62591	36027	10-10-84	466	12-10-84	7
I 07	12-18-84	White	50	25	50	25	25	Pt. 3	0.006	62607	36027	10-10-84	466	12-10-84	7
I 08	12-18-84	White	50	25	50	50	75	Pt. 5	0.007	62628	36027	10-10-84	466	12-10-84	7
I 09	12-18-84	White	50	25	25	100	50	Pt. 4	0.028	62644	36027	10-10-84	466	12-10-84	7
I 10	12-18-84	White	75	75	200	75	100	Pt. 3	0.015	62660	36027	10-10-84	466	12-10-84	7
I 11	12-18-84	White	75	100	75	75	75	Pt. 2	0.007	62674	36027	10-10-84	466	12-10-84	7

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GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
I 12	12-18-84	White	50	50	50	100	50	Pt. 4	0.013	62685	36027	10-10-84	466	12-10-84	7
I 15	1-2-85	White	50	75	75	100	50	Pt. 4	0.008	62715	36027	10-10-84	466	12-10-84	5
I 16	1-2-85	White	50	50	50	50	50	Pt. 5	0.005	62725	36027	10-10-84	466	12-10-84	5
I 17	12-20-84	White	75	25	25	75	50	Pt. 4	0.006	62735	36027	10-10-84	466	12-10-84	3
I 18	1-2-85	White	75	75	50	50	50	Pt. 2	0.006	62744	36027	10-10-84	466	12-10-84	5
I 19	1-2-85	White	75	50	25	50	75	Pt. 5	0.006	62752	36027	10-10-84	466	12-10-84	5
I 20	12-20-84	White	25	25	75	75	50	Pt. 3	0.006	62761	36027	10-10-84	466	12-10-84	7
I 21	12-20-84	White	50	75	50	25	25	Pt. 2	0.006	62770	36027	10-10-84	466	12-10-84	7
I 22	1-2-85	White	50	50	25	50	50	Pt. 5	0.005	62781	36027	10-10-84	466	12-10-84	5
I 23	1-2-85	White	50	50	25	25	50	Pt. 5	0.006	62789	36027	10-10-84	466	12-10-84	5
I 24	1-2-85	White	50	50	25	25	50	Pt. 5	0.005	62796	36027	10-10-84	466	12-10-84	5
I 25	1-2-85	White	50	25	25	50	25	Pt. 1	0.005	62798	36027	10-10-84	466	12-10-84	5
I 26	1-2-85	White	50	50	75	25	50	Pt. 3	0.006	62800	36027	10-10-84	466	12-10-84	5
I 27	1-2-85	White	75	50	50	50	50	Pt. 1	0.005	62802	36027	10-10-84	466	12-10-84	5
I 28	1-2-85	White	25	25	25	50	50	Pt. 5	0.005	62804	36027	10-10-84	466	12-10-84	5
I 29	1-2-85	White	50	0	50	25	50	Pt. 1	0.004	62806	36027	10-10-84	466	12-10-84	5
I 30	1-2-85	White	50	50	25	50	50	Pt. 1	0.005	62808	36027	10-10-84	466	12-10-84	5
I 31	1-2-85	White	50	75	50	50	25	Pt. 2	0.006	62810	36027	10-10-84	466	12-10-84	5
I 32	1-2-85	White	50	25	50	25	25	Pt. 3	0.006	62812	36027	10-10-84	466	12-10-84	5
I 33	1-2-85	White	0	50	50	0	50	Pt. 5	0.006	62814	36027	10-10-84	466	12-10-84	5
J 01	12-17-84	White	75	75	75	75	75	Pt. 5	0.005	62528	36024	10-10-84	466	12-10-84	3
J 02	12-17-84	White	25	50	50	50	100	Pt. 5	0.007	62539	36024	10-10-84	466	12-10-84	3
J 03	12-17-84	White	50	50	100	75	50	Pt. 3	0.007	62550	36024	10-10-84	466	12-10-84	3
J 04	12-17-84	White	50	50	50	50	75	Pt. 5	0.006	62565	36024	10-10-84	466	12-10-84	3
J 05	12-18-84	White	25	50	25	100	25	Pt. 4	0.007	62576	36024	10-10-84	466	12-10-84	7
J 06	12-18-84	White	50	75	50	75	100	Pt. 5	0.008	62592	36024	10-10-84	466	12-10-84	7
J 07	12-18-84	White	25	25	75	75	100	Pt. 5	0.007	62608	36027	10-10-84	466	12-10-84	7
J 08	12-18-84	White	50	25	25	50	75	Pt. 5	0.007	62628	36027	10-10-84	466	12-10-84	7
J 09	12-18-84	White	50	50	50	125	100	Pt. 4	0.007	62644	36027	10-10-84	466	12-10-84	7
J 10	12-18-84	White	75	50	50	100	100	Pt. 5	0.006	62660	36027	10-10-84	466	12-10-84	7
J 11	12-18-84	White	50	50	25	50	75	Pt. 5	0.008	62674	36027	10-10-84	466	12-10-84	7
J 12	12-18-84	White	50	75	50	50	50	Pt. 2	0.007	62685	36027	10-10-84	466	12-10-84	7
J 13	12-28-84	White	50	50	75	50	50	Pt. 3	0.009	62696	36027	10-10-84	466	12-10-84	7
J 14	12-18-84	White	50	50	50	50	50	Pt. 5	0.009	62706	36027	10-10-84	466	12-10-84	7
J 15	12-18-84	White	50	50	25	75	75	Pt. 5	0.007	62716	36027	10-10-84	466	12-10-84	7
J 16	1-2-85	White	100	50	50	75	50	Pt. 1	0.005	62725	36027	10-10-84	466	12-10-84	5
J 17	12-20-84	White	100	25	25	75	125	Pt. 5	0.006	62735	36027	10-10-84	466	12-10-84	3
J 18	12-20-84	White	50	75	25	50	50	Pt. 2	0.005	62745	36027	10-10-84	466	12-10-84	7
J 19	12-20-84	White	50	25	50	50	50	Pt. 5	0.006	62753	36027	10-10-84	466	12-10-84	7
J 20	12-20-84	White	50	25	75	50	25	Pt. 3	0.006	62761	36027	10-10-84	466	12-10-84	7
J 21	12-20-84	White	50	25	50	50	50	Pt. 5	0.005	62770	36027	10-10-84	466	12-10-84	7
J 22	1-2-85	White	75	50	75	50	50	Pt. 1	0.006	62781	36027	10-10-84	466	12-10-84	5
J 23	1-2-85	White	25	25	25	50	50	Pt. 5	0.006	62789	36027	10-10-84	466	12-10-84	5
J 24	1-2-85	White	50	50	25	25	25	Pt. 2	0.005	62797	36027	10-10-84	466	12-10-84	5
J 25	1-2-85	White	50	25	25	25	75	Pt. 5	0.006	62799	36027	10-10-84	466	12-10-84	5
J 26	1-2-85	White	50	25	25	25	50	Pt. 5	0.006	62801	36027	10-10-84	466	12-10-84	5
J 27	1-2-85	White	25	50	50	50	25	Pt. 2	0.006	62803	36027	10-10-84	466	12-10-84	5
J 28	1-2-85	White	50	50	75	25	50	Pt. 3	0.005	62805	36027	10-10-84	466	12-10-84	5
J 29	1-2-85	White	25	50	50	50	75	Pt. 5	0.004	62807	36027	10-10-84	466	12-10-84	5
J 30	1-2-85	White	50	25	50	25	25	Pt. 1	0.004	62809	36027	10-10-84	466	12-10-84	5
J 31	1-2-85	White	25	25	50	50	50	Pt. 5	0.006	62811	36027	10-10-84	466	12-10-84	5
J 32	1-2-85	White	50	50	25	25	25	Pt. 1	0.006	62813	36027	10-10-84	466	12-10-84	5
J 33	1-2-85	White	0	25	25	0	25	Pt. 5	0.006	62815	36027	10-10-84	466	12-10-84	5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
K 02	12-17-84	White	50	50	50	50	50	Pt. 1	0.007	62539	36024	10-10-84	466	12-10-84	3
K 03	12-17-84	White	50	50	50	50	100	Pt. 5	0.007	62550	36024	10-10-84	466	12-10-84	3
K 04	12-17-84	White	75	75	75	75	75	Pt. 2	0.008	62566	36024	10-10-84	466	12-10-84	3
K 05	12-18-84	White	50	100	75	75	50	Pt. 2	0.008	62576	36024	10-10-84	466	12-10-84	7
K 06	12-18-84	White	75	75	75	75	100	Pt. 5	0.008	62592	36024	10-10-84	466	12-10-84	7
K 07	12-18-84	White	50	75	25	50	50	Pt. 2	0.008	62608	36027	10-10-84	466	12-10-84	7
K 08	12-18-84	White	50	75	75	50	75	Pt. 2	0.009	62629	36027	10-10-84	466	12-10-84	7
K 09	12-18-84	White	75	75	25	50	75	Pt. 5	0.007	62645	36027	10-10-84	466	12-10-84	7
K 10	12-18-84	White	75	50	50	50	50	Pt. 1	0.007	62661	36027	10-10-84	466	12-10-84	7
K 11	12-18-84	White	75	50	25	50	75	Pt. 5	0.008	62675	36027	10-10-84	466	12-10-84	7
K 12	12-18-84	White	50	50	75	50	100	Pt. 5	0.009	62686	36027	10-10-84	466	12-10-84	7
K 13	12-28-84	White	50	50	75	50	100	Pt. 5	0.010	62696	36027	10-10-84	466	12-10-84	7
K 14	12-18-84	White	75	50	50	50	75	Pt. 5	0.009	62706	36027	10-10-84	466	12-10-84	7
K 15	12-18-84	White	50	50	50	50	50	Pt. 5	0.008	62716	36027	10-10-84	466	12-10-84	7
K 16	12-18-84	White	100	75	50	75	75	Pt. 1	0.007	62726	36027	10-10-84	466	12-10-84	7
K 17	12-20-84	White	50	25	50	50	25	Pt. 3	0.005	62736	36027	10-10-84	466	12-10-84	3
K 18	12-20-84	White	50	50	25	50	75	Pt. 5	0.006	62745	36027	10-10-84	466	12-10-84	7
K 19	12-20-84	White	75	50	75	25	50	Pt. 3	0.005	62753	36027	10-10-84	466	12-10-84	7
K 20	12-20-84	White	75	50	25	50	50	Pt. 1	0.006	62762	36027	10-10-84	466	12-10-84	7
K 21	12-20-84	White	50	50	50	75	50	Pt. 4	0.005	62771	36027	10-10-84	466	12-10-84	7
K 22	1-2-85	White	50	50	25	75	75	Pt. 5	0.006	62782	36027	10-10-84	466	12-10-84	5
K 23	1-2-85	White	0	50	25	50	25	Pt. 2	0.006	62790	36027	10-10-84	466	12-10-84	5
L 01	12-17-84	White	50	50	50	50	75	Pt. 5	0.007	62529	36024	10-10-84	466	12-10-84	3
L 02	12-17-84	White	100	50	50	75	75	Pt. 1	0.007	62540	36024	10-10-84	466	12-10-84	3
L 03	12-17-84	White	75	50	75	100	75	Pt. 4	0.007	62551	36024	10-10-84	466	12-10-84	3
L 04	12-17-84	White	75	75	75	75	75	Pt. 1	0.008	62566	36024	10-10-84	466	12-10-84	3
L 05	12-17-84	White	100	75	100	75	50	Pt. 1	0.007	62577	36024	10-10-84	466	12-10-84	3
L 06	12-17-84	White	75	75	75	75	100	Pt. 5	0.007	62593	36024	10-10-84	466	12-10-84	3
L 07	12-18-84	White	75	50	25	75	75	Pt. 5	0.007	62609	36027	10-10-84	466	12-10-84	7
L 08	12-18-84	White	50	75	50	50	50	Pt. 2	0.007	62629	36027	10-10-84	466	12-10-84	7
L 09	12-18-84	White	75	50	25	25	75	Pt. 5	0.007	62645	36027	10-10-84	466	12-10-84	7
L 10	12-18-84	White	50	75	50	50	75	Pt. 5	0.007	62661	36027	10-10-84	466	12-10-84	7
L 11	12-18-84	White	50	50	75	50	50	Pt. 3	0.007	62675	36027	10-10-84	466	12-10-84	7
L 12	12-18-84	White	25	25	25	50	75	Pt. 5	0.006	62686	36027	10-10-84	466	12-10-84	7
L 13	12-28-84	White	25	50	50	50	50	Pt. 5	0.005	62697	36027	10-10-84	466	12-10-84	7
L 14	12-18-84	White	50	25	50	75	25	Pt. 4	0.007	62707	36027	10-10-84	466	12-10-84	7
L 15	12-18-84	White	50	0	25	50	25	Pt. 1	0.005	62717	36027	10-10-84	466	12-10-84	7
L 16	12-18-84	White	50	25	50	75	50	Pt. 4	0.006	62726	36027	10-10-84	466	12-10-84	7
L 17	12-20-84	White	25	25	25	25	50	Pt. 5	0.006	62736	36027	10-10-84	466	12-10-84	3
L 18	12-20-84	White	50	25	25	50	50	Pt. 5	0.005	62746	36027	10-10-84	466	12-10-84	7
L 21	12-20-84	White	25	25	50	25	25	Pt. 3	0.005	62771	36027	10-10-84	466	12-10-84	7
L 22	1-2-85	White	50	50	75	25	50	Pt. 3	0.006	62782	36027	10-10-84	466	12-10-84	5
L 23	1-2-85	White	0	25	25	0	25	Pt. 5	0.006	62790	36027	10-10-84	466	12-10-84	5
M 01	12-17-84	White	50	50	50	50	50	Pt. 5	0.007	62530	36024	10-10-84	466	12-10-84	3
M 02	12-17-84	White	50	50	50	100	50	Pt. 4	0.007	62540	36024	10-10-84	466	12-10-84	3
M 03	12-17-84	White	100	100	50	50	100	Pt. 5	0.008	62551	36024	10-10-84	466	12-10-84	3
M 04	12-17-84	White	75	50	50	75	75	Pt. 5	0.008	62567	36024	10-10-84	466	12-10-84	3
M 05	12-17-84	White	75	75	75	100	75	Pt. 4	0.007	62577	36024	10-10-84	466	12-10-84	3
M 06	12-17-84	White	75	75	75	75	100	Pt. 5	0.008	62593	36024	10-10-84	466	12-10-84	3
M 07	12-18-84	White	50	50	100	75	75	Pt. 3	0.007	62609	36027	10-10-84	466	12-10-84	7
M 08	12-18-84	White	100	75	50	75	75	Pt. 1	0.007	62630	36027	10-10-84	466	12-10-84	7
M 09	12-18-84	White	100	100	50	100	125	Pt. 5	0.007	62646	36027	10-10-84	466	12-10-84	7
M 10	12-18-84	White	50	50	75	50	100	Pt. 5	0.007	62662	36027	10-10-84	466	12-10-84	7
M 11	12-18-84	White	50	25	25	75	75	Pt. 5	0.007	62676	36027	10-10-84	466	12-10-84	7

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GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
M 12	12-18-84	White	50	0	0	50	0	Pt. 4	0.007	62687	36027	10-10-84	466	12-10-84	7
M 13	12-28-84	White	50	50	50	50	75	Pt. 5	0.004	62697	36027	10-10-84	466	12-10-84	7
M 14	12-18-84	White	0	0	75	50	0	Pt. 3	0.005	62708	36027	10-10-84	466	12-10-84	7
M 15	12-18-84	White	50	50	50	50	50	Pt. 5	0.004	62717	36027	10-10-84	466	12-10-84	7
M 16	12-18-84	White	75	25	25	50	100	Pt. 5	0.005	62727	36027	10-10-84	466	12-10-84	7
M 17	12-20-84	White	50	50	25	50	75	Pt. 5	0.007	62737	36027	10-10-84	466	12-10-84	3
M 18	12-20-84	White	50	25	50	50	75	Pt. 5	0.005	62746	36027	10-10-84	466	12-10-84	7
M 21	12-20-84	White	0	25	50	25	75	Pt. 5	0.005	62772	36027	10-10-84	466	12-10-84	7
M 22	1-2-85	White	75	0	50	50	25	Pt. 1	0.005	62783	36027	10-10-84	466	12-10-84	5
M 23	1-2-85	White	0	50	25	0	50	Pt. 5	0.006	62791	36027	10-10-84	466	12-10-84	5
N 01	12-17-84	White	50	50	50	50	50	Pt. 1	0.008	62530	36024	10-10-84	466	12-10-84	3
N 02	12-17-84	White	75	50	75	75	100	Pt. 5	0.006	62541	36024	10-10-84	466	12-10-84	3
N 03	12-17-84	White	100	75	100	50	100	Pt. 3	0.009	62552	36024	10-10-84	466	12-10-84	3
N 04	12-17-84	White	75	75	50	75	100	Pt. 5	0.008	62567	36024	10-10-84	466	12-10-84	3
N 05	12-17-84	White	75	75	75	75	75	Pt. 2	0.009	62578	36027	10-10-84	466	12-10-84	3
N 06	12-17-84	White	75	75	50	100	75	Pt. 4	0.008	62594	36027	10-10-84	466	12-10-84	3
N 07	12-18-84	White	75	50	75	75	50	Pt. 4	0.008	62610	36027	10-10-84	466	12-10-84	7
N 08	12-18-84	White	50	50	50	50	200	Pt. 5	0.008	62630	36027	10-10-84	466	12-10-84	7
N 09	12-18-84	White	100	75	50	100	75	Pt. 4	0.008	62646	36027	10-10-84	466	12-10-84	7
N 10	12-18-84	White	50	50	75	100	50	Pt. 4	0.007	62662	36027	10-10-84	466	12-10-84	7
N 11	12-18-84	White	75	25	25	100	50	Pt. 4	0.008	62676	36027	10-10-84	466	12-10-84	7
N 12	12-18-84	White	75	50	75	50	50	Pt. 1	0.007	62687	36027	10-10-84	466	12-10-84	7
N 13	12-18-84	White	100	50	75	50	100	Pt. 5	0.008	62698	36027	10-10-84	466	12-10-84	7
N 14	12-18-84	White	75	25	75	50	50	Pt. 1	0.006	62708	36027	10-10-84	466	12-10-84	7
N 15	12-18-84	White	75	50	50	50	50	Pt. 1	0.006	62718	36027	10-10-84	466	12-10-84	7
N 16	12-18-84	White	25	50	75	50	50	Pt. 3	0.006	62727	36027	10-10-84	466	12-10-84	7
N 17	12-20-84	White	50	25	50	50	100	Pt. 5	0.006	62737	36027	10-10-84	466	12-10-84	3
N 18	12-20-84	White	50	75	50	50	50	Pt. 2	0.005	62747	36027	10-10-84	466	12-10-84	7
N 21	12-20-84	White	50	25	0	25	50	Pt. 5	0.005	62772	36027	10-10-84	466	12-10-84	7
N 22	[illegible]	White	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Pt. 5	[illegible]	[illegible]	[illegible]	[illegible]	466	[illegible]	5
N 23	1-2-85	White	0	50	25	0	50	Pt. 5	0.005	62791	36027	10-10-84	466	12-10-84	5
O 01	12-17-84	White	50	50	50	50	50	Pt. 3	0.007	62531	36024	10-10-84	466	12-10-84	3
O 02	12-17-84	White	75	75	75	75	100	Pt. 5	0.008	62541	36024	10-10-84	466	12-10-84	3
O 03	12-17-84	White	50	25	50	75	75	Pt. 4	0.008	62552	36024	10-10-84	466	12-10-84	3
O 11	12-18-84	White	25	50	25	50	25	Pt. 4	0.008	62677	36027	10-10-84	466	12-10-84	7
O 12	12-18-84	White	50	50	50	50	50	Pt. 5	0.007	62688	36027	10-10-84	466	12-10-84	7
O 13	12-18-84	White	50	50	50	50	25	Pt. 3	0.007	62698	36027	10-10-84	466	12-10-84	7
O 14	12-18-84	White	25	75	50	100	50	Pt. 4	0.006	62709	36027	10-10-84	466	12-10-84	7
O 15	12-18-84	White	50	50	50	50	100	Pt. 5	0.005	62718	36027	10-10-84	466	12-10-84	7
O 16	12-18-84	White	25	0	25	25	25	Pt. 4	0.006	62728	36027	10-10-84	466	12-10-84	7
O 17	12-20-84	White	25	25	0	25	50	Pt. 5	0.006	62738	36027	10-10-84	466	12-10-84	3
O 18	12-20-84	White	50	50	75	50	50	Pt. 3	0.004	62747	36027	10-10-84	466	12-10-84	7
O 20	12-20-84	White	50	25	25	50	50	Pt. 5	0.004	62762	36027	10-10-84	466	12-10-84	7
O 21	12-20-84	White	25	50	25	25	25	Pt. 2	0.004	62773	36027	10-10-84	466	12-10-84	7
O 22	1-2-85	White	50	25	50	50	25	Pt. 3	0.005	62784	36027	10-10-84	466	12-10-84	5
O 23	1-2-85	White	0	25	25	0	25	Pt. 5	0.005	62792	36027	10-10-84	466	12-10-84	5
P 01	12-17-84	White	50	50	50	75	50	Pt. 4	0.008	62531	36024	10-10-84	466	12-10-84	3
P 02	12-17-84	White	75	50	75	75	100	Pt. 5	0.008	62542	36024	10-10-84	466	12-10-84	3
P 03	12-17-84	White	75	100	75	75	50	Pt. 2	0.007	62553	36024	10-10-84	466	12-10-84	3
P 11	12-18-84	White	50	75	25	75	50	Pt. 2	0.009	62677	36027	10-10-84	466	12-10-84	7
P 12	12-18-84	White	50	50	25	100	75	Pt. 4	0.007	62688	36027	10-10-84	466	12-10-84	7
P 13	12-18-84	White	25	25	50	50	50	Pt. [illegible]	0.006	62699	36027	10-10-84	466	12-10-84	7
P 14	12-18-84	White	50	75	0	50	50	Pt. 2	0.007	62709	36027	10-10-84	466	12-10-84	7
P 15	12-18-84	White	50	75	75	50	50	Pt. 3	0.006	62719	36027	10-10-84	466	12-10-84	7

PBRF OUTDR RAD CLASS NOT ERB, APP. 3.2
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GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	OS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
P 16	12-18-84	White	50	50	50	25	50	Pt. 1	0.006	62728	36027	10-10-84	466	12-10-84	7
P 17	12-20-84	White	50	25	75	50	50	Pt. 3	0.005	62738	36027	10-10-84	466	12-10-84	3
P 18	12-20-84	White	25	25	25	25	50	Pt. 5	0.005	62748	36027	10-10-84	466	12-10-84	7
P 19	12-20-84	White	75	75	25	25	25	Pt. 2	0.005	62754	36027	10-10-84	466	12-10-84	7
P 20	12-20-84	White	75	25	50	50	50	Pt. 1	0.008	62763	36027	10-10-84	466	12-10-84	7
P 21	12-20-84	White	50	25	50	50	50	Pt. 5	0.005	62773	36027	10-10-84	466	12-10-84	7
P 22	1-2-85	White	75	25	25	50	50	Pt. 1	0.006	62784	36027	10-10-84	466	12-10-84	5
P 23	1-2-85	White	0	50	50	0	25	Pt. 2	0.005	62792	36027	10-10-84	466	12-10-84	5
Q 01	12-17-84	White	50	50	50	50	50	1	0.008	62532	36024	10-10-84	466	12-10-84	3
Q 02	12-17-84	White	75	25	25	75	50	Pt. 4	0.009	62542	36024	10-10-84	466	12-10-84	3
Q 03	12-17-84	White	50	75	75	100	100	Pt. 4	0.009	62553	36024	10-10-84	466	12-10-84	3
Q 11	12-18-84	White	50	25	50	75	50	Pt. 4	0.007	62678	36027	10-10-84	466	12-10-84	7
Q 12	12-18-84	White	50	100	25	50	50	Pt. 2	0.007	62689	36027	10-10-84	466	12-10-84	7
Q 13	12-18-84	White	100	50	25	50	75	Pt. 1	0.006	62699	36027	10-10-84	466	12-10-84	7
Q 14	12-18-84	White	50	0	50	100	50	Pt. 4	0.007	62710	36027	10-10-84	466	12-10-84	7
Q 15	12-18-84	White	50	75	50	25	75	Pt. 5	0.007	62719	36027	10-10-84	466	12-10-84	7
Q 16	12-18-84	White	50	25	25	50	100	Pt. 5	0.006	62729	36027	10-10-84	466	12-10-84	7
Q 17	12-20-84	White	50	50	25	75	75	Pt. 5	0.005	62739	36027	10-10-84	466	12-10-84	3
Q 18	12-20-84	White	50	75	25	50	25	Pt. 2	0.006	62748	36027	10-10-84	466	12-10-84	7
Q 19	12-20-84	White	75	50	100	100	50	Pt. 3	0.005	62754	36027	10-10-84	466	12-10-84	7
Q 20	12-20-84	White	75	50	100	75	75	Pt. 3	0.008	62763	36027	10-10-84	466	12-10-84	7
Q 21	12-20-84	White	50	25	25	25	75	Pt. 5	0.006	62774	36027	10-10-84	466	12-10-84	7
Q 22	12-20-84	White	25	125	50	75	50	Pt. 2	0.006	62785	36027	10-10-84	466	12-10-84	5
Q 23	1-2-85	White	0	25	50	0	25	Pt. 3	0.006	62793	36027	10-10-84	466	12-10-84	5
R 01	12-17-84	White	50	75	50	50	50	Pt. 2	0.007	62532	36024	10-10-84	466	12-10-84	3
R 02	12-17-84	White	25	50	50	50	50	Pt. 5	0.008	62543	36024	10-10-84	466	12-10-84	3
R 03	12-17-84	White	100	50	75	50	75	Pt. 1	0.009	62554	36024	10-10-84	466	12-10-84	3
R 11	12-18-84	White	50	25	25	50	75	Pt. 5	0.007	62678	36027	10-10-84	466	12-10-84	7
R 12	12-18-84	White	25	50	50	25	50	Pt. 5	0.007	62689	36027	10-10-84	466	12-10-84	7
R 13	12-28-84	White	50	75	50	50	50	Pt. 2	0.007	62700	36027	10-10-84	466	12-10-84	7
R 14	12-18-84	White	25	75	50	50	50	Pt. 2	0.006	62710	36027	10-10-84	466	12-10-84	7
R 15	12-18-84	White	75	50	25	50	50	Pt. 1	0.006	62720	36027	10-10-84	466	12-10-84	7
R 16	12-18-84	White	50	50	50	50	50	Pt. 5	0.006	62729	36027	10-10-84	466	12-10-84	7
R 17	12-20-84	White	50	75	50	25	75	Pt. 2	0.006	62739	36027	10-10-84	466	12-10-84	3
R 18	12-20-84	White	25	25	50	25	50	Pt. 5	0.006	62749	36027	10-10-84	466	12-10-84	7
R 19	12-20-84	White	75	50	75	75	50	Pt. 4	0.007	62755	36027	10-10-84	466	12-10-84	7
R 21	12-20-84	White	0	75	50	0	50	Pt. 2	0.005	62774	36027	10-10-84	466	12-10-84	7
R 22	12-20-84	White	50	25	25	75	50	Pt. 4	0.006	62785	36027	10-10-84	466	12-10-84	5
R 23	1-2-85	White	0	50	50	0	25	Pt. 2	0.005	62793	36027	10-10-84	466	12-10-84	5
S 01	12-17-84	White	50	50	50	75	75	Pt. 5	0.007	62533	36024	10-10-84	466	12-10-84	3
S 02	12-17-84	White	75	50	50	50	75	Pt. 5	0.007	62543	36024	10-10-84	466	12-10-84	3
S 03	12-17-84	White	75	75	75	50	75	Pt. 1	0.009	62554	36024	10-10-84	466	12-10-84	3
S 11	12-18-84	White	75	25	25	75	50	Pt. 1	0.007	62679	36027	10-10-84	466	12-10-84	7
S 12	12-18-84	White	50	25	25	100	50	Pt. 4	0.007	62690	36027	10-10-84	466	12-10-84	7
S 13	12-28-84	White	75	50	50	100	75	Pt. 4	0.006	62700	36027	10-10-84	466	12-10-84	7
S 14	12-28-85	White	50	75	50	25	50	Pt. 2	0.006	62711	36027	10-10-84	466	12-10-84	7
S 15	12-18-84	White	50	50	25	50	50	Pt. 5	0.006	62720	36027	10-10-84	466	12-10-84	7
S 16	12-18-84	White	50	25	75	25	50	Pt. 3	0.006	62730	36027	10-10-84	466	12-10-84	7
S 17	12-20-84	White	50	75	50	50	75	Pt. 5	0.006	62740	36027	10-10-84	466	12-10-84	3
S 18	12-20-84	White	25	75	25	50	25	Pt. 2	0.005	62749	36027	10-10-84	466	12-10-84	7
S 19	12-20-84	White	50	75	25	25	75	Pt. 5	0.005	62755	36027	10-10-84	466	12-10-84	7
S 20	12-20-84	White	50	25	75	50	50	Pt. 3	0.005	62764	36027	10-10-84	466	12-10-84	7
S 21	12-20-84	White	0	50	25	50	0	Pt. 2	0.005	62775	36027	10-10-84	466	12-10-84	7
S 22	12-20-84	White	50	25	25	50	25	Pt. 1	0.005	62786	36027	10-10-84	466	12-10-84	5

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GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
S 23	1-2-85	White	0	50	50	0	50	Pt. 5	0.005	62794	36027	10-10-84	466	12-10-84	5
T 01	12-17-84	White	50	50	75	50	100	Pt. 5	0.005	62533	36024	10-10-84	466	12-10-84	3
T 02	12-17-84	White	75	[illegible]	[illegible]	75	50	Pt. 4	0.009	62544	36024	10-10-84	466	12-10-84	3
T 03	[illegible]	White	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Pt. 4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12-10-84	3
T 04	12-20-84	White	100	50	75	75	75	Pt. 1	0.008	62570	36024	10-10-84	466	12-10-84	7
T 05	12-20-84	White	75	0	75	75	100	Pt. 5	0.070	62586	36027	10-10-84	466	12-10-84	7
T 06	12-20-84	White	50	75	50	75	50	Pt. 2	0.008	62602	36027	10-10-84	466	12-10-84	7
T 07	12-20-84	White	75	75	50	50	25	Pt. 1	0.007	62618	36027	10-10-84	466	12-10-84	7
T 08	12-18-84	White	75	75	75	75	50	Pt 2	0.007	62639	36027	10-10-84	466	12-10-84	7
T 09	12-18-84	White	50	50	75	75	100	Pt. 5	0.008	62655	36027	10-10-84	466	12-10-84	7
T 10	12-20-84	White	75	100	25	75	100	Pt. 5	0.008	62669	36027	10-10-84	466	12-10-84	7
T 11	12-18-84	White	50	50	75	50	50	Pt. 3	0.007	62679	36027	10-10-84	466	12-10-84	7
T 12	12-18-84	White	50	75	75	100	100	Pt. 5	0.006	62690	36027	10-10-84	466	12-10-84	7
T 13	12-18-84	White	50	25	50	50	50	Pt. 5	0.006	62701	36027	10-10-84	466	12-10-84	7
T 14	12-28-85	White	50	75	50	50	75	Pt. 5	0.006	62711	36027	10-10-84	466	12-10-84	7
T 15	12-18-84	White	25	50	25	25	25	Pt. 2	0.006	62721	36027	10-10-84	466	12-10-84	7
T 16	12-18-84	White	50	50	75	50	50	Pt. 3	0.006	62730	36027	10-10-84	466	12-10-84	7
T 17	12-20-84	White	50	75	50	50	50	Pt. 2	0.008	62740	36027	10-10-84	466	12-10-84	3
T 18	12-20-84	White	25	25	50	50	50	Pt. 5	0.006	62750	36027	10-10-84	466	12-10-84	7
T 19	12-20-84	White	50	25	75	100	50	Pt. 4	0.005	62756	36027	10-10-84	466	12-10-84	7
T 20	12-20-84	White	25	50	50	75	100	Pt. 5	0.006	62764	36027	10-10-84	466	12-10-84	7
T 21	12-20-84	White	50	50	75	0	50	Pt. 3	0.005	62775	36027	10-10-84	466	12-10-84	7
T 22	12-20-84	White	50	25	75	75	50	Pt. 4	0.006	62786	36027	10-10-84	466	12-10-84	5
T 23	1-2-85	White	0	75	25	0	25	Pt. 2	0.006	62794	36027	10-10-84	466	12-10-84	5
U 01	12-17-84	White	50	50	50	50	50	Pt. 5	0.007	62534	36024	10-10-84	466	12-10-84	3
U 02	12-17-84	White	50	100	50	50	50	Pt. 2	0.007	62544	36024	10-10-84	466	12-10-84	3
U 03	12-17-84	White	75	75	0	75	75	Pt. 2	0.019	62555	36024	10-10-84	466	12-10-84	3
U 04	12-17-84	White	50	50	50	75	50	Pt. 4	0.008	62571	36027	10-10-84	466	12-10-84	3
U 05	12-20-84	White	25	25	75	75	50	Pt. 3	0.007	62587	36027	10-10-84	466	12-10-84	7
U 06	12-18-84	White	100	50	25	25	50	Pt. 1	0.007	62603	36024	10-10-84	466	12-10-84	7
U 07	12-18-84	White	50	50	50	75	50	Pt. 4	0.008	62619	36027	10-10-84	466	12-10-84	7
U 08	12-18-84	White	50	25	50	75	75	Pt. 5	0.008	62639	36027	10-10-84	466	12-10-84	7
U 09	12-18-84	White	50	50	75	50	50	Pt. 3	0.007	62655	36027	10-10-84	466	12-10-84	7
U 10	12-20-84	White	75	100	75	75	50	Pt. 2	0.007	62669	36027	10-10-84	466	12-10-84	7
U 11	12-18-84	White	50	50	75	50	50	Pt. 3	0.007	62680	36027	10-10-84	466	12-10-84	7
U 12	12-18-84	White	50	25	25	50	25	Pt. 4	0.006	62691	36027	10-10-84	466	12-10-84	7
U 13	12-18-84	White	75	50	25	50	75	Pt. 5	0.006	62701	36027	10-10-84	466	12-10-84	7
U 14	12-18-85	White	50	75	25	50	50	Pt. 2	0.006	62712	36027	10-10-84	466	12-10-84	7
U 15	12-18-84	White	50	50	75	50	50	Pt. 3	0.007	62721	36027	10-10-84	466	12-10-84	7
U 16	12-18-84	White	50	50	100	75	25	Pt. 3	0.006	62731	36027	10-10-84	466	12-10-84	7
U 17	12-20-84	White	100	25	25	50	50	Pt. 1	0.006	62741	36027	10-10-84	466	12-10-84	3
U 18	12-20-84	White	50	25	75	50	75	Pt. 5	0.006	62750	36027	10-10-84	466	12-10-84	7
U 19	12-20-84	White	50	0	25	50	75	Pt. 5	0.007	62756	36027	10-10-84	466	12-10-84	7
U 20	12-20-84	White	25	0	75	50	50	Pt. 3	0.008	62765	36027	10-10-84	466	12-10-84	7
U 21	12-20-84	White	50	50	25	25	50	Pt. 5	0.006	62776	36027	10-10-84	466	12-10-84	7
U 22	12-20-84	White	50	75	75	25	50	Pt. 3	0.006	62787	36027	10-10-84	466	12-10-84	5
U 23	1-2-85	White	0	25	50	0	25	Pt. 3	0.005	62795	36027	10-10-84	466	12-10-84	5

PD235 Number of Records Read: 479
PD236 Number of Records Selected: 479

PBRF RAD CL SURF SOIL NOT BRB, APP 3.2 (pCi/g Dry)
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GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
BKGD-01-E	SURFACE SOIL	6.90	0.00	36.00									
BKGD-02-B	SURFACE SOIL	0.00	5.00	28.00									
BKGD-03-E	SURFACE SOIL	0.00	5.00	27.00									
BKGD-04-A	SURFACE SOIL	5.60	0.00	29.00									
BKGD-05-D	SURFACE SOIL	0.00	5.00	24.00									
BKGD-06-B	SURFACE SOIL	0.00	5.00	27.00									
BKGD-07-E	SURFACE SOIL	0.00	5.00	26.00									
BKGD-08-C	SURFACE SOIL	5.60	0.00	24.00									
BKGD-09-E	SURFACE SOIL	0.00	6.00	31.00									
BKGD-10-E	SURFACE SOIL	0.00	6.00	30.00									
BKGD-11-E	SURFACE SOIL	0.00	5.00	28.00									
BKGD-12-A	SURFACE SOIL	5.10	0.00	30.00									
BKGD-13-E	SURFACE SOIL	0.00	5.00	31.00									
BKGD-14-A	SURFACE SOIL	0.00	5.00	29.00									
BKGD-15-C	SURFACE SOIL	5.60	0.00	33.00									
BKGD-16-E	SURFACE SOIL	6.60	0.00	28.00									
BKGD-17-E	SURFACE SOIL	7.60	0.00	33.00									
BKGD-18-E	SURFACE SOIL	14.00	0.00	35.00									
BKGD-19-E	SURFACE SOIL	12.00	0.00	30.00									
BKGD-20-D	SURFACE SOIL	9.70	0.00	33.00									
A01-E	SURFACE SOIL	0.00	5.00	31.00									
A02-C	SURFACE SOIL	6.30	0.00	29.00									
A03-E	SURFACE SOIL	0.00	5.00	34.00									
A04-E	SURFACE SOIL	6.60	0.00	32.00									
A05-E	SURFACE SOIL	5.10	0.00	32.00									
A06-E	SURFACE SOIL	0.00	5.00	38.00									
A07-C	SURFACE SOIL	11.00	0.00	39.00									
A08-E	SURFACE SOIL	0.00	5.00	28.00									
A09-B	SURFACE SOIL	6.10	0.00	25.00									
A10-C	SURFACE SOIL	5.60	0.00	41.00									
A11-A	SURFACE SOIL	4.30	0.00	31.00									
A12-E	SURFACE SOIL	0.00	6.00	25.00									
A13-E	SURFACE SOIL	0.00	6.00	32.00									
A14-D	SURFACE SOIL	5.10	0.00	29.00									
A15-B	SURFACE SOIL	7.10	0.00	29.00									
A17-D	SURFACE SOIL	0.00	4.00	25.00									
A18-E	SURFACE SOIL	0.00	5.00	30.00									
A19-E	SURFACE SOIL	5.10	0.00	30.00									
A20-E	SURFACE SOIL	6.90	0.00	30.00									
A21-C	SURFACE SOIL	10.00	0.00	27.00									
A22-D	SURFACE SOIL	4.60	0.00	31.00									
B01-E	SURFACE SOIL	9.10	0.00	33.00									
B02-E	SURFACE SOIL	0.00	5.00	31.00									
B03-E	SURFACE SOIL	5.70	0.00	33.00									
B04-E	SURFACE SOIL	7.60	0.00	33.00									
B05-A	SURFACE SOIL	0.00	5.00	32.00									
B06-E	SURFACE SOIL	0.00	5.00	33.00									
B07-E	SURFACE SOIL	0.00	5.00	33.00									
B08-E	SURFACE SOIL	5.10	0.00	32.00									
B09-E	SURFACE SOIL	0.00	5.00	25.00									
B10-E	SURFACE SOIL	0.00	5.00	23.00									
B11-D	SURFACE SOIL	5.30	0.00	20.00									
B12-E	SURFACE SOIL	0.00	6.00	33.00									
B13-E	SURFACE SOIL	0.00	6.00	32.00									

FEMP RAD CL SURF SOIL NOT ERB, APP 3.2 (pCi/g Dry)
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GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
B14-B	SURFACE SOIL	0.00	5.00	27.00									
B15-E	SURFACE SOIL	5.10	0.00	31.00									
B16-E	SURFACE SOIL	0.00	4.00	9.10									
B17-E	SURFACE SOIL	0.00	5.00	29.00									
B21-E	SURFACE SOIL	8.60	0.00	32.00									
B22-C	SURFACE SOIL	8.60	0.00	31.00									
C01-C	SURFACE SOIL	0.00	5.00	33.00									
C02-A	SURFACE SOIL	0.00	5.00	32.00									
C03-E	SURFACE SOIL	0.00	5.00	43.00									
C04-C	SURFACE SOIL	0.00	5.00	38.00									
C05-A	SURFACE SOIL	5.60	0.00	35.00									
C06-E	SURFACE SOIL	0.00	5.00	33.00									
C07-D	SURFACE SOIL	5.60	0.00	33.00									
C08-D	SURFACE SOIL	8.00	0.00	37.00									
C09-C	SURFACE SOIL	0.00	5.00	27.00									
C10-E	SURFACE SOIL	10.00	0.00	26.00									
C11-B	SURFACE SOIL	5.30	0.00	21.00									
C12-A	SURFACE SOIL	0.00	6.00	28.00									
C13-E	SURFACE SOIL	0.00	6.00	32.00									
C14-E	SURFACE SOIL	6.10	0.00	32.00									
C15-E	SURFACE SOIL	6.10	0.00	31.00									
C21-E	SURFACE SOIL	5.10	0.00	29.00									
C22-B	SURFACE SOIL	7.60	0.00	33.00									
D01-E	SURFACE SOIL	0.00	5.00	25.00									
D02-E	SURFACE SOIL	0.00	5.00	34.00									
D03-B	SURFACE SOIL	0.00	5.00	32.00									
D04-D	SURFACE SOIL	6.30	0.00	37.00									
D05-E	SURFACE SOIL	5.10	0.00	29.00									
D06-E	SURFACE SOIL	7.60	0.00	33.00									
D07-D	SURFACE SOIL	6.10	0.00	31.00									
[illegible]	SURFACE SOIL	[illegible]	[illegible]	[illegible]									
D09-C	SURFACE SOIL	8.10	0.00	37.00									
D10-E	SURFACE SOIL	6.40	0.00	26.00									
D11-D	SURFACE SOIL	4.30	0.00	23.00									
D12-C	SURFACE SOIL	0.00	6.00	31.00									
D13-E	SURFACE SOIL	0.00	6.00	33.00									
D14-E	SURFACE SOIL	0.00	5.00	30.00									
D15-D	SURFACE SOIL	0.00	4.00	19.00									
D16-A	SURFACE SOIL	4.60	0.00	26.00									
D17-E	SURFACE SOIL	0.00	5.00	30.00									
D21-E	SURFACE SOIL	4.60	0.00	30.00									
D22-E	SURFACE SOIL	3.60	0.00	30.00									
E01-C	SURFACE SOIL	0.00	5.00	32.00									
E02-E	SURFACE SOIL	0.00	5.00	30.00									
E03-A	SURFACE SOIL	5.30	0.00	23.00									
E04-D	SURFACE SOIL	0.00	5.00	32.00									
E05-A	SURFACE SOIL	0.00	5.00	28.00									
E06-E	SURFACE SOIL	6.10	0.00	32.00									
E07-E	SURFACE SOIL	0.00	5.00	32.00									
E08-E	SURFACE SOIL	0.00	5.00	31.00									
E09-D	SURFACE SOIL	0.00	5.00	28.00									
E10-E	SURFACE SOIL	3.80	0.00	21.00									
E11-D	SURFACE SOIL	0.00	4.00	25.00									
E12-E	SURFACE SOIL	0.00	6.00	30.00									

PERF RAD CL SURF SOIL NOT ERB, APP 3.2 (pCi/g Dry)
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GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
E13-E	SURFACE SOIL	0.00	6.00	28.00									
E14-E	SURFACE SOIL	0.00	5.00	27.00									
E21-E	SURFACE SOIL	7.40	0.00	34.00									
E22-E	SURFACE SOIL	7.10	0.00	29.00									
F01-E	SURFACE SOIL	0.00	5.00	31.00									
F02-E	SURFACE SOIL	0.00	5.00	28.00									
F03-E	SURFACE SOIL	7.40	0.00	31.00									
F04-A	SURFACE SOIL	0.00	5.00	34.00									
F05-E	SURFACE SOIL	0.00	5.00	30.00									
F06-D	SURFACE SOIL	0.00	5.00	28.00									
F07-E	SURFACE SOIL	6.10	0.00	34.00									
F08-C	SURFACE SOIL	0.00	5.00	32.00									
F09-E	SURFACE SOIL	0.00	5.00	24.00									
F10-A	SURFACE SOIL	8.40	0.00	21.00									
F11-A	SURFACE SOIL	0.00	4.00	23.00									
F12-B	SURFACE SOIL	0.00	6.00	29.00									
F13-A	SURFACE SOIL	7.40	0.00	34.00									
F14-E	SURFACE SOIL	0.00	5.00	30.00									
G01-C	SURFACE SOIL	0.00	4.00	34.00									
G02-E	SURFACE SOIL	0.00	5.00	30.00									
G03-E	SURFACE SOIL	12.00	0.00	33.00									
G04-E	SURFACE SOIL	6.90	0.00	40.00									
G05-E	SURFACE SOIL	8.10	0.00	28.00									
G06-E	SURFACE SOIL	0.00	5.00	28.00									
G07-E	SURFACE SOIL	0.00	5.00	29.00									
G08-A	SURFACE SOIL	0.00	5.00	32.00									
G09-A	SURFACE SOIL	0.00	5.00	27.00									
G10-B	SURFACE SOIL	4.30	0.00	30.00									
G11-A	SURFACE SOIL	0.00	6.00	5.70									
G22-E	SURFACE SOIL	11.00	0.00	31.00									
G23-E	SURFACE SOIL	4.60	0.00	31.00									
G25-E	SURFACE SOIL	9.70	0.00	35.00									
G26-E	SURFACE SOIL	9.10	0.00	33.00									
G27-E	SURFACE SOIL	8.10	0.00	33.00									
G28-B	SURFACE SOIL	9.20	0.00	32.00									
G29-E	SURFACE SOIL	7.50	0.00	37.00									
G30-A	SURFACE SOIL	8.10	0.00	33.00									
G31-E	SURFACE SOIL	11.00	0.00	34.00									
G32-E	SURFACE SOIL	8.10	0.00	30.00									
G33-B	SURFACE SOIL	7.10	0.00	31.00									
H01-E	SURFACE SOIL	0.00	5.00	30.00									
H02-E	SURFACE SOIL	0.00	5.00	32.00									
H04-B	SURFACE SOIL	0.00	5.00	36.00									
H05-E	SURFACE SOIL	8.60	0.00	28.00									
H06-E	SURFACE SOIL	0.00	5.00	30.00									
H07-E	SURFACE SOIL	9.20	0.00	32.00									
H08-A	SURFACE SOIL	0.00	5.00	36.00									
H09-D	SURFACE SOIL	6.60	0.00	24.00									
H18-D	SURFACE SOIL	8.60	0.00	150.00									
H20-E	SURFACE SOIL	0.00	5.00	30.00									
H21-C	SURFACE SOIL	0.00	4.00	31.00									
H22-E	SURFACE SOIL	4.60	0.00	28.00									
H23-E	SURFACE SOIL	6.30	0.00	26.00									
H25-A	SURFACE SOIL	6.30	0.00	29.00									

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GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
H26-E	SURFACE SOIL	0.00	4.00	12.00									
H27-B	SURFACE SOIL	7.50	0.00	27.00									
H28-B	SURFACE SOIL	4.00	0.00	23.00									
H29-E	SURFACE SOIL	11.00	0.00	29.00									
H30-A	SURFACE SOIL	0.00	4.00	27.00									
H31-A	SURFACE SOIL	9.70	0.00	30.00									
H32-A	SURFACE SOIL	8.10	0.00	27.00									
H33-E	SURFACE SOIL	5.60	0.00	22.00									
I01-E	SURFACE SOIL	0.00	5.00	29.00									
I02-E	SURFACE SOIL	0.00	5.00	32.00									
I03-E	SURFACE SOIL	16.00	0.00	34.00									
I04-E	SURFACE SOIL	0.00	5.00	31.00									
I05-A	SURFACE SOIL	5.10	0.00	25.00									
I06-E	SURFACE SOIL	0.00	5.00	29.00									
I07-C	SURFACE SOIL	7.10	0.00	34.00									
I08-E	SURFACE SOIL	0.00	5.00	31.00									
I09-D	SURFACE SOIL	0.00	5.00	78.00									
I15-D	SURFACE SOIL	5.10	0.00	30.00									
I17-D	SURFACE SOIL	0.00	5.00	31.00									
I18-B	SURFACE SOIL	0.00	5.00	29.00									
I19-E	SURFACE SOIL	5.60	0.00	29.00									
I20-C	SURFACE SOIL	6.30	0.00	35.00									
I21-B	SURFACE SOIL	0.00	4.00	27.00									
I22-E	SURFACE SOIL	5.10	0.00	27.00									
I23-E	SURFACE SOIL	0.00	4.00	36.00									
I24-E	SURFACE SOIL	5.10	0.00	32.00									
I25-A	SURFACE SOIL	6.30	0.00	29.00									
I26-C	SURFACE SOIL	9.70	0.00	30.00									
I27-A	SURFACE SOIL	0.00	4.00	30.00									
I28-E	SURFACE SOIL	5.20	0.00	28.00									
I30-E	SURFACE SOIL	8.10	0.00	26.00									
I31-B	SURFACE SOIL	7.60	0.00	29.00									
I32-C	SURFACE SOIL	4.10	0.00	28.00									
I33-E	SURFACE SOIL	7.10	0.00	28.00									
J01-E	SURFACE SOIL	0.00	5.00	30.00									
J02-E	SURFACE SOIL	5.30	0.00	30.00									
J03-C	SURFACE SOIL	7.90	0.00	37.00									
J03-E	SURFACE SOIL	4.30	0.00	26.00									
J04-E	SURFACE SOIL	0.00	5.00	31.00									
J05-D	SURFACE SOIL	0.00	5.00	28.00									
J06-E	SURFACE SOIL	6.10	0.00	36.00									
J07-E	SURFACE SOIL	0.00	5.00	40.00									
J08-E	SURFACE SOIL	0.00	5.00	41.00									
J09-D	SURFACE SOIL	7.60	0.00	24.00									
J10-E	SURFACE SOIL	0.00	4.00	26.00									
J11-E	SURFACE SOIL	0.00	6.00	31.00									
J12-B	SURFACE SOIL	0.00	6.00	35.00									
J13-C	SURFACE SOIL	0.00	6.00	29.00									
J14-E	SURFACE SOIL	0.00	5.00	31.00									
J15-E	SURFACE SOIL	0.00	4.00	24.00									
J17-E	SURFACE SOIL	5.10	0.00	30.00									
J18-B	SURFACE SOIL	0.00	5.00	30.00									
J19-E	SURFACE SOIL	0.00	5.00	32.00									
J20-C	SURFACE SOIL	0.00	5.00	31.00									

PERF RAD CL SURF SOIL NOT ERB, APP 3.2 (pCi/g Dry)
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GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
J21-E	SURFACE SOIL	5.70	0.00	32.00									
J23-E	SURFACE SOIL	0.00	4.00	34.00									
J24-B	SURFACE SOIL	7.40	0.00	32.00									
J25-E	SURFACE SOIL	0.00	4.00	27.00									
J26-E	SURFACE SOIL	6.30	0.00	25.00									
J27-B	SURFACE SOIL	6.90	0.00	24.00									
J28-C	SURFACE SOIL	5.20	0.00	33.00									
J31-E	SURFACE SOIL	10.00	0.00	33.00									
J32-A	SURFACE SOIL	7.60	0.00	28.00									
J33-E	SURFACE SOIL	12.00	0.00	39.00									
K01-A	SURFACE SOIL	0.00	5.00	33.00									
K02-A	SURFACE SOIL	8.40	0.00	31.00									
K03-E	SURFACE SOIL	7.90	0.00	29.00									
K04-B	SURFACE SOIL	9.10	0.00	49.00									
K05-B	SURFACE SOIL	5.60	0.00	33.00									
K06-E	SURFACE SOIL	0.00	5.00	38.00									
K07-B	SURFACE SOIL	7.40	0.00	43.00									
K08-B	SURFACE SOIL	10.00	0.00	50.00									
K09-E	SURFACE SOIL	14.00	0.00	38.00									
K10-A	SURFACE SOIL	6.40	0.00	29.00									
K11-A	SURFACE SOIL	9.40	0.00	40.00									
K12-E	SURFACE SOIL	8.90	0.00	46.00									
K13-E	SURFACE SOIL	6.40	0.00	54.00									
K14-E	SURFACE SOIL	0.00	5.00	32.00									
K15-E	SURFACE SOIL	7.10	0.00	36.00									
K16-A	SURFACE SOIL	0.00	4.00	29.00									
K17-C	SURFACE SOIL	7.10	0.00	35.00									
K18-E	SURFACE SOIL	0.00	5.00	27.00									
K19-C	SURFACE SOIL	6.90	0.00	31.00									
K20-A	SURFACE SOIL	9.20	0.00	30.00									
K21-D	SURFACE SOIL	0.00	4.00	27.00									
K22-E	SURFACE SOIL	4.10	0.00	28.00									
K23-B	SURFACE SOIL	0.00	4.00	26.00									
L01-E	SURFACE SOIL	0.00	5.00	31.00									
L02-A	SURFACE SOIL	6.90	0.00	31.00									
L03-D	SURFACE SOIL	11.00	0.00	35.00									
L04-A	SURFACE SOIL	6.30	0.00	36.00									
L05-A	SURFACE SOIL	5.10	0.00	34.00									
L06-E	SURFACE SOIL	0.00	5.00	30.00									
L07-E	SURFACE SOIL	0.00	5.00	24.00									
L08-B	SURFACE SOIL	0.00	4.00	25.00									
L09-E	SURFACE SOIL	0.00	5.00	28.00									
L10-E	SURFACE SOIL	0.00	4.00	22.00									
L11-C	SURFACE SOIL	5.80	0.00	33.00									
L12-E	SURFACE SOIL	0.00	6.00	33.00									
L14-D	SURFACE SOIL	7.60	0.00	36.00									
L16-D	SURFACE SOIL	6.10	0.00	29.00									
L17-E	SURFACE SOIL	0.00	5.00	29.00									
L18-E	SURFACE SOIL	7.10	0.00	29.00									
L22-C	SURFACE SOIL	1.00	0.00	31.00									
L23-E	SURFACE SOIL	0.00	4.00	32.00									
M01-E	SURFACE SOIL	0.00	5.00	34.00									
M02-D	SURFACE SOIL	6.40	0.00	29.00									
M03-E	SURFACE SOIL	7.90	0.00	35.00									

PBHF RAD CL SURF SOIL NOT ERB, APP 3.2 (pCi/g Dry)
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GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
M04-E	SURFACE SOIL	0.00	4.00	29.00									
M05-D	SURFACE SOIL	5.10	0.00	29.00									
M06-E	SURFACE SOIL	5.60	0.00	34.00									
M07-C	SURFACE SOIL	0.00	5.00	33.00									
M08-A	SURFACE SOIL	0.00	4.00	29.00									
M09-E	SURFACE SOIL	0.00	5.00	23.00									
M10-E	SURFACE SOIL	4.80	0.00	28.00									
M11-E	SURFACE SOIL	0.00	6.00	30.00									
M17-E	SURFACE SOIL	0.00	5.00	26.00									
M18-E	SURFACE SOIL	0.00	5.00	19.00									
M21-E	SURFACE SOIL	0.00	4.00	4.20									
M22-A	SURFACE SOIL	0.00	6.00	28.00									
M23-E	SURFACE SOIL	0.00	4.00	23.00									
N01-A	SURFACE SOIL	0.00	5.00	27.00									
N02-E	SURFACE SOIL	4.80	0.00	31.00									
N03-C	SURFACE SOIL	5.80	0.00	33.00									
N04-E	SURFACE SOIL	0.00	5.00	32.00									
N05-B	SURFACE SOIL	5.60	0.00	38.00									
N06-D	SURFACE SOIL	0.00	5.00	31.00									
N07-D	SURFACE SOIL	6.10	0.00	30.00									
N08-E	SURFACE SOIL	0.00	4.00	29.00									
N09-D	SURFACE SOIL	0.00	5.00	25.00									
N10-D	SURFACE SOIL	4.30	0.00	24.00									
N11-D	SURFACE SOIL	7.40	0.00	40.00									
N12-A	SURFACE SOIL	10.00	0.00	37.00									
N13-E	SURFACE SOIL	6.40	0.00	37.00									
N14-A	SURFACE SOIL	0.00	5.00	29.00									
N15-A	SURFACE SOIL	0.00	4.00	27.00									
N16-C	SURFACE SOIL	0.00	4.00	27.00									
N17-E	SURFACE SOIL	0.00	5.00	27.00									
N18-B	SURFACE SOIL	0.00	5.00	24.00									
N21-E	SURFACE SOIL	7.10	0.00	10.00									
N22-E	SURFACE SOIL	7.10	0.00	23.00									
N23-E	SURFACE SOIL	6.10	0.00	31.00									
O01-C	SURFACE SOIL	0.00	5.00	29.00									
O02-E	SURFACE SOIL	5.70	0.00	34.00									
O03-D	SURFACE SOIL	5.80	0.00	34.00									
O11-D	SURFACE SOIL	0.00	6.00	37.00									
O12-E	SURFACE SOIL	8.90	0.00	36.00									
O13-C	SURFACE SOIL	7.90	0.00	36.00									
O14-D	SURFACE SOIL	6.60	0.00	34.00									
O15-E	SURFACE SOIL	0.00	4.00	30.00									
O16-D	SURFACE SOIL	0.00	4.00	28.00									
O17-E	SURFACE SOIL	0.00	5.00	30.00									
O18-C	SURFACE SOIL	8.10	0.00	21.00									
O22-C	SURFACE SOIL	13.00	0.00	28.00									
O23-E	SURFACE SOIL	8.10	0.00	29.00									
P01-D	SURFACE SOIL	0.00	5.00	30.00									
P02-E	SURFACE SOIL	0.00	5.00	35.00									
P03-B	SURFACE SOIL	9.90	0.00	25.00									
P11-B	SURFACE SOIL	7.40	0.00	39.00									
P12-D	SURFACE SOIL	7.40	0.00	35.00									
P13-E	SURFACE SOIL	0.00	6.00	31.00									
[illegible]	SURFACE SOIL	6.10	0.00	29.00									

PBRF RAD CL SURF SOIL NOT ERB, APP 3.2 (pCi/g Dry)
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GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
P15-C	SURFACE SOIL	5.60	0.00	31.00									
P16-A	SURFACE SOIL	0.00	4.00	25.00									
P17-C	SURFACE SOIL	0.00	5.00	28.00									
P18-E	SURFACE SOIL	5.60	0.00	25.00									
P19-B	SURFACE SOIL	0.00	5.00	29.00									
P20-A	SURFACE SOIL	16.00	0.00	44.00									
P21-E	SURFACE SOIL	0.00	3.00	29.00									
P22-A	SURFACE SOIL	8.10	0.00	31.00									
P23-B	SURFACE SOIL	13.00	0.00	22.00									
Q01-A	SURFACE SOIL	0.00	5.00	31.00									
Q02-E	SURFACE SOIL	0.00	5.00	29.00									
Q03-D	SURFACE SOIL	6.40	0.00	32.00									
Q11-D	SURFACE SOIL	0.00	6.00	34.00									
Q12-B	SURFACE SOIL	0.00	6.00	33.00									
Q13-A	SURFACE SOIL	0.00	6.00	29.00									
Q14-D	SURFACE SOIL	5.10	0.00	30.00									
Q15-E	SURFACE SOIL	7.10	0.00	36.00									
Q16-E	SURFACE SOIL	0.00	4.00	27.00									
Q17-E	SURFACE SOIL	0.00	5.00	28.00									
Q18-B	SURFACE SOIL	0.00	5.00	29.00									
Q19-C	SURFACE SOIL	0.00	5.00	31.00									
Q20-C	SURFACE SOIL	6.90	0.00	39.00									
Q21-E	SURFACE SOIL	0.00	3.00	27.00									
Q22-B	SURFACE SOIL	5.70	0.00	35.00									
Q23-C	SURFACE SOIL	9.20	0.00	27.00									
R01-B	SURFACE SOIL	0.00	5.00	24.00									
R02-D	SURFACE SOIL	6.90	0.00	31.00									
R03-A	SURFACE SOIL	0.00	4.00	35.00									
R11-E	SURFACE SOIL	0.00	6.00	28.00									
R12-E	SURFACE SOIL	0.00	6.00	32.00									
R13-B	SURFACE SOIL	0.00	6.00	33.00									
R14-B	SURFACE SOIL	0.00	5.00	31.00									
R15-A	SURFACE SOIL	0.00	4.00	28.00									
R16-E	SURFACE SOIL	0.00	4.00	29.00									
R17-B	SURFACE SOIL	0.00	5.00	30.00									
R18-E	SURFACE SOIL	0.00	5.00	33.00									
R19-D	SURFACE SOIL	0.00	5.00	34.00									
R20-D	SURFACE SOIL	5.10	0.00	29.00									
R21-B	SURFACE SOIL	9.20	0.00	27.00									
R22-D	SURFACE SOIL	4.00	0.00	33.00									
R23-B	SURFACE SOIL	9.70	0.00	32.00									
S01-E	SURFACE SOIL	0.00	5.00	35.00									
S02-E	SURFACE SOIL	0.00	5.00	29.00									
S03-A	SURFACE SOIL	4.30	0.00	33.00									
S11-A	SURFACE SOIL	6.90	0.00	27.00									
S12-D	SURFACE SOIL	0.00	6.00	33.00									
S13-D	SURFACE SOIL	0.00	6.00	29.00									
S14-B	SURFACE SOIL	7.60	0.00	28.00									
S15-E	SURFACE SOIL	0.00	5.00	30.00									
S16-C	SURFACE SOIL	4.60	0.00	27.00									
S17-E	SURFACE SOIL	0.00	5.00	24.00									
S18-B	SURFACE SOIL	0.00	5.00	29.00									
S19-E	SURFACE SOIL	0.00	5.00	30.00									
S20-C	SURFACE SOIL	0.00	3.00	28.00									

PBRF RAD CL SURF SOIL NOT ERB, APP 3.2 (pCi/g Dry)
04-23-86
14:33:38

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
S21-B	SURFACE SOIL	5.10	0.00	28.00									
S22-A	SURFACE SOIL	5.70	0.00	33.00									
S23-E	SURFACE SOIL	8.60	0.00	27.00									
T01-E	SURFACE SOIL	0.00	5.00	27.00									
T02-D	SURFACE SOIL	0.00	5.00	31.00									
T03-D	SURFACE SOIL	6.60	0.00	34.00									
T04-A	SURFACE SOIL	0.00	5.00	26.00									
T05-E	SURFACE SOIL	9.20	0.00	31.00									
T06-B	SURFACE SOIL	0.00	5.00	34.00									
T07-A	SURFACE SOIL	0.00	5.00	26.00									
T08-B	SURFACE SOIL	0.00	4.00	24.00									
T09-E	SURFACE SOIL	0.00	5.00	25.00									
T10-E	SURFACE SOIL	4.30	0.00	25.00									
T11-C	SURFACE SOIL	0.00	6.00	32.00									
T12-E	SURFACE SOIL	0.00	6.00	29.00									
T13-E	SURFACE SOIL	0.00	6.00	29.00									
T14-E	SURFACE SOIL	0.00	4.00	29.00									
T15-B	SURFACE SOIL	14.00	0.00	27.00									
T16-C	SURFACE SOIL	5.10	0.00	27.00									
T17-B	SURFACE SOIL	5.10	0.00	28.00									
T18-E	SURFACE SOIL	0.00	5.00	26.00									
T19-D	SURFACE SOIL	0.00	5.00	27.00									
T20-E	SURFACE SOIL	5.60	0.00	28.00									
T21-C	SURFACE SOIL	8.10	0.00	26.00									
T22-D	SURFACE SOIL	6.30	0.00	32.00									
T23-B	SURFACE SOIL	9.20	0.00	29.00									
U01-E	SURFACE SOIL	0.00	5.00	32.00									
U02-B	SURFACE SOIL	0.00	5.00	25.00									
U03-B	SURFACE SOIL	8.60	0.00	100.00									
U04-D	SURFACE SOIL	0.00	5.00	35.00									
U05-C	SURFACE SOIL	5.60	0.00	32.00									
U06-A	SURFACE SOIL	0.00	5.00	31.00									
U07-D	SURFACE SOIL	8.10	0.00	27.00									
U08-E	SURFACE SOIL	9.90	0.00	30.00									
U09-C	SURFACE SOIL	5.60	0.00	29.00									
U10-B	SURFACE SOIL	0.00	4.00	23.00									
U11-C	SURFACE SOIL	8.40	0.00	35.00									
U12-D	SURFACE SOIL	0.00	6.00	28.00									
U13-E	SURFACE SOIL	0.00	6.00	28.00									
U14-B	SURFACE SOIL	0.00	4.00	29.00									
U15-C	SURFACE SOIL	9.70	0.00	39.00									
U16-C	SURFACE SOIL	0.00	4.00	30.00									
U17-A	SURFACE SOIL	0.00	5.00	28.00									
U18-E	SURFACE SOIL	0.00	5.00	29.00									
U19-E	SURFACE SOIL	7.50	0.00	29.00									
U20-C	SURFACE SOIL	14.00	0.00	39.00									
U21-E	SURFACE SOIL	0.00	3.00	33.00									
U22-C	SURFACE SOIL	0.00	4.00	31.00									
U23-C	SURFACE SOIL	5.70	0.00	38.00									

FD235 Number of Records Read: 427
FD236 Number of Records Selected: 427

PBRF RAD CLASS IN ERB, APP. 3.2
05-14-86
12:57:37

GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
BG 01	12-17-84	White	0	0	0	0	0	Pt. 4	0.006	62522	36024	10-10-84	466	12-10-84	3
BG 02	12-17-84	White	0	0	0	0	0	Pt. 2	0.006	62522	36024	10-10-84	466	12-10-84	3
BG 03	12-17-84	White	0	0	0	0	0	Pt. 5	0.005	62523	36024	10-10-84	466	12-10-84	3
BG 04	12-17-84	White	0	0	0	0	0	Pt. 1	0.006	62523	36024	10-10-84	466	12-10-84	3
BG 05	12-18-84	White	0	0	0	0	0	Pt. 4	0.005	62556	36027	10-10-84	466	12-10-84	7
BG 06	12-18-84	White	0	0	0	0	0	Pt. 2	0.005	62556	36027	10-10-84	466	12-10-84	7
BG 07	12-18-84	White	0	0	0	0	0	Pt. 5	0.005	62557	36027	10-10-84	466	12-10-84	7
BG 08	12-18-84	White	0	0	0	0	0	Pt. 3	0.005	62557	36027	10-10-84	466	12-10-84	7
BG 09	12-18-84	White	0	0	0	0	0	Pt. 5	0.006	62558	36027	10-10-84	466	12-10-84	7
BG 10	12-18-84	White	0	0	0	0	0	Pt. 5	0.005	62558	36027	10-10-84	466	12-10-84	7
BG 11	12-18-84	White	0	0	0	0	0	Pt. 5	0.006	62559	36027	10-10-84	466	12-10-84	7
BG 12	12-18-84	White	0	0	0	0	0	Pt. 1	0.006	62559	36027	10-10-84	466	12-10-84	7
BG 13	12-18-84	White	0	0	0	0	0	Pt. 5	0.006	62560	36027	10-10-84	466	12-10-84	7
BG 14	12-18-84	White	0	0	0	0	0	Pt. 1	0.006	62560	36027	10-10-84	466	12-10-84	7
BG 15	12-20-84	White	0	0	0	0	0	Pt. 3	0.006	62620	36027	10-10-84	466	12-10-84	7
BG 16	12-20-84	White	0	0	0	0	0	Pt. 5	0.006	62620	36027	10-10-84	466	12-10-84	7
BG 17	12-20-84	White	0	0	0	0	0	Pt. 5	0.006	62621	36027	10-10-84	466	12-10-84	7
BG 18	12-20-84	White	0	0	0	0	0	Pt. 5	0.007	62621	36027	10-10-84	466	12-10-84	7
BG 19	12-20-84	White	0	0	0	0	0	Pt. 5	0.006	62622	36027	10-10-84	466	12-10-84	7
BG 20	12-20-84	White	0	0	0	0	0	Pt. 4	0.006	62622	36027	10-10-84	466	12-10-84	7
BG 21	12-20-84	White	0	0	0	0	0	Pt. 3	0.007	62623	36027	10-10-84	466	12-10-84	7
BG 22	12-20-84	White	0	0	0	0	0	Pt. 4	0.006	62623	36027	10-10-84	466	12-10-84	7
BG 23	1-2-85	White	0	0	0	0	0	Pt. 2	0.007	62757	36027	10-10-84	466	12-10-84	5
BG 24	1-2-85	White	0	0	0	0	0	Pt. 2	0.006	62757	36027	10-10-84	466	12-10-84	5
BG 25	1-2-85	White	0	0	0	0	0	Pt. 5	0.006	62758	36027	10-10-84	466	12-10-84	5
BG 26	1-2-85	White	0	0	0	0	0	Pt. 5	0.006	62758	36027	10-10-84	466	12-10-84	5
BG 27	1-3-85	White	0	0	0	0	0	Pt. 5	0.004	62759	36027	10-10-84	466	12-10-84	1
BG 28	1-3-85	White	0	0	0	0	0	Pt. 5	0.010	62759	36027	10-10-84	466	12-10-84	1
O 04	12-17-84	White	0	0	0	0	0	Pt. 1	0.032	62568	36027	10-10-84	466	12-10-84	7
O 05	12-17-84	White	0	0	0	0	0	Pt. 1	0.022	62578	36027	10-10-84	466	12-10-84	3
O 06	12-17-84	White	0	0	0	0	0	Pt. 1	0.024	62594	36027	10-10-84	466	12-10-84	3
O 07	12-18-84	White	0	0	0	0	0	Pt. 5	0.020	62610	36027	10-10-84	466	12-10-84	7
O 08	12-20-84	White	0	0	0	0	0	Pt. 1	0.018	62631	36027	10-10-84	466	12-10-84	7
O 09	12-20-85	White	0	0	0	0	0	Pt. 1	0.018	62647	36027	10-10-84	466	12-10-84	7
O 10	12-20-84	White	0	0	0	0	0	Pt. 5	0.014	62663	36027	10-10-84	466	12-10-84	7
P 04	12-17-84	White	0	0	0	0	0	Pt. 4	0.026	62568	36027	10-10-84	466	12-10-84	7
P 05 NE	12-20-84	White	0	0	0	0	0	Pt. 1	0.027	62579	36027	10-10-84	466	12-10-84	7
P 05 NW	12-20-84	White	0	0	0	0	0	Pt. 4	0.024	62579	36027	10-10-84	466	12-10-84	7
P 05 SE	12-20-84	White	0	0	0	0	0	Pt. 4	0.023	62580	36027	10-10-84	466	12-10-84	7
P 05 SW	12-20-84	White	0	0	0	0	0	Pt. 1	0.022	62580	36027	10-10-84	466	12-10-84	7
P 06 NE	12-20-84	White	0	0	0	0	0	Pt. 2	0.025	62595	36027	10-10-84	466	12-10-84	7
P 06 NW	12-20-84	White	0	0	0	0	0	Pt. 4	0.024	62595	36027	10-10-84	466	12-10-84	7
P 06 SE	12-20-84	White	0	0	0	0	0	Pt. 1	0.025	62596	36027	10-10-84	466	12-10-84	7
P 06 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.025	62596	36027	10-10-84	466	12-10-84	7
P 07 NE	12-20-84	White	0	0	0	0	0	Pt. 2	0.025	62611	36027	10-10-84	466	12-10-84	7
P 07 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.025	62611	36027	10-10-84	466	12-10-84	7
P 07 SE	12-20-84	White	0	0	0	0	0	Pt. 4	0.024	62612	36027	10-10-84	466	12-10-84	7
P 07 SW	12-20-84	White	0	0	0	0	0	Pt. 1	0.024	62612	36027	10-10-84	466	12-10-84	7
P 08 NE	12-20-84	White	0	0	0	0	0	Pt. 2	0.024	62631	36027	10-10-84	466	12-10-84	7
P 08 NE	12-20-84	White	0	0	0	0	0	Pt. 2	0.024	62633	36027	10-10-84	466	12-10-84	7
P 08 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.020	62632	36027	10-10-84	466	12-10-84	7
P 08 SE	12-20-84	White	0	0	0	0	0	Pt. 5	0.023	62632	36027	10-10-84	466	12-10-84	7
P 08 SW	12-20-84	White	0	0	0	0	0	Pt. 2	0.022	62633	36027	10-10-84	466	12-10-84	7
P 09 NE	12-20-84	White	0	0	0	0	0	Pt. 4	0.018	62647	36027	10-10-84	466	12-10-84	7

PBRF RAD CLASS IN EHB, APP. 3.2
05-14-86
12:57:37

GRID	DATE	ZONE	Beta-Gamma c/m - GS-3 PT 1	PT 2	PT 3	PT 4	PT 5	HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
P 09 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.017	62648	36027	10-10-84	466	12-10-84	7
P 09 SE	12-20-84	White	0	0	0	0	0	Pt. 4	0.018	62648	36027	10-10-84	466	12-10-84	7
P 09 SW	12-20-84	White	0	0	0	0	0	Pt. 2	0.020	62649	36027	10-10-84	466	12-10-84	7
P 10	12-20-84	White	0	0	0	0	0	Pt. 5	0.017	62663	36027	10-10-84	466	12-10-84	7
P 10 SE	12-20-84	White	0	0	0	0	0	Pt. 5	0.022	62664	36027	10-10-84	466	12-10-84	7
P 10 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.020	62664	36027	10-10-84	466	12-10-84	7
Q 04	12-20-84	White	0	0	0	0	0	Pt. 2	0.030	62569	36027	10-10-84	466	12-10-84	7
Q 05 NE	12-20-84	White	0	0	0	0	0	Pt. 1	0.043	62581	36027	10-10-84	466	12-10-84	7
Q 05 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.034	62581	36027	10-10-84	466	12-10-84	7
Q 05 SE	12-20-84	White	0	0	0	0	0	Pt. 2	0.060	62582	36027	10-10-84	466	12-10-84	7
Q 05 SW	12-20-84	White	0	0	0	0	0	Pt. 1	0.038	62582	36027	10-10-84	466	12-10-84	7
Q 06 NE	12-20-84	White	0	0	0	0	0	Pt. 2	0.033	62597	36027	10-10-84	466	12-10-84	7
Q 06 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.027	62597	36027	10-10-84	466	12-10-84	7
Q 06 SE	12-20-84	White	0	0	0	0	0	Pt. 4	0.030	62598	36027	10-10-84	466	12-10-84	7
Q 06 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.020	62598	36027	10-10-84	466	12-10-84	7
Q 07 NE	12-20-84	White	0	0	0	0	0	Pt. 3	0.026	62613	36027	10-10-84	466	12-10-84	7
Q 07 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.025	62613	36027	10-10-84	466	12-10-84	7
Q 07 SE	12-20-84	White	0	0	0	0	0	Pt. 1	0.026	62614	36027	10-10-84	466	12-10-84	7
Q 07 SW	12-20-84	White	0	0	0	0	0	Pt. 2	0.025	62614	36027	10-10-84	466	12-10-84	7
Q 08 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.025	62634	36027	10-10-84	466	12-10-84	7
Q 08 SE	12-20-84	White	0	0	0	0	0	Pt. 5	0.022	62634	36027	10-10-84	466	12-10-84	7
Q 08 SW	12-20-84	White	0	0	0	0	0	Pt. 2	0.022	62635	36027	10-10-84	466	12-10-84	7
Q 09 NE	12-20-84	White	0	0	0	0	0	Pt. 2	0.022	62649	36027	10-10-84	466	12-10-84	7
Q 09 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.022	62650	36027	10-10-84	466	12-10-84	7
Q 09 SE	12-20-84	White	0	0	0	0	0	Pt. 3	0.024	62650	36027	10-10-84	466	12-10-84	7
Q 09 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.021	62651	36027	10-10-84	466	12-10-84	7
Q 10 SE	12-20-84	White	0	0	0	0	0	Pt. 2	0.023	62665	36027	10-10-84	466	12-10-84	7
Q 10 SW	12-20-84	White	0	0	0	0	0	Pt. 4	0.023	62666	36027	10-10-84	466	12-10-84	7
R 04	12-20-84	White	0	0	0	0	0	Pt. 1	0.060	62569	36027	10-10-84	466	12-10-84	7
R 05 NE	12-20-84	White	0	0	0	0	0	Pt. 1	0.080	62583	36027	10-10-84	466	12-10-84	7
R 05 NW	12-20-84	White	0	0	0	0	0	Pt. 2	0.060	62583	36027	10-10-84	466	12-10-84	7
R 05 SE	12-20-84	White	0	0	0	0	0	Pt. 3	0.065	62584	36027	10-10-84	466	12-10-84	7
R 05 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.065	62584	36027	10-10-84	466	12-10-84	7
R 06 NE	12-20-84	White	0	0	0	0	0	Pt. 3	0.050	62599	36027	10-10-84	466	12-10-84	7
R 06 SE	12-20-84	White	0	0	0	0	0	Pt. 2	0.070	62600	36027	10-10-84	466	12-10-84	7
R 06 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.037	62599	36027	10-10-84	466	12-10-84	7
R 07 NE	12-20-84	White	0	0	0	0	0	Pt. 5	0.030	62615	36027	10-10-84	466	12-10-84	7
R 07 NW	12-20-84	White	0	0	0	0	0	Pt. 2	0.028	62615	36027	10-10-84	466	12-10-84	7
R 07 SE	12-20-84	White	0	0	0	0	0	Pt. 4	0.029	62616	36027	10-10-84	466	12-10-84	7
R 07 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.046	62600	36027	10-10-84	466	12-10-84	7
R 07 SW	12-20-84	White	0	0	0	0	0	Pt. 4	0.026	62616	36027	10-10-84	466	12-10-84	7
R 08 NE	12-20-84	White	0	0	0	0	0	Pt. 2	0.028	62635	36027	10-10-84	466	12-10-84	7
R 08 NW	12-20-84	White	0	0	0	0	0	Pt. 2	0.026	62636	36027	10-10-84	466	12-10-84	7
R 08 SE	12-20-84	White	0	0	0	0	0	Pt. 2	0.028	62636	36027	10-10-84	466	12-10-84	7
R 08 SW	12-20-84	White	0	0	0	0	0	Pt. 1	0.025	62637	36027	10-10-84	466	12-10-84	7
R 09 NE	12-20-84	White	0	0	0	0	0	Pt. 5	0.026	62652	36027	10-10-84	466	12-10-84	7
R 09 NW	12-20-84	White	0	0	0	0	0	Pt. 5	0.024	62651	36027	10-10-84	466	12-10-84	7
R 09 SE	12-20-84	White	0	0	0	0	0	Pt. 4	0.022	62652	36027	10-10-84	466	12-10-84	7
R 09 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.020	62653	36027	10-10-84	466	12-10-84	7
R 10	12-20-84	White	0	0	0	0	0	Pt. 5	0.022	62666	36027	10-10-84	466	12-10-84	7
R 10 SE	12-20-84	White	0	0	0	0	0	Pt. 5	0.028	62667	36027	10-10-84	466	12-10-84	7
R 10 SW	12-20-84	White	0	0	0	0	0	Pt. 1	0.029	62667	36027	10-10-84	466	12-10-84	7
S 04	12-20-84	White	0	0	0	0	0	Pt. 4	0.060	62570	36024	10-10-84	466	12-10-84	7
S 05	12-20-84	White	0	0	0	0	0	Pt. 3	0.031	62585	36027	10-10-84	466	12-10-84	7

PBRF RAD CLASS IN ERB, APP. 3.2
05-14-86
12:57:37

GRID	DATE	ZONE	Beta-Gamma c/m - GS-3					HI POINT	MR HR	RSR NO	GS3W NO	CAL DATE 1	PRM7 NO	CAL DATE 2	TIME
			PT 1	PT 2	PT 3	PT 4	PT 5								
S 05 NW	12-20-84	White	0	0	0	0	0	Pt. 3	0.090	62585	36027	10-10-84	466	12-10-84	7
S 05 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.070	62586	36027	10-10-84	466	12-10-84	7
S 06	12-20-84	White	0	0	0	0	0	Pt. 3	0.022	62601	36027	10-10-84	466	12-10-84	7
S 06 NW	12-20-84	White	0	0	0	0	0	Pt. 3	0.055	62601	36027	10-10-84	466	12-10-84	7
S 06 SW	12-20-84	White	0	0	0	0	0	Pt. 3	0.008	62602	36027	10-10-84	466	12-10-84	7
S 07	12-20-84	White	0	0	0	0	0	Pt. 5	0.028	62617	36027	10-10-84	466	12-10-84	7
S 07 NW	12-20-84	White	0	0	0	0	0	Pt. 3	0.038	62617	36027	10-10-84	466	12-10-84	7
S 07 SW	12-20-84	White	0	0	0	0	0	Pt. 4	0.029	62618	36027	10-10-84	466	12-10-84	7
S 08	12-20-84	White	0	0	0	0	0	Pt. 5	0.014	62637	36027	10-10-84	466	12-10-84	7
S 08 NW	12-20-84	White	0	0	0	0	0	Pt. 3	0.024	62638	36027	10-10-84	466	12-10-84	7
S 08 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.026	62638	36027	10-10-84	466	12-10-84	7
S 09	12-20-84	White	0	0	0	0	0	Pt. 5	0.010	62653	36027	10-10-84	466	12-10-84	7
S 09 NW	12-20-84	White	0	0	0	0	0	Pt. 1	0.016	62654	36027	10-10-84	466	12-10-84	7
S 09 SW	12-20-84	White	0	0	0	0	0	Pt. 5	0.023	62654	36027	10-10-84	466	12-10-84	7
S 10	12-20-84	White	0	0	0	0	0	Pt. 5	0.015	62668	36027	10-10-84	466	12-10-84	7
S 10 SW	12-20-84	White	0	0	0	0	0	Pt. 3	0.026	62668	36027	10-10-84	466	12-10-84	7

PD235 Number of Records Read: 124
PD236 Number of Records Selected: 124

PERF OUTDR RAD CLASS IN ERB, APP. 3.2 (pCi/g Dry)
05-14-86
14:21:08

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
BKGD-01-E	SURFACE SOIL	6.90	0.00	36.00									
BKGD-02-B	SURFACE SOIL	0.00	5.00	28.00									
BKGD-03-E	SURFACE SOIL	0.00	5.00	27.00									
BKGD-04-A	SURFACE SOIL	5.60	0.00	29.00									
BKGD-05-D	SURFACE SOIL	0.00	5.00	24.00									
BKGD-06-B	SURFACE SOIL	0.00	5.00	27.00									
BKGD-07-E	SURFACE SOIL	0.00	5.00	26.00									
BKGD-08-C	SURFACE SOIL	5.60	0.00	24.00									
BKGD-09-E	SURFACE SOIL	0.00	6.00	31.00									
BKGD-10-E	SURFACE SOIL	0.00	6.00	30.00									
BKGD-11-E	SURFACE SOIL	0.00	5.00	28.00									
BKGD-12-A	SURFACE SOIL	5.10	0.00	30.00									
BKGD-13-E	SURFACE SOIL	0.00	5.00	31.00									
BKGD-14-A	SURFACE SOIL	0.00	5.00	29.00									
BKGD-15-C	SURFACE SOIL	5.60	0.00	33.00									
BKGD-16-E	SURFACE SOIL	6.60	0.00	28.00									
BKGD-17-E	SURFACE SOIL	7.60	0.00	33.00									
BKGD-18-E	SURFACE SOIL	14.00	0.00	35.00									
BKGD-19-E	SURFACE SOIL	12.00	0.00	30.00									
BKGD-20-D	SURFACE SOIL	9.70	0.00	33.00									
BKGD-21-C	ERB SURFACE	14.00	0.00	44.00									
BKGD-22-D	ERB SURFACE	0.00	7.00	37.00									
BKGD-23-B	ERB SURFACE	11.00	0.00	42.00									
BKGD-24-B	ERB SURFACE	0.00	7.00	40.00									
BKGD-25-E	ERB SURFACE	14.00	0.00	39.00									
BKGD-26-E	ERB SURFACE	10.00	0.00	34.00									
O-04-A	SURFACE	7.10	0.00	150.00		3.10				14.10			.20
O-05-A	SURFACE	11.00	0.00	44.00		0.96							
O-06-A	SURFACE	5.10	0.00	47.00		1.10							
O-07-E	SURFACE	9.20	0.00	62.00		1.20							
O-08-A	SURFACE	0.00	6.00	60.00		1.10							
O-09-A	SURFACE	5.70	0.00	54.00		1.60							
O-10-E	SURFACE SOIL	4.30	0.00	35.00									
P-04-D	SURFACE	14.00	0.00	47.00		.57							
P-05-NE-A	SURFACE	11.00	0.00	38.00		1.10							
P-05-NW-D	SURFACE	9.70	0.00	46.00									
P-05-SE-D	SURFACE	7.60	0.00	68.00									
P-05-SW-A	SURFACE	9.20	0.00	61.00		3.10							
P-06-NE-B	SURFACE	8.60	0.00	15.00		1.20							
P-06-NW-D	SURFACE	11.00	0.00	58.00									
P-06-SE-A	SURFACE	8.60	0.00	58.00									
P-06-SW-E	SURFACE	8.00	0.00	41.00		1.10							
P-07-NE-B	SURFACE	12.00	0.00	45.00		.73							
P-07-NW-E	SURFACE	8.60	0.00	39.00									
P-07-SE-D	SURFACE	17.00	0.00	210.00									
P-07-SW-A	SURFACE	0.00	7.00	44.00		.97							
P-08-NE-B	SURFACE	0.00	6.00	39.00		1.10							
P-08-NW-E	SURFACE	0.00	6.00	40.00									
P-08-SE-E	SURFACE	0.00	6.00	43.00									
P-08-SW-B	SURFACE	0.00	6.00	42.00		1.20							
P-09-NE-D	SURFACE	8.10	0.00	77.00		1.50							
P-09-NW-E	SURFACE	6.40	0.00	66.00									
P-09-SE-D	SURFACE	0.00	4.00	38.00		1.0							
P-09-SW-B	SURFACE	13.00	0.00	150.00		1.80		29.80			0.20	0.19	

PERF OUTDR RAD CLASS IN ERB, APP. 3.2 (pCi/g Dry)
05-14-86
14:28:15

GRID AND SAMP NO	TYPE	NA 22	NB 94	K 40 NATL	RA 226 NATL LT	TH 228 NATL LT
BKGD-01-E	SURFACE SOIL					
BKGD-02-B	SURFACE SOIL					
BKGD-03-E	SURFACE SOIL					
BKGD-04-A	SURFACE SOIL					
BKGD-05-D	SURFACE SOIL					
BKGD-06-B	SURFACE SOIL					
BKGD-07-E	SURFACE SOIL					
BKGD-08-C	SURFACE SOIL					
BKGD-09-E	SURFACE SOIL					
BKGD-10-E	SURFACE SOIL					
BKGD-11-E	SURFACE SOIL					
BKGD-12-A	SURFACE SOIL					
BKGD-13-E	SURFACE SOIL					
BKGD-14-A	SURFACE SOIL					
BKGD-15-C	SURFACE SOIL					
BKGD-16-E	SURFACE SOIL					
BKGD-17-E	SURFACE SOIL					
BKGD-18-E	SURFACE SOIL					
BKGD-19-E	SURFACE SOIL					
BKGD-20-D	SURFACE SOIL					
BKGD-21-C	ERB SURFACE					
BKGD-22-D	ERB SURFACE					
BKGD-23-B	ERB SURFACE					
BKGD-24-B	ERB SURFACE					
BKGD-25-E	ERB SURFACE					
BKGD-26-E	ERB SURFACE					
O-04-A	SURFACE			18.40	2.0	
O-05-A	SURFACE					
O-06-A	SURFACE					
O-07-E	SURFACE					
O-08-A	SURFACE					
O-09-A	SURFACE					
O-10-E	SURFACE SOIL					
P-04-D	SURFACE					
P-05-NE-A	SURFACE					
P-05-NW-D	SURFACE					
P-05-SE-D	SURFACE					
P-05-SW-A	SURFACE					
P-06-NE-D	SURFACE					
P-06-NW-D	SURFACE					
P-06-SE-A	SURFACE					
P-06-SW-E	SURFACE					
P-07-NE-[illegible]	SURFACE					
P-07-NW-E	SURFACE					
P-07-SE-D	SURFACE					
P-07-SW-A	SURFACE					
P-08-NE-B	SURFACE					
P-08-NW-E	SURFACE					
P-08-SE-E	SURFACE					
P-08-SW-B	SURFACE					
P-09-NE-D	SURFACE					
P-09-NW-E	SURFACE					
P-09-SE-D	SURFACE					
P-09-SW-B	SURFACE			19.20		

PBRF OUTDR RAD CLASS IN ERB, APP. 3.2 (pCi/g Dry)
05-14-86
14:21:08

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
P-10-E	SURFACE SOIL	7.40	0.00	42.00									
P-10-SE-E	SURFACE	14.00	0.00	170.00									
P-10-SW-E	SURFACE	6.90	0.00	58.00		1.90							
Q-04-B	SURFACE	15.00	0.00	130.00		1.0							
Q-05-NE-A	SURFACE	16.00	0.00	81.00		2.60							
Q-05-NW-E	SURFACE	10.00	0.00	44.00									
Q-05-SE-B	SURFACE	9.20	0.00	54.00		3.20							
Q-05-SW-A	SURFACE	12.00	0.00	78.00		2.20							
Q-06-NE-B	SURFACE	9.70	0.00	59.00		1.60							
Q-06-NW-E	SURFACE	14.00	0.00	350.00		0.08		26.60		4.88			0.10
Q-06-SE-D	SURFACE	13.00	0.00	46.00		.98							
Q-06-SW-E	SURFACE	8.60	0.00	40.00		1.20							
Q-07-NE-C	SURFACE	17.00	0.00	63.00		1.80							
Q-07-NW-E	SURFACE	0.00	7.00	39.00									
Q-07-SE-A	SURFACE	0.00	7.00	46.00		.85							
Q-07-SW-B	SURFACE	0.00	6.00	40.00		.96							
Q-08-NE-B	SURFACE	0.00	6.00	38.00		1.10							
Q-08-NW-E	SURFACE	0.00	6.00	36.00									
Q-08-SE-E	SURFACE	0.00	6.00	44.00									
Q-08-SW-B	SURFACE	5.20	0.00	44.00		1.10							
Q-09-NE-B	SURFACE	13.00	0.00	44.00		150							
Q-09-NW-E	SURFACE	7.60	0.00	34.00									
Q-09-SE-C	SURFACE	7.60	0.00	40.00		.91							
Q-09-SW-E	SURFACE	0.00	4.00	43.00		1.50							
Q-10-E	SURFACE SOIL	9.40	0.00	65.00									
Q-10-SE-D	SURFACE	19.00	0.00	190.00									
Q-10-SW-D	SURFACE	8.70	0.00	63.00		1.60							
R-04-A	SURFACE	19.00	0.00	260.00									
R-05-NE-A	SURFACE	14.00	0.00	53.00		2.50		6.03		3.45			0.07
R-05-NW-E	SURFACE	15.00	0.00	64.00		1.50							
R-05-SE-C	SURFACE	13.00	0.00	78.00		6.40							
R-05-SW-E	SURFACE	20.00	0.00	170.00		6.70							
R-06-NE-B	SURFACE	11.00	0.00	45.00		2.70							
R-06-NW-E	SURFACE	13.00	0.00	51.00		.87							
R-06-SE-B	SURFACE	9.10	0.00	58.00		3.40		5.51		4.96			0.07
R-06-SW-E	SURFACE	15.00	0.00	56.00		2.00							
R-07-NE-E	SURFACE	0.00	6.00	55.00		1.50							
R-07-NW-B	SURFACE	0.00	6.00	46.00									
R-07-SE-D	SURFACE	0.00	6.00	49.00		.94							
R-07-SW-D	SURFACE	11.00	0.00	60.00		2.10							
R-08-NE-B	SURFACE	0.00	5.00	36.00		.87							
R-08-NW-B	SURFACE	6.30	0.00	100.00									
R-08-SE-B	SURFACE	7.50	0.00	34.00									
R-08-SW-A	SURFACE	8.70	0.00	45.00		1.30							
R-09-NE-E	SURFACE	0.00	5.00	50.00		1.10							
R-09-NW-E	SURFACE	7.50	0.00	43.00									
R-09-SE-D	SURFACE	5.80	0.00	120.00									
R-09-SW-E	SURFACE	5.80	0.00	43.00		1.60							
R-10-E	SURFACE SOIL	6.90	0.00	42.00									
R-10-SE-E	SURFACE	6.30	0.00	51.00									
R-10-SW-A	SURFACE	9.80	0.00	46.00		1.40							
S-04-D	SURFACE	37.00	0.00	740.00		24.00		113.00		126.00		.55	
S-05-E	SURFACE	15.00	0.00	89.00									
S-05-NW-C	SURFACE	12.00	0.00	53.00				5.37		6.56			.09

PERF OUTDR RAD CLASS IN ERB, APP. 3.2 (pCi/g Dry)
05-14-86
14:28:15

GRID AND SAMP NO	TYPE	NA 22	NB 94	K 40 NATL	RA 226 NATL LT	TH 228 NATL LT
P-10-E	SURFACE SOIL					
P-10-SE-E	SURFACE					
P-10-SW-E	SURFACE					
Q-04-B	SURFACE					
Q-05-NE-A	SURFACE					
Q-05-NW-E	SURFACE					
Q-05-SE-B	SURFACE					
Q-05-SW-A	SURFACE					
Q-06-NE-B	SURFACE					
Q-06-NW-E	SURFACE			17.0		
Q-06-SE-D	SURFACE					
Q-06-SW-E	SURFACE					
Q-07-NE-C	SURFACE					
Q-07-NW-E	SURFACE					
Q-07-SE-A	SURFACE					
Q-07-SW-B	SURFACE					
Q-08-NE-B	SURFACE					
Q-08-NW-E	SURFACE					
Q-08-SE-E	SURFACE					
Q-08-SW-B	SURFACE					
Q-09-NE-B	SURFACE					
Q-09-NW-E	SURFACE					
Q-09-SE-C	SURFACE					
Q-09-SW-E	SURFACE					
Q-10-E	SURFACE SOIL					
Q-10-SE-B	SURFACE					
Q-10-SW-D	SURFACE					
R-04-A	SURFACE					
R-05-NE-A	SURFACE			16.10		
R-05-NW-B	SURFACE					
R-05-SE-C	SURFACE					
R-05-SW-E	SURFACE					
R-06-NE-B	SURFACE					
R-06-NW-E	SURFACE					
R-06-SE-B	SURFACE			14.80		
R-06-SW-E	SURFACE					
R-07-NE-E	SURFACE					
R-07-NW-B	SURFACE					
R-07-SE-D	SURFACE					
R-07-SW-D	SURFACE					
R-08-NE-B	SURFACE					
R-08-NW-B	SURFACE					
[illegible]	[illegible]					
R-08-SW-A	SURFACE					
R-09-NE-E	SURFACE					
R-09-NW-E	SURFACE					
R-09-SE-D	SURFACE					
R-09-SW-E	SURFACE					
R-10-E	SURFACE SOIL					
R-10-SE-E	SURFACE					
R-10-SW-A	SURFACE					
S-04-D	SURFACE	.75	.69	15.40	4.00	.40
S-05-E	SURFACE					
S-05-NW-C	SURFACE			12.90		

FEMP OUTDR RAD CLASS IN ERB, APP. 3.2 (pCi/g Dry)
05-14-86
14:21:08

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
S-05-SW-E	SURFACE	23.00	0.00	330.00			.05	21.90		11.60			.10
S-06-E	SURFACE	14.00	0.00	85.00									
S-06-NW-C	SURFACE	8.60	0.00	37.00		11.00							
S-06-SW-C	SURFACE	18.00	0.00	53.00		2.50		5.77		3.59			.07
S-07-E	SURFACE	9.20	0.00	64.00									
S-07-NW-D	SURFACE	13.00	0.00	130.00									
S-07-SW-C	SURFACE	12.00	0.00	130.00		2.60							
S-08-E	SURFACE	0.00	5.00	57.00									
S-08-NW-C	SURFACE	0.00	5.00	57.00									
S-08-SW-E	SURFACE	7.60	0.00	110.00		5.30							
S-09-E	SURFACE	14.00	0.00	46.00									
S-09-NW-A	SURFACE	0.00	5.00	46.00									
S-09-SW-E	SURFACE	8.70	0.00	43.00		.91							
S-10-E	SURFACE SOIL	4.30	0.00	34.00									
S-10-SW-C	SURFACE	5.20	0.00	52.00									
BKGD-C-11E	ERB SOIL	6.10	0.00	35.00									
BKGD-C-05E	ERB SOIL	0.00	5.00	30.00									
BKGD-C-11E	ERB VEGT	1.80	0.00	11.00									
BKGD-C-05E	ERB VEGT	2.60	0.00	14.00									
O-04-NE	SH SURFACE	13.00	0.00	220.00									
P-09-NW	SH SURFACE	0.00	5.00	59.00									
Q-05-SW	SH SURFACE	14.00	0.00	350.00									
R-05-NE	SH SURFACE	20.00	0.00	520.00									
R-05-SW	SH SURFACE	18.00	0.00	410.00									
R-10-NW	SH SURFACE	0.00	5.00	73.00									
S-05-NW	SH SURFACE	27.00	0.00	750.00									
S-06-SW	SH SURFACE	19.00	0.00	550.00									
O-04-NE	VEGT	2.10	0.00	49.00									
P-09-NW	VEGT	5.30	0.00	41.00									
Q-05-SW	VEGT	3.50	0.00	97.00									
R-05-NE	VEGT	4.00	0.00	140.00									
R-05-SW	VEGT	6.20	0.00	160.00									
R-10-NW	VEGT	2.00	0.00	30.00									
S-05-NW	VEGT	8.30	0.00	180.00									
S-06-SW	VEGT	5.70	0.00	150.00									

PD235 Number of Records Read: 143
PD236 Number of Records Selected: 143

PERF OUTDR RAD CLASS IN ERB, APP. 3.2 (pCi/g Dry)
05-14-86
14:28:15

GRID AND SAMP NO	TYPE	NA 22	NB 94	K 40 NATL	RA 226 NATL LT	TH 228 NATL LT
S-05-SW-E	SURFACE			12.90		
S-06-E	SURFACE					
S-06-NW-C	SURFACE					
S-06-SW-C	SURFACE			15.90		
S-07-E	SURFACE					
S-07-NW-D	SURFACE					
S-07-SW-C	SURFACE					
S-08-E	SURFACE					
S-08-NW-C	SURFACE					
S-08-SW-E	SURFACE					
S-09-E	SURFACE					
S-09-NW-A	SURFACE					
S-09-SW-E	SURFACE					
S-10-E	SURFACE SOIL					
S-10-SW-C	SURFACE					
BKGD-C-11E	ERB SOIL					
BKGD-C-05E	ERB SOIL					
BKGD-C-11E	ERB VEGT					
BKGD-C-05E	ERB VEGT					
O-04-NE	SH SURFACE					
P-09-NW	SH SURFACE					
Q-05-SW	SH SURFACE					
R-05-NE	SH SURFACE					
R-05-SW	SH SURFACE					
R-10-NW	SH SURFACE					
S-05-NW	SH SURFACE					
S-06-SW	SH SURFACE					
O-04-NE	VEGT					
P-09-NW	VEGT					
Q-05-SW	VEGT					
R-05-NE	VEGT					
R-05-SW	VEGT					
R-10-NW	VEGT					
S-05-NW	VEGT					
S-06-SW	VEGT					

PD235 Number of Records Read: 143
PD236 Number of Records Selected: 143

APPENDIX 3.3

PBRF Outdoor Radiological Classification

Shallow Core (10') Soil Sampling

Outside the Emergency Retention Basin

Within the Emergency Retention Basin

RAD PERF CLASS SH CORE (10') SOIL OUTSIDE ERB (pCi/g Dry)
04-18-86
11:10:15

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
BKGD-26-01	SHALLOW CORE	0.00	6.00	25.00									
BKGD-26-02	SHALLOW CORE	10.00	0.00	32.00									
BKGD-26-03	SHALLOW CORE	0.00	6.00	29.00									
BKGD-26-04	SHALLOW CORE	6.50	0.00	29.00									
BKGD-26-05	SHALLOW CORE	6.50	0.00	34.00									
BKGD-26-06	SHALLOW CORE	8.10	0.00	45.00									
BKGD-26-07	SHALLOW CORE	0.00	6.00	34.00									
BKGD-26-08	SHALLOW CORE	0.00	6.00	30.00									
BKGD-05-01	SHALLOW CORE	0.00	6.00	26.00									
BKGD-05-02	SHALLOW CORE	0.00	6.00	26.00									
BKGD-05-03	SHALLOW CORE	0.00	6.00	26.00									
BKGD-05-04	SHALLOW CORE	0.00	6.00	23.00									
BKGD-05-05	SHALLOW CORE	0.00	6.00	25.00									
BKGD-05-06	SHALLOW CORE	0.00	6.00	24.00									
BKGD-05-07	SHALLOW CORE	15.00	0.00	64.00									
BKGD-05-08	SHALLOW CORE	24.00	0.00	85.00					.08		.08		.10
A-08-1	SHALLOW CORE	4.90	0.00	26.00									
A-08-2	SHALLOW CORE	0.00	4.00	27.00									
A-08-3	SHALLOW CORE	5.40	0.00	29.00									
A-08-4	SHALLOW CORE	4.90	0.00	31.00									
A-08-5	SHALLOW CORE	5.90	0.00	29.00									
A-08-6	SHALLOW CORE	9.70	0.00	34.00									
A-08-7	SHALLOW CORE	8.60	0.00	37.00									
A-08-8	SHALLOW CORE	12.00	0.00	36.00									
A-14-1	SHALLOW CORE	9.20	0.00	30.00									
A-14-2	SHALLOW CORE	0.00	4.00	22.00									
A-14-3	SHALLOW CORE	7.00	0.00	26.00									
A-14-4	SHALLOW CORE	4.90	0.00	30.00									
A-14-5	SHALLOW CORE	6.50	0.00	29.00									
A-14-6	SHALLOW CORE	8.60	0.00	31.00									
A-14-7	SHALLOW CORE	9.20	0.00	31.00									
A-14-8	SHALLOW CORE	9.70	0.00	36.00									
C-03-1	SHALLOW CORE	10.00	0.00	36.00									
C-03-2	SHALLOW CORE	5.60	0.00	28.00									
C-03-3	SHALLOW CORE	0.00	4.00	24.00									
C-03-4	SHALLOW CORE	0.00	4.00	24.00									
C-03-5	SHALLOW CORE	5.10	0.00	25.00									
C-03-6	SHALLOW CORE	11.00	0.00	33.00									
C-03-7	SHALLOW CORE	6.60	0.00	34.00									
C-03-8	SHALLOW CORE	6.60	0.00	28.00									
E-22-1	SHALLOW CORE	5.10	0.00	26.00									
E-22-2	SHALLOW CORE	0.00	4.00	30.00									
E-22-3	SHALLOW CORE	0.00	4.00	30.00									
E-22-4	SHALLOW CORE	0.00	4.00	26.00									
E-22-5	SHALLOW CORE	6.10	0.00	26.00									
E-22-6	SHALLOW CORE	6.60	0.00	32.00									
E-22-7	SHALLOW CORE	9.70	0.00	34.00									
E-22-8	SHALLOW CORE	11.00	0.00	33.00									
G-10-1	SHALLOW CORE	9.70	0.00	30.00									
G-10-2	SHALLOW CORE	13.00	0.00	32.00									
G-10-3	SHALLOW CORE	0.00	5.00	35.00									
G-10-4	SHALLOW CORE	7.60	0.00	36.00									
G-10-5	SHALLOW CORE	12.00	0.00	27.00									
G-10-6	SHALLOW CORE	0.00	5.00	30.00									

RAD PERF CLASS SH CORE (10") SOIL OUTSIDE ERB (pCi/g Dry)
04-18-86
11:10:15

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
G-10-7	SHALLOW CORE	5.10	0.00	30.00									
G-10-8	SHALLOW CORE	6.60	0.00	33.00									
G-11-1	SHALLOW CORE	12.00	0.00	28.00									
G-11-2	SHALLOW CORE	6.10	0.00	24.00									
G-11-3	SHALLOW CORE	7.60	0.00	32.00									
G-11-4	SHALLOW CORE	9.20	0.00	32.00									
G-11-5	SHALLOW CORE	9.70	0.00	29.00									
G-11-6	SHALLOW CORE	6.60	0.00	31.00									
G-11-7	SHALLOW CORE	0.00	5.00	31.00									
G-11-8	SHALLOW CORE	8.10	0.00	38.00									
H-09-1	SHALLOW CORE	5.40	0.00	28.00									
H-09-2	SHALLOW CORE	5.90	0.00	28.00									
H-09-3	SHALLOW CORE	0.00	4.00	28.00									
H-09-4	SHALLOW CORE	5.40	0.00	28.00									
H-09-5	SHALLOW CORE	10.00	0.00	31.00									
H-09-6	SHALLOW CORE	10.00	0.00	38.00									
H-09-7	SHALLOW CORE	6.60	0.00	37.00									
H-09-8	SHALLOW CORE	9.70	0.00	38.00									
H-17-1	SHALLOW CORE	6.10	0.00	33.00									
H-17-2	SHALLOW CORE	5.60	0.00	26.00									
H-17-3	SHALLOW CORE	0.00	5.00	28.00									
H-17-4	SHALLOW CORE	11.00	0.00	30.00									
H-17-5	SHALLOW CORE	8.60	0.00	30.00									
H-17-6	SHALLOW CORE	11.00	0.00	26.00									
H-17-7	SHALLOW CORE	7.00	0.00	29.00									
H-17-8	SHALLOW CORE	9.20	0.00	30.00									
I-9-1	SHALLOW CORE	14.00	0.00	200.00									
I-9-2	SHALLOW CORE	93.00	0.00	1500.00				187.0			.20		.02
I-9-3	SHALLOW CORE	19.00	0.00	300.00									
I-9-4	SHALLOW CORE	6.60	0.00	170.00									
I-9-5	SHALLOW CORE	5.60	0.00	180.00									
I-9-6	SHALLOW CORE	7.10	0.00	97.00									
I-9-7	SHALLOW CORE	7.60	0.00	33.00									
I-9-8	SHALLOW CORE	13.00	0.00	35.00									
J-3-1	SHALLOW CORE	8.40	0.00	36.00									
J-3-2	SHALLOW CORE	6.20	0.00	28.00									
J-3-3	SHALLOW CORE	0.00	4.00	26.00									
J-3-4	SHALLOW CORE	7.30	0.00	31.00									
J-3-5	SHALLOW CORE	10.00	0.00	43.00									
J-3-6	SHALLOW CORE	8.90	0.00	39.00									
J-3-7	SHALLOW CORE	11.00	0.00	42.00									
J-3-8	SHALLOW CORE	6.20	0.00	31.00									
J-8-1	SHALLOW CORE	8.90	0.00	34.00									
J-8-2	SHALLOW CORE	12.00	0.00	37.00									
J-8-3	SHALLOW CORE	5.10	0.00	26.00									
J-8-4	SHALLOW CORE	0.00	4.00	23.00									
J-8-5	SHALLOW CORE	0.00	4.00	43.00									
J-8-6	SHALLOW CORE	4.10	0.00	34.00									
J-8-7	SHALLOW CORE	12.00	0.00	32.00									
J-8-8	SHALLOW CORE	6.20	0.00	39.00									
K-03-2	SHALLOW CORE	0.00	8.00	26.00									
K-03-3	SHALLOW CORE	0.00	8.00	25.00									
K-03-4	SHALLOW CORE	0.00	8.00	26.00									
K-03-5	SHALLOW CORE	0.00	8.00	28.00									

RAD PERF CLASS SH CORE (10') SOIL OUTSIDE ERB (pCi/g Dry)
04-18-86
11:10:15

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
K-03-6	SHALLOW CORE	0.00	8.00	40.00									
K-03-7	SHALLOW CORE	8.10	0.00	45.00									
K-03-8	SHALLOW CORE	0.00	8.00	34.00									
K-08-1	SHALLOW CORE	8.60	0.00	42.00									
K-08-2	SHALLOW CORE	13.00	0.00	62.00									
K-08-3	SHALLOW CORE	0.00	8.00	28.00									
K-08-4	SHALLOW CORE	14.00	0.00	35.00									
K-08-5	SHALLOW CORE	0.00	8.00	25.00									
K-08-6	SHALLOW CORE	0.00	8.00	32.00									
K-08-7	SHALLOW CORE	14.00	0.00	44.00									
K-08-8	SHALLOW CORE	8.60	0.00	47.00									
K-09-1	SHALLOW CORE	0.00	8.00	38.00									
K-15-1	SHALLOW CORE	8.10	0.00	31.00									
K-15-2	SHALLOW CORE	0.00	5.00	23.00									
K-15-3	SHALLOW CORE	0.00	5.00	19.00									
K-15-4	SHALLOW CORE	5.10	0.00	21.00									
K-15-5	SHALLOW CORE	5.10	0.00	34.00									
K-15-6	SHALLOW CORE	6.10	0.00	26.00									
K-15-7	SHALLOW CORE	8.10	0.00	30.00									
K-15-8	SHALLOW CORE	11.00	0.00	36.00									
O-12-1	SHALLOW CORE	6.10	0.00	32.00									
O-12-2	SHALLOW CORE	0.00	5.00	26.00									
O-12-3	SHALLOW CORE	0.00	5.00	24.00									
O-12-4	SHALLOW CORE	0.00	5.00	21.00									
O-12-5	SHALLOW CORE	0.00	5.00	29.00									
O-12-6	SHALLOW CORE	6.10	0.00	40.00									
O-12-7	SHALLOW CORE	0.00	5.00	37.00									
O-12-8	SHALLOW CORE	7.10	0.00	35.00									
O-14-1	SHALLOW CORE	8.60	0.00	34.00									
O-14-2	SHALLOW CORE	6.50	0.00	35.00									
O-14-3	SHALLOW CORE	5.90	0.00	32.00									
O-14-4	SHALLOW CORE	4.90	0.00	27.00									
O-14-5	SHALLOW CORE	9.70	0.00	35.00									
O-14-6	SHALLOW CORE	5.90	0.00	39.00									
O-14-7	SHALLOW CORE	11.00	0.00	44.00									
O-14-8	SHALLOW CORE	9.20	0.00	36.00									
P-12-1	SHALLOW CORE	6.60	0.00	27.00									
P-12-2	SHALLOW CORE	6.60	0.00	24.00									
P-12-3	SHALLOW CORE	0.00	5.00	23.00									
P-12-4	SHALLOW CORE	0.00	5.00	23.00									
P-12-5	SHALLOW CORE	0.00	5.00	25.00									
P-12-6	SHALLOW CORE	0.00	5.00	36.00									
P-12-7	SHALLOW CORE	0.00	5.00	34.00									
P-12-8	SHALLOW CORE	0.00	5.00	36.00									
P-13-1	SHALLOW CORE	0.00	5.00	20.00									
P-13-2	SHALLOW CORE	0.00	5.00	25.00									
P-13-3	SHALLOW CORE	0.00	5.00	29.00									
P-13-4	SHALLOW CORE	0.00	5.00	28.00									
P-13-5	SHALLOW CORE	5.10	0.00	30.00									
P-13-6	SHALLOW CORE	5.10	0.00	37.00									
P-13-7	SHALLOW CORE	0.00	5.00	27.00									
P-13-8	SHALLOW CORE	0.00	5.00	32.00									
Q-12-1	SHALLOW CORE	9.20	0.00	35.00									
Q-12-2	SHALLOW CORE	3.60	0.00	30.00									

RAD PERF CLASS SH CORE (10") SOIL OUTSIDE ERB (pCi/g Dry)
04-18-86
11:10:15

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
Q-12-3	SHALLOW CORE	4.60	0.00	26.00									
Q-12-4	SHALLOW CORE	5.60	0.00	25.00									
Q-12-5	SHALLOW CORE	5.10	0.00	33.00									
Q-12-6	SHALLOW CORE	4.10	0.00	32.00									
Q-12-7	SHALLOW CORE	9.70	0.00	39.00									
Q-12-8	SHALLOW CORE	11.00	0.00	39.00									
Q-14-1	SHALLOW CORE	5.60	0.00	32.00									
Q-14-2	SHALLOW CORE	5.60	0.00	24.00									
Q-14-3	SHALLOW CORE	0.00	5.00	30.00									
Q-14-4	SHALLOW CORE	7.60	0.00	30.00									
Q-14-5	SHALLOW CORE	5.60	0.00	27.00									
Q-14-6	SHALLOW CORE	10.00	0.00	30.00									
Q-14-7	SHALLOW CORE	11.00	0.00	33.00									
Q-14-8	SHALLOW CORE	6.60	0.00	24.00									
Q-22-1	SHALLOW CORE	0.00	5.00	30.00									
Q-22-2	SHALLOW CORE	0.00	5.00	22.00									
Q-22-3	SHALLOW CORE	0.00	5.00	21.00									
Q-22-4	SHALLOW CORE	0.00	5.00	21.00									
Q-22-5	SHALLOW CORE	8.60	0.00	26.00									
Q-22-6	SHALLOW CORE	0.00	5.00	32.00									
Q-22-7	SHALLOW CORE	0.00	5.00	32.00									
Q-22-8	SHALLOW CORE	6.10	0.00	40.00									
R-11-1	SHALLOW CORE	4.60	0.00	29.00									
R-11-2	SHALLOW CORE	5.60	0.00	30.00									
R-11-3	SHALLOW CORE	6.10	0.00	28.00									
R-11-4	SHALLOW CORE	14.00	0.00	35.00									
R-11-5	SHALLOW CORE	0.00	3.00	24.00									
R-11-6	SHALLOW CORE	9.70	0.00	40.00									
R-11-7	SHALLOW CORE	5.60	0.00	32.00									
R-11-8	SHALLOW CORE	8.10	0.00	37.00									
R-13-1	SHALLOW CORE	5.90	0.00	34.00									
R-13-2	SHALLOW CORE	7.60	0.00	33.00									
R-13-3	SHALLOW CORE	5.90	0.00	32.00									
R-13-4	SHALLOW CORE	7.60	0.00	35.00									
R-13-5	SHALLOW CORE	9.70	0.00	36.00									
R-13-6	SHALLOW CORE	10.00	0.00	42.00									
R-13-7	SHALLOW CORE	7.00	0.00	41.00									
R-13-8	SHALLOW CORE	11.00	0.00	42.00									
S-12-1	SHALLOW CORE	0.00	5.00	28.00									
S-12-2	SHALLOW CORE	0.00	5.00	25.00									
S-12-3	SHALLOW CORE	0.00	5.00	33.00									
S-12-4	SHALLOW CORE	0.00	5.00	27.00									
S-12-5	SHALLOW CORE	0.00	5.00	30.00									
S-12-6	SHALLOW CORE	6.60	0.00	35.00									
S-12-7	SHALLOW CORE	0.00	5.00	30.00									
S-12-8	SHALLOW CORE	9.70	0.00	38.00									
S-14-1	SHALLOW CORE	5.60	0.00	25.00									
S-14-2	SHALLOW CORE	7.60	0.00	26.00									
S-14-3	SHALLOW CORE	11.00	0.00	30.00									
S-14-4	SHALLOW CORE	8.10	0.00	27.00									
S-14-5	SHALLOW CORE	8.10	0.00	31.00									
S-14-6	SHALLOW CORE	5.60	0.00	36.00									
S-14-7	SHALLOW CORE	6.60	0.00	33.00									
S-14-8	SHALLOW CORE	16.00	0.00	43.00									

RAD PERF CLASS SH CORE (10') SOIL OUTSIDE ERB (pCi/g Dry)
04-18-86
11:10:15

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
U-03-1	SHALLOW CORE	5.10	0.00	29.00									
U-03-1	SHALLOW CORE	7.60	0.00	53.00									
U-03-2	SHALLOW CORE	5.60	0.00	28.00									
U-03-4	SHALLOW CORE	6.10	0.00	29.00									
U-03-5	SHALLOW CORE	8.60	0.00	30.00									
U-03-6	SHALLOW CORE	7.60	0.00	31.00									
U-03-7	SHALLOW CORE	11.00	0.00	28.00									
U-03-8	SHALLOW CORE	0.00	5.00	29.00									
U-04-1	SHALLOW CORE	6.60	0.00	38.00									
U-04-2	SHALLOW CORE	7.10	0.00	30.00									
U-04-3	SHALLOW CORE	0.00	5.00	23.00									
U-04-4	SHALLOW CORE	0.00	5.00	21.00									
U-04-5	SHALLOW CORE	0.00	5.00	22.00									
U-04-6	SHALLOW CORE	0.00	5.00	22.00									
U-04-7	SHALLOW CORE	0.00	5.00	22.00									
U-04-8	SHALLOW CORE	15.00	0.00	36.00									
U-08-1	SHALLOW CORE	0.00	5.00	23.00									
U-08-1	SHALLOW CORE	0.00	5.00	22.00									
U-08-2	SHALLOW CORE	0.00	5.00	22.00									
U-08-3	SHALLOW CORE	0.00	5.00	21.00									
U-08-5	SHALLOW CORE	0.00	5.00	21.00									
U-08-6	SHALLOW CORE	7.60	0.00	28.00									
U-08-7	SHALLOW CORE	0.00	5.00	25.00									
U-08-8	SHALLOW CORE	0.00	5.00	23.00									
U-14-1	SHALLOW CORE	5.90	0.00	28.00									
U-14-2	SHALLOW CORE	5.40	0.00	28.00									
U-14-3	SHALLOW CORE	0.00	5.00	23.00									
U-14-4	SHALLOW CORE	0.00	5.00	21.00									
U-14-5	SHALLOW CORE	0.00	5.00	23.00									
U-14-6	SHALLOW CORE	7.60	0.00	25.00									
U-14-7	SHALLOW CORE	9.70	0.00	39.00									
U-14-8	SHALLOW CORE	11.00	0.00	43.00									

PD235 Number of Records Read: 248
PD236 Number of Records Selected: 248

RAD PERF CLASS SH CORE SOIL IN BRB (pCi/g Dry)
04-18-86
14:39:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
HKOD-26-01	SHALLOW CORE	9.00	6.00	25.00									
HKOD-26-02	SHALLOW CORE	10.00	0.00	32.00									
HKOD-26-03	SHALLOW CORE	0.00	6.00	29.00									
HKOD-26-04	SHALLOW CORE	6.50	0.00	29.00									
HKOD-26-05	SHALLOW CORE	6.50	0.00	34.00									
HKOD-26-06	SHALLOW CORE	8.10	0.00	45.00									
HKOD-26-07	SHALLOW CORE	0.00	6.00	34.00									
HKOD-26-08	SHALLOW CORE	0.00	6.00	30.00									
HKOD-05-01	SHALLOW CORE	0.00	6.00	26.00									
HKOD-05-02	SHALLOW CORE	0.00	6.00	26.00									
HKOD-05-03	SHALLOW CORE	0.00	6.00	26.00									
HKOD-05-04	SHALLOW CORE	0.00	6.00	23.00									
HKOD-05-05	SHALLOW CORE	0.00	6.00	25.00									
HKOD-05-06	SHALLOW CORE	0.00	6.00	24.00									
HKOD-05-07	SHALLOW CORE	15.00	0.00	64.00									
HKOD-05-08	SHALLOW CORE	24.00	0.00	85.00					.08		.08		.10
P-5-1	SHALLOW CORE	8.10	0.00	35.00									
P-5-2	SHALLOW CORE	5.10	0.00	32.00									
P-5-3	SHALLOW CORE	4.10	0.00	31.00									
P-5-4	SHALLOW CORE	6.10	0.00	24.00									
P-5-5	SHALLOW CORE	7.60	0.00	44.00									
P-5-6	SHALLOW CORE	0.00	3.00	31.00									
P-5-7	SHALLOW CORE	5.10	0.00	31.00									
P-5-8	SHALLOW CORE	5.60	0.00	41.00									
P-7-1	SHALLOW CORE	0.00	3.00	34.00									
P-7-2	SHALLOW CORE	6.10	0.00	36.00									
P-7-3	SHALLOW CORE	7.60	0.00	33.00									
P-7-4	SHALLOW CORE	7.10	0.00	36.00									
P-7-5	SHALLOW CORE	9.20	0.00	38.00									
P-7-6	SHALLOW CORE	4.60	0.00	30.00									
P-7-7	SHALLOW CORE	8.10	0.00	38.00									
P-7-8	SHALLOW CORE	13.00	0.00	39.00									
P-9-1	SHALLOW CORE	0.00	5.00	59.00									
P-9-2	SHALLOW CORE	0.00	5.00	46.00									
P-9-3	SHALLOW CORE	0.00	5.00	31.00									
P-9-4	SHALLOW CORE	0.00	5.00	26.00									
P-9-5	SHALLOW CORE	0.00	5.00	28.00									
P-9-6	SHALLOW CORE	0.00	5.00	29.00									
P-9-7	SHALLOW CORE	7.60	0.00	38.00									
P-9-8	SHALLOW CORE	6.10	0.00	44.00									
Q-6-1	SHALLOW CORE	0.00	5.00	42.00									
Q-6-2	SHALLOW CORE	0.00	5.00	27.00									
Q-6-3	SHALLOW CORE	7.10	0.00	31.00									
Q-6-4	SHALLOW CORE	9.70	0.00	31.00									
Q-6-5	SHALLOW CORE	0.00	5.00	32.00									
Q-6-6	SHALLOW CORE	0.00	5.00	25.00									
Q-6-7	SHALLOW CORE	5.10	0.00	35.00									
Q-6-8	SHALLOW CORE	0.00	5.00	21.00									
Q-9-1	SHALLOW CORE	0.00	5.00	26.00									
Q-9-2	SHALLOW CORE	0.00	5.00	34.00									
Q-9-3	SHALLOW CORE	0.00	5.00	29.00									

RAD PERF CLASS SR CORE SOIL IN ERB (pCi/g Dry)
04-18-86
14:39:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
Q-9-7	SHALLOW CORE	7.10	0.00	34.00									
Q-9-8	SHALLOW CORE	6.60	0.00	30.00									
R-5-1	SHALLOW CORE	0.00	5.00	78.00									
R-5-2	SHALLOW CORE	0.00	5.00	33.00		2.10							
R-5-3	SHALLOW CORE	0.00	5.00	31.00									
R-5-4	SHALLOW CORE	0.00	5.00	31.00									
R-5-5	SHALLOW CORE	8.10	0.00	38.00									
R-5-6	SHALLOW CORE	5.60	0.00	41.00									
R-5-7	SHALLOW CORE	7.60	0.00	42.00									
R-5-8	SHALLOW CORE	8.10	0.00	43.00									
R-7-1	SHALLOW CORE	0.00	5.00	39.00									
R-7-2	SHALLOW CORE	5.60	0.00	26.00		.89							
R-7-3	SHALLOW CORE	0.00	5.00	32.00									
R-7-4	SHALLOW CORE	0.00	5.00	28.00									
R-7-5	SHALLOW CORE	0.00	5.00	26.00									
R-7-6	SHALLOW CORE	0.00	5.00	31.00									
R-7-7	SHALLOW CORE	0.00	5.00	34.00									
R-7-8	SHALLOW CORE	6.60	0.00	32.00									
R-9-1	SHALLOW CORE	0.00	5.00	35.00									
R-9-2	SHALLOW CORE	0.00	5.00	29.00									
R-9-3	SHALLOW CORE	0.00	5.00	37.00									
R-9-4	SHALLOW CORE	0.00	5.00	29.00									
R-9-5	SHALLOW CORE	7.10	0.00	36.00									
R-9-6	SHALLOW CORE	10.00	0.00	39.00									
R-9-7	SHALLOW CORE	0.00	5.00	37.00									
R-9-8	SHALLOW CORE	6.10	0.00	37.00									

FD235 Number of Records Read: 80
FD236 Number of Records Selected: 80

APPENDIX 3.4

PBRF Outdoor Radiological Classification

Deep Core (30') Soil Sampling

RAD PERF OUTDR CLASS DP CORE (30') SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
BKGD-17-01	DEEP CORE	0.00	6.00	28.00									
BKGD-17-02	DEEP CORE	0.00	6.00	23.00									
BKGD-17-03	DEEP CORE	0.00	6.00	19.00									
BKGD-17-04	DEEP CORE	6.50	0.00	25.00									
BKGD-17-05	DEEP CORE	0.00	6.00	24.00									
BKGD-17-06	DEEP CORE	0.00	6.00	24.00									
BKGD-17-07	DEEP CORE	15.00	0.00	41.00									
BKGD-17-08	DEEP CORE	0.00	6.00	29.00									
BKGD-17-09	DEEP CORE	12.00	0.00	53.00									
BKGD-17-10	DEEP CORE	16.00	0.00	44.00									
BKGD-17-11	DEEP CORE	13.00	0.00	47.00									
BKGD-17-12	DEEP CORE	10.00	0.00	37.00									
BKGD-17-13	DEEP CORE	12.00	0.00	47.00									
BKGD-17-14	DEEP CORE	10.00	0.00	44.00									
BKGD-17-15	DEEP CORE	11.00	0.00	44.00									
BKGD-17-16	DEEP CORE	7.60	0.00	50.00									
BKGD-17-17	DEEP CORE	0.00	6.00	45.00									
BKGD-17-18	DEEP CORE	0.00	6.00	46.00									
BKGD-21-01	DEEP CORE	0.00	6.00	28.00									
BKGD-21-02	DEEP CORE	0.00	6.00	30.00									
BKGD-21-03	DEEP CORE	0.00	6.00	22.00									
BKGD-21-04	DEEP CORE	5.40	0.00	27.00									
BKGD-21-05	DEEP CORE	13.00	0.00	49.00									
BKGD-21-06	DEEP CORE	17.00	0.00	50.00									
BKGD-21-07	DEEP CORE	16.00	0.00	38.00									
BKGD-21-08	DEEP CORE	16.00	0.00	39.00									
BKGD-21-09	DEEP CORE	11.00	0.00	39.00									
BKGD-21-10	DEEP CORE	16.00	0.00	40.00									
BKGD-21-11	DEEP CORE	14.00	0.00	46.00									
BKGD-21-12	DEEP CORE	8.60	0.00	51.00									
BKGD-21-13	DEEP CORE	8.60	0.00	570.00					.07		.07		.08
BKGD-21-14	DEEP CORE	12.00	0.00	48.00									
BKGD-21-15	DEEP CORE	11.00	0.00	54.00									
BKGD-21-16	DEEP CORE	7.60	0.00	49.00									
BKGD-21-17	DEEP CORE	9.20	0.00	49.00									
BKGD-21-18	DEEP CORE	5.90	0.00	48.00									
A-17-01	DEEP CORE	5.10	0.00	22.00									
A-17-02	DEEP CORE	0.00	4.00	21.00									
A-17-03	DEEP CORE	7.10	0.00	23.00									
A-17-04	DEEP CORE	6.10	0.00	25.00									
A-17-05	DEEP CORE	9.20	0.00	25.00									
A-17-06	DEEP CORE	0.00	4.00	24.00									
A-17-07	DEEP CORE	8.10	0.00	28.00									
A-17-08	DEEP CORE	6.60	0.00	30.00									
A-17-09	DEEP CORE	5.10	0.00	33.00									
A-17-10	DEEP CORE	5.60	0.00	30.00									
A-17-11	DEEP CORE	7.60	0.00	34.00									
A-17-12	DEEP CORE	9.20	0.00	41.00									
A-17-13	DEEP CORE	13.00	0.00	41.00									
A-17-14	DEEP CORE	13.00	0.00	51.00									
A-17-15	DEEP CORE	11.00	0.00	49.00									
A-17-16	DEEP CORE	10.00	0.00	30.00									
A-19-01	DEEP CORE	6.10	0.00	27.00									
A-19-02	DEEP CORE	0.00	5.00	75.00									

RAD PERF OUTDR CLASS DP CORE (30') SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
A-19-03	DEEP CORE	0.00	5.00	27.00									
A-19-04	DEEP CORE	0.00	5.00	34.00									
A-19-05	DEEP CORE	0.00	5.00	28.00									
A-19-06	DEEP CORE	0.00	5.00	25.00									
A-19-07	DEEP CORE	0.00	5.00	25.00									
A-19-08	DEEP CORE	0.00	5.00	40.00									
A-19-09	DEEP CORE	7.90	0.00	41.00									
A-19-10	DEEP CORE	0.00	5.00	31.00									
A-19-11	DEEP CORE	0.00	5.00	40.00									
A-19-12	DEEP CORE	0.00	5.00	43.00									
A-19-13	DEEP CORE	6.80	0.00	43.00									
A-19-14	DEEP CORE	9.10	0.00	54.00									
A-19-15	DEEP CORE	0.00	5.00	29.00									
A-19-16	DEEP CORE	0.00	5.00	25.00									
B-17-01	DEEP CORE	0.00	5.00	23.00									
B-17-02	DEEP CORE	5.80	0.00	21.00									
B-17-03	DEEP CORE	0.00	5.00	19.00									
B-17-04	DEEP CORE	5.80	0.00	25.00									
B-17-05	DEEP CORE	0.00	5.00	23.00									
B-17-06	DEEP CORE	0.00	5.00	25.00									
B-17-07	DEEP CORE	0.00	5.00	28.00									
B-17-08	DEEP CORE	0.00	5.00	23.00									
B-17-09	DEEP CORE	9.80	0.00	35.00									
B-17-10	DEEP CORE	0.00	5.00	30.00									
B-17-11	DEEP CORE	0.00	5.00	28.00									
B-17-12	DEEP CORE	0.00	5.00	30.00									
B-17-13	DEEP CORE	10.00	0.00	42.00									
B-17-14	DEEP CORE	6.40	0.00	46.00									
B-17-15	DEEP CORE	6.40	0.00	29.00									
C-17-01	DEEP CORE	5.10	0.00	26.00									
C-17-02	DEEP CORE	4.60	0.00	28.00									
C-17-03	DEEP CORE	4.60	0.00	27.00									
C-17-04	DEEP CORE	0.00	3.00	27.00									
C-17-05	DEEP CORE	8.10	0.00	28.00									
C-17-06	DEEP CORE	4.60	0.00	30.00									
C-17-07	DEEP CORE	5.60	0.00	37.00									
C-17-08	DEEP CORE	10.00	0.00	30.00									
C-17-09	DEEP CORE	14.00	0.00	41.00									
C-17-10	DEEP CORE	11.00	0.00	35.00									
C-17-11	DEEP CORE	7.60	0.00	37.00									
C-17-12	DEEP CORE	13.00	0.00	46.00									
C-17-13	DEEP CORE	15.00	0.00	56.00									
C-17-14	DEEP CORE	17.00	0.00	42.00									
C-17-15	DEEP CORE	15.00	0.00	33.00									
C-17-16	DEEP CORE	8.10	0.00	32.00									
C-17-17	ROCK	0.00	4.00	5.30									
C-17-18	ROCK	0.00	4.00	5.80									
C-21-01	DEEP CORE	0.00	6.00	27.00									
C-21-02	DEEP CORE	0.00	6.00	26.00									
C-21-03	DEEP CORE	0.00	6.00	23.00									
C-21-04	DEEP CORE	0.00	6.00	26.00									
C-21-05	DEEP CORE	0.00	6.00	29.00									
C-21-06	DEEP CORE	7.00	0.00	25.00									
C-21-07	DEEP CORE	0.00	6.00	30.00									

RAD PERF OUTDR CLASS DP CORE (30') SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
C-21-08	DEEP CORE	12.00	0.00	30.00									
C-21-09	DEEP CORE	14.00	0.00	42.00									
C-21-10	DEEP CORE	8.60	0.00	31.00									
C-21-11	DEEP CORE	0.00	6.00	33.00									
C-21-12	DEEP CORE	15.00	0.00	44.00									
C-21-13	DEEP CORE	12.00	0.00	53.00									
C-21-14	DEEP CORE	5.90	0.00	47.00									
C-21-15	DEEP CORE	15.00	0.00	55.00									
F-14-01	DEEP CORE	6.50	0.00	26.00									
F-14-02	DEEP CORE	9.70	0.00	25.00									
F-14-03	DEEP CORE	10.00	0.00	27.00									
F-14-04	DEEP CORE	11.00	0.00	32.00									
F-14-05	DEEP CORE	6.50	0.00	29.00									
F-14-06	DEEP CORE	16.00	0.00	43.00									
F-14-07	DEEP CORE	7.60	0.00	34.00									
F-14-08	DEEP CORE	8.10	0.00	33.00									
F-14-09	DEEP CORE	11.00	0.00	38.00									
F-14-10	DEEP CORE	10.00	0.00	19.00									
F-14-11	DEEP CORE	12.00	0.00	47.00									
F-14-12	DEEP CORE	18.00	0.00	43.00									
F-14-13	DEEP CORE	15.00	0.00	54.00									
F-14-14	DEEP CORE	9.20	0.00	44.00									
F-14-15	DEEP CORE	8.60	0.00	36.00									
F-14-16	ROCK	3.80	0.00	19.00									
F-14-17	ROCK	0.00	4.00	5.70									
F-14-18	ROCK	4.30	0.00	27.00									
G-12-01	DEEP CORE	0.00	6.00	9.40									
G-12-02	DEEP CORE	0.00	6.00	8.90									
G-12-03	DEEP CORE	0.00	6.00	16.00									
G-12-04	DEEP CORE	8.10	0.00	37.00									
G-12-05	DEEP CORE	7.00	0.00	25.00									
G-12-06	DEEP CORE	8.60	0.00	28.00									
G-12-07	DEEP CORE	12.00	0.00	26.00									
G-12-08	DEEP CORE	12.00	0.00	33.00									
G-12-09	DEEP CORE	8.60	0.00	27.00									
G-12-10	DEEP CORE	0.00	5.00	30.00									
G-12-11	DEEP CORE	0.00	5.00	36.00									
G-12-12	DEEP CORE	0.00	5.00	42.00									
G-12-13	DEEP CORE	0.00	5.00	49.00									
G-12-14	DEEP CORE	6.90	0.00	43.00									
G-12-15	DEEP CORE	0.00	5.00	36.00									
G-12-16	DEEP CORE	0.00	5.00	33.00									
G-12-17	ROCK	0.00	4.00	5.90									
G-12-18	ROCK	0.00	4.00	20.00									
G-13-01	DEEP CORE	0.00	5.00	7.10									
G-13-02	DEEP CORE	0.00	5.00	10.00									
G-13-03	DEEP CORE	11.00	0.00	32.00									
G-13-04	DEEP CORE	0.00	5.00	30.00									
G-13-05	DEEP CORE	8.60	0.00	31.00									
G-13-06	DEEP CORE	5.40	0.00	19.00									
G-13-07	DEEP CORE	0.00	5.00	30.00									
G-13-08	DEEP CORE	9.20	0.00	28.00									
G-13-09	DEEP CORE	0.00	5.00	28.00									
G-13-10	DEEP CORE	6.50	0.00	29.00									

RAD PERF OUTDR CLASS DP CORE (30") SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
G-13-11	DEEP CORE	8.60	0.00	33.00									
G-13-12	DEEP CORE	8.60	0.00	42.00									
G-13-13	DEEP CORE	16.00	0.00	53.00									
G-13-14	DEEP CORE	6.50	0.00	44.00									
G-13-15	DEEP CORE	15.00	0.00	45.00									
G-13-16	DEEP CORE	0.45	0.00	1.40									
G-13-17	ROCK	0.00	4.00	12.00									
G-13-18	ROCK	0.00	4.00	22.00									
G-14-01	DEEP CORE	0.00	4.00	11.00									
G-14-02	DEEP CORE	0.00	4.00	9.60									
G-14-03	DEEP CORE	11.00	0.00	27.00									
G-14-04	DEEP CORE	6.10	0.00	31.00									
G-14-05	DEEP CORE	5.60	0.00	31.00									
G-14-06	DEEP CORE	5.60	0.00	30.00									
G-14-07	DEEP CORE	6.60	0.00	31.00									
G-14-08	DEEP CORE	7.60	0.00	33.00									
G-14-09	DEEP CORE	6.10	0.00	36.00									
G-14-10	DEEP CORE	7.60	0.00	34.00									
G-14-11	DEEP CORE	4.60	0.00	38.00									
G-14-12	DEEP CORE	8.10	0.00	37.00									
G-14-13	DEEP CORE	10.00	0.00	38.00									
G-14-14	DEEP CORE	8.10	0.00	44.00									
G-14-15	DEEP CORE	5.10	0.00	44.00									
G-14-16	DEEP CORE	0.00	4.00	31.00									
G-14-17	ROCK	5.60	0.00	7.30									
G-14-18	ROCK	0.00	4.00	10.00									
G-17-01	DEEP CORE	0.00	5.00	6.10									
G-17-02	DEEP CORE	5.60	0.00	13.00									
G-17-03	DEEP CORE	13.00	0.00	27.00									
G-17-04	DEEP CORE	0.00	5.00	26.00									
G-17-05	DEEP CORE	9.20	0.00	29.00									
G-17-06	DEEP CORE	6.10	0.00	29.00									
G-17-07	DEEP CORE	6.10	0.00	33.00									
G-17-08	DEEP CORE	6.60	0.00	28.00									
G-17-09	DEEP CORE	6.50	0.00	31.00									
G-17-10	DEEP CORE	7.60	0.00	35.00									
G-17-11	DEEP CORE	11.00	0.00	30.00									
G-17-12	DEEP CORE	14.00	0.00	30.00									
G-17-13	DEEP CORE	13.00	0.00	46.00									
G-17-14	DEEP CORE	16.00	0.00	55.00									
G-17-15	DEEP CORE	16.00	0.00	60.00									
G-17-16	DEEP CORE	0.00	4.00	12.00									
G-17-17	DEEP CORE	0.00	4.00	11.00									
G-17-18	DEEP CORE	0.00	4.00	28.00									
G-18-01	DEEP CORE	7.60	0.00	18.00									
G-18-02	DEEP CORE	5.90	0.00	25.00									
G-18-03	DEEP CORE	0.00	4.00	29.00									
G-18-04	DEEP CORE	5.40	0.00	28.00									
G-18-05	DEEP CORE	9.20	0.00	36.00									
G-18-06	DEEP CORE	8.10	0.00	30.00									
G-18-07	DEEP CORE	7.10	0.00	27.00									
G-18-08	DEEP CORE	4.60	0.00	35.00									
G-18-09	DEEP CORE	7.60	0.00	30.00									
G-18-10	DEEP CORE	5.10	0.00	25.00									

RAD PERF OUTDR CLASS DP CORE (30') SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
G-18-11	DEEP CORE	8.60	0.00	31.00									
G-18-12	DEEP CORE	6.60	0.00	28.00									
G-18-13	DEEP CORE	6.60	0.00	31.00									
G-18-14	DEEP CORE	8.10	0.00	33.00									
G-18-15	DEEP CORE	15.00	0.00	37.00									
G-18-16	DEEP CORE	0.00	4.00	13.00									
G-18-17	DEEP CORE	0.00	4.00	4.40									
G-18-18	DEEP CORE	0.00	4.00	48.00									
H-20-01	DEEP CORE	0.00	4.00	27.00									
H-20-02	DEEP CORE	5.40	0.00	27.00									
H-20-03	DEEP CORE	12.00	0.00	29.00									
H-20-04	DEEP CORE	8.10	0.00	29.00									
H-20-05	DEEP CORE	11.00	0.00	33.00									
H-20-06	DEEP CORE	11.00	0.00	34.00									
H-20-07	DEEP CORE	14.00	0.00	34.00									
H-20-08	DEEP CORE	8.60	0.00	38.00									
H-20-09	DEEP CORE	13.00	0.00	46.00									
H-20-10	DEEP CORE	10.00	0.00	35.00									
H-20-11	DEEP CORE	17.00	0.00	42.00									
H-20-12	DEEP CORE	15.00	0.00	42.00									
H-20-13	DEEP CORE	15.00	0.00	50.00									
H-20-14	DEEP CORE	14.00	0.00	48.00									
H-20-15	DEEP CORE	9.20	0.00	35.00									
H-20-16	DEEP CORE	7.60	0.00	21.00									
H-20-17	DEEP CORE	0.00	6.00	28.00									
H-20-18	DEEP CORE	0.00	6.00	28.00									
HL-01	DEEP CORE	8.60	0.00	26.00									
HL-02	DEEP CORE	0.00	6.00	22.00									
HL-03	DEEP CORE	6.60	0.00	20.00									
HL-04	DEEP CORE	0.00	6.00	26.00									
HL-05	DEEP CORE	6.10	0.00	28.00									
HL-06	DEEP CORE	0.00	6.00	18.00									
HL-07	DEEP CORE	8.10	0.00	27.00									
HL-08	DEEP CORE	0.00	6.00	31.00									
HL-09	DEEP CORE	0.00	6.00	28.00									
HL-10	DEEP CORE	0.00	6.00	26.00									
HL-11	DEEP CORE	0.00	6.00	26.00									
HL-12	DEEP CORE	0.00	6.00	24.00									
HL-13	DEEP CORE	0.00	6.00	25.00									
HL-14	DEEP CORE	0.00	6.00	28.00									
HL-15	DEEP CORE	6.10	0.00	24.00									
HL-16	ROCK	0.00	6.00	7.90									
HL-17	ROCK	0.00	6.00	29.00									
HL-19	CONCRT CHI	0.00	6.00	12.00									
HL-20	CONCR FOOT	0.00	6.00	28.00									
I-12-01	DEEP CORE	0.00	4.00	10.00									
I-12-02	DEEP CORE	0.00	4.00	16.00									
I-12-03	DEEP CORE	10.00	0.00	28.00									
I-12-04	DEEP CORE	7.60	0.00	26.00									
I-12-05	DEEP CORE	4.60	0.00	28.00									
I-12-06	DEEP CORE	12.00	0.00	37.00									
I-12-07	DEEP CORE	5.60	0.00	34.00									
I-12-08	DEEP CORE	14.00	0.00	36.00									
I-12-09	DEEP CORE	13.00	0.00	35.00									

RAD PERF OUTDR CLASS DP CORE (30') SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
I-12-10	DEEP CORE	7.60	0.00	36.00									
I-12-11	DEEP CORE	6.10	0.00	37.00									
I-12-12	DEEP CORE	15.00	0.00	41.00									
I-12-13	DEEP CORE	11.00	0.00	37.00									
I-12-14	DEEP CORE	14.00	0.00	31.00									
I-12-15	DEEP CORE	7.60	0.00	19.00									
I-12-16	DEEP CORE	0.00	4.00	8.90									
I-12-17	DEEP CORE	18.00	0.00	52.00									
I-12-18	DEEP CORE	5.40	0.00	28.00									
K-13-01	DEEP CORE	11.00	0.00	34.00									
K-13-02	DEEP CORE	0.00	4.00	27.00									
K-13-03	DEEP CORE	4.90	0.00	20.00									
K-13-04	DEEP CORE	0.00	5.00	23.00									
K-13-05	DEEP CORE	0.00	5.00	32.00									
K-13-06	DEEP CORE	5.10	0.00	27.00									
K-13-07	DEEP CORE	9.70	0.00	32.00									
K-13-08	DEEP CORE	5.10	0.00	37.00									
K-13-09	DEEP CORE	9.70	0.00	35.00									
K-13-10	DEEP CORE	5.60	0.00	29.00									
K-13-11	DEEP CORE	5.10	0.00	38.00									
K-13-12	DEEP CORE	9.20	0.00	39.00									
K-13-13	DEEP CORE	7.60	0.00	45.00									
K-13-14	DEEP CORE	0.00	5.00	32.00									
K-13-15	DEEP CORE	10.00	0.00	39.00									
K-13-16	ROCK	0.00	4.00	11.00									
K-13-17	ROCK	4.70	0.00	29.00									
K-14-01	DEEP CORE	6.60	0.00	33.00									
K-14-02	DEEP CORE	6.60	0.00	31.00									
K-14-03	DEEP CORE	5.10	0.00	29.00									
K-14-04	DEEP CORE	6.60	0.00	27.00									
K-14-05	DEEP CORE	8.60	0.00	31.00									
K-14-06	DEEP CORE	6.50	0.00	33.00									
K-14-07	DEEP CORE	10.00	0.00	30.00									
K-14-08	DEEP CORE	7.00	0.00	39.00									
K-14-09	DEEP CORE	6.50	0.00	35.00									
K-14-10	DEEP CORE	8.10	0.00	31.00									
K-14-11	DEEP CORE	7.60	0.00	44.00									
K-14-12	DEEP CORE	8.60	0.00	33.00									
K-14-13	DEEP CORE	11.00	0.00	57.00									
K-14-14	DEEP CORE	7.00	0.00	41.00									
K-14-15	DEEP CORE	7.60	0.00	42.00									
K-14-16	ROCK	0.00	4.00	13.00									
K-14-17	ROCK	0.00	4.00	30.00									
K-15-01	DEEP CORE	0.00	6.00	22.00									
K-15-02	DEEP CORE	0.00	4.00	24.00									
K-15-03	DEEP CORE	0.00	4.00	30.00									
K-15-04	DEEP CORE	14.00	0.00	22.00									
K-15-05	DEEP CORE	6.60	0.00	30.00									
K-15-06	DEEP CORE	9.70	0.00	24.00									
K-15-07	DEEP CORE	6.10	0.00	35.00									
K-15-08	DEEP CORE	9.20	0.00	26.00									
K-15-09	DEEP CORE	8.60	0.00	34.00									
K-15-10	DEEP CORE	7.[illegible]	0.00	37.00									
K-[illegible]	[illegible] CORE	6.[illegible]	0.00	[illegible].00									

RAD PERF OUTDR CLASS DP CORE (30') SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
K-15-12	DEEP CORE	11.00	0.00	58.00									
K-15-13	DEEP CORE	9.70	0.00	31.00									
K-15-14	DEEP CORE	9.20	0.00	40.00									
K-15-15	DEEP CORE	8.10	0.00	37.00									
K-15-16	DEEP CORE	5.10	0.00	33.00									
L-12-01	DEEP CORE	8.10	0.00	35.00									
L-12-02	DEEP CORE	10.00	0.00	49.00									
L-12-03	DEEP CORE	0.00	4.00	28.00									
L-12-04	DEEP CORE	6.50	0.00	33.00									
L-12-05	DEEP CORE	6.50	0.00	37.00									
L-12-06	DEEP CORE	6.50	0.00	30.00									
L-12-07	DEEP CORE	8.10	0.00	33.00									
L-12-08	DEEP CORE	8.60	0.00	36.00									
L-12-09	DEEP CORE	5.90	0.00	35.00									
L-12-10	DEEP CORE	7.60	0.00	37.00									
L-12-11	DEEP CORE	9.70	0.00	38.00									
L-12-12	DEEP CORE	11.00	0.00	44.00									
L-12-13	DEEP CORE	10.00	0.00	42.00									
L-12-14	ROCK	4.70	0.00	21.00									
L-12-15	ROCK	0.00	4.00	14.00									
L-12-16	ROCK	0.00	4.00	5.10									
M-12-01	DEEP CORE	8.30	0.00	26.00									
M-12-02	DEEP CORE	5.70	0.00	24.00									
M-12-03	DEEP CORE	6.40	0.00	25.00									
M-12-04	DEEP CORE	12.00	0.00	22.00									
M-12-05	DEEP CORE	5.10	0.00	21.00									
M-12-06	DEEP CORE	9.50	0.00	36.00									
M-12-07	DEEP CORE	5.70	0.00	32.00									
M-12-08	DEEP CORE	4.40	0.00	29.00									
M-12-09	DEEP CORE	0.00	4.00	30.00									
M-12-10	DEEP CORE	5.10	0.00	30.00									
M-12-11	DEEP CORE	7.00	0.00	35.00									
M-12-12	DEEP CORE	8.30	0.00	40.00									
M-12-13	DEEP CORE	4.40	0.00	43.00									
M-12-14	DEEP CORE	7.60	0.00	44.00									
M-12-15	ROCK	7.00	0.00	8.20									
M-12-16	ROCK	5.90	0.00	21.00									
M-17-01	DEEP CORE	7.60	0.00	19.00									
M-17-02	DEEP CORE	4.30	0.00	23.00									
M-17-03	DEEP CORE	0.00	4.00	24.00									
M-17-04	DEEP CORE	12.00	0.00	28.00									
M-17-05	DEEP CORE	0.00	4.00	21.00									
M-17-06	DEEP CORE	4.90	0.00	23.00									
M-17-07	DEEP CORE	16.00	0.00	34.00									
M-17-08	DEEP CORE	12.00	0.00	30.00									
M-17-09	DEEP CORE	11.00	0.00	31.00									
M-17-10	DEEP CORE	15.00	0.00	33.00									
M-17-11	DEEP CORE	10.00	0.00	35.00									
M-17-12	DEEP CORE	17.00	0.00	37.00									
M-17-13	DEEP CORE	14.00	0.00	48.00									
M-17-14	DEEP CORE	14.00	0.00	53.00									
M-17-15	DEEP CORE	17.00	0.00	39.00									
M-17-16	DEEP CORE	15.00	0.00	36.00									
M-17-17	DEEP CORE	7.60	0.00	35.00									

RAD PERF OUTDR CLASS DP CORE (30') SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
N-12-01	DEEP CORE	0.00	4.00	26.00									
N-12-02	DEEP CORE	0.00	4.00	22.00									
N-12-03	DEEP CORE	0.00	6.00	24.00									
N-12-04	DEEP CORE	0.00	6.00	23.00									
N-12-05	DEEP CORE	0.00	6.00	26.00									
N-12-06	DEEP CORE	0.00	6.00	31.00									
N-12-07	DEEP CORE	9.50	0.00	30.00									
N-12-08	DEEP CORE	0.00	6.00	37.00									
N-12-09	DEEP CORE	9.50	0.00	35.00									
N-12-10	DEEP CORE	8.10	0.00	36.00									
N-12-11	DEEP CORE	13.00	0.00	43.00									
N-12-12	DEEP CORE	12.00	0.00	47.00									
N-12-13	DEEP CORE	13.00	0.00	40.00									
N-12-14	DEEP CORE	18.00	0.00	44.00									
N-12-15	ROCK	4.30	0.00	5.60									
N-12-16	ROCK	0.00	4.00	5.90									
N-14-01	DEEP CORE	16.00	0.00	33.00									
N-14-02	DEEP CORE	10.00	0.00	26.00									
N-14-03	DEEP CORE	0.00	4.00	27.00									
N-14-04	DEEP CORE	10.00	0.00	28.00									
N-14-05	DEEP CORE	8.10	0.00	28.00									
N-14-06	DEEP CORE	16.00	0.00	33.00									
N-14-07	DEEP CORE	8.60	0.00	29.00									
N-14-08	DEEP CORE	7.60	0.00	33.00									
N-14-09	DEEP CORE	13.00	0.00	36.00									
N-14-10	DEEP CORE	9.20	0.00	31.00									
N-14-11	DEEP CORE	12.00	0.00	36.00									
N-14-12	DEEP CORE	9.20	0.00	39.00									
N-14-13	DEEP CORE	12.00	0.00	52.00									
N-14-14	DEEP CORE	10.00	0.00	33.00									
N-14-15	ROCK	0.00	4.00	6.70									
N-14-16	ROCK	0.00	4.00	6.50									
N-15-01	DEEP CORE	0.00	6.00	25.00									
N-15-02	DEEP CORE	0.00	6.00	22.00									
N-15-03	DEEP CORE	0.00	6.00	28.00									
N-15-04	DEEP CORE	7.60	0.00	27.00									
N-15-05	DEEP CORE	8.10	0.00	25.00									
N-15-06	DEEP CORE	6.50	0.00	27.00									
N-15-07	DEEP CORE	5.90	0.00	27.00									
N-15-08	DEEP CORE	0.00	6.00	29.00									
N-15-09	DEEP CORE	6.50	0.00	32.00									
N-15-10	DEEP CORE	0.00	6.00	27.00									
N-15-11	DEEP CORE	9.20	0.00	36.00									
N-15-12	DEEP CORE	11.00	0.00	40.00									
N-15-13	DEEP CORE	13.00	0.00	42.00									
N-15-14	DEEP CORE	0.00	6.00	29.00									
N-15-15	ROCK	0.00	4.00	16.00									
N-15-16	ROCK	0.00	4.00	21.00									
N-16-01	DEEP CORE	0.00	6.00	28.00									
N-16-02	DEEP CORE	0.00	4.00	23.00									
N-16-03	DEEP CORE	0.00	4.00	25.00									
N-16-04	DEEP CORE	6.50	0.00	26.00									
N-16-05	DEEP CORE	8.60	0.00	31.00									
N-16-06	DEEP CORE	0.00	4.00	23.00									

RAD PERF OUTDR CLASS DP CORE (30') SOIL (pCi/g Dry)
04-18-86
09:54:18

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
N-16-07	DEEP CORE	4.90	0.00	25.00									
N-16-08	DEEP CORE	7.60	0.00	31.00									
N-16-09	DEEP CORE	10.00	0.00	41.00									
N-16-10	DEEP CORE	8.10	0.00	34.00									
N-16-11	DEEP CORE	9.20	0.00	31.00									
N-16-12	DEEP CORE	4.30	0.00	42.00									
N-16-13	DEEP CORE	12.00	0.00	41.00									
N-16-14	DEEP CORE	15.00	0.00	50.00									
N-16-15	DEEP CORE	15.00	0.00	39.00									
N-16-16	ROCK	0.00	4.00	19.00									
N-16-17	ROCK	5.90	0.00	22.00									
RB-01	DEEP CORE	0.00	7.00	22.00									
RB-02	DEEP CORE	0.00	7.00	25.00									
RB-03	DEEP CORE	0.00	7.00	27.00									
RB-04	DEEP CORE	0.00	7.00	29.00									
RB-05	DEEP CORE	0.00	7.00	24.00									
RB-06	DEEP CORE	0.00	7.00	24.00									
RB-07	DEEP CORE	0.00	7.00	20.00									
RB-08	DEEP CORE	0.00	7.00	24.00									
RB-09	DEEP CORE	0.00	7.00	25.00									
RB-10	DEEP CORE	0.00	7.00	24.00									
RB-11	DEEP CORE	3.60	0.00	27.00									
RB-12	DEEP CORE	5.10	0.00	24.00									
RB-13	DEEP CORE	4.60	0.00	22.00									
RB-14	DEEP CORE	4.60	0.00	30.00									
RB-15	DEEP CORE	3.60	0.00	24.00									
RB-16	DEEP CORE	6.60	0.00	27.00									
RB-17	DEEP CORE	6.10	0.00	24.00									

FD235 Number of Records Read: 460
FD236 Number of Records Selected: 460

APPENDIX 3.5

PBRF Outdoor Radiological Classification

Catch Basin Water and Silt Sampling

PBRF OUTER CLASS CB WATER SAMPL (pCi/l)
05-14-86
09:15:26

GRID AND SAMP NO	LABORATORY	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
BKGD CB-19		WATER*	0.00	1.00	1.30									
BKGD CB-26 BB RN		WATER*	1.80	0.00	7.30									
BKGD CB-52		WATER*	0.00	6.00	4.80									
CB-0	WESTWOOD		0.00	5.00	5.70									
CB-01	WESTWOOD		0.00	2.00	4.60									
CB-01A	WESTWOOD		0.00	3.00	2.50									
CB-02	WESTWOOD		0.00	2.00	4.30									
CB-02A	WESTWOOD		0.00	4.00	3.40									
CB-03	WESTWOOD		0.00	2.00	4.60									
CB-03A	WESTWOOD		0.00	4.00	4.80									
CB-04	WESTWOOD		0.00	5.00	5.60									
CB-04A	WESTWOOD		0.00	4.00	2.00									
CB-05	WESTWOOD		0.00	5.00	6.50									
CB-05A	WESTWOOD		0.00	3.00	2.30									
CB-06	WESTWOOD		0.00	3.00	2.70									
CB-06A	WESTWOOD		0.00	4.00	4.90									
CB-07	WESTWOOD		0.00	3.00	3.20									
CB-07A	WESTWOOD		0.00	3.00	9.20									
CB-08	WESTWOOD		0.00	2.00	11.00									
CB-08A	WESTWOOD		0.00	3.00	4.20									
CB-09	WESTWOOD		0.00	2.00	4.20									
CB-09A	WESTWOOD		0.00	3.00	5.10									
CB-10	WESTWOOD		0.00	2.00	3.70									
CB-10A	WESTWOOD		0.00	3.00	4.40									
CB-11	WESTWOOD		0.00	2.00	4.60									
CB-11A	WESTWOOD		0.00	3.00	6.10									
CB-12	WESTWOOD		0.00	1.00	3.00									
CB-12A	WESTWOOD		0.00	3.00	4.10									
CB-13	WESTWOOD		0.00	1.00	5.30									
CB-13A	WESTWOOD		0.00	3.00	11.00									
CB-14	WESTWOOD		0.00	2.00	4.40									
CB-14A	WESTWOOD		0.00	2.00	3.50									
CB-15	WESTWOOD		0.00	2.00	2.90									
CB-15A	WESTWOOD		0.00	2.00	3.80									
CB-16	WESTWOOD		0.00	3.00	2.70									
CB-16A	WESTWOOD		0.00	2.00	5.10									
CB-17	WESTWOOD		0.00	1.00	3.30									
CB-17A	WESTWOOD		0.00	3.00	6.60									
CB-18	WESTWOOD		0.00	2.00	3.60									
CB-18A	WESTWOOD		0.00	2.00	3.10									
CB-19	WESTWOOD		0.00	3.00	4.40									
CB-19A	WESTWOOD		0.00	1.00	5.60									
CB-20	WESTWOOD		0.00	2.00	3.50									
CB-21	WESTWOOD		0.00	0.80	3.00									
CB-23	WESTWOOD		0.00	2.00	2.10									
CB-24	WESTWOOD		0.00	2.00	1.80									
CB-27	WESTWOOD		0.00	5.00	5.70									
CB-28	WESTWOOD		0.00	5.00	4.20									
CB-29	WESTWOOD		0.00	3.00	3.30									
CB-30	WESTWOOD		0.00	5.00	26.00									
ESB SUMP	WESTWOOD		0.00	1.00	13.00									

FBRF OUTDR CL CB SILT SAMPL (pCi/g Dry)
05-14-86
09:40:48

GRID AND SAMP NO	LABORATORY	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
BKGD CB-19		SILT	0.00	5.00	15.00									
BKGD CB-52		CB SILT	6.90	0.00	15.00									
CB-0		SILT	0.00	5.00	9.90									
CB-01		SILT	6.60	0.00	28.00									
CB-01A		SILT	12.00	0.00	40.00									
CB-02		SILT	0.00	5.00	18.00									
CB-02A		SILT	0.00	5.00	29.00									
CB-03		SILT	0.00	5.00	13.00									
CB-03A		SILT	0.00	5.00	29.00									
CB-04		SILT	0.00	5.00	15.00									
CB-04A		SILT	0.00	5.00	23.00									
CB-05		SILT	15.00	0.00	42.00									
CB-05A		SILT	0.00	5.00	20.00									
CB-06		SILT	0.00	5.00	25.00									
CB-06A		SILT	5.10	0.00	19.00									
CB-07		SILT	11.00	0.00	40.00									
CB-07A		SILT	0.00	5.00	330.00									
CB-08		SILT	8.60	0.00	34.00									
CB-09		SILT	6.60	0.00	42.00									
CB-10		SILT	0.00	5.00	16.00									
CB-10A		SILT	0.00	5.00	7.30									
CB-11		SILT	5.10	0.00	28.00									
CB-11A		SILT	0.00	5.00	9.40									
CB-12		SILT	8.60	0.00	26.00									
CB-12A		SILT	0.00	5.00	18.00									
CB-13		SILT	0.00	5.00	28.00									
CB-13A		SILT	7.60	0.00	81.00									
CB-14		SILT	0.00	5.00	20.00									
CB-15		SILT	10.00	0.00	38.00									
CB-16		SILT	0.00	5.00	32.00									
CB-17		SILT	0.00	5.00	26.00									
CB-17A		SILT	0.00	5.00	26.00									
CB-18		SILT	11.00	0.00	41.00									
CB-18A		SILT	0.00	5.00	30.00									
CB-19A		SILT	7.40	0.00	42.00									
CB-20		SILT	8.60	0.00	42.00									
CB-21		SILT	5.70	0.00	31.00									
CB-23		SILT	5.20	0.00	19.00									
CB-24		SILT	8.10	0.00	27.00									
CB-25		SILT	9.20	0.00	24.00									
CB-27		SILT	0.00	5.00	24.00									
CB-28		SILT	0.00	5.00	52.00									
CB-29		SILT	10.00	0.00	58.00									
CB-30		SILT	0.00	5.00	29.00									

FD235 Number of Records Read: 95
FD236 Number of Records Selected: 44

APPENDIX 3.6

Pentolite Ditch Silt and Soil Sampling and Monitoring Data

PBRF OUTDR RAD CLASS PD RAD SURVEY
04-21-86
10:51:14

GRID	TYPE	LOCATION	DATE	RSR NO	ALPHA	Beta-Gamma c/m (GS-3) PT 1	PT 2	PT 3	PT 4	PT 5	PT 5 BTTM	HI PT	HI PT BANK	MR HR	MR HR BANK	MR HR BTTM	MR HR BTTM
PD BKGD 1	SURFACE	PD FOX ROAD	4-23-85	63390		25	75	75	50		50	0.0		0.000			0.013
PD BKGD 2	SURFACE	PD FOX ROAD	4-23-85	63390		75	25	50	75		75	4		0.025			0.025
PD BKGD 3	SURFACE	PD FOX ROAD	4-23-85	63391		100	100	100	75		100	1		0.023			0.025
PD BKGD 4	SURFACE	PD FOX ROAD	4-23-85	63391		100	100	100	75		75	3		0.021			0.019
PD BKGD 5	SURFACE	PD FOX ROAD	4-23-85	63392		50	25	50	50		25	1		0.007			0.007
PD BKGD 1	SURFACE	PD TAYLOR RD	4-30-85	63400		75	50	75	50		50	1		0.007			0.008
PD BKGD 2	SURFACE	PD TAYLOR RD	4-30-85	63400		50	75	100	50		75	3		0.008			0.007
PD BKGD 3	SURFACE	PD TAYLOR RD	4-30-85	63401		75	75	25	75		75	2		0.008			0.008
PD BKGD 4	SURFACE	PD TAYLOR RD	4-30-85	63401		50	75	50	75		50	4		0.009			0.008
PD 1	SURFACE		4-19-85	63343		75	75	50	100	50			4				
PD 2	SURFACE		4-19-85	63343		150	50	125	300	125			4		0.040	0.043	
PD 3	SURFACE		4-19-85	63344		75	100	75	50	75			2		0.016	0.020	
PD 4	SURFACE		4-19-85	63344		100	50	75	75	100			1		0.021	0.022	
PD 5	SURFACE		4-19-85	63345		50	75	25	50	75			2		0.014	0.017	
PD 6	SURFACE		4-19-85	63345		100	100	50	100	50			1		0.013	0.025	
PD 7	SURFACE		4-19-85	63346		25	75	75	50	100			2		0.018	0.024	
PD 8	SURFACE		4-19-85	63346		100	75	75	25	50			1		0.025	0.027	
PD 9	SURFACE		4-19-85	63347		50	75	25	150	100			4		0.038	0.031	
PD 10	SURFACE		4-19-85	63347		100	25	100	50	25			1		0.021	0.022	
PD 11	SURFACE		4-19-85	63348		50	75	75	75	50			4		0.023	0.018	
PD 12	SURFACE		4-19-85	63348		50	75	25	100	50			4		0.022	0.017	
PD 13	SURFACE		4-19-85	63350		100	75	25	50	75			1		0.018	0.016	
PD 14	SURFACE		4-19-85	63350		50	50	75	25	50			3		0.015	0.024	
PD 15	SURFACE		4-19-85	63351		50	75	50	25	100			2		0.016	0.030	
PD 16	SURFACE		4-19-85	63351		50	75	25	50	100			2		0.015	0.020	
PD 17	SURFACE		4-19-85	63352		50	50	50	50	75			3		0.013	0.020	
PD 18	SURFACE		4-19-85	63352		25	75	50	50	100			2		0.015	0.028	
PD 19	SURFACE		4-19-85	63353		25	50	50	25	50			3		0.013	0.016	
PD 20	SURFACE		4-19-85	63353		50	75	100	25	100			3		0.015	0.015	
PD 21	SURFACE		4-19-85	63354		75	75	50	50	50			2		0.014	0.020	
PD 22	SURFACE		4-19-85	63354		75	100	25	75	75			2		0.013	0.019	
PD 23	SURFACE		4-19-85	63355		100	50	25	50	50			1		0.018	0.020	
PD 24	SURFACE		4-19-85	63355		50	75	75	50	100			2		0.014	0.019	
PD 25	SURFACE		4-19-85	63356		75	25	50	75	50			4		0.017	0.016	
PD 26	SURFACE		4-19-85	63356		50	25	100	25	50			3		0.012	0.018	
PD 27	SURFACE		4-19-85	63357		50	50	75	50	100			3		0.013	0.022	
PD 28	SURFACE		4-19-85	63357		100	50	25	50	50			1		0.015	0.020	
PD 29	SURFACE		4-19-85	63358		150	50	50	25	100			1		0.018	0.025	
PD 30	SURFACE		4-19-85	63358		50	75	75	100	125			4		0.015	0.034	
PD 31	SURFACE		4-19-85	63359		50	50	25	75	100			4		0.016	0.027	
PD 32	SURFACE		4-19-85	63359		75	100	25	75	50			2		0.012	0.013	
PD 33	SURFACE		4-19-85	63360		50	50	25	25	50			2		0.014	0.016	
PD 34	SURFACE		4-19-85	63360		50	75	50	50	50			2		0.011	0.013	
PD 35	SURFACE		4-19-85	63361		75	25	50	25	50			1		0.013	0.016	
PD 36	SURFACE		4-19-85	63361		75	50	75	50	50			3		0.010	0.019	
PD 37	SURFACE		4-19-85	63362		50	50	25	75	50			4		0.009	0.014	
PD 38	SURFACE		4-19-85	63362		50	50	50	50	50			4		0.009	0.024	
PD 39	SURFACE		4-19-85	63363		75	75	50	50	50			2		0.007	0.011	
PD 40	SURFACE		4-19-85	63363		50	25	50	75	50			4		0.009	0.013	
PD 41	SURFACE		4-19-85	63364		75	25	100	25	50			3		0.009	0.009	
PD 42	SURFACE		4-19-85	63364		50	75	50	25	50			2		0.007	0.010	
PD 43	SURFACE		4-19-85	63365		50	50	50	50	50			3		0.007	0.011	
PD 44	SURFACE		4-19-85	63365		50	50	100	25	50			3		0.007	0.010	
PD 45	SURFACE		4-19-85	63366			25	50	75	50			4		0.007	0.008	

PBRF OUTDR RAD CLASS PD RAD SURVEY
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GRID	TYPE	LOCATION	DATE	RSR NO	DIST	ZONE	GS3W NO	GS3W CAL DATE	PRM7 NO	PRM7 CAL DATE
PD BKGD 1	SURFACE	PD FOX ROAD	4-23-85	63390	1 M		36027	4-9-85	466	4-11-85
PD BKGD 2	SURFACE	PD FOX ROAD	4-23-85	63390	1 M		36027	4-9-85	466	4-11-85
PD BKGD 3	SURFACE	PD FOX ROAD	4-23-85	63391	1 M		36027	4-9-85	466	4-11-85
PD BKGD 4	SURFACE	PD FOX ROAD	4-23-85	63391	1 M		36027	4-9-85	466	4-11-85
PD BKGD 5	SURFACE	PD FOX ROAD	4-23-85	63392	1 M		36027	4-9-85	466	4-11-85
PD BKGD 1	SURFACE	PD TAYLOR RD	4-30-85	63400	1 M		36027	4-9-85	466	4-11-85
PD BKGD 2	SURFACE	PD TAYLOR RD	4-30-85	63400	1 M		36027	4-9-85	466	4-11-85
PD BKGD 3	SURFACE	PD TAYLOR RD	4-30-85	63401	1 M		36027	4-9-85	466	4-11-85
PD BKGD 4	SURFACE	PD TAYLOR RD	4-30-85	63401	1 M		36027	4-9-85	466	4-11-85
PD 1	SURFACE		4-19-85	63343	1M	WHITE	36027	4-9-85	466	4-11-85
PD 2	SURFACE		4-19-85	63343	1M	WHITE	36027	4-9-85	466	4-11-85
PD 3	SURFACE		4-19-85	63344	1M	WHITE	36027	4-9-85	466	4-11-85
PD 4	SURFACE		4-19-85	63344	1M	WHITE	36027	4-9-85	466	4-11-85
PD 5	SURFACE		4-19-85	63345	1M	WHITE	36027	4-9-85	466	4-11-85
PD 6	SURFACE		4-19-85	63345	1M	WHITE	36027	4-9-85	466	4-11-85
PD 7	SURFACE		4-19-85	63346	1M	WHITE	36027	4-9-85	466	4-11-85
PD 8	SURFACE		4-19-85	63346	1M	WHITE	36027	4-9-85	466	4-11-85
PD 9	SURFACE		4-19-85	63347	1M	WHITE	36027	4-9-85	466	4-11-85
PD 10	SURFACE		4-19-85	63347	1M	WHITE	36027	4-9-85	466	4-11-85
PD 11	SURFACE		4-19-85	63348	1M	WHITE	36027	4-9-85	466	4-11-85
PD 12	SURFACE		4-19-85	63348	1M	WHITE	36027	4-9-85	466	4-11-85
PD 13	SURFACE		4-19-85	63350	1M	WHITE	36027	4-9-85	466	4-11-85
PD 14	SURFACE		4-19-85	63350	1M	WHITE	36027	4-9-85	466	4-11-85
PD 15	SURFACE		4-19-85	63351	1M	WHITE	36027	4-9-85	466	4-11-85
PD 16	SURFACE		4-19-85	63351	1M	WHITE	36027	4-9-85	466	4-11-85
PD 17	SURFACE		4-19-85	63352	1M	WHITE	36027	4-9-85	466	4-11-85
PD 18	SURFACE		4-19-85	63352	1M	WHITE	36027	4-9-85	466	4-11-85
PD 19	SURFACE		4-19-85	63353	1M	WHITE	36027	4-9-85	466	4-11-85
PD 20	SURFACE		4-19-85	63353	1M	WHITE	36027	4-9-85	466	4-11-85
PD 21	SURFACE		4-19-85	63354	1M	WHITE	36027	4-9-85	466	4-11-85
PD 22	SURFACE		4-19-85	63354	1M	WHITE	36027	4-9-85	466	4-11-85
PD 23	SURFACE		4-19-85	63355	1M	WHITE	36027	4-9-85	466	4-11-85
PD 24	SURFACE		4-19-85	63355	1M	WHITE	36027	4-9-85	466	4-11-85
PD 25	SURFACE		4-19-85	63356	1M	WHITE	36027	4-9-85	466	4-11-85
PD 26	SURFACE		4-19-85	63356	1M	WHITE	36027	4-9-85	466	4-11-85
PD 27	SURFACE		4-19-85	63357	1M	WHITE	36027	4-9-85	466	4-11-85
PD 28	SURFACE		4-19-85	63357	1M	WHITE	36027	4-9-85	466	4-11-85
PD 29	SURFACE		4-19-85	63358	1M	WHITE	36027	4-9-85	466	4-11-85
PD 30	SURFACE		4-19-85	63358	1M	WHITE	36027	4-9-85	466	4-11-85
PD 31	SURFACE		4-19-85	63359	1M	WHITE	36027	4-9-85	466	4-11-85
PD 32	SURFACE		4-19-85	63359	1M	WHITE	36027	4-9-85	466	4-11-85
PD 33	SURFACE		4-19-85	63360	1M	WHITE	36027	4-9-85	466	4-11-85
PD 34	SURFACE		4-19-85	63360	1M	WHITE	36027	4-9-85	466	4-11-85
PD 35	SURFACE		4-19-85	63361	1M	WHITE	36027	4-9-85	466	4-11-85
PD 36	SURFACE		4-19-85	63361	1M	WHITE	36027	4-9-85	466	4-11-85
PD 37	SURFACE		4-19-85	63362	1M	WHITE	36027	4-9-85	466	4-11-85
PD 38	SURFACE		4-19-85	63362	1M	WHITE	36027	4-9-85	466	4-11-85
PD 39	SURFACE		4-19-85	63363	1M	WHITE	36027	4-9-85	466	4-11-85
PD 40	SURFACE		4-19-85	63363	1M	WHITE	36027	4-9-85	466	4-11-85
PD 41	SURFACE		4-19-85	63364	1M	WHITE	36027	4-9-85	466	4-11-85
PD 42	SURFACE		4-19-85	63364	1M	WHITE	36027	4-9-85	466	4-11-85
PD 43	SURFACE		4-19-85	63365	1M	WHITE	36027	4-9-85	466	4-11-85
PD 44	SURFACE		4-19-85	63365	1M	WHITE	36027	4-9-85	466	4-11-85
PD 45	SURFACE		4-19-85	63366	1M	WHITE	36027	4-9-85	466	4-11-85

PBRF OUTDR RAD CLASS PD RAD SURVEY
04-21-86
10:51:14

GRID	TYPE	LOCATION	DATE	RSR NO	ALPHA	Beta-Gamma c/m (GS-3) PT 1	PT 2	PT 3	PT 4	PT 5	PT 5 BTTM	HI PT	HI PT BANK	MR HR	MR HR BANK	MR HR BTTM	MR HR BTTM
PD 46	SURFACE		4-19-85	63366		50	50	75	50	50			3		0.007	0.007	
PD 47	SURFACE		4-19-85	63367		50	50	75	25	25			3		0.008	0.007	
PD 48	SURFACE		4-19-85	63367		75	25	50	50	50			1		0.008	0.007	
PD 49	SURFACE		4-19-85	63368		50	50	50	75	25			4		0.007	0.007	
PD 50	SURFACE		4-19-85	63368		50	75	25	50	25			2		0.006	0.007	
PD 51	SURFACE		4-19-85	63369		75	50	75	25	25			3		0.007	0.007	
PD 52	SURFACE		4-19-85	63369		75	25	50	25	25			1		0.008	0.006	
PD 53	SURFACE		4-19-85	63370		100	50	25	50	50			1		0.007	0.007	
PD 54	SURFACE		4-19-85	63370		75	50	75	50	25			3		0.006	0.006	
PD 55	SURFACE		4-19-85	63371		50	75	50	50	25			2		0.007	0.006	
PD 56	SURFACE		4-19-85	63371		75	50	50	50	50			1		0.010	0.006	
PD 57	SURFACE		4-19-85	63372		75	25	75	50	25			3		0.008	0.008	
PD 58	SURFACE		4-19-85	63372		75	50	50	75	25			4		0.007	0.007	
PD 59	SURFACE		4-19-85	63373		100	50	50	75	25			1		0.008	0.007	
PD 60	SURFACE		4-19-85	63373		50	50	75	20	50			3		0.007	0.008	
PD 61	SURFACE		4-19-85	63374		50	50	25	75	50			4		0.008	0.007	
PD 62	SURFACE		4-19-85	63374		100	50	50	50	50			1		0.007	0.007	
PD 63	SURFACE		4-19-85	63376		50	25	50	50	50			1		0.008	0.007	
PD 64	SURFACE		4-19-85	63376		50	25	25	75	50			4		0.010	0.008	
PD 65	SURFACE		4-19-85	63377		75	25	50	100	25			4		0.009	0.009	
PD 66	SURFACE		4-19-85	63377		50	50	50	50	50			2		0.008	0.008	
PD 67	SURFACE		4-19-85	63378		75	75	50	75	25			4		0.010	0.008	
PD 68	SURFACE		4-19-85	63378		25	50	50	50	75			2		0.009	0.008	
PD 69	SURFACE		4-19-85	63379		50	50	25	25	50			2		0.007	0.009	
PD 70	SURFACE		4-19-85	63379		50	25	50	75	25			4		0.007	0.009	
PD 71	SURFACE		4-19-85	63380		50	75	50	100	25			4		0.007	0.010	
PD 72	SURFACE		4-19-85	63380		100	25	25	50	50			1		0.008	0.011	
PD 73	SURFACE		4-19-85	63381		50	50	75	25	75			3		0.009	0.011	
PD 74	SURFACE		4-19-85	63381		25	50	50	50	50			2		0.008	0.010	
PD 75	SURFACE		4-19-85	63382		50	75	50	50	25			2		0.008	0.010	
PD 76	SURFACE		4-19-85	63382		75	50	25	75	50			4		0.007	0.010	
PD 77	SURFACE		4-19-85	63383		50	50	50	50	25			2		0.008	0.010	
PD 78	SURFACE		4-19-85	63383		50	50	25	25	50			2		0.007	0.011	
PD 79	SURFACE		4-19-85	63384		50	50	50	75	25			4		0.008	0.011	
PD 80	SURFACE		4-19-85	63384		75	100	50	50	50			2		0.008	0.009	
PD 81	SURFACE		4-19-85	63385		50	25	25	50	50			4		0.008	0.014	
PD 82	SURFACE		4-19-85	63385		50	50	50	75	50			4		0.008	0.011	
PD 83	SURFACE		4-19-85	63386		50	25	25	50	25			4		0.007	0.012	
PD 84	SURFACE		4-19-85	63386		50	50	25	75	75			4		0.007	0.017	
PD 85	SURFACE		4-19-85	63387		75	75	25	75	50			4		0.007	0.017	
PD 86	SURFACE		4-19-85	63387		50	25	50	50	50			3		0.007	0.016	
PD 87	SURFACE		4-19-85	63388		50	50	50	50	50			2		0.008	0.016	
PD 88	SURFACE		4-19-85	63388		75	25	50	75	50			4		0.008	0.016	
PD 89	SURFACE		4-19-85	63389		25	50	25	75	0			4		0.008	0.000	
PD 90	SURFACE		4-19-85	63389		50	50	25	25	0			2		0.008	0.000	

PD235 Number of Records Read: 99
PD236 Number of Records Selected: 99

PBRF OUTDR RAD CLASS PD RAD SURVEY
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10:57:10

GRID	TYPE	LOCATION	DATE	RSR NO	DIST	ZONE	GS3W NO	GS3W CAL DATE	PRM7 NO	PRM7 CAL DATE
PD 46	SURFACE		4-19-85	63366	1M	WHITE	36027	4-9-85	466	4-11-85
PD 47	SURFACE		4-19-85	63367	1M	WHITE	36027	4-9-85	466	4-11-85
PD 48	SURFACE		4-19-85	63367	1M	WHITE	36027	4-9-85	466	4-11-85
PD 49	SURFACE		4-19-85	63368	1M	WHITE	36027	4-9-85	466	4-11-85
PD 50	SURFACE		4-19-85	63368	1M	WHITE	36027	4-9-85	466	4-11-85
PD 51	SURFACE		4-19-85	63369	1M	WHITE	36027	4-9-85	466	4-11-85
PD 52	SURFACE		4-19-85	63369	1M	WHITE	36027	4-9-85	466	4-11-85
PD 53	SURFACE		4-19-85	63370	1M	WHITE	36027	4-9-85	466	4-11-85
PD 54	SURFACE		4-19-85	63370	1M	WHITE	36027	4-9-85	466	4-11-85
PD 55	SURFACE		4-19-85	63371	1M	WHITE	36027	4-9-85	466	4-11-85
PD 56	SURFACE		4-19-85	63371	1M	WHITE	36027	4-9-85	466	4-11-85
PD 57	SURFACE		4-19-85	63372	1M	WHITE	36027	4-9-85	466	4-11-85
PD 58	SURFACE		4-19-85	63372	1M	WHITE	36027	4-9-85	466	4-11-85
PD 59	SURFACE		4-19-85	63373	1M	WHITE	36027	4-9-85	466	4-11-85
PD 60	SURFACE		4-19-85	63373	1M	WHITE	36027	4-9-85	466	4-11-85
PD 61	SURFACE		4-19-85	63374	1M	WHITE	36027	4-9-85	466	4-11-85
PD 62	SURFACE		4-19-85	63374	1M	WHITE	36027	4-9-85	466	4-11-85
PD 63	SURFACE		4-19-85	63376	1M	WHITE	36027	4-9-85	466	4-11-85
PD 64	SURFACE		4-19-85	63376	1M	WHITE	36027	4-9-85	466	4-11-85
PD 65	SURFACE		4-19-85	63377	1M	WHITE	36027	4-9-85	466	4-11-85
PD 66	SURFACE		4-19-85	63377	1M	WHITE	36027	4-9-85	466	4-11-85
PD 67	SURFACE		4-19-85	63378	1M	WHITE	36027	4-9-85	466	4-11-85
PD 68	SURFACE		4-19-85	63378	1M	WHITE	36027	4-9-85	466	4-11-85
PD 69	SURFACE		4-19-85	63379	1M	WHITE	36027	4-9-85	466	4-11-85
PD 70	SURFACE		4-19-85	63379	1M	WHITE	36027	4-9-85	466	4-11-85
PD 71	SURFACE		4-19-85	63380	1M	WHITE	36027	4-9-85	466	4-11-85
PD 72	SURFACE		4-19-85	63380	1M	WHITE	36027	4-9-85	466	4-11-85
PD 73	SURFACE		4-19-85	63381	1M	WHITE	36027	4-9-85	466	4-11-85
PD 74	SURFACE		4-19-85	63381	1M	WHITE	36027	4-9-85	466	4-11-85
PD 75	SURFACE		4-19-85	63382	1M	WHITE	36027	4-9-85	466	4-11-85
PD 76	SURFACE		4-19-85	63382	1M	WHITE	36027	4-9-85	466	4-11-85
PD 77	SURFACE		4-19-85	63383	1M	WHITE	36027	4-9-85	466	4-11-85
PD 78	SURFACE		4-19-85	63383	1M	WHITE	36027	4-9-85	466	4-11-85
PD 79	SURFACE		4-19-85	63384	1M	WHITE	36027	4-9-85	466	4-11-85
PD 80	SURFACE		4-19-85	63384	1M	WHITE	36027	4-9-85	466	4-11-85
PD 81	SURFACE		4-19-85	63385	1M	WHITE	36027	4-9-85	466	4-11-85
PD 82	SURFACE		4-19-85	63385	1M	WHITE	36027	4-9-85	466	4-11-85
PD 83	SURFACE		4-19-85	63386	1M	WHITE	36027	4-9-85	466	4-11-85
PD 84	SURFACE		4-19-85	63386	1M	WHITE	36027	4-9-85	466	4-11-85
PD 85	SURFACE		4-19-85	63387	1M	WHITE	36027	4-9-85	466	4-11-85
PD 86	SURFACE		4-19-85	63387	1M	WHITE	36027	4-9-85	466	4-11-85
PD 87	SURFACE		4-19-85	63388	1M	WHITE	36027	4-9-85	466	4-11-85
PD 88	SURFACE		4-19-85	63388	1M	WHITE	36027	4-9-85	466	4-11-85
PD 89	SURFACE		4-19-85	63389	1M	WHITE	36027	4-9-85	466	4-11-85
PD 90	SURFACE		4-19-85	63389	1M	WHITE	36027	4-9-85	466	4-11-85

PD235 Number of Records Read: 99
PD236 Number of Records Selected: 99

PD OUTDR RAD CLASS PD SAMPL (pCi/g Dry)
05-14-86
10:13:22

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
BKGD-01	TYRD SILT	8.90	0.00	39.00									
BKGD-02	TYRD SILT	8.90	0.00	35.00									
BKGD-03	TYRD SILT	7.00	0.00	35.00									
BKGD-04	TYRD SILT	11.00	0.00	42.00				.46			.10		.20
BKGD-01	PD SILT	8.10	0.00	53.00									
BKGD-02	PD SILT	21.00	0.00	61.00									
BKGD-03	PD SILT	25.00	0.00	63.00				.19					
BKGD-04	PD SILT	10.00	0.00	57.00							.08		.10
BKGD-05	PD SILT	13.00	0.00	31.00									
PD-01	SILT	9.70	0.00	43.00									
PD-02	SILT	9.70	0.00	78.00				96.20			1.0	1.12	
PD-03	SILT	6.60	0.00	43.00									
PD-04	SILT	6.10	0.00	44.00									
PD-05	SILT	5.60	0.00	42.00									
PD-06	SILT	7.60	0.00	35.00									
PD-07	SILT	15.00	0.00	59.00									
PD-08	SILT	5.10	0.00	39.00									
PD-09	SILT	11.00	0.00	60.00									
PD-10	SILT	12.00	0.00	48.00									
PD-11	SILT	8.60	0.00	44.00									
PD-12	SILT	6.10	0.00	36.00									
PD-13	SILT	0.00	3.00	35.00									
PD-14	SILT	8.10	0.00	57.00									
PD-15	SILT	6.10	0.00	33.00				3.95		0.49			0.08
PD-16	SILT	3.60	0.00	37.00									
PD-17	SILT	10.00	0.00	37.00									
PD-18	SILT	16.00	0.00	63.00									
PD-19	SILT	7.10	0.00	34.00									
PD-20	SILT	6.10	0.00	38.00									
PD-21	SILT	5.90	0.00	39.00									
PD-22	SILT	12.00	0.00	61.00									
PD-23	SILT	4.90	0.00	28.00									
PD-24	SILT	11.00	0.00	49.00									
PD-25	SILT	15.00	0.00	59.00									
PD-26	SILT	3.80	0.00	63.00									
PD-27	SILT	9.70	0.00	51.00									
PD-28	SILT	15.00	0.00	63.00									
PD-29	SILT	4.30	0.00	55.00									
PD-30	SILT	8.10	0.00	56.00									
PD-31	SILT	9.20	0.00	75.00									
PD-32	SILT	11.00	0.00	34.00									
PD-33	SILT	6.60	0.00	60.00									
PD-34	SILT	11.00	0.00	58.00									
PD-35	SILT	10.00	0.00	70.00									
PD-36	SILT	8.60	0.00	62.00									
PD-37	SILT	7.60	0.00	57.00									
PD-38	SILT	6.60	0.00	43.00									
PD-39	SILT	14.00	0.00	40.00									
PD-40	SILT	10.00	0.00	46.00									
PD-41	SILT	7.10	0.00	36.00									
PD-42	SILT	5.60	0.00	32.00									
PD-43	SILT	5.60	0.00	32.00									
PD-44	SILT	6.10	0.00	27.00									
PD-45	SILT	7.60	0.00	37.00									

FD OUTDR RAD CLASS FD SAMPL (pCi/g Dry)
05-14-86
10:18:58

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	RA 226 NATL	RA 226 NATL LT	TH 228 NATL	TH 228 NATL LT
BKGD-01	TYRD SILT	8.90	0.00	39.00					
BKGD-02	TYRD SILT	8.90	0.00	35.00					
BKGD-03	TYRD SILT	7.00	0.00	35.00					
BKGD-04	TYRD SILT	11.00	0.00	42.00					
BKGD-01	FD SILT	8.10	0.00	53.00					
BKGD-02	FD SILT	21.00	0.00	61.00					
BKGD-03	FD SILT	25.00	0.00	63.00					
BKGD-04	FD SILT	10.00	0.00	57.00					
BKGD-05	FD SILT	13.00	0.00	31.00					
FD-01	SILT	9.70	0.00	43.00					
FD-02	SILT	9.70	0.00	78.00			8.0		
FD-03	SILT	6.60	0.00	43.00					
FD-04	SILT	6.10	0.00	44.00					
FD-05	SILT	5.60	0.00	42.00					
FD-06	SILT	7.60	0.00	35.00					
FD-07	SILT	15.00	0.00	59.00					
FD-08	SILT	5.10	0.00	39.00					
FD-09	SILT	11.00	0.00	60.00					
FD-10	SILT	12.00	0.00	48.00					
FD-11	SILT	8.60	0.00	44.00					
FD-12	SILT	6.10	0.00	36.00					
FD-13	SILT	0.00	3.00	35.00					
FD-14	SILT	8.10	0.00	57.00					
FD-15	SILT	6.10	0.00	33.00			1.0		
FD-16	SILT	3.60	0.00	37.00					
FD-17	SILT	10.00	0.00	37.00					
FD-18	SILT	16.00	0.00	63.00					
FD-19	SILT	7.10	0.00	34.00					
FD-20	SILT	6.10	0.00	38.00					
FD-21	SILT	5.90	0.00	39.00					
FD-22	SILT	12.00	0.00	61.00					
FD-23	SILT	4.90	0.00	28.00					
FD-24	SILT	11.00	0.00	49.00					
FD-25	SILT	15.00	0.00	59.00					
FD-26	SILT	3.80	0.00	63.00					
FD-27	SILT	9.70	0.00	51.00					
FD-28	SILT	15.00	0.00	63.00					
FD-29	SILT	4.30	0.00	55.00					
FD-30	SILT	8.10	0.00	56.00					
FD-31	SILT	9.20	0.00	75.00					
FD-32	SILT	11.00	0.00	34.00					
FD-33	SILT	6.60	0.00	60.00					
FD-34	SILT	11.00	0.00	58.00					
FD-35	SILT	10.00	0.00	70.00					
FD-36	SILT	8.60	0.00	62.00					
FD-37	SILT	7.60	0.00	57.00					
FD-38	SILT	6.60	0.00	43.00					
FD-39	SILT	14.00	0.00	40.00					
FD-40	SILT	10.00	0.00	46.00					
FD-41	SILT	7.10	0.00	36.00					
FD-42	SILT	5.60	0.00	32.00					
FD-43	SILT	5.60	0.00	32.00					
FD-44	SILT	6.10	0.00	27.00					
FD-45	SILT	7.60	0.00	37.00					

PD OUTDR RAD CLASS PD SAMPL (pCi/g Dry)
05-14-86
10:13:22

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
PD-46	SILT	0.00	4.00	25.00									
PD-47	SILT	6.50	0.00	23.00									
PD-48	SILT	4.30	0.00	25.00									
PD-49	SILT	0.00	4.00	24.00									
PD-50	SILT	12.00	0.00	27.00									
PD-51	SILT	5.40	0.00	29.00									
PD-52	SILT	0.00	4.00	26.00									
PD-53	SILT	0.00	4.00	26.00									
PD-54	SILT	5.40	0.00	26.00									
PD-55	SILT	6.50	0.00	25.00									
PD-56	SILT	13.00	0.00	32.00									
PD-57	SILT	5.90	0.00	27.00									
PD-58	SILT	5.40	0.00	26.00									
PD-59	SILT	5.40	0.00	25.00									
PD-60	SILT	3.80	0.00	26.00									
PD-61	SILT	7.10	0.00	29.00									
PD-62	SILT	11.00	0.00	29.00									
PD-63	SILT	7.60	0.00	26.00									
PD-64	SILT	4.10	0.00	28.00									
PD-65	SILT	7.60	0.00	31.00									
PD-66	SILT	8.60	0.00	34.00									
PD-67	SILT	10.00	0.00	35.00									
PD-68	SILT	6.60	0.00	32.00									
PD-69	SILT	8.10	0.00	36.00									
PD-70	SILT	8.10	0.00	36.00									
PD-71	SILT	12.00	0.00	39.00									
PD-72	SILT	11.00	0.00	37.00									
PD-73	SILT	9.20	0.00	34.00									
PD-74	SILT	7.60	0.00	35.00									
PD-75	SILT	7.60	0.00	35.00									
PD-76	SILT	13.00	0.00	30.00									
PD-77	SILT	10.00	0.00	38.00									
PD-78	SILT	12.00	0.00	43.00									
PD-79	SILT	9.70	0.00	34.00									
PD-80	SILT	22.00	0.00	43.00									
PD-81	SILT	16.00	0.00	42.00									
PD-82	SILT	12.00	0.00	35.00									
PD-83	SILT	11.00	0.00	37.00									
PD-84	SILT	12.00	0.00	41.00									
PD-85	SILT	12.00	0.00	43.00									
PD-86	SILT	7.10	0.00	43.00									
PD-87	SILT	15.00	0.00	39.00									
PD-88	SILT	9.70	0.00	39.00									
PD-89	SILT	18.00	0.00	44.00									
PD-90	SILT	9.70	0.00	38.00									
BKGD-01	TYRD SOIL	7.00	0.00	31.00									
BKGD-02	TYRD SOIL	0.00	7.00	31.00									
BKGD-03	TYRD SOIL	0.00	7.00	43.00				.11			.05		.06
BKGD-04	TYRD SOIL	7.00	0.00	38.00									
BKGD-01B	PD SURFACE	9.70	0.00	47.00									
BKGD-02D	PD SURFACE	10.00	0.00	70.00				.17			.06		.07
BKGD-03A	PD SURFACE	16.00	0.00	56.00									
BKGD-04C	PD SURFACE	16.00	0.00	67.00									
BKGD-05A	PD SURFACE	9.70	0.00	39.00									

PD OUTDR RAD CLASS PD SAMPL (pCi/g Dry)
05-14-86
10:18:58

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	RA 226 NATL	RA 226 NATL LT	TH 228 NATL	TH 228 NATL LT
PD-46	SILT	0.00	4.00	25.00					
PD-47	SILT	6.50	0.00	23.00					
PD-48	SILT	4.30	0.00	25.00					
PD-49	SILT	0.00	4.00	24.00					
PD-50	SILT	12.00	0.00	27.00					
PD-51	SILT	5.40	0.00	29.00					
PD-52	SILT	0.00	4.00	26.00					
PD-53	SILT	0.00	4.00	26.00					
PD-54	SILT	5.40	0.00	26.00					
PD-55	SILT	6.50	0.00	25.00					
PD-56	SILT	13.00	0.00	32.00					
PD-57	SILT	5.90	0.00	27.00					
PD-58	SILT	5.40	0.00	26.00					
PD-59	SILT	5.40	0.00	25.00					
PD-60	SILT	3.80	0.00	26.00					
PD-61	SILT	7.10	0.00	29.00					
PD-62	SILT	11.00	0.00	29.00					
PD-63	SILT	7.60	0.00	26.00					
PD-64	SILT	4.10	0.00	28.00					
PD-65	SILT	7.60	0.00	31.00					
PD-66	SILT	8.60	0.00	34.00					
PD-67	SILT	10.00	0.00	35.00					
PD-68	SILT	6.60	0.00	32.00					
PD-69	SILT	8.10	0.00	36.00					
PD-70	SILT	8.10	0.00	36.00					
PD-71	SILT	12.00	0.00	39.00					
PD-72	SILT	11.00	0.00	37.00					
PD-73	SILT	9.20	0.00	34.00					
PD-74	SILT	7.60	0.00	35.00					
PD-75	SILT	7.60	0.00	35.00					
PD-76	SILT	13.00	0.00	30.00					
PD-77	SILT	10.00	0.00	38.00					
PD-78	SILT	12.00	0.00	43.00					
PD-79	SILT	9.70	0.00	34.00					
PD-80	SILT	22.00	0.00	43.00					
PD-81	SILT	16.00	0.00	42.00					
PD-82	SILT	12.00	0.00	35.00					
PD-83	SILT	11.00	0.00	37.00					
PD-84	SILT	12.00	0.00	41.00					
PD-85	SILT	12.00	0.00	43.00					
PD-86	SILT	7.10	0.00	43.00					
PD-87	SILT	15.00	0.00	39.00					
PD-88	SILT	9.70	0.00	39.00					
PD-89	SILT	18.00	0.00	44.00					
PD-90	SILT	9.70	0.00	38.00					
BKGD-01	TYRD SOIL	7.00	0.00	31.00					
BKGD-02	TYRD SOIL	0.00	7.00	31.00					
BKGD-03	TYRD SOIL	0.00	7.00	43.00					
BKGD-04	TYRD SOIL	7.00	0.00	38.00					
BKGD-01B	PD SURFACE	9.70	0.00	47.00					
BKGD-02D	PD SURFACE	10.00	0.00	70.00					
BKGD-03A	PD SURFACE	16.00	0.00	56.00					
BKGD-04C	PD SURFACE	16.00	0.00	67.00					
BKGD-05A	PD SURFACE	9.70	0.00	39.00					

FD OUTDR RAD CLASS FD SAMPL (pCi/g Dry)
05-14-86
10:13:22

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	SR 90	SR 90 LT	CS 137	CS 137 LT	CO 60	CO 60 LT	CS 134	CS 134 LT
FD-02D	SURFACE SOIL	13.00	0.00	590.00				760.0		180.00		9.14	
FD-04A	SURFACE SOIL	11.00	0.00	35.00									
FD-08A	SURFACE SOIL	8.60	0.00	29.00									
FD-09D	SURFACE SOIL	12.00	0.00	42.00				14.00		2.36		.19	
FD-10A	SURFACE SOIL	10.00	0.00	34.00									
FD-11D	SURFACE SOIL	5.60	0.00	42.00									
FD-12D	SURFACE SOIL	7.10	0.00	60.00									
BKGD-01	FXRD SHAL CR	27.00	0.00	72.00									
BKGD-02	FXRD SHAL CR	22.00	0.00	81.00									
BKGD-03	FXRD SHAL CR	32.00	0.00	100.00									
BKGD-04	FXRD SHAL CR	36.00	0.00	99.00									
BKGD-05	FXRD SHAL CR	42.00	0.00	110.00									
BKGD-06	FXRD SHAL CR	30.00	0.00	94.00									
FD-01-01	SHALLOW CORE	0.00	5.00	27.00									
FD-01-02	SHALLOW CORE	0.00	5.00	28.00									
FD-01-03	SHALLOW CORE	5.70	0.00	30.00									
FD-01-04	SHALLOW CORE	9.60	0.00	30.00									
FD-01-05	SHALLOW CORE	0.00	5.00	43.00									
FD-01-06	SHALLOW CORE	0.00	5.00	32.00									
FD-01-07	SHALLOW CORE	360.00	0.00	34.00									
FD-01-08	SHALLOW CORE	7.40	0.00	43.00									
FD-38-01	SHALLOW CORE	0.00	5.00	24.00									
FD-38-02	SHALLOW CORE	6.80	0.00	29.00									
FD-38-03	SHALLOW CORE	0.00	5.00	24.00									
FD-38-04	SHALLOW CORE	15.00	0.00	32.00									
FD-38-05	SHALLOW CORE	7.40	0.00	24.00									
FD-38-06	SHALLOW CORE	0.00	5.00	32.00									
FD-38-07	SHALLOW CORE	6.20	0.00	38.00									
FD-38-08	SHALLOW CORE	7.40	0.00	35.00									
FD-48-01	SHALLOW CORE	8.10	0.00	28.00									
FD-48-02	SHALLOW CORE	6.10	0.00	24.00									
FD-48-03	SHALLOW CORE	6.10	0.00	30.00									
FD-48-04	SHALLOW CORE	8.60	0.00	25.00									
FD-48-05	SHALLOW CORE	7.60	0.00	30.00									
FD-48-06	SHALLOW CORE	8.10	0.00	36.00									
FD-48-07	SHALLOW CORE	10.00	0.00	41.00									
FD-48-08	SHALLOW CORE	8.60	0.00	31.00									
FD-88-01	SHALLOW CORE	12.00	0.00	39.00									
FD-88-02	SHALLOW CORE	8.10	0.00	31.00									
FD-88-03	SHALLOW CORE	12.00	0.00	48.00									
FD-88-04	SHALLOW CORE	7.60	0.00	53.00									
FD-88-05	SHALLOW CORE	7.60	0.00	38.00									
FD-88-06	SHALLOW CORE	11.00	0.00	42.00									
FD-88-07	SHALLOW CORE	13.00	0.00	35.00									
FD-88-08	SHALLOW CORE	12.00	0.00	41.00									

FD235 Number of Records Read: 153
FD236 Number of Records Selected: 153

PD OUTDR RAD CLASS PD SAMPL (pCi/g Dry)
05-14-86
10:18:58

GRID AND SAMP NO	TYPE	ALPHA	ALPHA LT	BETA	BETA LT	RA 226 NATL	RA 226 NATL LT	TH 228 NATL	TH 228 NATL LT
PD-02D	SURFACE SOIL	13.00	0.00	590.00			20.00		2.0
PD-04A	SURFACE SOIL	11.00	0.00	35.00					
PD-08A	SURFACE SOIL	8.60	0.00	29.00					
PD-09D	SURFACE SOIL	12.00	0.00	42.00					
PD-10A	SURFACE SOIL	10.00	0.00	34.00					
PD-11D	SURFACE SOIL	5.60	0.00	42.00					
PD-12D	SURFACE SOIL	7.10	0.00	60.00					
BKGD-01	FXRD SHAL CR	27.00	0.00	72.00					
BKGD-02	FXRD SHAL CR	22.00	0.00	81.00					
BKGD-03	FXRD SHAL CR	32.00	0.00	100.00					
BKGD-04	FXRD SHAL CR	36.00	0.00	99.00					
BKGD-05	FXRD SHAL CR	42.00	0.00	110.00					
BKGD-06	FXRD SHAL CR	30.00	0.00	94.00					
PD-01-01	SHALLOW CORE	0.00	5.00	27.00					
PD-01-02	SHALLOW CORE	0.00	5.00	28.00					
PD-01-03	SHALLOW CORE	5.70	0.00	30.00					
PD-01-04	SHALLOW CORE	9.60	0.00	30.00					
PD-01-05	SHALLOW CORE	0.00	5.00	43.00					
PD-01-06	SHALLOW CORE	0.00	5.00	32.00					
PD-01-07	SHALLOW CORE	360.00	0.00	34.00					
PD-01-08	SHALLOW CORE	7.40	0.00	43.00					
PD-38-01	SHALLOW CORE	0.00	5.00	24.00					
PD-38-02	SHALLOW CORE	6.80	0.00	29.00					
PD-38-03	SHALLOW CORE	0.00	5.00	24.00					
PD-38-04	SHALLOW CORE	15.00	0.00	32.00					
PD-38-05	SHALLOW CORE	7.40	0.00	24.00					
PD-38-06	SHALLOW CORE	0.00	5.00	32.00					
PD-38-07	SHALLOW CORE	6.20	0.00	38.00					
PD-38-08	SHALLOW CORE	7.40	0.00	35.00					
PD-48-01	SHALLOW CORE	8.10	0.00	28.00					
PD-48-02	SHALLOW CORE	6.10	0.00	24.00					
PD-48-03	SHALLOW CORE	6.10	0.00	30.00					
PD-48-04	SHALLOW CORE	8.60	0.00	25.00					
PD-48-05	SHALLOW CORE	7.60	0.00	30.00					
PD-48-06	SHALLOW CORE	8.10	0.00	36.00					
PD-48-07	SHALLOW CORE	10.00	0.00	41.00					
PD-48-08	SHALLOW CORE	8.60	0.00	31.00					
PD-88-01	SHALLOW CORE	12.00	0.00	39.00					
PD-88-02	SHALLOW CORE	8.10	0.00	31.00					
PD-88-03	SHALLOW CORE	12.00	0.00	48.00					
PD-88-04	SHALLOW CORE	7.60	0.00	53.00					
PD-88-05	SHALLOW CORE	7.60	0.00	38.00					
PD-88-06	SHALLOW CORE	11.00	0.00	42.00					
PD-88-07	SHALLOW CORE	13.00	0.00	35.00					
PD-88-08	SHALLOW CORE	12.00	0.00	41.00					

PD236 Number of Records Read: 153
PD236 Number of Records Selected: 153

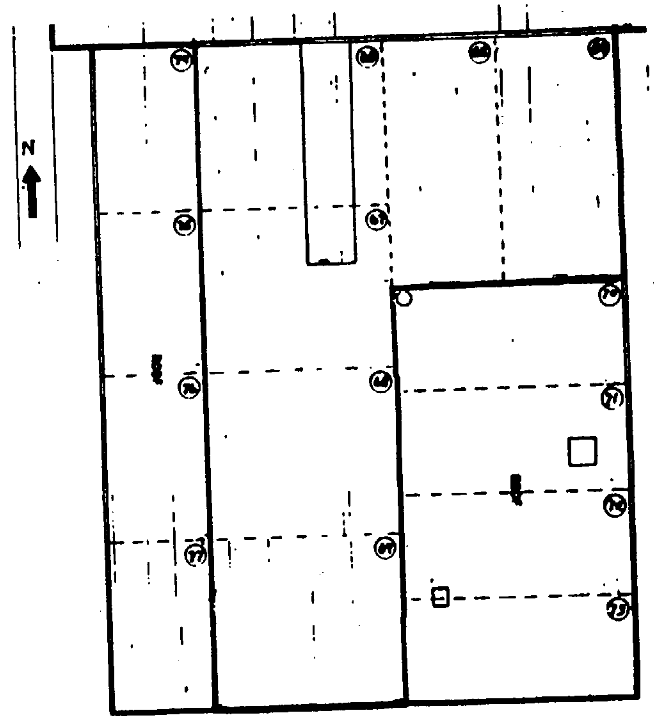
APPENDIX 3.7

PBRF Outdoor Radiological Classification
Building Rooftop Radiological Evaluation

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
14:37:20

βγ c/m - G53

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
HL 64	4-5-85	Roof	White	75	50	75	100	100	Pt. 5	0	59	0.006
HL 65	4-5-85	Roof	White	50	50	50	50	75	Pt. 5	0	59	0.006
HL 66	4-5-85	Roof	White	50	75	75	75	50	Pt. 3	0	59	0.006
HL 67	4-5-85	Roof	White	50	50	50	50	100	Pt. 5	0	59	0.007
HL 68	4-5-85	Roof	White	75	50	75	50	75	Pt. 1	0	59	0.008
HL 69	4-5-85	Roof	White	50	50	75	50	50	Pt. 3	0	59	0.005
HL 70	4-5-85	Roof	White	50	75	100	75	100	Pt. 5	0	59	0.012
HL 71	4-5-85	Roof	White	50	100	75	125	50	Pt. 4	0	59	0.016
HL 72	4-5-85	Roof	White	50	50	50	75	50	Pt. 4	0	59	0.013
HL 73	4-5-85	Roof	White	75	50	75	50	50	Pt. 1	0	59	0.007
HL 74	4-10-85	Roof	White	75	50	50	50	50	Pt. 1	0	59	0.002
HL 75	4-10-85	Roof	White	50	50	25	75	50	Pt. 4	0	59	0.001
HL 76	4-10-85	Roof	White	50	75	50	75	25	Pt. 4	0	59	0.001
HL 77	4-10-85	Roof	White	75	50	75	25	25	Pt. 3	0	59	0.001



BLDG 1112 - HOT LAB ROOF
GRID INDEX

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
14:52:51

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
HL 64	4-5-85	Roof	White		0	0	63283	36027	1-7-85	466	12-10-84
HL 65	4-5-85	Roof	White		0	0	63283	36027	1-7-85	466	12-10-84
HL 66	4-5-85	Roof	White		0	0	63284	36027	1-7-85	466	12-10-84
HL 67	4-5-85	Roof	White		0	0	63284	36027	1-7-85	466	12-10-84
HL 68	4-5-85	Roof	White		0	0	63285	36027	1-7-85	466	12-10-84
HL 69	4-5-85	Roof	White		0	0	63285	36027	1-7-85	466	12-10-84
HL 70	4-5-85	Roof	White		0	0	63286	36027	1-7-85	466	12-10-84
HL 71	4-5-85	Roof	White		0	0	63286	36027	1-7-85	466	12-10-84
HL 72	4-5-85	Roof	White		0	0	63287	36027	1-7-85	466	12-10-84
HL 73	4-5-85	Roof	White		0	0	63287	36027	1-7-85	466	12-10-84
HL 74	4-10-85	Roof	White		0	0	63290	36027	4-9-85	466	12-10-84
HL 75	4-10-85	Roof	White		0	0	63290	36027	4-9-85	466	12-10-84
HL 76	4-10-85	Roof	White		0	0	63291	36027	4-9-85	466	12-10-84
HL 77	4-10-85	Roof	White		0	0	63291	36027	4-9-85	466	12-10-84

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
15:10:17

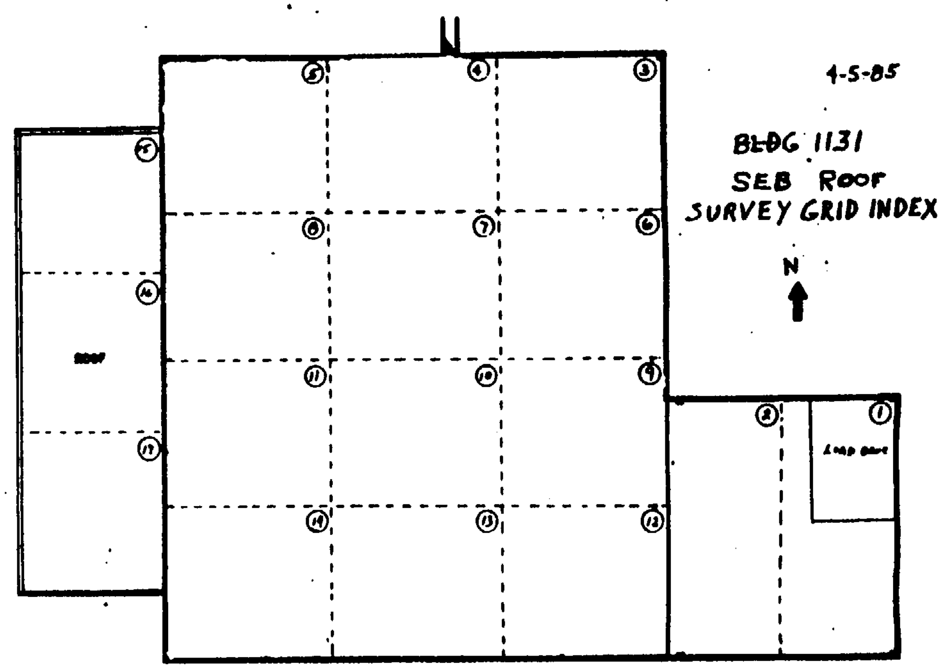
Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Cutie Pie Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff
HL 64	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 65	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 66	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 67	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 68	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 69	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 70	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 71	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 72	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 73	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 74	4-10-85	Roof	White	423	4-9-85			2	0.34	0.42
HL 75	4-10-85	Roof	White	423	4-9-85			4	0.34	0.42
HL 76	4-10-85	Roof	White	423	4-9-85			4	0.34	0.42
HL 77	4-10-85	Roof	White	423	4-9-85			4	0.34	0.42

SEB RAD SURVEY BLDG 1131
12-11-85
11:02:58

BY C/M - G53

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR	REC#
SEB 1	4-5-85	Roof	White	0	50	50	50	50	Pt. 5	0	59	0.004	1
SEB 2	4-5-85	Roof	White	50	50	50	50	50	Pt. 5	0	59	0.004	2
SEB 3	4-5-85	Roof	White	75	75	50	50	50	Pt. 1	0	59	0.004	3
SEB 4	4-5-85	Roof	White	50	50	50	75	50	Pt. 4	0	59	0.004	4
SEB 5	4-5-85	Roof	White	50	75	50	25	75	Pt. 5	0	59	0.003	5
SEB 6	4-5-85	Roof	White	50	75	75	50	50	Pt. 2	0	59	0.003	6
SEB 7	4-5-85	Roof	White	50	100	50	50	50	Pt. 2	0	59	0.003	7
SEB 8	4-5-85	Roof	White	50	50	75	50	75	Pt. 3	0	59	0.004	8
SEB 9	4-5-85	Roof	White	50	50	25	50	50	Pt. 5	0	59	0.004	9
SEB 10	4-5-85	Roof	White	25	50	25	50	50	Pt. 5	0	59	0.004	10
SEB 11	4-5-85	Roof	White	50	25	75	50	75	Pt. 1	0	59	0.005	11
SEB 12	4-5-85	Roof	White	75	50	50	50	50	Pt. 1	0	59	0.005	12
SEB 13	4-5-85	Roof	White	50	50	50	50	75	Pt. 5	0	59	0.004	13
SEB 14	4-5-85	Roof	White	25	50	50	50	50	Pt. 2	0	59	0.005	14
SEB 15	4-5-85	Roof	White	50	50	50	50	50	Pt. 5	0	59	0.004	15
SEB 16	4-5-85	Roof	White	50	25	25	100	50	Pt. 4	0	59	0.004	16
SEB 17	4-5-85	Roof	White	50	50	75	75	50	Pt. 4	0	59	0.004	17

FD235 Number of Records Read: 17
FD236 Number of Records Selected: 17



SEB RAD SURVEY BLDG 1131
12-11-85
11:06:49

Grid	Date	Type	SBR No	Smear A DPM	Smear B DPM	RSR No	G33W Ser No	Cal Date	PRM7 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
SEB 1	4-5-85	Roof		0	0	63276	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	1
SEB 2	4-5-85	Roof		0	0	63276	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	2
SEB 3	4-5-85	Roof		0	0	63277	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	3
SEB 4	4-5-85	Roof		0	0	63277	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	4
SEB 5	4-5-85	Roof		0	0	63278	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	5
SEB 6	4-5-85	Roof		0	0	63278	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	6
SEB 7	4-5-85	Roof		0	0	63279	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	7
SEB 8	4-5-85	Roof		0	0	63279	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	8
SEB 9	4-5-85	Roof		0	0	63280	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	9
SEB 10	4-5-85	Roof		0	0	63280	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	10
SEB 11	4-5-85	Roof		0	0	63281	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	11
SEB 12	4-5-85	Roof		0	0	63281	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	12
SEB 13	4-5-85	Roof		0	0	63282	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	13
SEB 14	4-5-85	Roof		0	0	63282	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	14
SEB 15	4-5-85	Roof		0	0	63292	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	15
SEB 16	4-5-85	Roof		0	0	63292	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	16
SEB 17	4-5-85	Roof		0	0	63293	36027	1-7-85	466	12-10-84	2	0.00	0.00	0.00	17

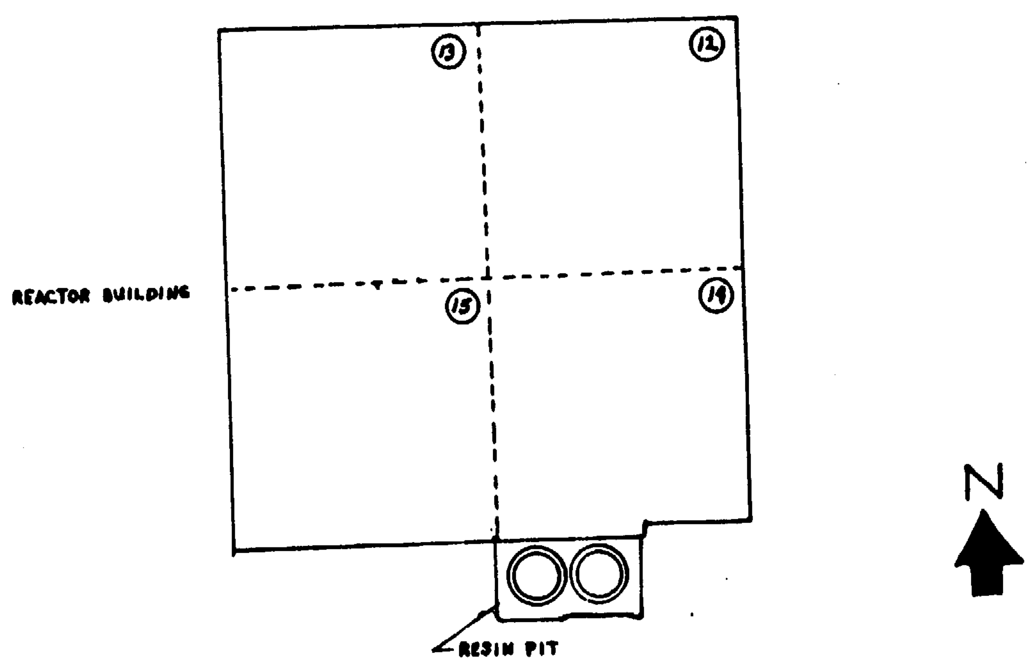
FD235 Number of Records Read: 17
FD236 Number of Records Selected: 17

PPH RAD SURVEY GRIDS
12-19-85
12:55:39

β-γ C/M - GS3

GRID	TYPE	DATE	INSR NO	PT 1	PT 2	PT 3	PT 4	PT 5	HI PT	MR HR	DIST 2	ALPHA	AREA CM	DIST 1	SMEAR	ADPM	SMEAR	BDPM	SER NO
PPH-12	ROOF	4-11-85	63300	50	25	50	50	50	5	0.005	1M	8.8	59	CONT	0		0		0
PPH-13	ROOF	4-11-85	63300	50	50	25	25	50	1	0.006	1M	14.7	59	CONT	0		0		0
PPH-14	ROOF	4-11-85	63301	25	50	25	25	75	5	0.006	1M	8.8	59	CONT	0		0		0
PPH-15	ROOF	4-11-85	63301	50	25	50	75	50	4	0.006	1M	11.8	59	CONT	0		0		0

FD235 Number of Records Read: 41
FD236 Number of Records Selected: 41



BLDG 1134 PRIMARY PUMP HOUSE ROOF
SURVEY GRID-INDEX

4-12-85

PFH RAD SURVEY GRIDS
12-19-85
12:59:23

GRID	TYPE	ZONE	GB3W NO	GB3W CAL DATE	PRM7 NO	PRM7 CAL DATE	PRS1 NO	PRS1 CAL DATE	PRS1 EFF	NC A EFF	NC B EFF	REC#
PFH-12	ROOF	WHITE	36027	4-9-85	466	12-10-84	423	4-9-85	34	42	37	38
PFH-13	ROOF	WHITE	36027	4-9-85	466	12-10-84	423	4-9-85	34	42	37	39
PFH-14	ROOF	WHITE	36027	4-9-85	466	12-10-84	423	4-9-85	34	42	37	40
PFH-15	ROOF	WHITE	36027	4-9-85	466	12-10-84	423	4-9-85	34	42	37	41

FD235 Number of Records Read: 41
FD236 Number of Records Selected: 41

TELEDYNE ISOTOPES

APPENDIX 3.8

Procedure for Collecting Concrete Core Samples From the PBRF Bioshield

Title: Determining Activity in Reactor Tank Area

Introduction:

This procedure describes the method to be used in determining the activity in the Plum Brook Reactor Tank. This test will resolve the uncertainties of:

a. The tritium buildup in the tank
b. The activity of the core at several distances with only air shielding
c. The content dose rate of the core in the RA-8 area
d. The concrete activation

2. General Information

2.1 Tritium buildup will be determined by shutting off the reactor tank nitrogen purge for a ten day period. The tank atmosphere will then be sampled for any buildup.

2.2 Dose rates at core contact and various distances from the core will be obtained by irradiating high level TLD's in the RA-8 rabbit tube. Readings will be taken at full and intermediate insertion distances. A standard PBRF rabbit will be modified as shown on Teledyne Isotope sketch RE 12485. Plastic covered steel cable will be used to insert and withdraw the rabbit. The plastic will facilitate decontamination.

2.3 The amount of concrete activation will be determined by drilling three holes at the core level. One hole will be in the area of the thermal column, one in the area of a beam hole, and one in the general area behind the thermal shields. Location of the holes are shown on the attached sketch RE 21985. The cores and/or drilling dust will be checked for gross alpha-beta as well as a gamma scan with particular attention to the presence of Europium 154. 152

Approved by: Dean W. Sheibley
Area Safety Committee
April 15, 1985
Issue Date

Len Homyak 4/11/85
Manager, Plum Brook Reactor Facility

Precautions and Limitations

3.1 Work will be done under a Safe Work Permit, AD-19. Tritium air monitoring and use of SCBA will be a condition of the SWP when performing work under Sections 4.1 and 4.2.

3.2 A mirror will be available to look into the hole drilled in the concrete.

3.3 A plot on semi log paper of drilling depths vs. dose rate will be made during the drilling procedure. A straight line projection of this data will predict the dose to be expected at any depth.

4. Procedure

4.1 Determine tritium buildup in the reactor tank.

4.1.1 Inform the Plum Brook Station Communications Center that the N2 purge system is being taken out of service and that they will receive an N2 purge system off-normal alarm.

4.1.2 Close 36V88

4.1.3 Close 33V119

4.1.4 Disconnect N2 tubing and connect a Gast air sampling pump and evacuated tritium sample flask where the N2 supply line was removed from the lily pad pressure gauge tee. See Sketch RE 22085

4.1.5 Open valves T-1 and T-2, operate pump for two minutes. Volume of the sampling line will be predetermined to minimize pump purging time yet still ensure that a good undiluted sample is obtained. If previous tritium monitoring has determined that tritium is present, the sampling pump discharge shall be connected to a gas scrubber.

4.1.6 Shut off pump and close valve T-2.

4.1.7 Open the tritium sample flask valve for one minute to obtain a sample.

4.1.8 Close the tritium sample flask valve and valve T-1. Remove the flask and send to the laboratory for analysis.

4.1.9 Once a day monitor reactor tank pressure of the lily pad gauge. If the pressure exceeds 15 PSI, suspend the test by opening 33V119 and 36V88.

4.1.10 Permit the reactor tank to stand with no N2 flow for ten days.

4.1.11 Reconnect another evacuated tritium sampling flask per Section 4.1.4 and repeat steps 4.1.5, 4.1.6, 4.1.7, and 4.1.8.

4.1.12 Remove sampling system and valve T-1 and reinstall the N2 supply line.

4.1.13 Open valve 36V88.

4.1.14 Open valve 33V119.

4.1.15 Adjust N2 flow per OM-2.

4.1.16 Inform Plum Brook Station Communications Center that the N2 purge system is back in operation and they should acknowledge any future alarms.

4.2 Determine Core Activity

4.2.1 If as a result of section 4.1, it is found no danger exists from tritium buildup continue with this procedure.

4.2.2 Secure the N2 purge system per sections 4.1.1 thru 4.1.3.

4.2.3 Using a six point heavy duty impact socket and long wrench handles, twist off the welded flange bolts on rabbit tube RA-8.

4.2.4 Remove RA-8 shielding plug (PF-S-30560) and determine radiation dose rates.

4.2.5 Insert the modified rabbit containing a high level TLD into the reactor tank region. Use the insertion distance and times supplied by the Reactor Engineering Study Office. A total of four insertions lasting a maximum time of ten minutes are planned. Monitor all rabbits for contamination.

4.2.6 When all irradiations are complete, reinstall the RA-8 shielding plug.

4.2 7 Establish N2 purge per sections 4.1.12 thru 4.1.15.

4.2.8 Send all TLD's to the contract laboratory for interpretation.

4.2.9 Report TLD readings to Reactor Engineering Study Office.

4.3 <u>Determine</u> <u>Concrete</u> <u>Activity</u>

4.3.1 Set up a 1 1/4 inch diamond core drill in the location shown on sketch RE 21985. Use oversize drill shank (1 inch diameter) to minimize streaming. A low voltage continuity alarm shall be wired to the drill and reactor tank so that contact of the drill with the tank will cause the alarm.

4.3.2 Drill to a depth of 4 inches, remove and save the core.

4.3.3 Monitor the hole for gross beta-gamma and record on the semi log graph.

4.3.4 Continue steps 4.3.2 and 4.3.3 until within 3 inches of the reactor tank. After recording each reading on the graph, project the curve to determine the estimated field at the tank.

4.3.5 Vacuum out the hole and dispose of the dust using appropriate monitoring. The vacuum pump exhaust shall be filtered to minimize potential airborne contamination.

4.3.6 Insert special drill bushing, sketch RE 22385 into the hole.

4.3.7 With a long shank 3/8 inch masonry drill, drill one inch deep. Withdraw the drill saving all the drill dust.

4.3.8 Withdraw the drill bushing saving any drill dust.

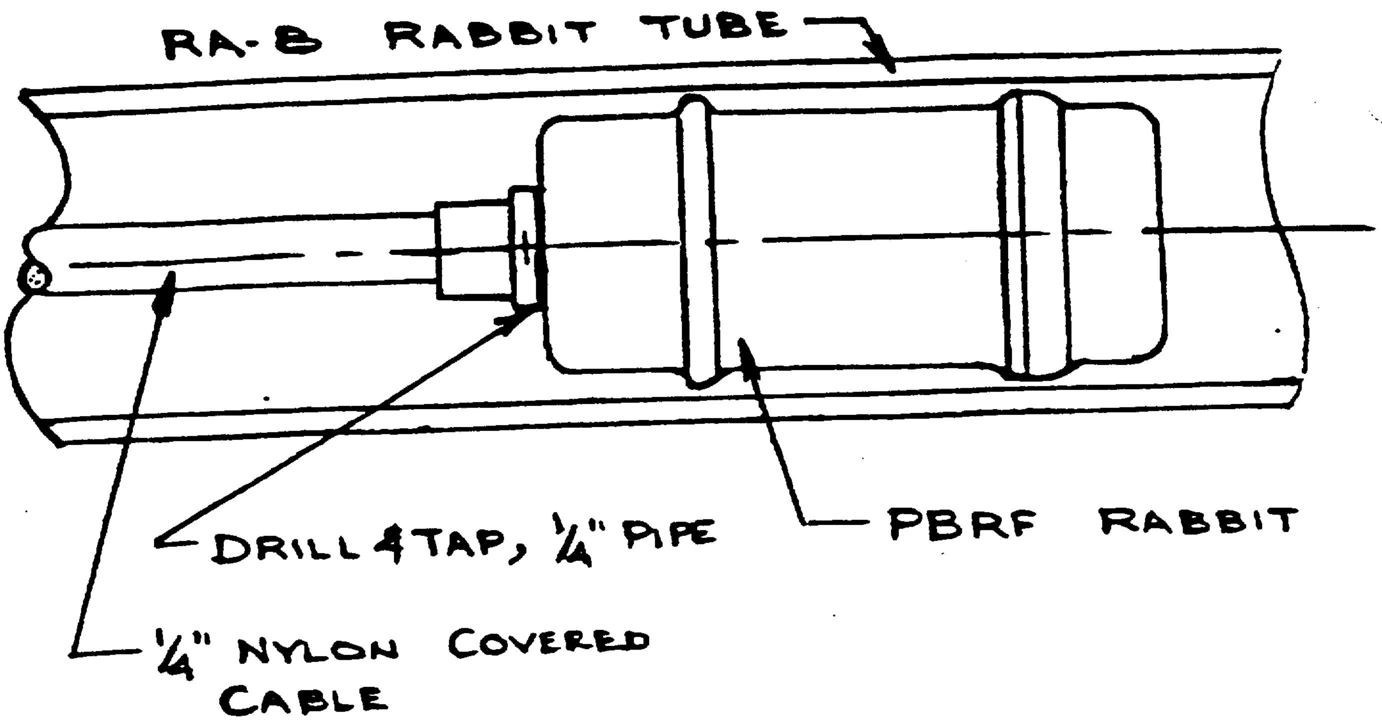
4.3.9 Vacuum out the hole saving the dust. Combine all dust, place in a plastic bag and label.

4.3.10 Repeat section 4.3.6 thru 4.3.9 until through the concrete.

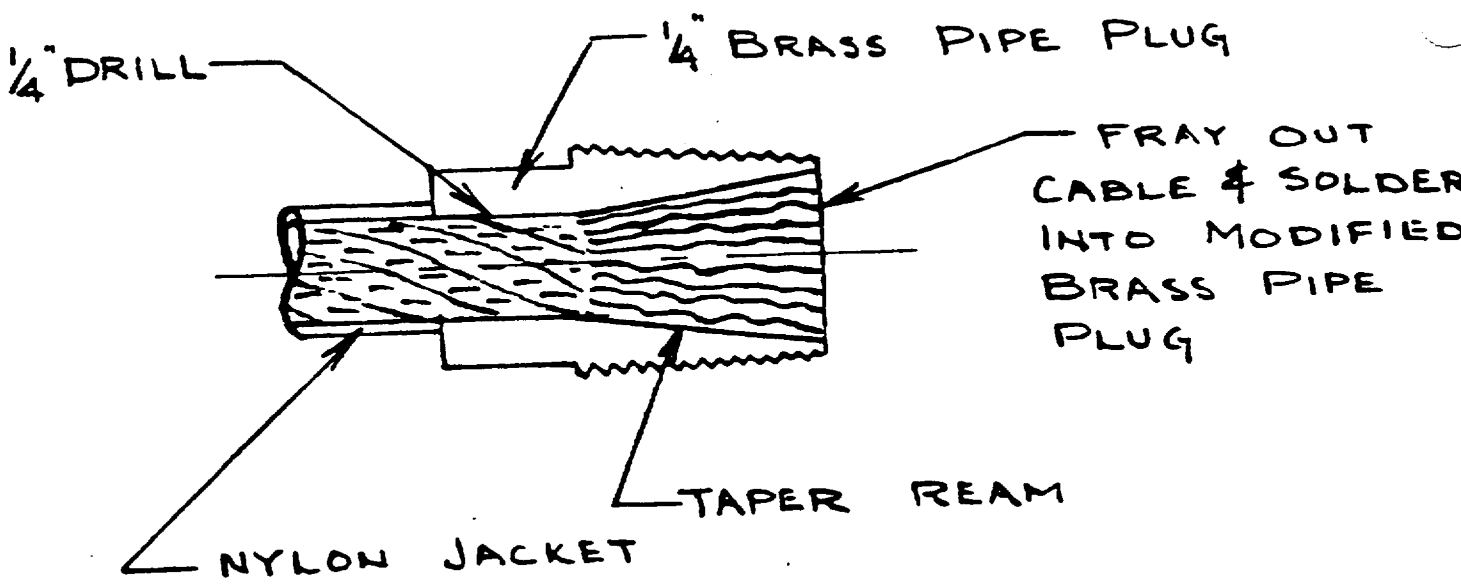
4.3.11 If the field at the surface of the concrete exceeds 100 mR/hr, install shielding plug as shown on sketch RE 22485.

4.3.12 Send all cores and drilling dust samples to the contract laboratory for gross alpha-beta analysis, gamma scan, and tritium analysis.

4.3.13 Report findings to Reactor Engineering Study Office.



• CORE ACTIVITY RABBIT •

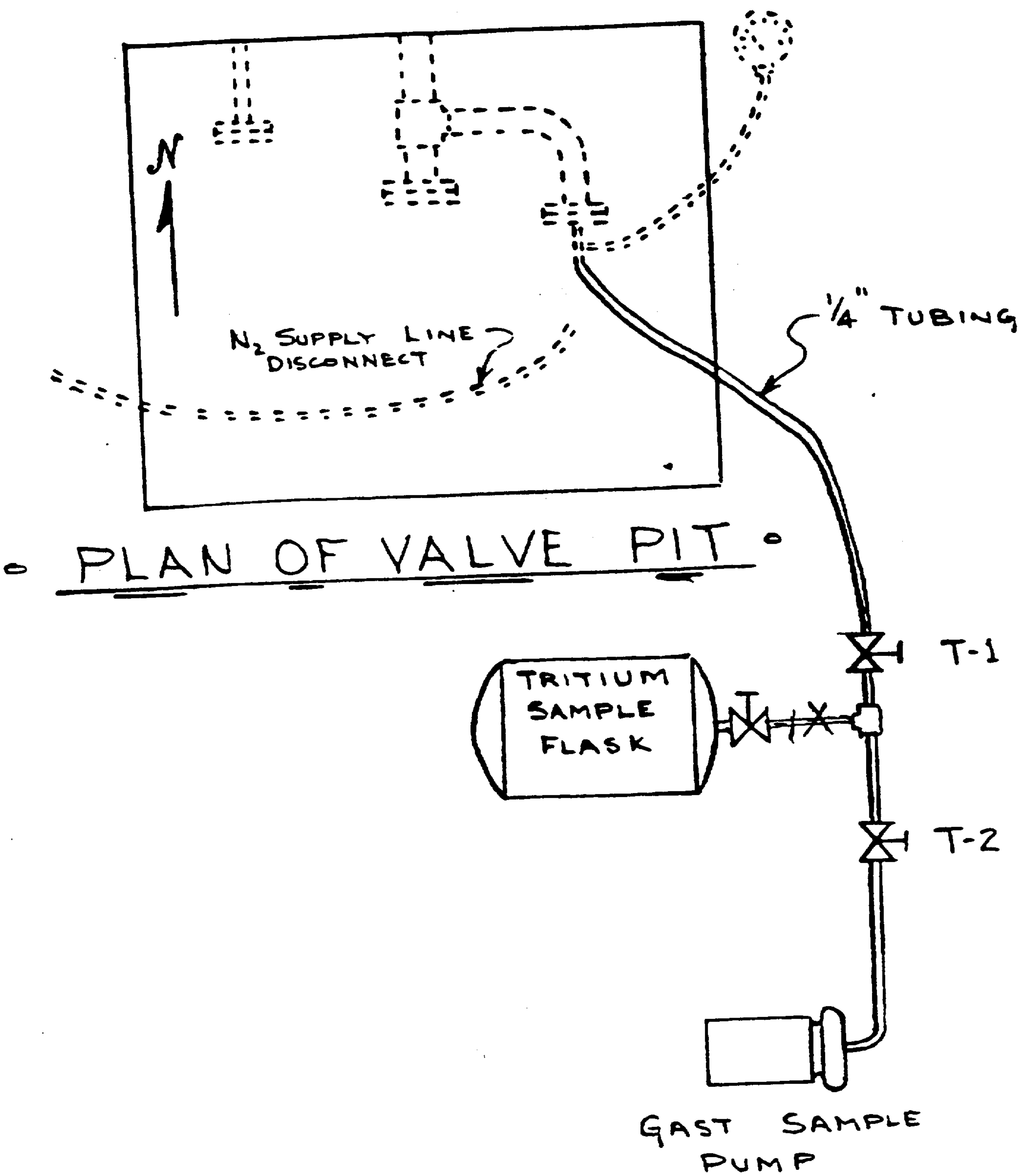


• CABLE END FITTING •

TELEDYNE ISOTOPES

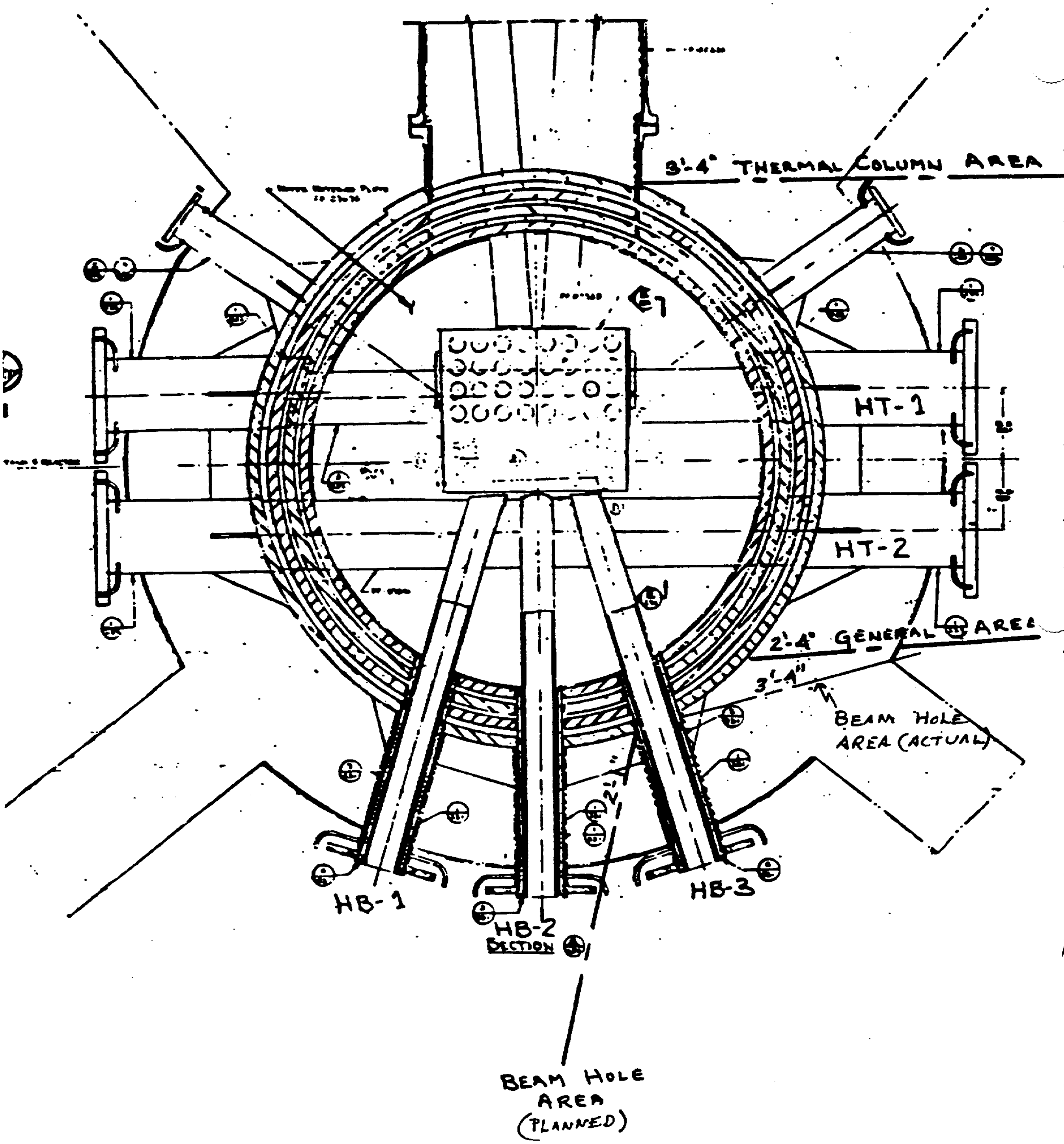
REACTOR CORE ACTIVITY-TEST FIXTURE

DRAWN BY EJM	SCALE	SK-RF 12485



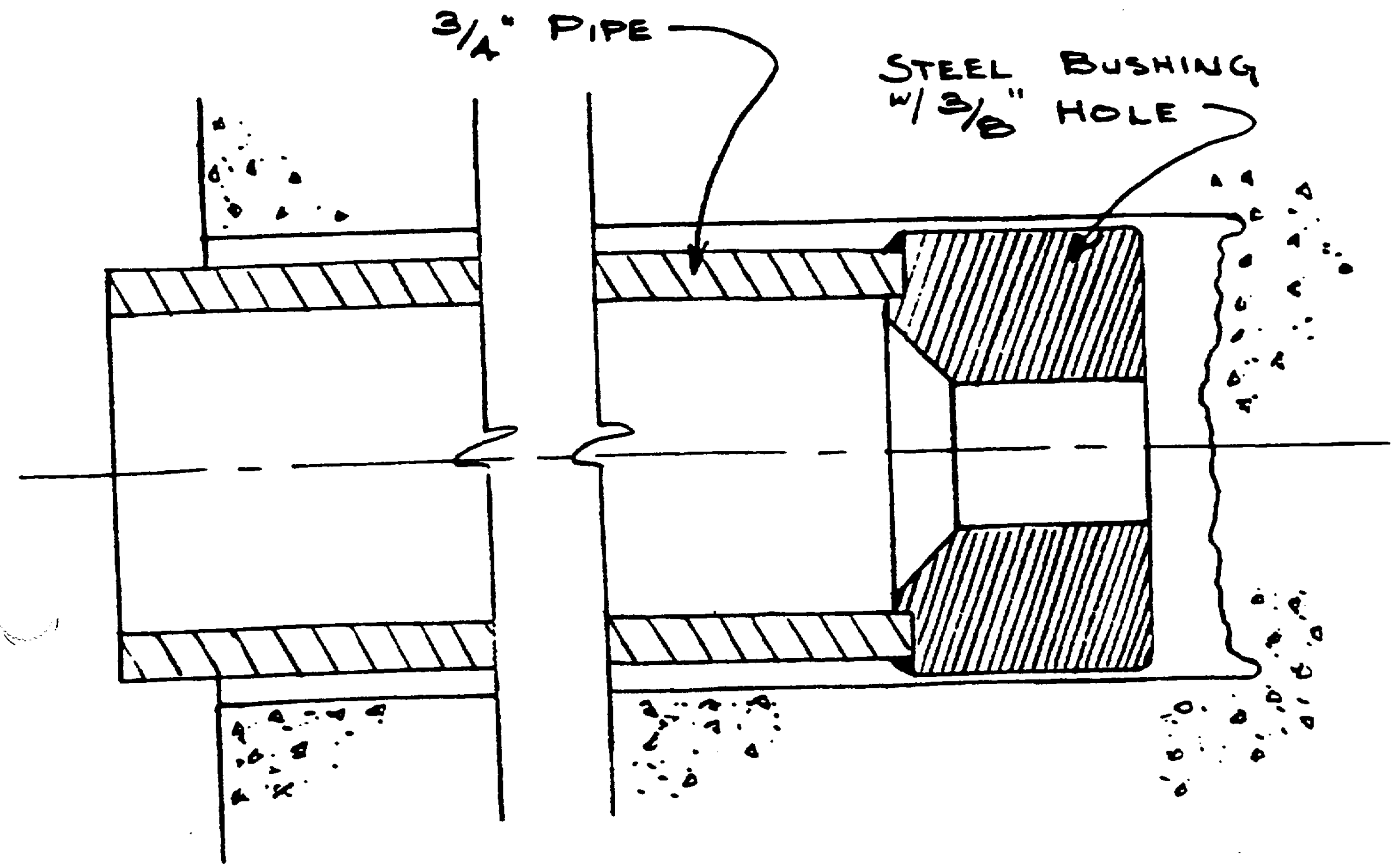
N
N_2 SUPPLY LINE DISCONNECT
1/4" TUBING
PLAN OF VALVE PIT
T-1
TRITIUM SAMPLE FLASK
T-2
GAST SAMPLE PUMP

SK-RE22085

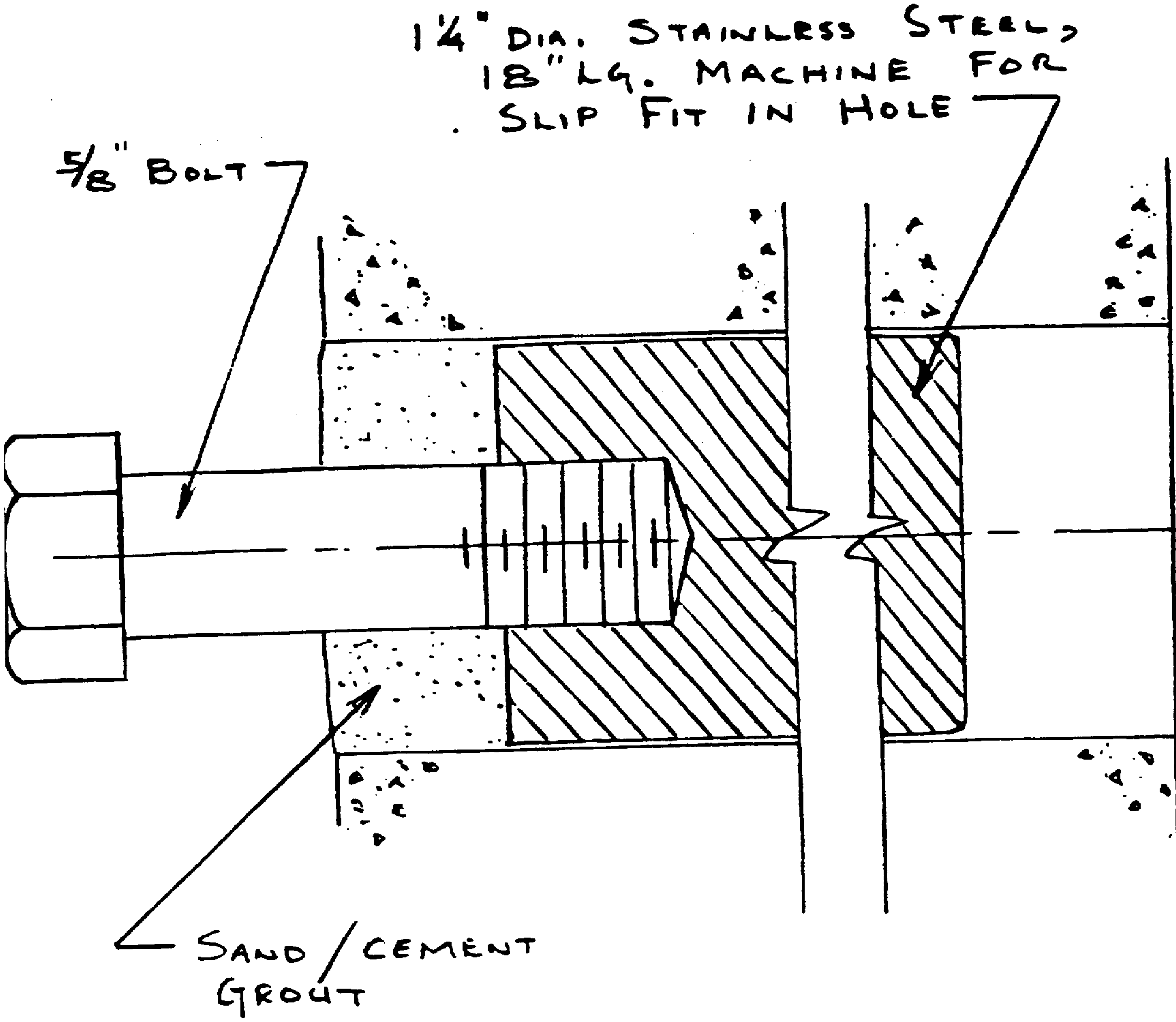


3'-4" THERMAL COLUMN AREA
HT-1
HT-2
2'-4" GENERAL AREA
3'-4"
BEAM HOLE AREA (ACTUAL)
2'-1"
HB-1
HB-2
SECTION
HB-3
BEAM HOLE AREA (PLANNED)

SK-RE 21985



DRILL BUSHING


1¼" DIA. STAINLESS STEEL, 18" LG. MACHINE FOR SLIP FIT IN HOLE
5/8" BOLT
SAND / CEMENT GROUT

SK-RE 2248

TELEDYNE ISOTOPES

APPENDIX 3.9

1. Letter of May 16, 1985 From Teledyne Isotopes, Inc. Regarding the Findings on the Hot Retention Area Water Infiltration

2. Letter of August 9, 1985 From Teledyne Isotopes, Inc. Regarding Follow Up Evaluation of the Hot Retention Area Water Infiltration

TELEDYNE ISOTOPES
PLUM BROOK OPERATIONS
P.O BOX 2304
SANDUSKY, OHIO 44870
TELEPHONE (419) 625-7

May 16, 1985

Mr. Earl C. Boitel, Jr.
PBRF Manager
NASA, Lewis Research Center
Mail Stop 86-8
21000 Brookpark Road
Cleveland, OH 44135

Dear Mr. Boitel:

This correspondence contains additional information regarding water infiltration of the PBRF-HRA structure.

Background

On Wednesday, May 8, 1985, employees of our PBRF Engineering Study Team cut open the welded caps on the hatches to the Hot Retention Area for purposes of entering that structure and performing an evaluation of the current condition of that facility. Several feet of water was noted throughout the annulus and further investigation showed that several inches of water were in tanks 2, 5 and 7. Mr. Thomas Junod, PBRF Radiation Safety Officer was promptly notified by telephone and he in turn notified Mr. Leonard Homyak and yourself. Prompt notification was made because of the fact that the End Condition Statement for the HRA called for the structure and its tanks to be dry.

Immediate Action

Samples of the water were collected on May 9, 1985 and analyzed for gross alpha and gross beta radioactivity. Water samples were also collected from the bottom of the CRA's for similar analysis in the event CRA water would be used for dilution, if needed. (Our Plans call for pumping out the CRA's to evaluate those structures. If dilution water is needed for the HRA water then we would need to know the activity levels in the CRA to calculate dilution ratios.)

Results of these analyses are as follows.

	alpha µCi/ml	beta µCi/ml
HRA - NW Annulus	0.09×10^{-7}	4.20×10^{-7}
HRA - SE Annulus	0.02×10^{-7}	3.50×10^{-7}
HRA - Tank 2	0.12×10^{-7}	43.00×10^{-7}
HRA - Tank 5	0.01×10^{-7}	49.00×10^{-7}
HRA - Tank 7	0.17×10^{-7}	2964.00×10^{-7}
CRA Basin 1 (bottom of structure)	0.06×10^{-7}	0.43×10^{-7}
CRA Basin 2 (bottom of structure)	0.05×10^{-7}	0.56×10^{-7}

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Some Limits of Release of Radioactivity in Water per 10CFR20, App. B, Table II, Column 2.

Cobalt 60	Sol.	5×10^{-5} µCi/ml
	Insol.	3×10^{-5} µCi/ml
Iron 59	Sol.	6×10^{-5} µCi/ml
	Insol.	5×10^{-5} µCi/ml
Nickel 59	Sol.	2×10^{-4} µCi/ml
	Insol.	2×10^{-3} µCi/ml
Nickel 63	Sol.	3×10^{-5} µCi/ml
	Insol.	7×10^{-4} µCi/ml
Strontium 90	Sol.	3×10^{-7} µCi/ml
	Insol.	4×10^{-5} µCi/ml
Unknown Mixtures of Isotopes		3×10^{-8} µCi/ml
Mixtures of Isotopes where I 129, Ra 226 and Ra 228 are known not to be present		1×10^{-7} µCi/ml
Mixtures of Isotopes where Sr 90, I 125, I 126, I 129, I 131, Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th nat., Cm 248, Cf 254, and Fm 256 are known not to be present		3×10^{-6} µCi/ml

In addition to collecting and analyzing the water samples, a review of appropriate station drawings was made to determine the construction features of the HRA and to attempt to determine how water entered the structure. The following drawings were helpful in this matter.

HOT RETENTION AREA
REFERENCE PRINTS

PF00827	Hot Retention Tanks, Gen. Arrangement and Details
PF00828	Hot Retention Tanks Concrete Details
PF00829	Hot Retention Tanks Concrete and Steel Details
PF00845	HRA Pipe Tunnel Elec. Power and Light
PF00846	Liquid Level Indicator Transducer Housing
PF00855	Hot Retention Tanks Distribution Piping
PF00856	Hot Retention Tanks Distribution Piping
PF04301	Site Plan and Underground Utilities, Area 17
FS30542	Standby Tank Leakage Alarm System Wiring
FS30567	Standby HRA Footer Drain Alarm Actuator

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The structure annulus was also entered on May 15, 1985, for a preliminary inspection. The general radiation field was approximately 0.08 mR/hr. The structure appeared to be dry and in good condition above the waterline. It should be noted that there was 34.75 inches of water in the structure and a few inches each in tanks 2, 5 and 7. A thorough inspection could not be made because of the depth of the water and limited portable lighting. The estimated quantities of water are as follows.

HRA annulus (99,000 gallons) - Displacement of 8 tanks (66,100 gallons) = 32,900 gallons net quantity in HRA

Tank 2 - estimated 2 inches x 237 gallons per inch = 474 gallons

Tank 5 - estimated 7 inches x 237 gallons per inch = 1659 gallons

Tank 7 - estimated 4 inches x 237 gallons per inch = 948 to 1422 gallons

CRA (dilution water) 500,000 gallons x 2 = 1,000,000 gallons

Total activity in HRA annulus	=	5.0 μCi
Total activity in HRA 2	=	7.7 μCi
Total activity in HRA 5	=	30.7 μCi
Total activity in HRA 7	=	1593.0 μCi (1.6 mCi)

<u>Discussion of Source of Water Infiltration</u>

Review of the drawings show that the HRA footers and floor were poured on bedrock. No footer drains are shown, however, a well casing and sump were sunk to footer depth external to the south wall of the HRA structure. This sump has been operational and is alarmed to the Communications Center and RSCB. It pumps to the WEMS ditches.

Another sump is centered within the structure to pump out groundwater infiltration. This sump (which discharges to tanks 1 and 2) apparently was secured at the time PBRF was placed in standby and has not operated since then.

When PBRF was operational, both the external and internal sumps operated. Since shutdown only the external sump has operated.

At first it was thought that the 34.75 inch depth of water in the structure was deep enough to cover flanged cover plates over access ports in the sidewalls of each tank. If the seals on any of these flanged ports had small leaks then the water within the structure could have gradually leaked into the tanks. It was first thought that this happened only with tanks 2, 5 and 7 and that water leaking into the structures and tanks became contaminated due to residual contamination in the dry structures and tanks. (The relative levels of radioactivity in the respective structures and tanks follow the same relative levels of radioactivity in the previously dry structures.)

On May 16, 1985 the pipe chase in the HRA superstructure was again entered. A soaking spring rain had occurred on the previous day and that day. It was noted that the HRA roof leaked in several places and that rainwater was draining into the HRA pipe chase. From there it was following normal gravity flow to the HRA tank access hatches. Tanks 2, 5 and 7 appeared to be receiving this runoff.

On the basis of the above it appears that the HRA structure has received its water as a result of groundwater infiltration, and the HRA tanks received their water as a result of roof leakage and drainage into certain tanks. Mixing of the low activity structures water and the higher activity tank water does not appear to have occurred.

Discussion of Disposal of Contaminated Water

All contaminated water samples were analyzed for gross radioactivity at Plum Brook. Additional samples will be sent to our Westwood Laboratories for isotopic identification (via GeLi gamma spectrometry) and strontium 90 separation and analysis. These analyses will permit the use of the most optimum discharge concentrations for purposes of dilution and release of the 33,000 gallons of HRA structures water (which currently is approximately 10 X MPC-U).

Similar analyses will likely permit evaluation and disposal of water in tank 2 (474 gallons and 100 X MPC-U) and tank 5 (1659 gallons and 100 X MPC-U). (Note that the MPC for unknown mixtures of isotopes is 3×10^{-8} µCi/ml.) Water in tank 7 may have to be concentrated and evaporated and the residue disposed of as dry solid waste in an approved drum due to total curie content (1.6 mCi).

Depending on isotopic identification it is conceivable that the MPC for these waters can be approximately 3×10^{-5} µCi/ml which would permit direct discharge of all water except tank 7. Tank 7 then would require approximate dilutions ranging from 10:1 to 100:1 for direct discharge.

As an alternate, direct pumping of mildly contaminated water can be made to the ERB where low level accumulations of radioactivity presently exist within the containment dike.

Portable temporary pumps and lines should be used because of the fact that radioactive contamination internally in present inoperative systems is unknown.

Discussion of End Condition for HRA

The presently defined end condition for the HRA has not maintained a dry structure as originally intended. It may be appropriate for the PBRF Radiation Safety Committee to evaluate this end condition and modify it as follows.

1. Do not weld-seal the HRA hatches closed, but, instead, hinge them and lock them with a heavy hasp/lock.

2. Reactivate the central internal structures sump pump and revise its discharge by:

   a. Breaking its connection to tanks 1 and 2 and directing its discharge to either the WEMS ditches or CRA. An alternative to this is to connect the internal scupper drains through an existing 4 inch capped pipe to the external sump pump. Gravity flow would bring infiltrated water to the external sump and then to the ditch.

   b. Alarm it and maintain a running time meter on it to obtain a pumping history.

3. Schedule a monthly structures inspection for a period of one year (or until a suitable period of observation establishes the nature of water infiltration.

4. Thereafter revise the schedule in 3. above to a quarterly schedule of inspection, with a provision for special inspections after heavy rains (greater than 1 inch per 24 hours).

Discussion of HRA Tank Corrosion

The eight HRA tanks are bedded on several inches of sand on top of HRA floor. These areas have been flooded as described above. When the HRA structure is dried again there will be moist sand beneath all eight HRA tanks for some time since this sand will not dry quickly. This moist sand with the presence of air in the intergranular spaces will hasten the metal corrosion of these tanks from the outside. Thorough ultrasonic testing of these tanks will be necessary before they can ever again be committed to storage of radioactive liquids. Metallurgical recommendations should be solicited to determine optimum conditions to minimize corrosion.

As we continue to gather additional information I will keep you informed.

Very truly yours,

John E. Ross / MLE

John E. Ross
General Manager
Plum Brook Operations

JER/ko

c: Mr. Thomas Junod
Mr. Leonard Homyak
Mr. Raphael Koch
Mr. Donald Young
Mr. Lee Early
Mr. Robert Korns
Mr. Eugene O'Brien
PBRF Engineering Study File
Mr. Steve Black
Dr. Donald Schutz
Mr. John Minderman

TELEDYNE ISOTOPES

PLUM BROOK OPERATIONS
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TELEPHONE (419) 625-

August 9, 1985

Mr. Earl Boitel
NASA Lewis Research Center
Mail Stop 86-8
21000 Brookpark Road
Cleveland, Ohio 44135

SUBJECT: PBRF Hot Retention Area Water Infiltration and Correspondence Dated 5/16/85 From J.E. Ross To Mr. Earl Boitel, Jr., PBRF Manager.

Dear Earl:

The purpose of this correspondence is to update you on the status of the HRA water infiltration problem as reported via my correspondence dated 5/16/85. Another purpose is to request an early decision and corrective action in changing the end condition statement for the HRA.

Two problems exist as defined in the above referenced letter:

1. Groundwater infiltration into the HRA structure annulus area outside of the tanks.

2. Rainwater accumulation in certain HRA tanks (2, 5, and 7) through roof leakage in the HRA pipe chase.

As long as these problems go uncorrected it will be impossible to maintain dry conditions (according to the present end condition statement) on an extended basis with our present staff and funding without detracting significantly from our other responsibilities at Plum Brook.

The isotopic analysis of HRA samples indicated the predominant isotopes in the HRA structures water to be K-40 (a naturally occurring isotope in soil and rock structures) with traces of 137-Cesium and 60-Cobalt. The predominant isotopes present in the tank water were found to be 137-Cesium, 60-Cobalt, and 90-Strontium. Enclosure 1 is a copy of this report. It should be noted that these man-made isotopes have showed up in samples of the ROLB Sump, Hot Lab Decon Room Sink and Hot Pipe Tunnel Cell Drain leak as well as other areas.

Based on the analytical data a work sheet was developed to plan dilution factors necessary to dispose of the HRA water. This was reviewed with Mr. Tom Junod, PBRF Health and Safety Officer to obtain his concurrence. This data appears in Enclosure 2. Water in the structure met release limits without dilution (Average MPCF=0.14), as did water in tank 5 (MPCF=0.48). Water in tanks 2 and 7 required dilution factors of 14 and 347 respectively.

It was decided not to pump out the 3 HRA tanks because:

1. Rainwater is still leaking in and will continue so until the pipe chase roof structure is altered or repaired.

2. The quantity of water in the tanks is relatively small compared to their capacity.

3. This water presents no immediate problem because it is contained in a secured/shutdown enclosure.

4. Pumpout under a controlled release requires extensive preplanning, records keeping and effort which is best reserved for that time at which the leakage is stopped and the problem resolved.

It was necessary to pump out the HRA structure because:

1. The source of the leak had to be determined.

2. The level of water was within a few Pan inches of flooding the 8 non-submersible pumps for the tank pumpouts.

3. The level of water was approximately twice that needed to float the tanks and an increasing upward buoyancy force would continue to increase risk of tank rupture or structure damage as the depth increased.

4. A radiological survey and structures evaluation was needed for the PBRF Engineering Study.

Pumpout of the HRA structure took place during the period 7/9/85 thru 7/25/85. Water was discharged to a nearby WEMS catch basin and diluted with near equal quantities of raw water. Samples were obtained at the catch basin, WEMS outlet and Plum Brook stream outfall. All samples were well within release limits. Enclosure 3 summarized this data. Since the structure has been pumped dry we have observed the rate of water accumulation during the past two weeks. This rate appears to be 41 gallons per day at this time.

Examination of the structure from inside the annulus reveals that the walls and ceiling are in excellent condition with no evidence of leaks. It appears that groundwater infiltration is occurring at

TELEDYNE ISOTOPES

a fairly uniform rate of 41 gallons a day at floor level or sump level. The exact location could not be identified because the metal tank retaining pans cover all floor area except a 4" wide perimeter area. It should be noted that blistering of the tank paint occurred beneath the water line and that corrosion has been observed to progress rapidly in just the few weeks since this structure was pumped dry. The water itself minimized tank corrosion although it degraded the coating.

Enclosure 4 is a sketch showing the relative elevations of the HRA floor, inside sump and outside sump (South side). Since the bottom of the outside South sump is at -28' elevation, the submersible pump probably is pumping from 1' - 1 1/2' above the bottom. This means that the elevation of the upper float is probably somewhere in the -25'to -24' elevation which is at or above floor level of the HRA structure.

On first thought a convenient solution would appear to be simply deepen the outside sump by several feet. While this may be desireable I do not believe it will solve the problem. The structure sits directly on bed rock and the outside sump is at the South end of the building. Flow of ground water to the sump will be sufficiently slow so that a hydrostatic head of ground water around the large HRA structure will probably always exist. This appears to be confirmed by drill logs obtained around the HRA in May 1985. Enclosure 5 is a copy of these logs. Please note that these occurred during the fourth dryest Spring on record in this part of Ohio. It can be seen that a groundwater table lies from -7' to -23' on the East - Southeast side of the structure. (Hole # I-12-E) The other holes on the West side show moist conditions also. The hydraulic head of groundwater is evidently sufficient to force infiltration through even the tiniest of leaks.

Based on the foregoing evaluations several options exist for the HRA structure:

1. Refil the HRA structure to the previous water level to minimize HRA tank corrosion and maintain the level at that point by automatic pump with level controls and alarms. This would preserve the tanks for future use if needed.

2. Activate the structure indoor sump pump, and pump to tanks 1 and 2 as originally designed. This is the simplest immediate solution but will eventually cause production of large quantities of contaminated water requiring extensive disposal or processing.

3. Activate the structure indoor sump pump (with a new electrical service line) and pump to CRA 1 via a new heavy wall plastic pipe. Pumping directly to the WEMS ditch is not recommended since trace quantities of 137- Cesium and 60-Cobalt were identified in the HRA structure water. Their exact source could not be determined and there is always the question as to when tanks 1 thru 8 start to leak and cause cross contamination. After these changes are made the lower portions of the tanks should be surface prepared, primed and recoated to preserve their integrity.

Any of the above solutions will require a change in the end condition statement. I would recommend that the 3rd alternative be <u>promptly</u> considered at this time so that work can be completed before cold weather complicates trenching operations.

An additional recommendation is offered to alleviate the rainwater infiltration of the HRA pipe chase and tanks. Enclosure 6 shows the numerous penetrations on the roof of this pipe chase along with evidence of cracks, seal failure, etc. It is recommended that these valve extensions, etc. be removed, saved for future use if needed, and the roof be resealed with a membrane/ballast enclosure. After this is completed then water in tanks 2, 5, and 7 can be processed and/or disposed of.

John E. Ross

John E. Ross

General Manager
Plum Brook Operations

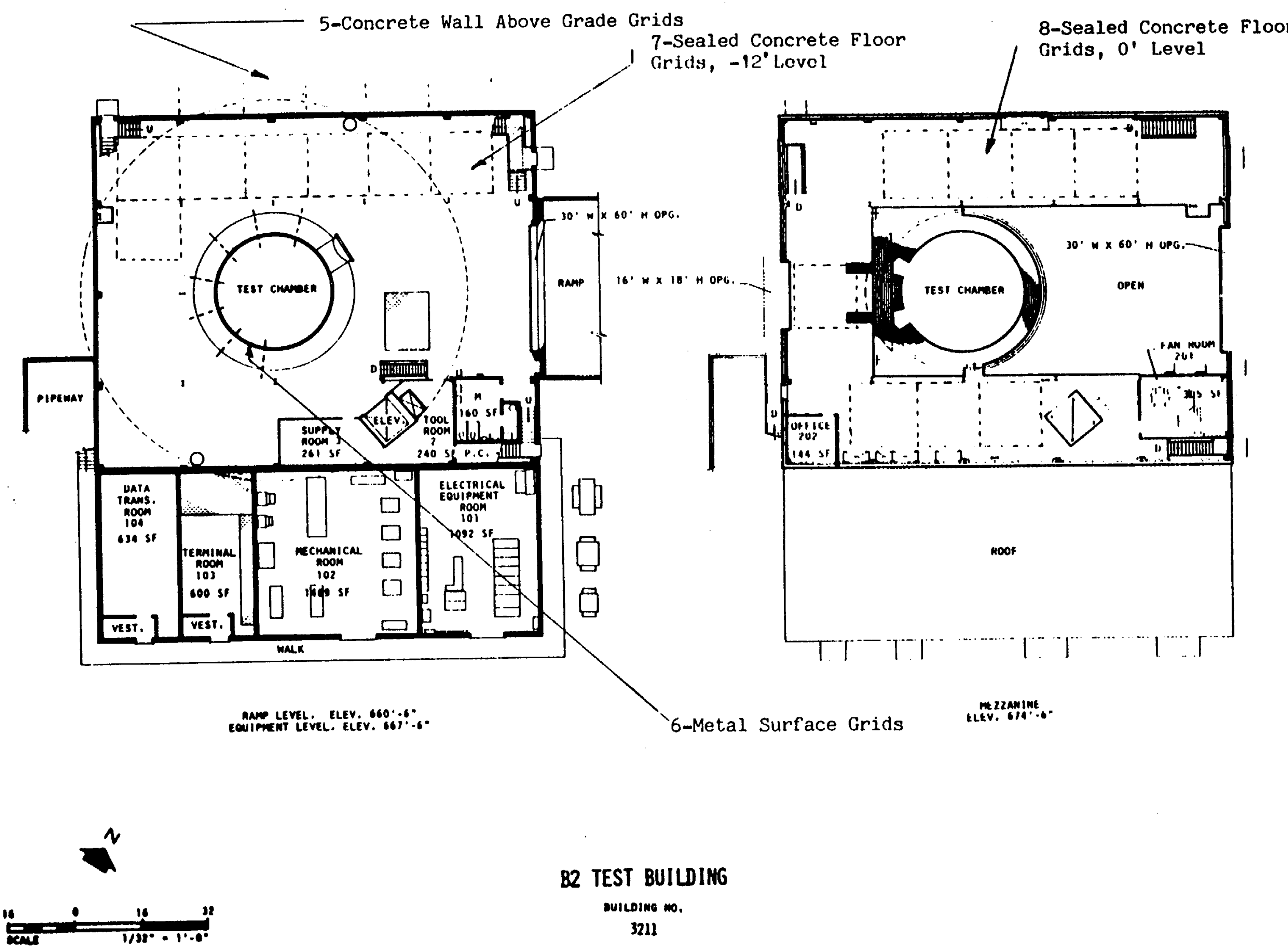
JER/el

Enclosures: 6

Copies: L. Homyak
T. Junod
R. Koch
PBRF Engineering (2)

APPENDIX 3.10

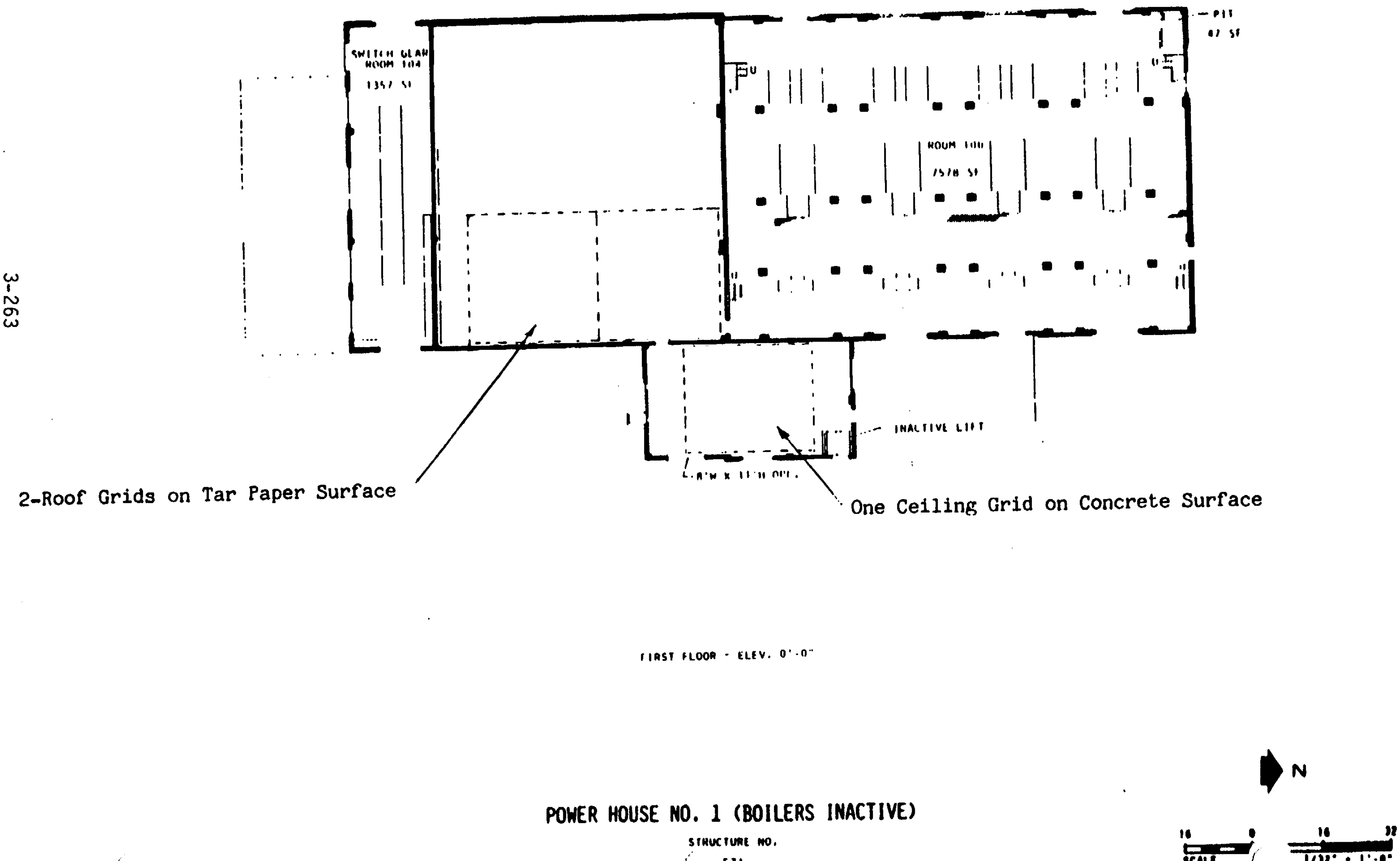
Radiological Monitoring Data For The PBRF Structures Background Radiation Evaluation



B2 TEST BUILDING

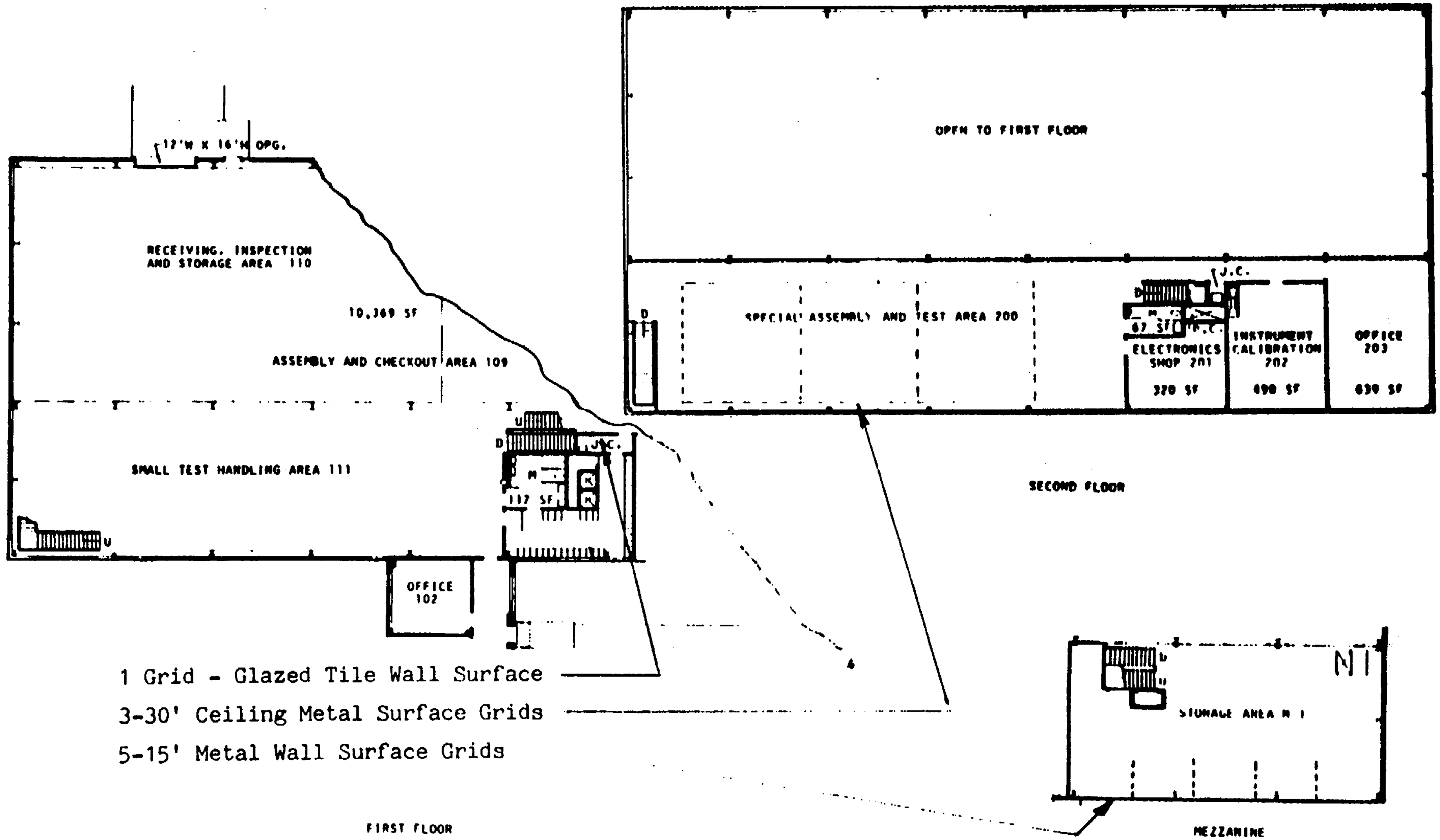
BUILDING NO.

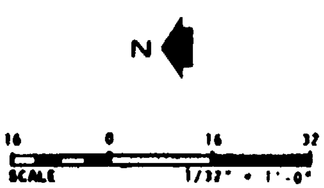
3211



POWER HOUSE NO. 1 (BOILERS INACTIVE)

STRUCTURE NO.
531

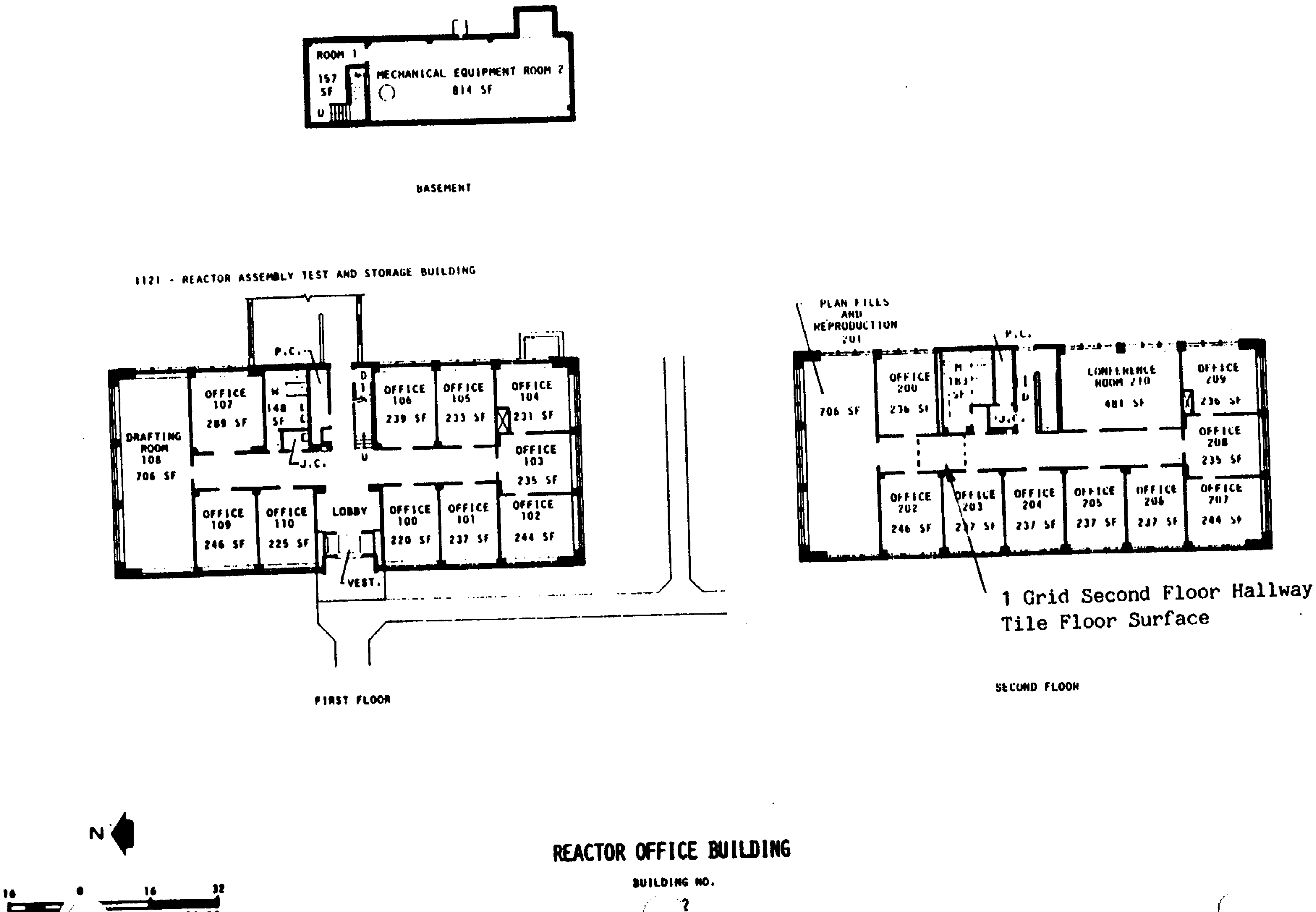




REACTOR ASSEMBLY TEST AND STORAGE BUILDING

BUILDING NO.

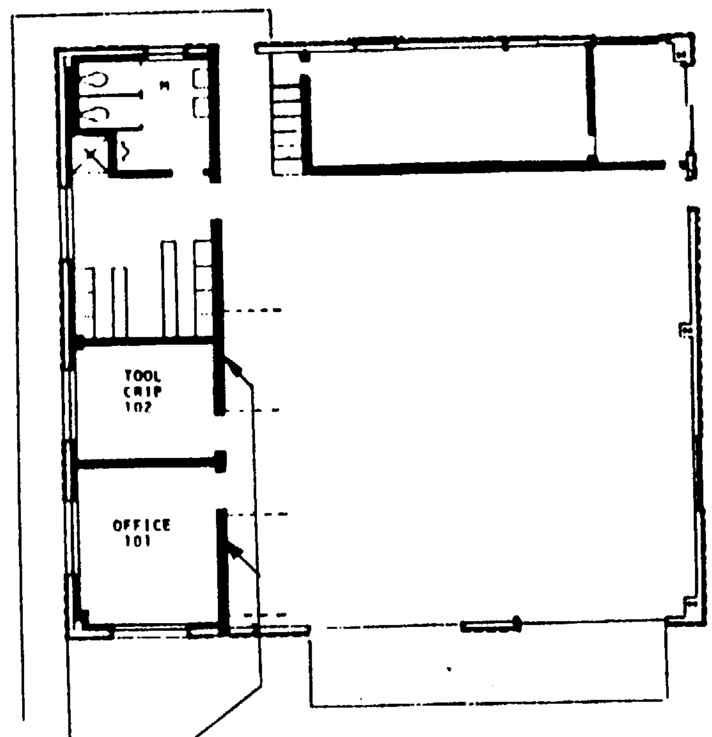
1121



REACTOR OFFICE BUILDING

BUILDING NO.

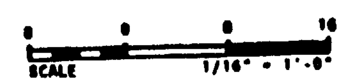
2

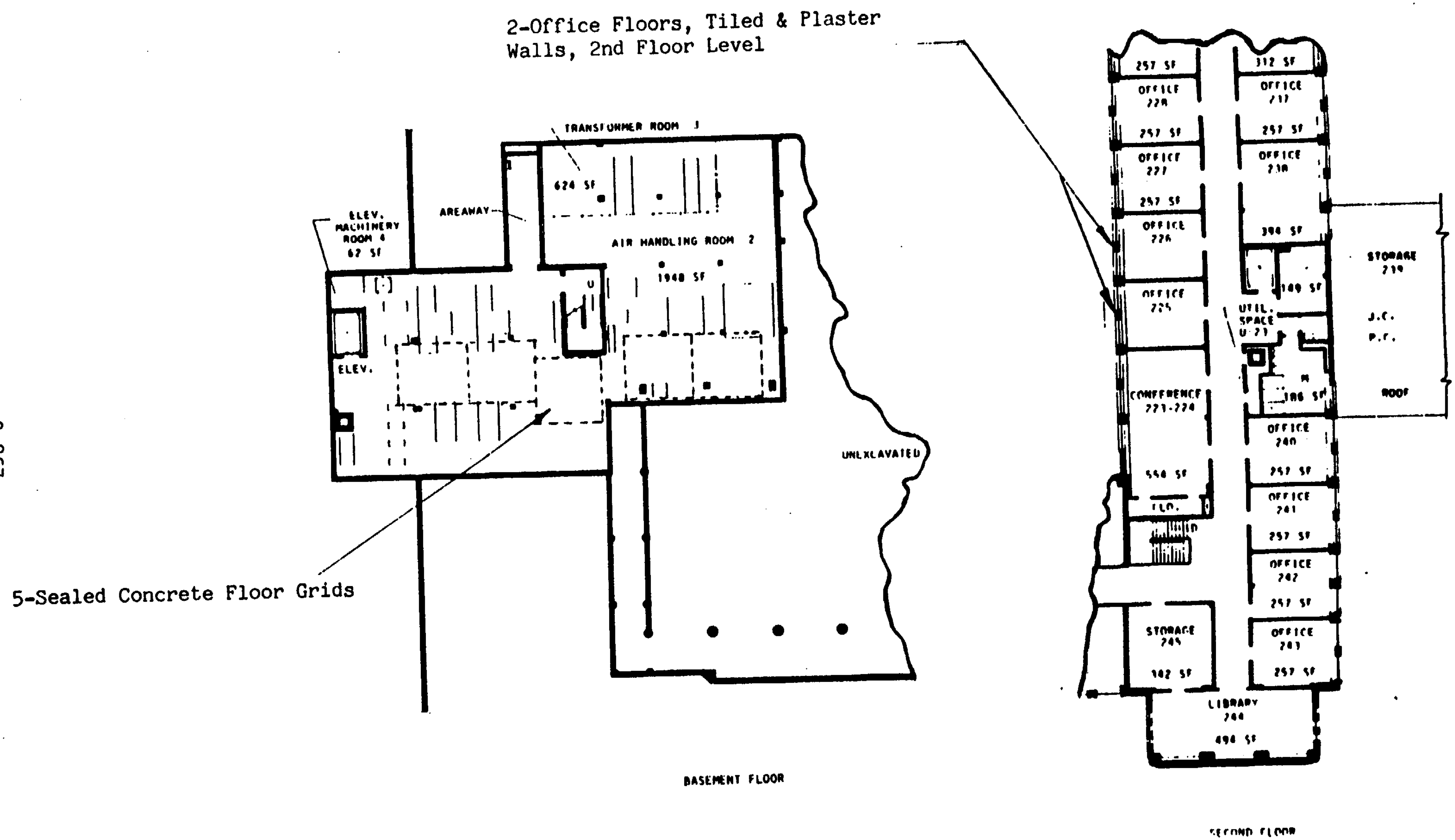


FIRST FLOOR

2-Concrete Block Wall
Surfaces, 0' Level

PLANT PROTECTION BUILDING
7233

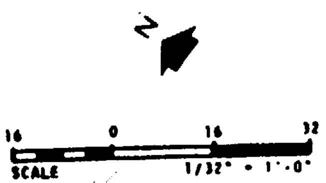




ENGINEERING BUILDING

BUILDING NO.

7141



BUILDING BACKGROUNDS RAD SURVEY GRIDS
12-18-85
10:27:55

GRID	TYPE	DATE	RSR NO	ZONE	PT 1	PT 2	PT 3	PT 4	PT 5	HI PT	MR HR	DIST 2	ALPH	AREA	CM	DIST 1	SMEAR ADPM	SMEAR BDPM	SSR NO
BG B-2 #1	CONCRETE FLOOR	11-22-85	63607	WHITE	25	<25	<25	<25	25	5	0.004	1M	3	59		CONT	0	15	53081
BG B-2 #2	CONCRETE FLOOR	11-22-85	63607	WHITE	<25	<25	<25	<25	25	5	0.003	1M	0	59		CONT	.27	10	53081
BG B-2 #3	CONCRETE FLOOR	11-22-85	63608	WHITE	50	<25	25	<25	25	1	0.004	1M	1	59		CONT	0	10	53081
BG B-2 #4	CONCRETE FLOOR	11-22-85	63608	WHITE	25	<25	25	<25	<25	1	0.004	1M	1	59		CONT	0	11	53081
BG B-2 #5	CONCRETE FLOOR	11-22-85	63609	WHITE	<25	50	50	25	25	2	0.003	1M	1	59		CONT	.54	11	53081
BG B-2 #6	CONCRETE FLOOR	11-22-85	63609	WHITE	25	25	25	<25	50	5	0.004	1M	0	59		CONT	0	15	53081
BG B-2 #7	CONCRETE FLOOR	11-22-85	63610	WHITE	50	50	<25	50	25	4	0.003	1M	0	59		CONT	0	0	53081
BG B-2 #8	CONCRETE FLOOR	11-22-85	63610	WHITE	25	25	50	25	25	3	0.004	1M	0	59		CONT	0	19	53081
BG B-2 #9	CONCRETE FLOOR	11-22-85	63611	WHITE	25	25	25	50	50	4	0.005	1M	0	59		CONT	.27	7	53081
BG B-2 #10	CONCRETE FLOOR	11-22-85	63611	WHITE	25	25	50	25	25	3	0.004	1M	0	59		CONT	0	7	53081
BG B-2 #11	CONCRETE FLOOR	11-22-85	63612	WHITE	50	25	25	<25	25	1	0.005	1M	0	59		CONT	.54	12	53081
BG B-2 #12	CONCRETE FLOOR	11-22-85	63612	WHITE	25	50	25	25	25	2	0.004	1M	0	59		CONT	.54	15	53081
BG B-2 #13	CONCRETE FLOOR	11-22-85	63613	WHITE	25	25	25	50	<25	4	0.006	1M	0	59		CONT	0	12	53081
BG B-2 #14	CONCRETE FLOOR	11-22-85	63613	WHITE	25	25	50	25	25	3	0.004	1M	0	59		CONT	.54	9	53081
BG B-2 #15	CONCRETE FLOOR	11-22-85	63614	WHITE	25	25	<25	<25	25	5	0.005	1M	0	59		CONT	.27	19	53081
BG B-2 #16	N. WALL	11-22-85	63618	WHITE	25	25	25	25	50	5	0.005	1M	1	59		CONT	.27	11	53081
BG B-2 #17	N. WALL	11-22-85	63618	WHITE	50	25	25	25	25	1	0.004	1M	4	59		CONT	.54	4	53081
BG B-2 #18	N. WALL	11-22-85	63619	WHITE	25	50	25	25	25	2	0.004	1M	0	59		CONT	.27	3	53081
BG B-2 #19	N. WALL	11-22-85	63619	WHITE	50	25	25	25	25	1	0.004	1M	9	59		CONT	.27	12	53081
BG B-2 #20	N. WALL	11-22-85	63620	WHITE	50	25	50	25	25	3	0.004	1M	3	59		CONT	0	12	53081
BG B2 CT-1	METAL CONT TANK	11-22-85	63615	WHITE	25	25	25	25	25	5	0.002	1M	1	59		CONT	0	7	53081
BG B2 CT-2	METAL CONT TANK	11-22-85	63615	WHITE	25	25	25	25	25	5	0.002	1M	0	59		CONT	0	18	53081
BG B2 CT-3	METAL CONT TANK	11-22-85	63616	WHITE	25	25	25	25	25	3	0.002	1M	0	59		CONT	0	14	53081
BG B2 CT-4	METAL CONT TANK	11-22-85	63616	WHITE	25	25	25	25	25	1	0.002	1M	1	59		CONT	0	5	53081
BG B2 CT-5	METAL CONT TANK	11-22-85	63617	WHITE	25	25	25	25	25	4	0.001	1M	0	59		CONT	.27	8	53081
BG B2 CT-6	METAL CONT TANK	11-22-85	63617	WHITE	25	25	25	25	25	3	0.002	1M	3	59		CONT	.27	12	53081
BG PH #1	PH ROOF	11-25-85	63621	WHITE	50	25	25	25	<25	1	0.005	1M	0	59		CONT	0	0	0
BG PH #2	PH ROOF	11-25-85	63621	WHITE	25	50	25	<25	25	2	0.005	1M	0	59		CONT	0	0	0
BG PH #3	CONCRETE CEIL	11-25-85	63622	WHITE	25	<25	<25	<25	<25	1	0.005	1M	0	59		CONT	0	3	53083
BG ATS #1	W. WALL	11-25-85	63623	WHITE	25	<25	25	25	25	3	0.004	1M	0	59		CONT	.27	22	53083
BG ATS #2	W. WALL	11-25-85	63623	WHITE	25	25	<25	25	25	5	0.004	1M	0	59		CONT	.27	10	53083
BG ATS #3	W. WALL	11-25-85	63624	WHITE	25	25	25	25	50	5	0.004	1M	1	59		CONT	0	10	53083
BG ATS #4	W. WALL	11-25-85	63624	WHITE	25	25	50	25	25	3	0.004	1M	3	59		CONT	.54	1	53083
BG ATS #5	W. WALL	11-25-85	63625	WHITE	25	<25	25	25	<25	3	0.004	1M	0	59		CONT	.27	8	53083
BG ATS #6	E. WALL	11-25-85	63627	WHITE	25	25	50	25	50	5	0.009	1M	7	59		CONT	0	16	53083
BG ATS #7	METAL CEILING	11-25-85	63626	WHITE	25	25	<25	<25	25	5	0.002	1M	4	59		CONT	.54	8	53083
BG ATS #8	METAL CEILING	11-25-85	63626	WHITE	25	25	25	50	25	4	0.003	1M	0	59		CONT	0	9	53083
BG ATS #9	METAL CEILING	11-25-85	63627	WHITE	<25	<25	<25	25	<25	3	0.003	1M	3	59		CONT	0	6	53083
BG ROB #1	HALLWAY	11-25-85	63628	WHITE	25	<25	0	0	50	5	0.006	1M	4	59		CONT	.54	13	53083
BG FS #1	S. WALL	11-25-85	63629	WHITE	<25	25	<25	<25	<25	2	0.004	1M	1	59		CONT	0	12	53083
BG FS #2	S. WALL	11-25-85	63629	WHITE	25	<25	50	25	25	3	0.004	1M	0	59		CONT	.27	14	53083
BG EB #1	CONCRETE FLOOR	12-12-84	63630	WHITE	50	50	75	75	50	3	0.005	1M	6	59		CONT	0	0	0
BG EB #2	CONCRETE FLOOR	12-12-84	63630	WHITE	100	75	75	100	125	5	0.005	1M	5	59		CONT	0	0	0
BG EB #3	CONCRETE FLOOR	11-25-85	63631	WHITE	<25	25	25	25	<25	2	0.005	1M	1	59		CONT	0	23	53083
BG EB #4	CONCRETE FLOOR	11-25-85	63631	WHITE	25	25	25	25	25	5	0.005	1M	0	59		CONT	.27	26	53083
BG EB #5	CONCRETE FLOOR	11-25-85	63632	WHITE	25	25	25	25	25	3	0.005	1M	1	59		CONT	.81	25	53083
BG EB #6	TILE FLOOR	11-25-85	63633	WHITE	<25	25	25	<25	25	5	0.004	1M	4	59		CONT	0	6	53083
BG EB #7	N. WALL	11-25-85	63633	WHITE	25	25	25	25	25	4	0.003	1M	10	59		CONT	.27	8	53083
BG EB #8	E. WALL	11-25-85	63634	WHITE	<25	25	<25	25	25	5	0.004	1M	4	59		CONT	0	5	53083
BG EB #9	S. WALL	11-25-85	63634	WHITE	25	25	25	25	25	1	0.004	1M	9	59		CONT	0	15	53083
BG EB #10	W. WALL	11-25-85	63635	WHITE	25	25	25	25	25	5	0.003	1M	1	59		CONT	0	18	53083
BG EB #11	TILE FLOOR	11-25-85	63635	WHITE	25	<25	25	25	<25	4	0.004	1M	10	59		CONT	.54	.55	53083
BG EB #12	N. WALL	11-25-85	63636	WHITE	25	25	25	25	25	1	0.004	1M	13	59		CONT	19	15	53083
BG EB #13	E. WALL	11-25-85	63636	WHITE	50	25	25	25	25	1	0.004	1M	7	59		CONT	0	10	53083

BUILDING BACKGROUNDS RAD SURVEY GRIDS
12-18-85
10:32:23

GRID	TYPE	GS3W NO	GS3W CAL DATE	PRM7 NO	PRM7 CAL DATE	PRS1 NO	PRS1 CAL DATE	PRS1 EFF	NC A EFF	NC B EFF	REC#
BG B-2 #1	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	1
BG B-2 #2	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	2
BG B-2 #3	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	3
BG B-2 #4	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	4
BG B-2 #5	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	5
BG B-2 #6	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	6
BG B-2 #7	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	7
BG B-2 #8	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	8
BG B-2 #9	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	9
BG B-2 #10	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	10
BG B-2 #11	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	11
BG B-2 #12	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	12
BG B-2 #13	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	13
BG B-2 #14	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	14
BG B-2 #15	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	15
BG B-2 #16	N. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	16
BG B-2 #17	N. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	17
BG B-2 #18	N. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	18
BG B-2 #19	N. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	19
BG B-2 #20	N. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	20
BG B2 CT-1	METAL CONT TANK	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	21
BG B2 CT-2	METAL CONT TANK	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	22
BG B2 CT-3	METAL CONT TANK	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	23
BG B2 CT-4	METAL CONT TANK	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	24
BG B2 CT-5	METAL CONT TANK	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	25
BG B2 CT-6	METAL CONT TANK	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	26
BG PH #1	PH ROOF	36024	10-24-85	466	10-22-85	0		34	37	37	27
BG PH #2	PH ROOF	36024	10-24-85	466	10-22-85	0		34	37	37	28
BG PH #3	CONCRETE CEIL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	29
BG ATS #1	W. WALL	63624	10-24-85	466	10-22-85	423	10-24-85	34	37	37	30
BG ATS #2	W. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	31
BG ATS #3	W. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	32
BG ATS #4	W. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	33
BG ATS #5	W. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	34
BG ATS #6	E. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	35
BG ATS #7	METAL CEILING	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	36
BG ATS #8	METAL CEILING	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	37
BG ATS #9	METAL CEILING	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	38
BG ROB #1	HALLWAY	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	39
BG FS #1	S. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	40
BG FS #2	S. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	41
BG EB #1	CONCRETE FLOOR	36024	10-10-84	466	12-10-84	423	12-10-84	34	37	37	42
BG EB #2	CONCRETE FLOOR	36024	10-10-84	466	12-10-84	423	12-10-84	34	37	37	43
BG EB #3	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	44
BG EB #4	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	45
BG EB #5	CONCRETE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	46
BG EB #6	TILE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	47
BG EB #7	N. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	48
BG EB #8	E. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	49
BG EB #9	S. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	50
BG EB #10	W. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	51
BG EB #11	TILE FLOOR	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	52
BG EB #12	N. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	53
BG EB #13	E. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	54

BUILDING BACKGROUNDS RAD SURVEY GRIDS
12-18-85
10:27:55

GRID	TYPE	DATE	RSR NO	ZONE	PT 1	PT 2	PT 3	PT 4	PT 5	HI PT	MR HR	DIST 2	ALPH	AREA CM	DIST 1	SMEAR ADPM	SMEAR BDPM	SSR NO
BG BB #14	S. WALL	11-25-85	63637	WHITE	25	25	25	25	25	3	0.004	1M	12	59	CONT	.27	9	53083
BG BB #15	W. WALL	11-25-85	63637	WHITE	25	25	25	25	25	3	0.004	1M	18	59	CONT	.27	7	53083

FD235 Number of Records Read: 56
FD236 Number of Records Selected: 56

BUILDING BACKGROUNDS RAD SURVEY GRIDS
12-18-85
10:32:23

GRID	TYPE	OS3W NO	OS3W CAL DATE	PRM7 NO	PRM7 CAL DATE	PRS1 NO	PRS1 CAL DATE	PRS1 EFF	NC A EFF	NC B EFF	REC#
BG EB #14	S. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	55
BG EB #15	W. WALL	36024	10-24-85	466	10-22-85	423	10-24-85	34	37	37	56

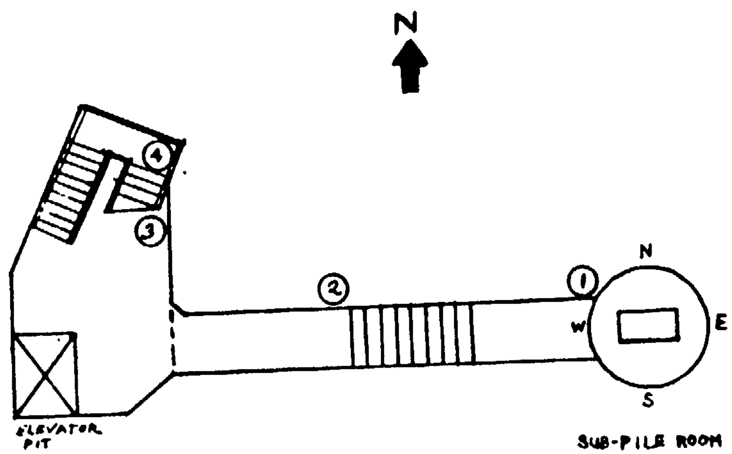
PD235 Number of Records Read: 56
PD236 Number of Records Selected: 56

APPENDIX 3.11

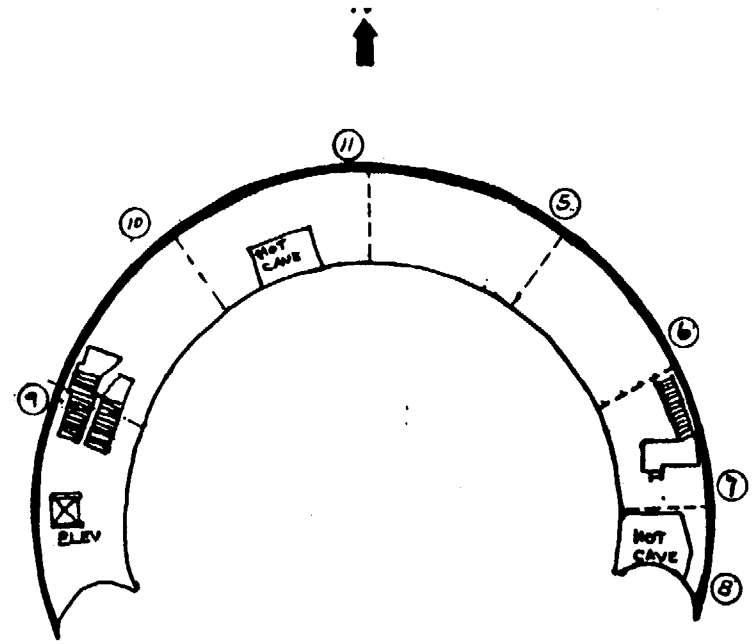
Radiological Monitoring Data For The PBRF

1. Building #1111 - Containment Vessel
2. Building #1111 - Outside The Containment Vessel

1. Building #1111 - Containment Vessel



SUB-PILE ROOM
-40' LEVEL
GRIDS CV-1 to 4



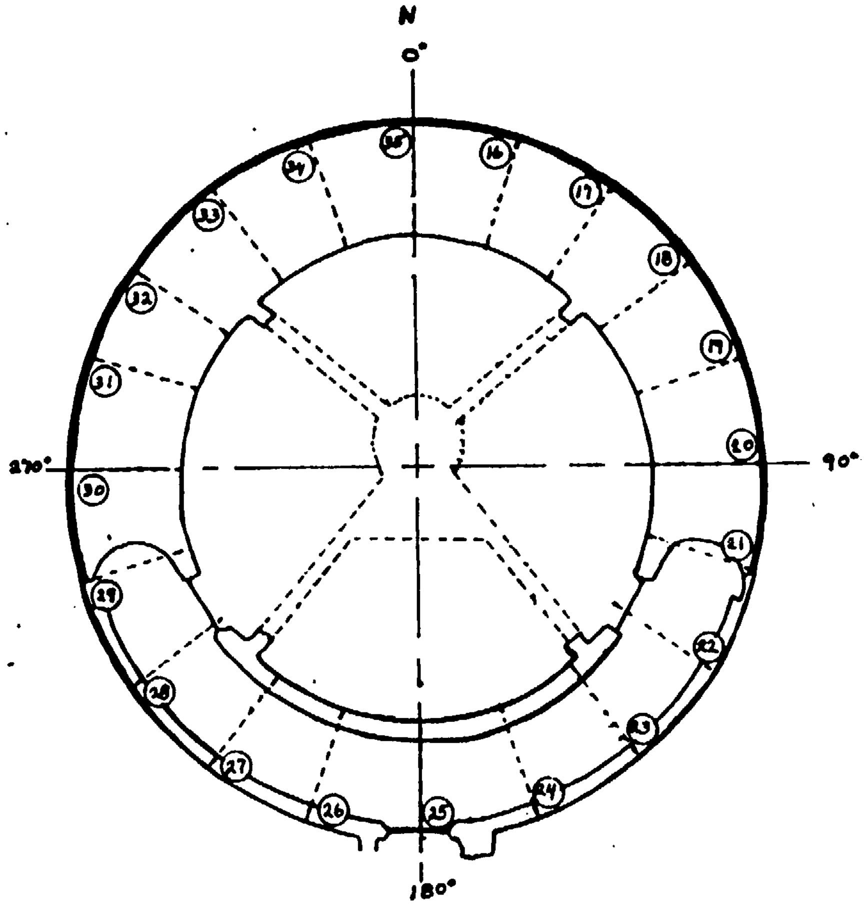
SUB-BASEMENT - ELEV. -25'-0"

SUB PILEROOM ONE AREA
CV-1 FROM DOOR TO TOP OF STAIRS
CV-2 FROM TOP OF STAIRS TO END OF CORRIDORE
CV-3 AREA EXCLUDING ELEVATOR PIT
CV-4 STAIRWELL AREA

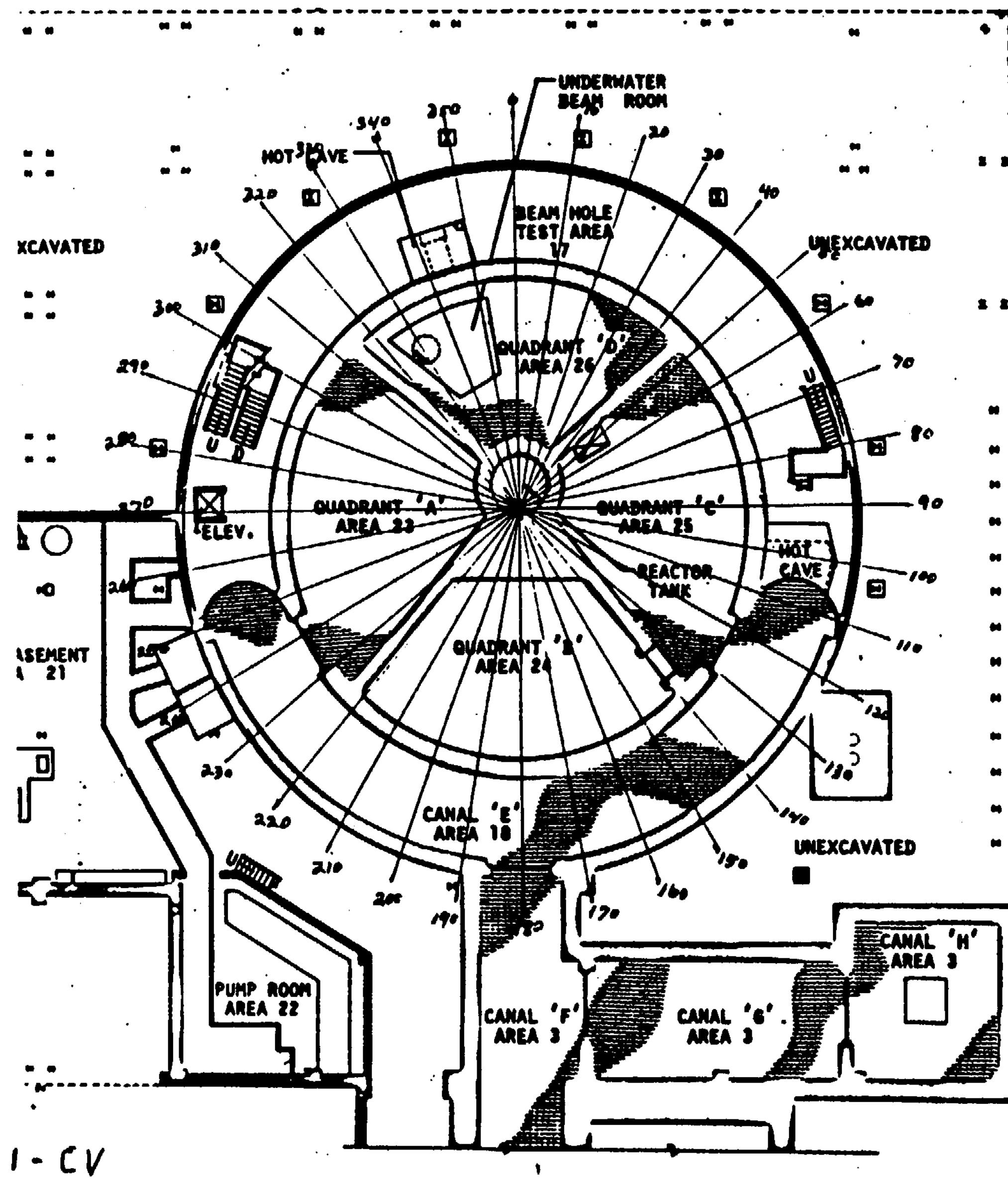
BLDG 1111 - CV GRID INDEX

-25'-0" LEVEL CONTAINS
CV GRIDS 5-6-7-8-9-10-11
EAST STAIRWELL HAS GRIDS 12-13
WEST STAIRWELL HAS GRIDS 14-15
-15'-0" Level & -7'0" ARE SAME
GRID NUMBERS FOR ORIENTATION.

BLDG 1111 - CV
GRID INDEX



REACTOR CONTAINMENT VESSEL
FLOOR GRID PLAN O' LEVEL
WALL GRIDS FOR CV USED SAME
GRID NUMBERS PLUS 0', 20' & 30'
FLOORS DO NOT INCLUDE QUADRANT &
CANAL FLOORS



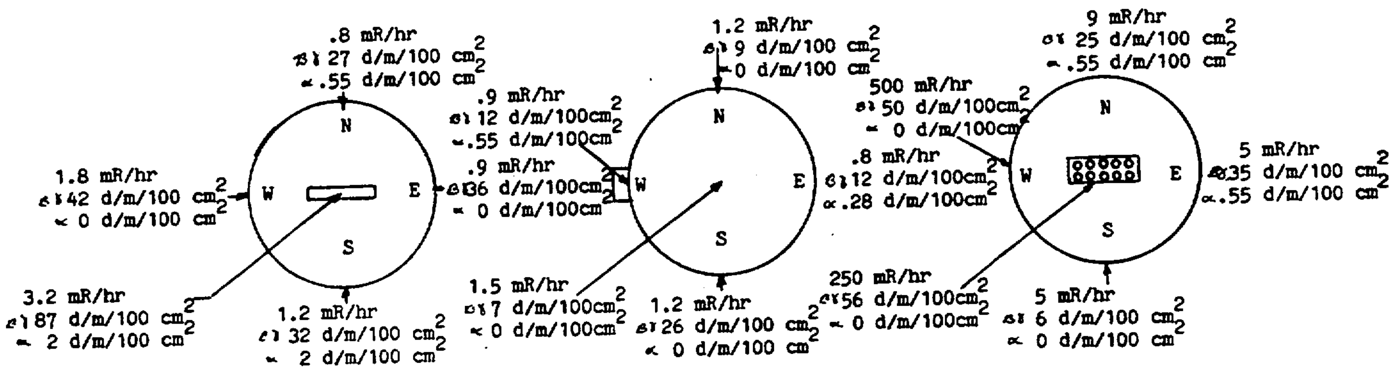
BLDG 1111 - CV

GRID INDEX & POLAR COORD.

REFERENCE

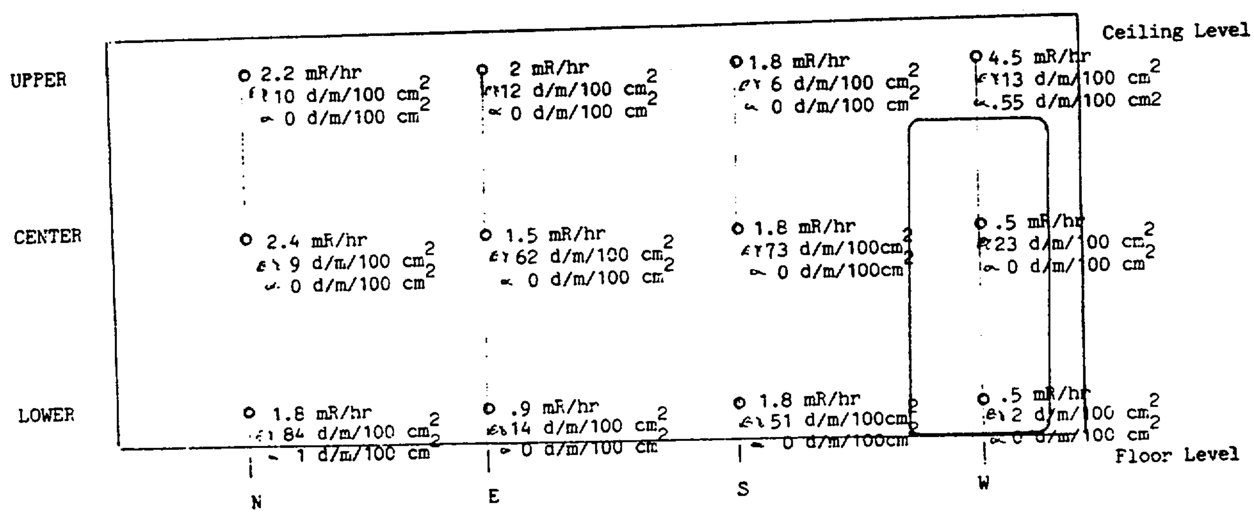
SUB-BASEMENT - ELEV. -25'-0"

REF. DRWG. PF-00103



SUMP DISH FLOOR PLATE CEILING

Ceiling Readings in Mr/hr with Cutie Pie - Contact



REACTOR BUILDING

SUB-PILE ROOM

RAD SURVEY CONTAINMENT VESSEL
09-12-85
00:02:18

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
-7' CV 9	5-2-85	Floor	Magenta Yellow	125	100	0	0	0	Pt 1	50	59	0.006
CV 1	5-2-85	E. Wall	Magenta Yellow	300	1000	1000	400	2000	Pt 5	32	59	0.380
CV 1	5-2-85	S.Wall	Magenta Yellow	150	200	1500	300	150	Pt 3	44	59	0.250
CV 1	5-2-85	Ceiling	Magenta Yellow	200	200	100	100	150	Pt 1	53	59	0.050
CV 2	5-2-85	Floor	Magenta Yellow	150	200	250	2500	250	Pt 4	206	59	0.100
CV 2	5-2-85	N. Wall	Magenta Yellow	500	700	4000	900	700	Pt 3	38	59	0.150
CV 2	5-2-85	S. Wall	Magenta Yellow	450	1000	200	250	150	Pt 2	59	59	0.020
CV 2	5-2-85	Ceiling	Magenta Yellow	250	200	250	250	250	Pt 5	26	59	0.018
CV 3	5-2-85	Floor	Magenta Yellow	300	250	2000	150	150	Pt 3	24	59	0.160
CV 3	5-2-85	N. Wall	Magenta Yellow	200	250	200	250	200	Pt 4	32	59	0.008
CV 3	5-2-85	E. Wall	Magenta Yellow	200	250	150	150	250	Pt 5	35	59	0.018
CV 3	5-2-85	S. Wall	Magenta Yellow	0	0	150	100	100	Pt 3	29	59	0.028
CV 3	5-2-85	W. Wall	Magenta Yellow	0	150	200	250	150	Pt 4	29	59	0.032
CV 3	5-2-85	Ceiling	Magenta Yellow	250	150	150	200	200	Pt 1	44	59	0.009
CV 4	5-2-85	Floor	Magenta Yellow	150	150	125	100	100	Pt 1	53	59	0.010
CV 4	5-2-85	Stairwell	Magenta Yellow	150	150	100	125	0	Pt 2	44	59	0.010
CV 5	5-2-85	Floor	Magenta Yellow	150	150	125	150	200	Pt 5	18	59	0.007
CV 5	5-2-85	Wall	Magenta Yellow	200	150	150	150	100	Pt 1	24	59	0.007
CV 5	5-2-85	Wall	Magenta Yellow	100	100	150	200	150	Pt 4	59	59	0.006
CV 6	5-2-85	Floor	Magenta Yellow	100	250	150	100	200	Pt 2	48	59	0.010
CV 6	5-2-85	Wall	Magenta Yellow	200	125	200	100	150	Pt 3	29	59	0.010
CV 6	5-2-85	Wall	Magenta Yellow	125	100	175	200	125	Pt 4	27	59	0.008
CV 7	5-2-85	Floor	Magenta Yellow	150	100	150	200	175	Pt 4	29	59	0.010
CV 7	5-2-85	Wall	Magenta Yellow	150	100	100	150	100	Pt 1	44	59	0.005
CV 7	5-2-85	Wall	Magenta Yellow	100	175	200	150	150	Pt 3	24	59	0.015
CV 8	5-2-85	Floor	Magenta Yellow	500	0	0	150	0	Pt 1	18	59	0.080
CV 8	5-2-85	Wall	Magenta Yellow	150	150	150	200	150	Pt 4	41	59	0.035
CV 8	5-2-85	Wall	Magenta Yellow	150	200	300	200	150	Pt 3	38	59	0.050
CV 9	5-2-85	Floor	Magenta Yellow	100	125	200	150	300	Pt 5	15	59	0.011
CV 9	5-2-85	Wall	Magenta Yellow	150	125	150	125	150	Pt 3	24	59	0.018
CV 9	5-2-85	Wall	Magenta Yellow	100	125	100	125	150	Pt 5	27	59	0.006
CV 10	5-2-85	Floor	Magenta Yellow	175	200	125	150	250	Pt 5	24	59	0.022
CV 10	5-2-85	Wall	Magenta Yellow	200	200	200	200	400	Pt 5	44	59	0.050
CV 10	5-2-85	Wall	Magenta Yellow	125	100	125	100	150	Pt 5	15	59	0.008
SPR	5-1-85	Dish	Magenta Yellow	2000	2500	1800	3000	6000	Pt 5	6	59	3.200
SPR	5-1-85	Ceiling	Magenta Yellow	0	0	0	0	0	Pt 4	0	59	500.000
SPR	5-1-85	Floor	Magenta Yellow	2100	2000	3000	2000	3800	Pt 5	38	59	2.000
SPR	5-1-85	W. Wall	Magenta Yellow	12000	500	1100	0	0	Pt 1	15	59	5.000
SPR	5-1-85	S. Wall	Magenta Yellow	2000	2200	2500	0	0	Pt 3	15	59	2.000
SPR	5-1-85	E. Wall	Magenta Yellow	3000	2500	1000	0	0	Pt 1	9	59	2.000
SPR	5-1-85	N. Wall	Magenta Yellow	5000	7000	2200	0	0	Pt 2	18	59	2.000
CV 1	5-2-85	Floor	Magenta Yellow	3000	2500	400	200	300	Pt 1	44	59	0.450
CV 1	5-2-85	N. Wall	Magenta Yellow	250	700	250	150	200	Pt 2	12	59	0.180
-7 CV 8	5-3-85	Floor	Magenta Yellow	100	100	0	0	0	Pt 1	41	59	0.011
-7 CV 7	5-3-85	Floor	Magenta Yellow	125	75	0	0	0	Pt 1	29	59	0.008
-7 CV 6	5-3-85	Floor	Magenta Yellow	100	100	0	0	0	Pt 2	35	59	0.011
-7 CV 5	5-3-85	Floor	Magenta Yellow	200	100	0	0	0	Pt 1	27	59	0.011
-7 CV 11	5-3-85	Floor	Magenta Yellow	125	150	0	0	0	Pt 2	29	59	0.007

PD235 Number of Records Read: 156
PD236 Number of Records Selected: 156

RAD SURVEY CONTAINMENT VESSEL
09-12-85
00:12:46

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
-7' CV 9	5-2-85	Floor	Magenta Yellow	53029	0	5	63469	36027	4-9-85	466	4-11-85
CV 1	5-2-85	E. Wall	Magenta Yellow	53025	0	2	63436	36027	4-9-85	466	4-11-85
CV 1	5-2-85	S.Wall	Magenta Yellow	53025	0	3	63436	36027	4-9-85	466	4-11-85
CV 1	5-2-85	Ceiling	Magenta Yellow	53025	0	0	63437	36027	4-9-85	466	4-11-85
CV 2	5-2-85	Floor	Magenta Yellow	53025	0	104	63437	36027	4-9-85	466	4-11-85
CV 2	5-2-85	N. Wall	Magenta Yellow	53025	0	185	63438	36027	4-9-85	466	4-11-85
CV 2	5-2-85	S. Wall	Magenta Yellow	53025	0	0	63438	36027	4-9-85	466	4-11-85
CV 2	5-2-85	Ceiling	Magenta Yellow	53025	0	2	63439	36027	4-9-85	466	4-11-85
CV 3	5-2-85	Floor	Magenta Yellow	53025	0	57	63439	36027	4-9-85	466	4-11-85
CV 3	5-2-85	N. Wall	Magenta Yellow	53025	0	2	63440	36027	4-9-85	466	4-11-85
CV 3	5-2-85	E. Wall	Magenta Yellow	53025	0	4	63440	36027	4-9-85	466	4-11-85
CV 3	5-2-85	S. Wall	Magenta Yellow	53025	0	0	63441	36027	4-9-85	466	4-11-85
CV 3	5-2-85	W. Wall	Magenta Yellow	53025	0	0	63441	36027	4-9-85	466	4-11-85
CV 3	5-2-85	Ceiling	Magenta Yellow	53025	0	0	63442	36027	4-9-85	466	4-11-85
CV 4	5-2-85	Floor	Magenta Yellow	53025	2	17	63442	36027	4-9-85	466	4-11-85
CV 4	5-2-85	Stairwell	Magenta Yellow	53025	0	7	63443	36027	4-9-85	466	4-11-85
CV 5	5-2-85	Floor	Magenta Yellow	53025	2	50	63444	36027	4-9-85	466	4-11-85
CV 5	5-2-85	Wall	Magenta Yellow	53025	0	3	63444	36027	4-9-85	466	4-11-85
CV 5	5-2-85	Wall	Magenta Yellow	53025	0	0	63445	36027	4-9-85	466	4-11-85
CV 6	5-2-85	Floor	Magenta Yellow	53025	3	189	63445	36027	4-9-85	466	4-11-85
CV 6	5-2-85	Wall	Magenta Yellow	53025	0	5	63446	36027	4-9-85	466	4-11-85
CV 6	5-2-85	Wall	Magenta Yellow	53025	2	1	63446	36027	4-9-85	466	4-11-85
CV 7	5-2-85	Floor	Magenta Yellow	53026	0	0	63447	36027	4-9-85	466	4-11-85
CV 7	5-2-85	Wall	Magenta Yellow	53026	0	22	63447	36027	4-9-85	466	4-11-85
CV 7	5-2-85	Wall	Magenta Yellow	53026	0	0	63448	36027	4-9-85	466	4-11-85
CV 8	5-2-85	Floor	Magenta Yellow	53026	3	15	63448	36027	4-9-85	466	4-11-85
CV 8	5-2-85	Wall	Magenta Yellow	53026	0	2	63449	36027	4-9-85	466	4-11-85
CV 8	5-2-85	Wall	Magenta Yellow	53026	0	33	63449	36027	4-9-85	466	4-11-85
CV 9	5-2-85	Floor	Magenta Yellow	53029	0	8	63450	36027	4-9-85	466	4-11-85
CV 9	5-2-85	Wall	Magenta Yellow	53029	0	0	63450	36027	4-9-85	466	4-11-85
CV 9	5-2-85	Wall	Magenta Yellow	53029	0	2	63451	36027	4-9-85	466	4-11-85
CV 10	5-2-85	Floor	Magenta Yellow	53029	0	8	63451	36027	4-9-85	466	4-11-85
CV 10	5-2-85	Wall	Magenta Yellow	53029	0	0	63453	36027	4-9-85	466	4-11-85
CV 10	5-2-85	Wall	Magenta Yellow	53029	0	0	63453	36027	4-9-85	466	4-11-85
SPR	5-1-85	Dish	Magenta Yellow	53023	2	45	63432	36027	4-9-85	466	4-11-85
SPR	5-1-85	Ceiling	Magenta Yellow	53023	0	34	63432	36027	4-9-85	466	4-11-85
SPR	5-1-85	Floor	Magenta Yellow	53023	0	13	63433	36027	4-9-85	466	4-11-85
SPR	5-1-85	W. Wall	Magenta Yellow	53023	0	12	63433	36027	4-9-85	466	4-11-85
SPR	5-1-85	S. Wall	Magenta Yellow	53023	0	43	63434	36027	4-9-85	466	4-11-85
SPR	5-1-85	E. Wall	Magenta Yellow	53023	0	29	63434	36027	4-9-85	466	4-11-85
SPR	5-1-85	N. Wall	Magenta Yellow	53023	0	34	63434	36027	4-9-85	466	4-11-85
CV 1	5-2-85	Floor	Magenta Yellow	53025	0	5	63435	36027	4-9-85	466	4-11-85
CV 1	5-2-85	N. Wall	Magenta Yellow	53025	0	0	63435	36027	4-9-85	466	4-11-85
-7 CV 8	5-3-85	Floor	Magenta Yellow	53026	0	19	63468	36027	4-9-85	466	4-11-85
-7 CV 7	5-3-85	Floor	Magenta Yellow	53026	1	13	63468	36027	4-9-85	466	4-11-85
-7 CV 6	5-3-85	Floor	Magenta Yellow	53026	0	55	63468	36027	4-9-85	466	4-11-85
-7 CV 5	5-3-85	Floor	Magenta Yellow	53025	0	47	63468	36027	4-9-85	466	4-11-85
-7 CV 11	5-3-85	Floor	Magenta Yellow	53029	0	5	63468	36027	4-9-85	466	4-11-85

PD235 Number of Records Read: 156
PD236 Number of Records Selected: 156

RAD SURVEY CONTAINMENT VESSEL
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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
-7' CV 9	5-2-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	110
CV 1	5-2-85	E. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	111
CV 1	5-2-85	S.Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	112
CV 1	5-2-85	Ceiling	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	113
CV 2	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	114
CV 2	5-2-85	N. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	115
CV 2	5-2-85	S. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	116
CV 2	5-2-85	Ceiling	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	117
CV 3	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	118
CV 3	5-2-85	N. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	119
CV 3	5-2-85	E. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	120
CV 3	5-2-85	S. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	121
CV 3	5-2-85	W. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	122
CV 3	5-2-85	Ceiling	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	123
CV 4	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	124
CV 4	5-2-85	Stairwell	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	126
CV 5	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	127
CV 5	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	128
CV 5	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	129
CV 6	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	130
CV 6	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	131
CV 6	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	132
CV 7	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	133
CV 7	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	134
CV 7	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	135
CV 8	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	136
CV 8	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	137
CV 8	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	138
CV 9	5-2-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	139
CV 9	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	140
CV 9	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	141
CV 10	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	142
CV 10	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	143
CV 10	5-2-85	Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	144
SPR	5-1-85	Dish	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	145
SPR	5-1-85	Ceiling	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	146
SPR	5-1-85	Floor	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	147
SPR	5-1-85	W. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	148
SPR	5-1-85	S. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	149
SPR	5-1-85	E. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	150
SPR	5-1-85	N. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	151
CV 1	5-2-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	152
CV 1	5-2-85	N. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	153
-7 CV 8	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	154
-7 CV 7	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	155
-7 CV 6	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	156
-7 CV 5	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	157
-7 CV 11	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	158

PD235 Number of Records Read: 156
PD236 Number of Records Selected: 156

RAD SURVEY CONTAINMENT VESSEL
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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
CV 16	5-3-85	Floor	Magenta Yellow	150	150	200	100	150	Pt 3	35	59	0.032
CV 17	5-3-85	Floor	Magenta Yellow	150	150	150	200	150	Pt 4	41	59	0.010
CV 18	5-3-85	Floor	Magenta Yellow	200	150	150	200	200	Pt 4	24	59	0.014
CV 19	5-3-85	Floor	Magenta Yellow	150	150	200	175	125	Pt 3	53	59	0.018
CV 20	5-3-85	Floor	Magenta Yellow	100	150	150	100	150	Pt 5	65	59	0.015
CV 21	5-3-85	Floor	Magenta Yellow	150	150	125	150	100	Pt 1	41	59	0.012
CV 22	5-3-85	Floor	Magenta Yellow	175	300	250	175	0	Pt 2	65	59	0.060
CV 23	5-3-85	Floor	Magenta Yellow	150	250	300	175	0	Pt 3	68	59	0.048
CV 24	5-3-85	Floor	Magenta Yellow	175	100	250	100	0	Pt 3	65	59	0.024
CV 25	5-3-85	Floor	Magenta Yellow	150	175	200	100	0	Pt 3	48	59	0.026
CV 26	5-3-85	Floor	Magenta Yellow	150	200	125	200	0	Pt 4	59	59	0.026
CV 27	5-3-85	Floor	Magenta Yellow	150	175	125	150	0	Pt 2	41	59	0.018
CV 28	5-3-85	Floor	Magenta Yellow	150	400	150	200	0	Pt 2	65	59	0.060
CV 29	5-3-85	Floor	Magenta Yellow	250	1000	500	100	0	Pt 2	74	59	0.210
CV 30	5-3-85	Floor	Magenta Yellow	200	175	300	150	200	Pt 3	82	59	0.040
CV 31	5-3-85	Floor	Magenta Yellow	250	150	250	0	350	Pt 5	59	59	0.030
CV 32	5-3-85	Floor	Magenta Yellow	150	150	200	100	125	Pt 3	71	59	0.025
CV 33	5-3-85	Floor	Magenta Yellow	200	200	250	100	175	Pt 3	65	59	0.024
CV 34	5-3-85	Floor	Magenta Yellow	200	125	150	150	150	Pt 1	62	59	0.010
CV 35	5-3-85	Floor	Magenta Yellow	100	200	200	150	200	Pt 5	59	59	0.014
0' CV 16	5-3-85	Wall	Magenta Yellow	100	100	100	125	125	Pt 5	15	59	0.012
0' CV 17	5-3-85	Wall	Magenta Yellow	200	150	150	50	100	Pt 1	12	59	0.012
0' CV 18	5-3-85	Wall	Magenta Yellow	150	125	125	150	100	Pt 4	24	59	0.011
0' CV 19	5-3-85	Wall	Magenta Yellow	200	100	125	125	125	Pt 1	24	59	0.012
0' CV 20	5-3-85	Wall	Magenta Yellow	125	100	100	50	150	Pt 5	32	59	0.010
0' CV 21	5-3-85	Wall	Magenta Yellow	125	200	100	175	125	Pt 2	24	59	0.015
0' CV 22	5-3-85	Wall	Magenta Yellow	150	125	100	150	125	Pt 4	29	59	0.011
0' CV 23	5-3-85	Wall	Magenta Yellow	150	75	100	150	75	Pt 4	24	59	0.014
0' CV 24	5-3-85	Wall	Magenta Yellow	200	150	150	100	125	Pt 1	32	59	0.017
0' CV 25	5-3-85	Wall	Magenta Yellow	150	175	175	200	150	Pt 4	24	59	0.014
0' CV 26	5-3-85	Wall	Magenta Yellow	100	100	150	175	150	Pt 4	32	59	0.016
0' CV 27	5-3-85	Wall	Magenta Yellow	125	100	100	125	100	Pt 4	18	59	0.015
1' CV 28	5-3-85	Wall	Magenta Yellow	200	200	200	150	150	Pt 3	44	59	0.016
0' CV 29	5-3-85	Wall	Magenta Yellow	200	200	200	250	225	Pt 4	32	59	0.017
0' CV 30	5-3-85	Wall	Magenta Yellow	250	200	150	200	150	Pt 1	38	59	0.020
0'CV 31	5-3-85	Wall	Magenta Yellow	100	175	175	100	150	Pt 3	32	59	0.009
0' CV 32	5-3-85	Wall	Magenta Yellow	0	175	150	150	150	Pt 2	41	59	0.012
0' CV 33	5-3-85	Wall	Magenta Yellow	100	125	100	150	150	Pt 5	48	59	0.009
0' CV 34	5-3-85	Wall	Magenta Yellow	175	100	150	125	150	Pt 1	35	59	0.011
0' CV 35	5-3-85	Wall	Magenta Yellow	200	100	175	150	200	Pt 5	48	59	0.010
+20' CV 16	5-3-85	Wall	Magenta Yellow	50	50	50	50	75	Pt 5	27	59	0.016
+20' CV 17	5-3-85	Wall	Magenta Yellow	75	50	50	75	100	Pt 5	35	59	0.020
+20' CV 18	5-3-85	Wall	Magenta Yellow	50	100	75	75	0	Pt 2	53	59	0.025
+20' CV 19	5-3-85	Wall	Magenta Yellow	100	75	100	75	150	Pt 5	29	59	0.038
+20' CV 20	5-3-85	Wall	Magenta Yellow	175	100	50	100	175	Pt 1	41	59	0.036
+20' CV 21	5-3-85	Wall	Magenta Yellow	125	75	125	100	100	Pt 3	35	59	0.020
+20' CV 22	5-3-85	Wall	Magenta Yellow	100	75	100	100	25	Pt 3	38	59	0.022
+20' CV 23	5-3-85	Wall	Magenta Yellow	125	75	75	50	100	Pt 1	48	59	0.036
+20' CV 24	5-3-85	Wall	Magenta Yellow	75	75	25	100	50	Pt 4	12	59	0.012
+20' CV 25	5-3-85	Wall	Magenta Yellow	75	25	50	50	50	Pt 1	50	59	0.012
+20' CV 26	5-3-85	Wall	Magenta Yellow	25	50	75	50	50	Pt 3	35	59	0.013
+20' CV 27	5-3-85	Wall	Magenta Yellow	50	50	100	25	50	Pt 3	32	59	0.014
+20' CV 28	5-3-85	Wall	Magenta Yellow	100	100	100	50	100	Pt 5	68	59	0.030
+20' CV 29	5-3-85	Wall	Magenta Yellow	150	75	75	100	100	Pt 5	48	59	0.028

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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
CV 16	5-3-85	Floor	Magenta Yellow	53029	2	53	63470	36027	4-9-85	466	4-11-85
CV 17	5-3-85	Floor	Magenta Yellow	53029	2	62	63470	36027	4-9-85	466	4-11-85
CV 18	5-3-85	Floor	Magenta Yellow	53029	5	104	63471	36027	4-9-85	466	4-11-85
CV 19	5-3-85	Floor	Magenta Yellow	53029	2	12	63471	36027	4-9-85	466	4-11-85
CV 20	5-3-85	Floor	Magenta Yellow	53029	0	5	63472	36027	4-9-85	466	4-11-85
CV 21	5-3-85	Floor	Magenta Yellow	53029	0	8	63473	36027	4-9-85	466	4-11-85
CV 22	5-3-85	Floor	Magenta Yellow	53029	0	45	63473	36027	4-9-85	466	4-11-85
CV 23	5-3-85	Floor	Magenta Yellow	53030	0	24	63474	36027	4-9-85	466	4-11-85
CV 24	5-3-85	Floor	Magenta Yellow	53030	0	53	63474	36027	4-9-85	466	4-11-85
CV 25	5-3-85	Floor	Magenta Yellow	53030	2	35	63475	36027	4-9-85	466	4-11-85
CV 26	5-3-85	Floor	Magenta Yellow	53030	0	2	63475	36027	4-9-85	466	4-11-85
CV 27	5-3-85	Floor	Magenta Yellow	53030	0	24	63476	36027	4-9-85	466	4-11-85
CV 28	5-3-85	Floor	Magenta Yellow	53030	0	66	63476	36027	4-9-85	466	4-11-85
CV 29	5-3-85	Floor	Magenta Yellow	53030	0	27	63477	36027	4-9-85	466	4-11-85
CV 30	5-3-85	Floor	Magenta Yellow	53030	0	5	63477	36027	4-9-85	466	4-11-85
CV 31	5-3-85	Floor	Magenta Yellow	53030	0	22	63478	36027	4-9-85	466	4-11-85
CV 32	5-3-85	Floor	Magenta Yellow	53030	3	0	63478	36027	4-9-85	466	4-11-85
CV 33	5-3-85	Floor	Magenta Yellow	53030	0	12	63479	36027	4-9-85	466	4-11-85
CV 34	5-3-85	Floor	Magenta Yellow	53030	2	0	63479	36027	4-9-85	466	4-11-85
CV 35	5-3-85	Floor	Magenta Yellow	53030	2	16	63480	36027	4-9-85	466	4-11-85
0' CV 16	5-3-85	Wall	Magenta Yellow	53032	2	2	63481	36027	4-9-85	466	4-11-85
0' CV 17	5-3-85	Wall	Magenta Yellow	53032	2	18	63481	36027	4-9-85	466	4-11-85
0' CV 18	5-3-85	Wall	Magenta Yellow	53032	0	0	63483	36027	4-9-85	466	4-11-85
0' CV 19	5-3-85	Wall	Magenta Yellow	53032	3	0	63483	36027	4-9-85	466	4-11-85
0' CV 20	5-3-85	Wall	Magenta Yellow	53032	0	0	63484	36027	4-9-85	466	4-11-85
0' CV 21	5-3-85	Wall	Magenta Yellow	53032	0	0	63484	36027	4-9-85	466	4-11-85
0' CV 22	5-3-85	Wall	Magenta Yellow	53032	2	28	63485	36027	4-9-85	466	4-11-85
0' CV 23	5-3-85	Wall	Magenta Yellow	53032	0	14	63485	36027	4-9-85	466	4-11-85
0' CV 24	5-3-85	Wall	Magenta Yellow	53032	1	0	63486	36027	4-9-85	466	4-11-85
0' CV 25	5-3-85	Wall	Magenta Yellow	53032	0	0	63486	36027	4-9-85	466	4-11-85
0' CV 26	5-3-85	Wall	Magenta Yellow	53032	0	0	63487	36027	4-9-85	466	4-11-85
0' CV 27	5-3-85	Wall	Magenta Yellow	53032	1	0	63487	36027	4-9-85	466	4-11-85
1' CV 28	5-3-85	Wall	Magenta Yellow	53032	0	12	63488	36027	4-9-85	466	4-11-85
0' CV 29	5-3-85	Wall	Magenta Yellow	53032	0	0	63488	36027	4-9-85	466	4-11-85
0' CV 30	5-3-85	Wall	Magenta Yellow	53032	0	0	63489	36027	4-9-85	466	4-11-85
0'CV 31	5-3-85	Wall	Magenta Yellow	53032	0	4	63489	36027	4-9-85	466	4-11-85
0' CV 32	5-3-85	Wall	Magenta Yellow	53032	0	0	63490	36027	4-9-85	466	4-11-85
0' CV 33	5-3-85	Wall	Magenta Yellow	53032	2	0	63490	36027	4-9-85	466	4-11-85
0' CV 34	5-3-85	Wall	Magenta Yellow	53032	0	0	63491	36027	4-9-85	466	4-11-85
0' CV 35	5-3-85	Wall	Magenta Yellow	53032	0	0	63491	36027	4-9-85	466	4-11-85
+20' CV 16	5-3-85	Wall	Magenta Yellow	53032	0	0	63492	36027	4-9-85	466	4-11-85
+20' CV 17	5-3-85	Wall	Magenta Yellow	53032	0	0	63492	16027	4-9-85	466	4-11-85
+20' CV 18	5-3-85	Wall	Magenta Yellow	53032	0	0	63493	16027	4-9-85	466	4-11-85
+20' CV 19	5-3-85	Wall	Magenta Yellow	53032	0	31	63493	36027	4-9-85	466	4-11-85
+20' CV 20	5-3-85	Wall	Magenta Yellow	53032	2	2	63494	36027	4-9-85	466	4-11-85
+20' CV 21	5-3-85	Wall	Magenta Yellow	53032	0	0	63494	36027	4-9-85	466	4-11-85
+20' CV 22	5-3-85	Wall	Magenta Yellow	53032	2	2	63495	36027	4-9-85	466	4-11-85
+20' CV 23	5-3-85	Wall	Magenta Yellow	53032	2	0	63495	36027	4-9-85	466	4-11-85
+20' CV 24	5-3-85	Wall	Magenta Yellow	53032	0	18	63496	36027	4-9-85	466	4-11-85
+20' CV 25	5-3-85	Wall	Magenta Yellow	53032	2	0	63496	36027	4-9-85	466	4-11-85
+20' CV 26	5-3-85	Wall	Magenta Yellow	53033	0	12	63497	36027	4-9-85	466	4-11-85
+20' CV 27	5-3-85	Wall	Magenta Yellow	53033	0	28	63497	36027	4-9-85	466	4-11-85
+20' CV 28	5-3-85	Wall	Magenta Yellow	53033	0	10	63498	36027	4-9-85	466	4-11-85
+2[illegible]' CV 29	5-3-85	Wall	Magenta Yellow	53033	2	0	63498	36027	4-9-85	466	4-[illegible]85

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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
CV 16	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	1
CV 17	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	2
CV 18	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	3
CV 19	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	4
CV 20	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	5
CV 21	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	6
CV 22	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	7
CV 23	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	9
CV 24	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	10
CV 25	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	11
CV 26	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	12
CV 27	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	13
CV 28	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	14
CV 29	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	15
CV 30	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	16
CV 31	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	17
CV 32	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	18
CV 33	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	19
CV 34	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	20
CV 35	5-3-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	21
0' CV 16	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	22
0' CV 17	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	23
0' CV 18	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	24
0' CV 19	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	25
0' CV 20	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	26
0' CV 21	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	27
0' CV 22	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	28
0' CV 23	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	29
O' CV 24	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	30
0' CV 25	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	31
0' CV 26	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	32
0' CV 27	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	33
1' CV 28	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	34
O' CV 29	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	35
0' CV 30	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	36
0'CV 31	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	37
0' CV 32	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	38
0' CV 33	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	39
0' CV 34	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	40
0' CV 35	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	41
+20' CV 16	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	42
+20' CV 17	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	43
+20' CV 18	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	44
+20' CV 19	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	45
+20' CV 20	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	46
+20' CV 21	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	47
+20' CV 22	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	48
+20' CV 23	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	49
+20' CV 24	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	50
+20' CV 25	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	51
+20' CV 26	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	52
+20' CV 27	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	53
+20' CV 28	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	54
+20' CV 29	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	55

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
+20' CV 30	5-3-85	Wall	Magenta Yellow	100	75	75	100	150	Pt 5	35	59	0.038
+20' CV 31	5-3-85	Wall	Magenta Yellow	75	100	50	50	100	Pt 2	29	59	0.028
+20' CV 32	5-3-85	Wall	Magenta Yellow	100	125	100	50	150	Pt 5	29	59	0.042
+20' CV 33	5-3-85	Wall	Magenta Yellow	100	50	50	75	50	Pt 1	38	59	0.036
+20' CV 34	5-3-85	Wall	Magenta Yellow	50	50	50	50	75	Pt 5	15	59	0.015
+20' cv 35	5-3-85	Wall	Magenta Yellow	50	100	50	75	75	Pt 2	41	59	0.012
+30' CV 16	5-6-85	Wall	Magenta Yellow	75	125	75	75	100	Pt 2	48	59	0.009
+30' CV 17	5-6-85	Wall	Magenta Yellow	100	50	75	75	50	Pt 1	29	59	0.010
+30' CV 18	5-6-85	Wall	Magenta Yellow	50	100	100	50	100	Pt 3	59	59	0.015
+30' CV 19	5-6-85	Wall	Magenta Yellow	150	50	50	100	75	Pt 1	35	59	0.013
+30' CV 20	5-6-85	Wall	Magenta Yellow	75	50	50	50	75	Pt 5	38	59	0.012
+30' CV 21	5-6-85	Wall	Magenta Yellow	50	100	75	75	75	Pt 2	27	59	0.014
+30' CV 22	5-6-85	Wall	Magenta Yellow	100	75	100	75	75	Pt 1	48	59	0.014
+30' CV 23	5-6-85	Wall	Magenta Yellow	50	100	75	50	100	Pt 5	38	59	0.017
+30' CV 24	5-6-85	Wall	Magenta Yellow	75	100	50	50	100	Pt 5	21	59	0.015
+30' CV 25	5-6-85	Wall	Magenta Yellow	50	50	50	50	75	Pt 5	21	59	0.012
+30' CV 26	5-6-85	Wall	Magenta Yellow	50	50	50	100	50	Pt 4	29	59	0.013
+30' CV 27	5-6-85	Wall	Magenta Yellow	50	100	100	75	75	Pt 3	38	59	0.012
+30' CV 28	5-6-85	Wall	Magenta Yellow	75	75	100	50	100	Pt 5	32	59	0.013
+30' CV 29	5-6-85	Wall	Magenta Yellow	75	50	50	50	75	Pt 1	65	59	0.015
+30' CV 30	5-6-85	Wall	Magenta Yellow	50	50	50	75	50	Pt 4	24	59	0.015
+30' CV 31	5-6-85	Wall	Magenta Yellow	50	50	50	100	75	Pt 4	32	59	0.015
+30' CV 32	5-6-85	Wall	Magenta Yellow	50	50	75	50	50	Pt 3	62	59	0.013
+30' CV 33	5-6-85	Wall	Magenta Yellow	50	50	50	75	50	Pt 4	65	59	0.017
+30' CV 34	5-6-85	Wall	Magenta Yellow	100	75	50	50	50	Pt 1	85	59	0.010
+30' CV 35	5-6-85	Wall	Magenta Yellow	50	50	50	50	75	Pt 5	50	59	0.009
-25' CV 11	5-2-85	Floor	Magenta Yellow	150	200	150	150	100	Pt 2	32	59	0.012
-25' CV 11	5-2-85	Wall	Magenta Yellow	125	200	150	125	100	Pt 2	21	59	0.008
-25' CV 11	5-2-85	Wall	Magenta Yellow	150	125	150	150	100	Pt 3	29	59	0.007
CV 12	5-2-85	Floor	Magenta Yellow	125	200	0	150	0	Pt 2	29	59	0.008
CV 13	5-2-85	Floor	Magenta Yellow	200	150	150	150	0	Pt 1	27	59	0.008
CV 14	5-2-85	Floor	Magenta Yellow	150	125	0	125	0	Pt 1	65	59	0.007
CV 15	5-2-85	Floor	Magenta Yellow	200	150	150	125	0	Pt 1	27	59	0.008
-15' CV 7	5-2-85	Wall	Magenta Yellow	150	150	100	150	200	Pt 5	41	59	0.007
-15' CV 8	5-2-85	Wall	Magenta Yellow	150	125	100	100	150	Pt 5	41	59	0.007
-10' CV 10	5-2-85	Wall	Magenta Yellow	100	125	125	125	125	Pt 5	48	59	0.006
-15' CV 6	5-2-85	Wall	Magenta Yellow	125	100	150	200	100	Pt 4	23	59	0.010
-15' CV 5	5-2-85	Wall	Magenta Yellow	150	150	150	100	100	Pt 1	38	59	0.008
-15' CV 5	5-2-85	Wall	Magenta Yellow	100	150	100	100	100	Pt 2	35	59	0.010
-15' CV 10	5-2-85	Wall	Magenta Yellow	150	250	400	200	200	Pt 3	65	59	0.008
-15' CV 11	5-3-85	Wall	Magenta Yellow	0	150	150	0	150	Pt 5	41	59	0.007
-7' CV 8	5-3-85	Wall	Magenta Yellow	125	100	125	100	100	Pt 1	38	59	0.012
-7' CV 8	5-3-85	Wall	Magenta Yellow	200	150	125	200	150	Pt 1	29	59	0.016
-7' CV 8	5-3-85	Wall	Magenta Yellow	150	150	100	150	125	Pt 2	18	59	0.007
-7' CV 7	5-3-85	Wall	Magenta Yellow	125	125	150	75	150	Pt 5	32	59	0.007
17' CV 6	5-3-85	Wall	Magenta Yellow	100	150	150	100	200	Pt 5	38	59	0.010
-7' CV 5	5-3-85	Wall	Magenta Yellow	150	150	100	125	200	Pt 5	29	59	0.011
-7' CV 5	5-3-85	Wall	Magenta Yellow	150	125	125	200	150	Pt 4	35	59	0.006
-7' CV 11	5-3-85	Wall	Magenta Yellow	150	125	150	150	150	Pt 5	53	59	0.007
-7' CV 10	5-3-85	Wall	Magenta Yellow	100	100	150	100	250	Pt 5	29	59	0.007
-7' CV 10	5-2-85	Wall	Magenta Yellow	100	100	100	100	100	Pt 3	29	59	0.006
-7' CV 9	5-2-85	Wall	Magenta Yellow	150	250	150	125	100	Pt 2	41	59	0.006
-7' CV 9	5-2-85	Wall	Magenta Yellow	150	100	150	125	150	Pt 5	50	59	0.008
-7' CV 10	5-2-85	Floor	Magenta Yellow	100	200	0	0	0	Pt 2	44	59	0.007

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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
+20' CV 30	5-3-85	Wall	Magenta Yellow	53033	2	0	63499	36027	4-9-85	466	4-11-85
+20' CV 31	5-3-85	Wall	Magenta Yellow	53033	0	0	63499	36027	4-9-85	466	4-11-85
+20' CV 32	5-3-85	Wall	Magenta Yellow	53033	2	0	63500	36027	4-9-85	466	4-11-85
+20' CV 33	5-3-85	Wall	Magenta Yellow	53033	0	0	63500	36027	4-9-85	466	4-11-85
+20' CV 34	5-3-85	Wall	Magenta Yellow	53033	0	3	63501	36027	4-9-85	466	4-11-85
+20' cv 35	5-3-85	Wall	Magenta Yellow	53033	0	0	63501	36027	4-9-85	466	4-11-85
+30' CV 16	5-6-85	Wall	Magenta Yellow	53035	1	0	63502	36027	4-9-85	466	4-11-85
+30' CV 17	5-6-85	Wall	Magenta Yellow	53035	0	0	63502	36027	4-9-85	466	4-11-85
+30' CV 18	5-6-85	Wall	Magenta Yellow	53035	2	0	63503	36027	4-9-85	466	4-11-85
+30' CV 19	5-6-85	Wall	Magenta Yellow	53035	2	0	63503	36027	4-9-85	466	4-11-85
+30' CV 20	5-6-85	Wall	Magenta Yellow	53035	1	0	63504	36027	4-9-85	466	4-11-85
+30' CV 21	5-6-85	Wall	Magenta Yellow	53035	0	0	63504	36027	4-9-85	466	4-11-85
+30' CV 22	5-6-85	Wall	Magenta Yellow	53035	0	0	63505	36027	4-9-85	466	4-11-85
+30' CV 23	5-6-85	Wall	Magenta Yellow	53035	0	0	63505	36027	4-9-85	466	4-11-85
+30' CV 24	5-6-85	Wall	Magenta Yellow	53035	0	0	63506	36027	4-9-85	466	4-11-85
+30' CV 25	5-6-85	Wall	Magenta Yellow	53035	0	0	63506	36027	4-9-85	466	4-11-85
+30' CV 26	5-6-85	Wall	Magenta Yellow	53035	0	0	63507	36027	4-9-85	466	4-11-85
+30' CV 27	5-6-85	Wall	Magenta Yellow	53035	2	0	63507	36027	4-9-85	466	4-11-85
+30' CV 28	5-6-85	Wall	Magenta Yellow	53035	0	0	63508	36027	4-9-85	466	4-11-85
+30' CV 29	5-6-85	Wall	Magenta Yellow	53035	2	0	63508	36027	4-9-85	466	4-11-85
+30' CV 30	5-6-85	Wall	Magenta Yellow	53035	0	0	63509	36027	4-9-85	466	4-11-85
+30' CV 31	5-6-85	Wall	Magenta Yellow	53035	0	0	63509	36027	4-9-85	466	4-11-85
+30' CV 32	5-6-85	Wall	Magenta Yellow	53035	1	0	63510	36027	4-9-85	466	4-11-85
+30' CV 33	5-6-85	Wall	Magenta Yellow	53035	0	0	63510	36027	4-9-85	466	4-11-85
+30' CV 34	5-6-85	Wall	Magenta Yellow	53035	0	0	63511	36027	4-9-85	466	4-11-85
+30' CV 35	5-6-85	Wall	Magenta Yellow	53035	0	0	63511	36027	4-9-85	466	4-11-85
-25' CV 11	5-2-85	Floor	Magenta Yellow	53029	0	0	63454	36027	4-9-85	466	4-11-85
-25' CV 11	5-2-85	Wall	Magenta Yellow	53029	0	0	63454	36027	4-9-85	466	4-11-85
-25' CV 11	5-2-85	Wall	Magenta Yellow	53029	0	11	63455	36027	4-9-85	466	4-11-85
CV 12	5-2-85	Floor	Magenta Yellow	53029	1	8	63455	36027	4-9-85	466	4-11-85
CV 13	5-2-85	Floor	Magenta Yellow	53029	2	5	63456	36027	4-9-85	466	4-11-85
CV 14	5-2-85	Floor	Magenta Yellow	53029	0	0	63456	36027	4-9-85	466	4-11-85
CV 15	5-2-85	Floor	Magenta Yellow	53029	0	16	63457	36027	4-9-85	466	4-11-85
-15' CV 7	5-2-85	Wall	Magenta Yellow	53026	1	0	63457	36027	4-9-85	466	4-11-85
-15' CV 8	5-2-85	Wall	Magenta Yellow	53026	0	0	63458	36027	4-9-85	466	4-11-85
-10' CV 10	5-2-85	Wall	Magenta Yellow	53029	0	0	63458	36027	4-9-85	466	4-11-85
-15' CV 6	5-2-85	Wall	Magenta Yellow	53025	0	9	63459	36027	4-9-85	466	4-11-85
-15' CV 5	5-2-85	Wall	Magenta Yellow	53025	0	0	63459	36027	4-9-85	466	4-11-85
-15' CV 5	5-2-85	Wall	Magenta Yellow	53025	0	0	63460	36027	4-9-85	466	4-11-85
-15' CV 10	5-2-85	Wall	Magenta Yellow	53029	0	12	63460	36027	4-9-85	466	4-11-85
-15' CV 11	5-3-85	Wall	Magenta Yellow	53025	0	0	63461	36027	4-9-85	466	4-11-85
-7' CV 8	5-3-85	Wall	Magenta Yellow	53026	0	0	63461	36027	4-9-85	466	4-11-85
-7' CV 8	5-3-85	Wall	Magenta Yellow	53026	0	2	63462	36027	4-9-85	466	4-11-85
-7' CV 8	5-3-85	Wall	Magenta Yellow	53026	0	0	63462	36027	4-9-85	466	4-11-85
-7' CV 7	5-3-85	Wall	Magenta Yellow	53026	1	0	63463	36027	4-9-85	466	4-11-85
17' CV 6	5-3-85	Wall	Magenta Yellow	53026	0	3	63463	36027	4-9-85	466	4-11-85
-7' CV 5	5-3-85	Wall	Magenta Yellow	53025	0	0	63464	36027	4-9-85	466	4-11-85
-7' CV 5	5-3-85	Wall	Magenta Yellow	53025	0	0	63464	36027	4-9-85	466	4-11-85
-7' CV 11	5-3-85	Wall	Magenta Yellow	53029	0	0	63465	36027	4-9-85	466	4-11-85
-7' CV 10	5-3-85	Wall	Magenta Yellow	53029	0	106	63465	36027	4-9-85	466	4-11-85
-7' CV 10	5-2-85	Wall	Magenta Yellow	53029	2	0	63466	36027	4-9-85	466	4-11-85
-7' CV 9	5-2-85	Wall	Magenta Yellow	53029	0	0	63466	36027	4-9-85	466	4-11-85
-7' CV 9	5-2-85	Wall	Magenta Yellow	53029	0	3	63467	36027	4-9-85	466	4-11-85
-7' CV 10	5-2-85	Floor	Magenta Yellow	53029	0	12	63469	36027	4-9-85	466	4-11-85

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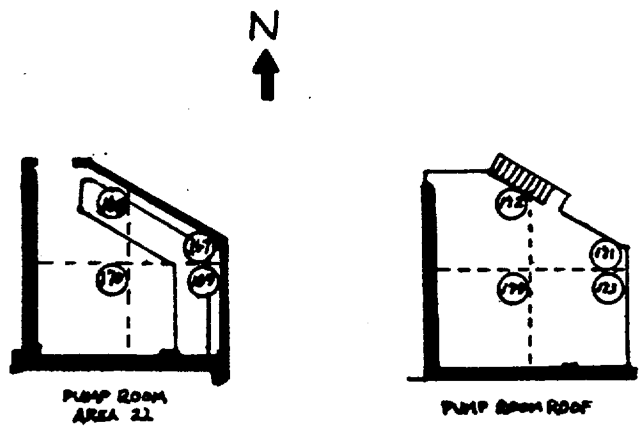
Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
+20' CV 30	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	56
+20' CV 31	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	57
+20' CV 32	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	58
+20' CV 33	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	59
+20' CV 34	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	60
+20' cv 35	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	61
+30' CV 16	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	62
+30' CV 17	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	63
+30' CV 18	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	64
+30' CV 19	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	65
+30' CV 20	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	66
+30' CV 21	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	67
+30' CV 22	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	68
+30' CV 23	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	69
+30' CV 24	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	70
+30' CV 25	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	71
+30' CV 26	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	72
+30' CV 27	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	73
+30' CV 28	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	74
+30' CV 29	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	75
+30' CV 30	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	76
+30' CV 31	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	77
+30' CV 32	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	78
+30' CV 33	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	79
+30' CV 34	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	80
+30' CV 35	5-6-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	81
-25' CV 11	5-2-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	82
-25' CV 11	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	83
-25' CV 11	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	84
CV 12	5-2-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	85
CV 13	5-2-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	86
CV 14	5-2-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	87
CV 15	5-2-85	Floor	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	88
-15' CV 7	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	89
-15' CV 8	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	90
-10' CV 10	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	91
-15' CV 6	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	92
-15' CV 5	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	93
-15' CV 5	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	94
-15' CV 10	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	95
-15' CV 11	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	96
-7' CV 8	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	97
-7' CV 8	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	98
-7' CV 8	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	99
-7' CV 7	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	100
17' CV 6	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	101
-7' CV 5	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	102
-7' CV 5	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	103
-7' CV 11	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	104
-7' CV 10	5-3-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	105
-7' CV 10	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	106
-7' CV 9	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	107
-7' CV 9	5-2-85	Wall	Magenta Yellow	423	4-9-85	5	0.34	0.37	0.38	108
- [illegible] 10	5-2-85	Floor	Magenta Yellow	423	4-[illegible]	5	0.34	0.37	0.38	[illegible]

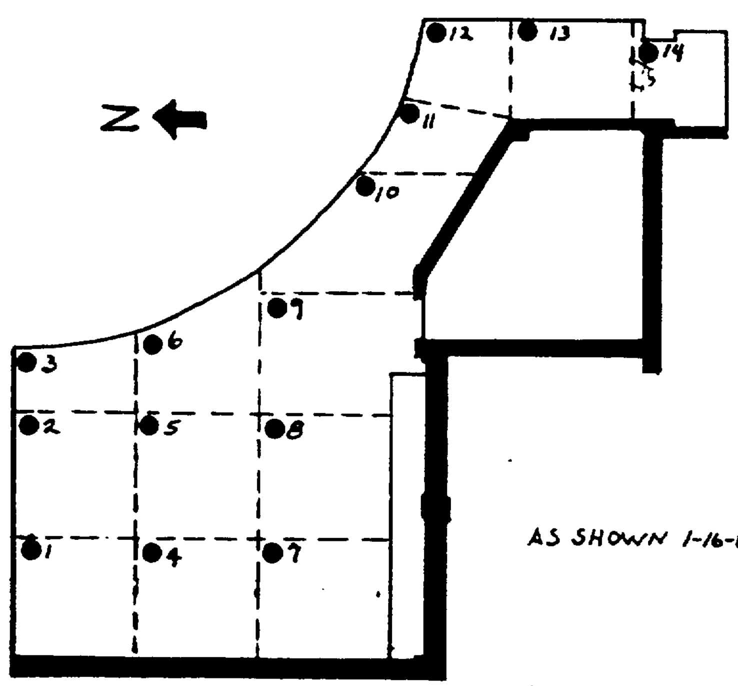
2. Building #1111 - Outside The Containment Vessel



REACTOR BUILDING 1111

SUB-BASEMENT ELEV -25'-0"

PPP RM. GRID INDEX

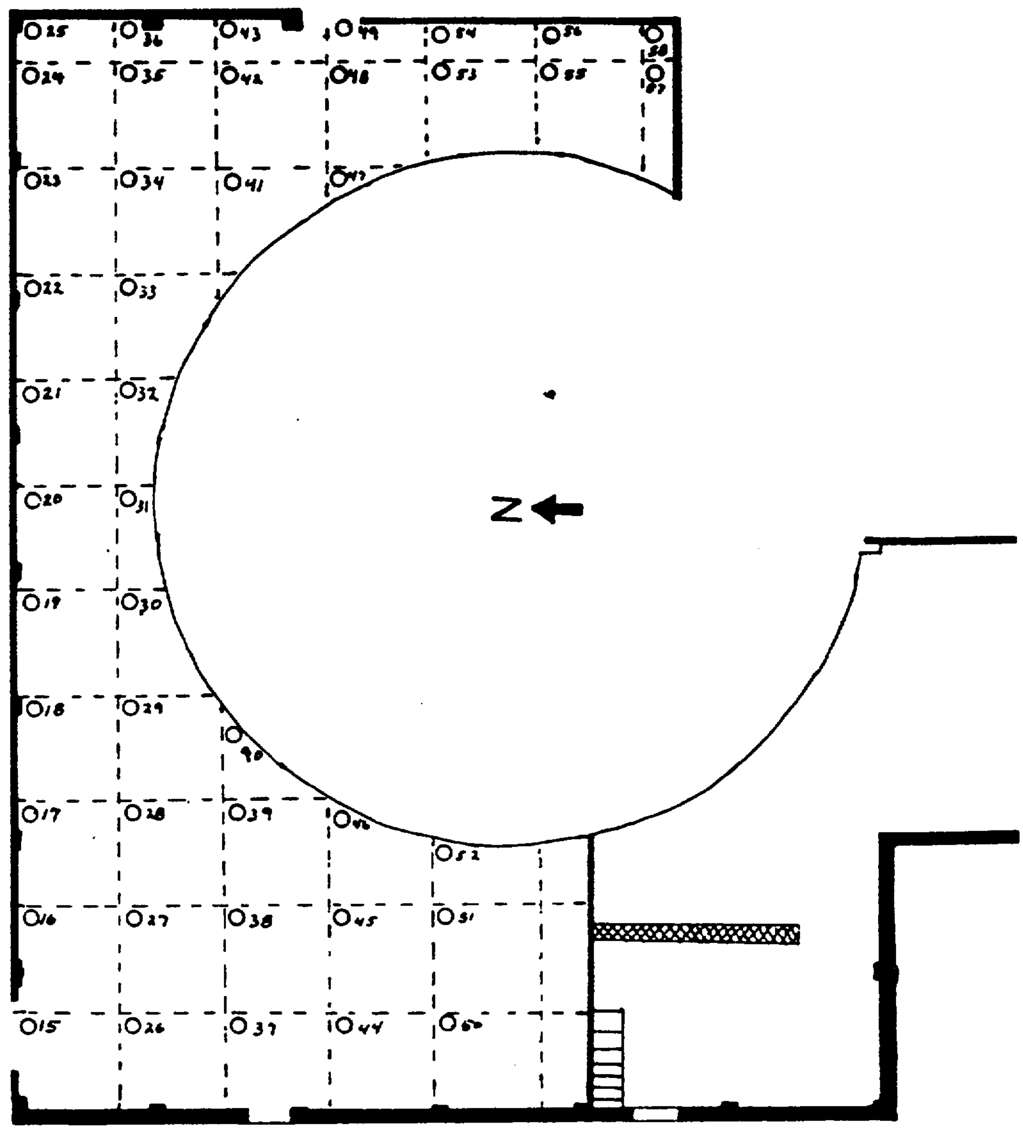


AS SHOWN 1-16-85 ●

REACTOR BUILDING 1111

FLOOR SURFACE GRID INDEX

SUB BASEMENT ELEV -25'-0"

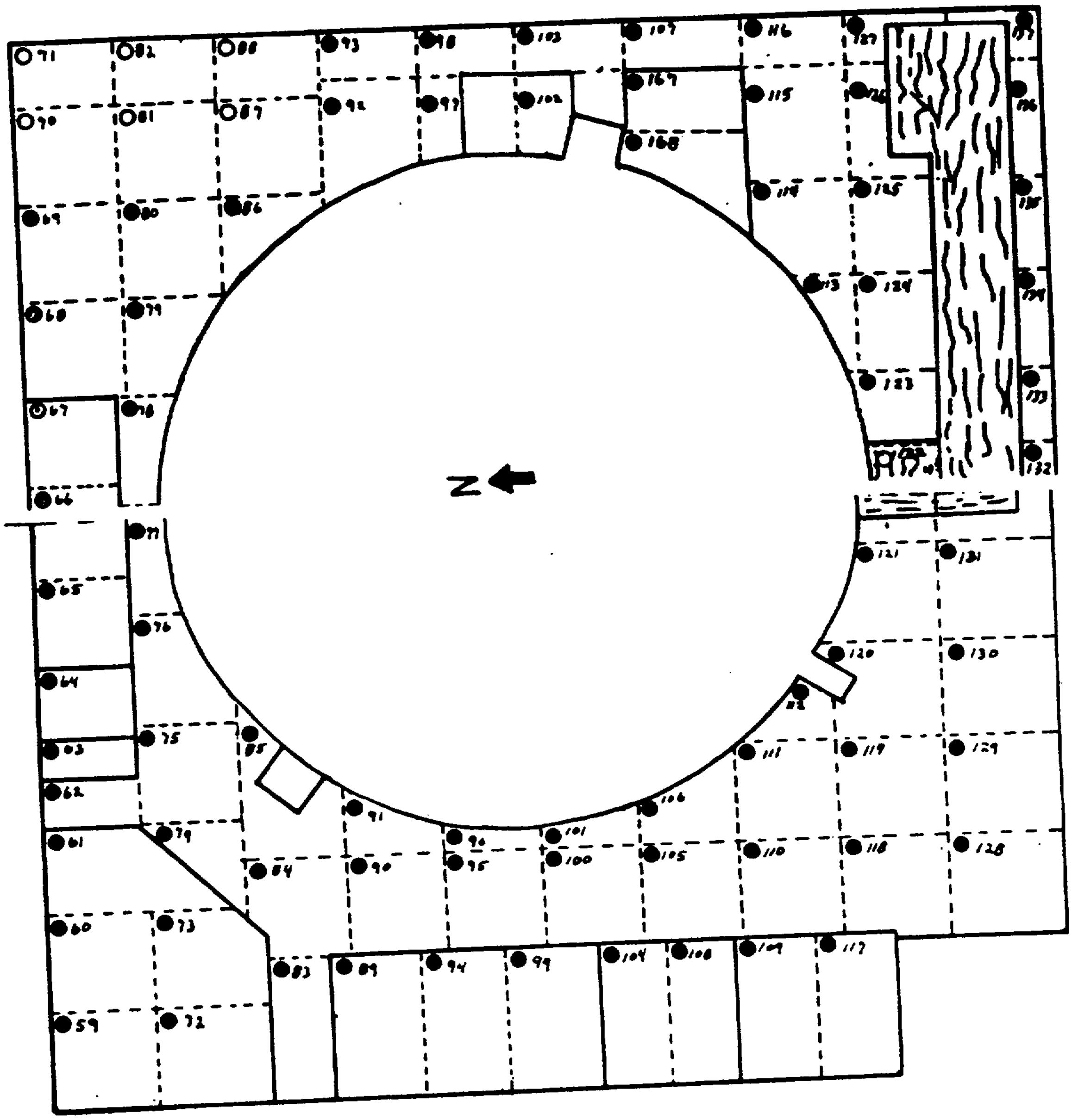


REACTOR BUILDING 1111

FLOOR SURFACE GRID INDEX

ELEVATION – 15'-0"

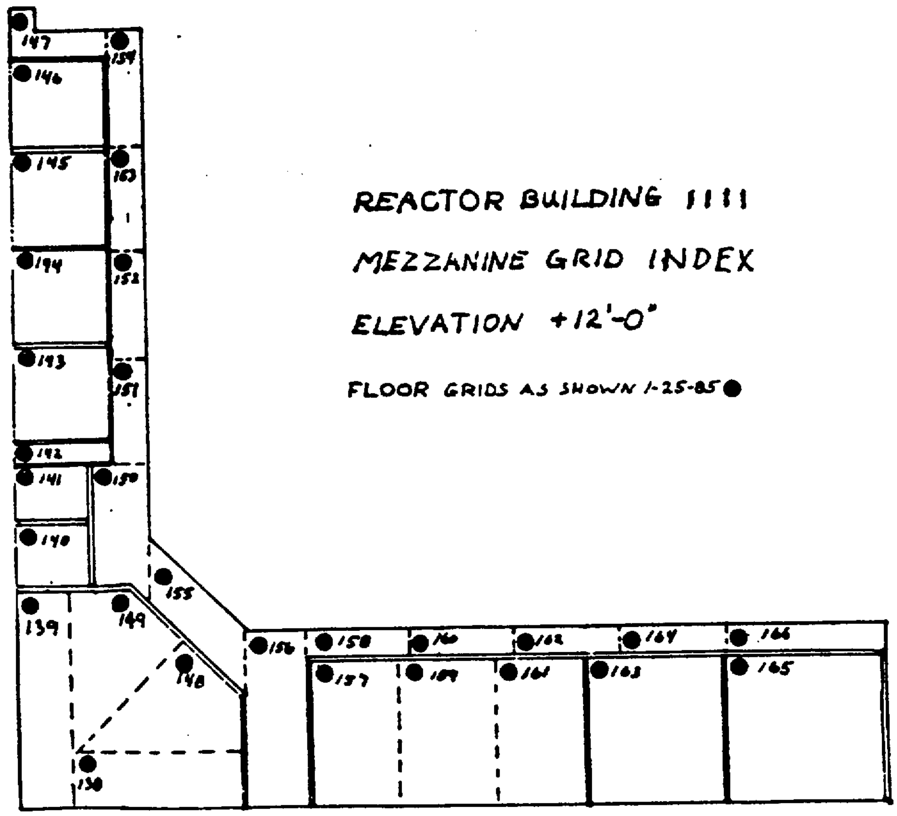
AS SHOWN 1-16-85



REACTOR BUILDING 1111

FLOOR SURFACE GRID INDEX

ELEVATION 0'-0"



REACTOR BUILDING 1111

MEZZANINE GRID INDEX

ELEVATION +12'-0"

FLOOR GRIDS AS SHOWN 1-25-85 ●

RAD SURVEY REACTOR BLDG. 1111
09-12-85
00:35:27

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
RB 1	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	8	59	0.005
RB 2	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	3	59	0.006
RB 3	1-28-85	Floor	White	100	50	50	75	100	Pt. 5	11	59	0.007
RB 4	1-28-85	Floor	White	75	75	50	50	50	Pt. 1	11	59	0.006
RB 5	1-28-85	Floor	White	75	75	50	50	50	Pt. 1	14	59	0.007
RB 6	1-28-85	Floor	White	75	75	75	50	75	Pt. 5	14	59	0.007
RB 7	1-28-85	Floor	White	50	50	50	50	50	Pt. 2	8	59	0.005
RB 8	1-28-85	Floor	White	50	100	75	50	75	Pt. 2	14	59	0.005
RB 9	1-28-85	Floor	White	50	50	75	100	75	Pt. 4	14	59	0.007
RB 10	1-28-85	Floor	White	50	75	100	75	75	Pt. 3	14	59	0.016
RB 11	1-28-85	Floor	White	50	50	100	100	100	Pt. 5	6	59	0.019
RB 12	1-28-85	Floor	White	75	75	50	100	75	Pt. 4	8	59	0.011
RB 12	1-28-85	E. Wall	White	50	50	50	100	100	Pt. 5	6	59	0.011
RB 13	1-28-85	Floor	White	75	5000	100	100	100	Pt. 2	22	59	0.014
RB 13	1-28-85	E. Wall	White	50	100	75	100	50	Pt. 4	8	59	0.014
RB 14	1-28-85	Floor	White	200	400	200	100	100	Pt. 2	11	59	0.014
RB 14	1-28-85	E. Wall	White	75	100	100	125	100	Pt. 4	8	59	0.014
RB 15	1-28-85	Floor	White	50	50	100	75	100	Pt. 5	8	59	0.005
RB 16	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	14	59	0.005
RB 17	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	0	59	0.006
RB 18	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	8	59	0.005
RB 19	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	3	59	0.005
RB 20	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	14	59	0.006
RB 21	1-28-85	Floor	White	50	25	50	50	50	Pt. 5	11	59	0.005
RB 22	1-28-85	Floor	White	50	25	25	50	50	Pt. 5	8	59	0.005
RB 23	1-28-85	Floor	White	50	50	50	50	75	Pt. 5	6	59	0.005
RB 24	1-28-85	Floor	White	50	50	25	50	50	Pt. 5	6	59	0.005
RB 25	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	3	59	0.004
RB 26	1-28-85	Floor	White	75	100	100	50	75	Pt. 2	0	59	0.005
RB 27	1-28-85	Floor	White	50	50	50	50	75	Pt. 5	3	59	0.005
RB 28	1-28-85	Floor	White	50	50	50	50	100	Pt. 5	3	59	0.005
RB 29	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	6	59	0.006
RB 30	1-28-85	Floor	White	50	0	100	75	100	Pt. 5	3	59	0.007
RB 31	1-28-85	Floor	White	100	0	0	150	0	Pt. 4	8	59	0.007
RB 32	1-28-85	Floor	White	75	0	0	75	0	Pt. 4	3	59	0.008
RB 33	1-28-85	Floor	White	50	75	0	75	100	Pt. 5	6	59	0.010
RB 34	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	6	59	0.006
RB 35	1-28-85	Floor	White	50	50	50	75	50	Pt. 4	6	59	0.005
RB 36	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	14	59	0.004
RB 37	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	8	59	0.005
RB 38	1-28-85	Floor	White	50	50	50	75	50	Pt. 4	8	59	0.005
RB 39	1-28-85	Floor	White	100	75	50	50	75	Pt. 1	0	59	0.006
RB 40	1-28-85	Floor	White	100	0	0	75	100	Pt. 1	0	59	0.010
RB 41	1-28-85	Floor	White	50	100	0	100	0	Pt. 4	3	59	0.008
RB 42	1-28-85	Floor	White	50	50	50	50	100	Pt. 5	8	59	0.006
RB 43	1-28-85	Floor	White	50	75	50	50	50	Pt. 2	6	59	0.005
RB 44	1-28-85	Floor	White	50	50	50	50	50	Pt. 5	3	59	0.005
RB 45	1-28-85	Floor	White	100	75	50	50	50	Pt. 1	3	59	0.006
RB 46	1-28-85	Floor	White	75	100	75	50	100	Pt. 5	8	59	0.007
RB 47	1-28-85	Floor	White	75	0	0	0	0	Pt. 1	6	59	0.014
RB 48	1-28-85	Floor	White	75	75	75	50	100	Pt. 5	3	59	0.007
RB 49	1-28-85	Floor	White	50	50	50	50	50	Pt. 4	6	59	0.005
RB 50	1-28-85	Floor	White	50	0	0	50	50	Pt. 5	6	59	0.004
RB 51	1-28-85	Floor	White	50	0	0	50	50	Pt. 5	3	59	0.005

RAD SURVEY REACTOR BLDG. 1111
09-12-85
00:49:15

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
RB 1	1-28-85	Floor	White	52916	0	0	62857	36027	1-7-85	466	12-10-84
RB 2	1-28-85	Floor	White	52916	0	3	62857	36027	1-7-85	466	12-10-84
RB 3	1-28-85	Floor	White	52916	2	16	62858	36027	1-7-85	466	12-10-84
RB 4	1-28-85	Floor	White	52916	1	0	62858	36027	1-7-85	466	12-10-84
RB 5	1-28-85	Floor	White	52916	1	8	62859	36027	1-7-85	466	12-10-84
RB 6	1-28-85	Floor	White	52916	2	5	62859	36027	1-7-85	466	12-10-84
RB 7	1-28-85	Floor	White	52916	2	6	62860	36027	1-7-85	466	12-10-84
RB 8	1-28-85	Floor	White	52916	0	1	62860	36027	1-7-85	466	12-10-84
RB 9	1-28-85	Floor	White	52916	0	2	62861	36027	1-7-85	466	12-10-84
RB 10	1-28-85	Floor	White	52916	1	1	62861	36027	1-7-85	466	12-10-84
RB 11	1-28-85	Floor	White	52916	0	3	62862	36027	1-7-85	466	12-10-84
RB 12	1-28-85	Floor	White	52916	1	19	62863	36027	1-7-85	466	12-10-84
RB 12	1-28-85	E. Wall	White	52916	1	25	62863	36027	1-7-85	466	12-10-84
RB 13	1-28-85	Floor	White	52916	0	352	62864	36027	1-7-85	466	12-10-84
RB 13	1-28-85	E. Wall	White	52916	0	30	62864	36027	1-7-85	466	12-10-84
RB 14	1-28-85	Floor	White	52916	0	23	62865	36027	1-7-85	466	12-10-84
RB 14	1-28-85	E. Wall	White	52916	0	2	62865	36027	1-7-85	466	12-10-84
RB 15	1-28-85	Floor	White	52916	0	0	62866	36027	1-7-85	466	12-10-84
RB 16	1-28-85	Floor	White	52916	0	0	62866	36027	1-7-85	466	12-10-84
RB 17	1-28-85	Floor	White	52916	0	0	62867	36027	1-7-85	466	12-10-84
RB 18	1-28-85	Floor	White	52916	2	8	62867	36027	1-7-85	466	12-10-84
RB 19	1-28-85	Floor	White	52916	1	0	62868	36027	1-7-85	466	12-10-84
RB 20	1-28-85	Floor	White	52916	0	0	62868	36027	1-7-85	466	12-10-84
RB 21	1-28-85	Floor	White	52916	1	0	62869	36027	1-7-85	466	12-10-84
RB 22	1-28-85	Floor	White	52916	0	7	62869	36027	1-7-85	466	12-10-84
RB 23	1-28-85	Floor	White	52916	1	3	62870	36027	1-7-85	466	12-10-84
RB 24	1-28-85	Floor	White	52916	1	0	62870	36027	1-7-85	466	12-10-84
RB 25	1-28-85	Floor	White	52916	0	12	62871	36027	1-7-85	466	12-10-84
RB 26	1-28-85	Floor	White	52916	0	7	62871	36027	1-7-85	466	12-10-84
RB 27	1-28-85	Floor	White	52916	0	1	62872	36027	1-7-85	466	12-10-84
RB 28	1-28-85	Floor	White	52917	0	10	62872	36027	1-7-85	466	12-10-84
RB 29	1-28-85	Floor	White	52917	0	0	62873	36027	1-7-85	466	12-10-84
RB 30	1-28-85	Floor	White	52917	0	10	62873	36027	1-7-85	466	12-10-84
RB 31	1-28-85	Floor	White	52917	0	6	62874	36027	1-7-85	466	12-10-84
RB 32	1-28-85	Floor	White	52917	0	0	62874	36027	1-7-85	466	12-10-84
RB 33	1-28-85	Floor	White	52917	1	3	62874	36027	1-7-85	466	12-10-84
RB 34	1-28-85	Floor	White	52917	0	5	62875	36027	1-7-85	466	12-10-84
RB 35	1-28-85	Floor	White	52917	0	2	62875	36027	1-7-85	466	12-10-84
RB 36	1-28-85	Floor	White	52917	0	3	62876	36027	1-7-85	466	12-10-84
RB 37	1-28-85	Floor	White	52917	0	0	62876	36027	1-7-85	466	12-10-84
RB 38	1-28-85	Floor	White	52917	0	0	62877	36027	1-7-85	466	12-10-84
RB 39	1-28-85	Floor	White	52917	0	0	62877	36027	1-7-85	466	12-10-84
RB 40	1-28-85	Floor	White	52917	0	13	62878	36027	1-7-85	466	12-10-84
RB 41	1-28-85	Floor	White	52917	1	14	62878	36027	1-7-85	466	12-10-84
RB 42	1-28-85	Floor	White	52917	0	0	62879	36027	1-7-85	466	12-10-84
RB 43	1-28-85	Floor	White	52917	0	3	62879	36027	1-7-85	466	12-10-84
RB 44	1-28-85	Floor	White	52917	2	0	62880	36027	1-7-85	466	12-10-84
RB 45	1-28-85	Floor	White	52917	1	4	62880	36027	1-7-85	466	12-10-84
RB 46	1-28-85	Floor	White	52917	0	0	62881	36027	1-7-85	466	12-10-84
RB 47	1-28-85	Floor	White	52917	1	7	62881	36027	1-7-85	466	12-10-84
RB 48	1-28-85	Floor	White	52920	0	9	62882	36027	1-7-85	466	12-10-84
RB 49	1-28-85	Floor	White	52920	0	2	62882	36027	1-7-85	466	12-10-84
RB 50	1-28-85	Floor	White	52920	0	9	62883	36027	1-7-85	466	12-10-84
RB 51	1-28-85	Floor	White	52920	0	10	62883	36027	1-7-85	466	12-10-84

RAD SURVEY REACTOR BLDG. 1111
09-12-85
01:07:30

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
RB 1	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	1
RB 2	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	2
RB 3	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	3
RB 4	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	4
RB 5	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	5
RB 6	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	6
RB 7	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	7
RB 8	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	8
RB 9	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	9
RB 10	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	10
RB 11	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	11
RB 12	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	12
RB 12	1-28-85	E. Wall	White	423	2-14-85	3	0.34	0.40	0.42	13
RB 13	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	14
RB 13	1-28-85	E. Wall	White	423	2-14-85	3	0.34	0.40	0.42	15
RB 14	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	16
RB 14	1-28-85	E. Wall	White	423	2-14-85	3	0.34	0.40	0.42	17
RB 15	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	18
RB 16	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	19
RB 17	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	20
RB 18	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	21
RB 19	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	22
RB 20	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	23
RB 21	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	24
RB 22	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	25
RB 23	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	26
RB 24	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	27
RB 25	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	28
RB 26	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	29
RB 27	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	30
RB 28	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	31
RB 29	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	32
RB 30	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	33
RB 31	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	34
RB 32	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	35
RB 33	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	36
RB 34	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	37
RB 35	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	38
RB 36	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	39
RB 37	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	40
RB 38	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	41
RB 39	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	43
RB 40	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	44
RB 41	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	45
RB 42	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	46
RB 43	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	47
RB 44	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	48
RB 45	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	49
RB 46	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	50
RB 47	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	51
RB 48	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	52
RB 49	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	53
RB 50	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	54
RP[illegible]	1-28-85	Floor	White	423	2-1[illegible]5	3	0.34	0.40	0.42	

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
RB 52	1-28-85	Floor	White	50	0	0	75	50	Pt. 4	3	59	0.006
RB 53	1-28-85	Floor	White	50	50	0	0	100	Pt. 5	8	59	0.009
RB 54	1-28-85	Floor	White	0	0	50	50	50	Pt. 3	6	59	0.007
RB 55	1-28-85	Floor	White	50	75	0	0	75	Pt. 2	8	59	0.012
RB 56	1-28-85	Floor	White	0	0	100	75	125	Pt. 5	0	59	0.008
RB 57	1-28-85	Floor	White	150	0	0	200	0	Pt. 4	8	59	0.040
RB 58	1-28-85	Floor	White	0	0	0	100	0	Pt. 4	8	59	0.009
RB 59	1-31-85	Floor	White	25	25	25	75	50	Pt. 4	0	59	0.005
RB 60	1-31-85	Floor	White	25	25	50	25	25	Pt. 3	6	59	0.004
RB 61	1-31-85	Floor	White	25	25	25	50	50	Pt. 5	3	59	0.005
RB 62	1-31-85	Floor	White	25	50	75	50	75	Pt. 5	0	59	0.009
RB 63	1-31-85	Floor	White	50	75	50	50	25	Pt. 2	0	59	0.012
RB 64	1-31-85	Floor	White	50	50	25	50	75	Pt. 5	6	59	0.009
RB 65	1-31-85	Floor	White	50	50	50	75	50	Pt. 4	3	59	0.008
RB 66	1-31-85	Floor	White	50	50	25	25	50	Pt. 5	6	59	0.007
RB 67	1-31-85	Floor	White	100	50	50	50	75	Pt. 1	3	59	0.007
RB 68	1-31-85	Floor	White	75	25	50	50	75	Pt. 5	3	59	0.005
RB 69	1-31-85	Floor	White	50	75	50	75	50	Pt. 4	6	59	0.005
RB 70	1-31-85	Floor	White	50	25	75	50	75	Pt. 5	1	59	0.004
RB 71	1-31-85	Floor	White	50	50	50	75	75	Pt. 5	0	59	0.005
RB 72	1-31-85	Floor	White	25	50	25	50	50	Pt. 5	6	59	0.005
RB 73	1-31-85	Floor	White	50	50	100	75	50	Pt. 3	0	59	0.006
RB 74	1-31-85	Floor	White	50	50	50	0	50	Pt. 5	0	59	0.007
RB 75	1-31-85	Floor	White	50	75	50	75	100	Pt. 5	0	59	0.006
RB 76	1-31-85	Floor	White	75	50	50	100	75	Pt. 4	0	59	0.008
RB 77	1-31-85	Floor	White	100	0	0	75	75	Pt. 1	3	59	0.009
RB 78	1-31-85	Floor	White	75	0	0	75	100	Pt. 5	0	59	0.006
RB 79	1-31-85	Floor	White	75	100	100	75	75	Pt. 3	3	59	0.007
RB 80	1-31-85	Floor	White	50	50	100	75	75	Pt. 3	3	59	0.007
RB 81	1-31-85	Floor	White	50	50	50	75	75	Pt. 5	0	59	0.006
RB 82	1-31-85	Floor	White	25	50	100	50	25	Pt. 3	1	59	0.006
RB 83	1-31-85	Floor	White	75	75	50	50	75	Pt. 5	3	59	0.010
RB 84	1-31-85	Floor	White	50	50	75	100	50	Pt. 4	3	59	0.008
RB 85	1-31-85	Floor	White	50	0	100	50	100	Pt. 5	6	59	0.005
RB 86	1-31-85	Floor	White	50	75	0	50	250	Pt. 5	3	59	0.008
RB 87	1-31-85	Floor	White	50	50	75	75	50	Pt. 4	1	59	0.006
RB 88	1-31-85	Floor	White	25	75	50	75	75	Pt. 5	1	59	0.006
RB 89	1-31-85	Floor	White	50	50	75	75	100	Pt. 5	3	59	0.007
RB 90	1-31-85	Floor	White	75	0	75	75	25	Pt. 1	3	59	0.007
RB 91	1-31-85	Floor	White	50	0	50	75	75	Pt. 4	3	59	0.007
RB 92	1-31-85	Floor	White	50	50	0	75	100	Pt. 5	6	59	0.006
RB 93	1-31-85	Floor	White	75	75	75	75	50	Pt. 4	3	59	0.006
RB 94	1-31-85	Floor	White	50	75	50	75	75	Pt. 5	6	59	0.007
RB 95	1-31-85	Floor	White	75	25	50	75	75	Pt. 5	3	59	0.007
RB 96	1-31-85	Floor	White	0	0	50	100	0	Pt. 4	3	59	0.007
RB 97	1-31-85	Floor	White	75	75	0	0	0	Pt. 2	3	59	0.005
RB 98	1-31-85	Floor	White	50	100	50	50	75	Pt. 2	3	59	0.007
RB 99	1-31-85	Floor	White	50	25	100	75	50	Pt. 3	8	59	0.008
RB 100	1-31-85	Floor	White	50	50	75	75	50	Pt. 3	0	59	0.008
RB 101	1-31-85	Floor	White	0	0	75	100	0	Pt. 4	3	59	0.006
RB 102	1-31-85	Floor	White	50	0	0	0	100	Pt. 5	3	59	0.005
RB 103	1-31-85	Floor	White	50	75	100	75	75	Pt. 3	8	59	0.009
RB 104	1-31-85	Floor	White	50	75	75	50	50	Pt. 2	3	59	0.008
RB 105	1-31-85	Floor	White	50	50	50	50	100	Pt. 5	0	59	0.008

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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
RB 52	1-28-85	Floor	White	52920	0	10	62883	36027	1-7-85	466	12-10-84
RB 53	1-28-85	Floor	White	52920	2	7	62884	36027	1-7-85	466	12-10-84
RB 54	1-28-85	Floor	White	52920	2	0	62884	36027	1-7-85	466	12-10-84
RB 55	1-28-85	Floor	White	52920	0	1	62884	36027	1-7-85	466	12-10-84
RB 56	1-28-85	Floor	White	52920	0	1	62885	36027	1-7-85	466	12-10-84
RB 57	1-28-85	Floor	White	52920	1	0	62885	36027	1-7-85	466	12-10-84
RB 58	1-28-85	Floor	White	52920	0	10	62885	36027	1-7-85	466	12-10-84
RB 59	1-31-85	Floor	White	52921	0	1	62886	36027	1-7-85	466	12-10-84
RB 60	1-31-85	Floor	White	52921	0	10	62886	36027	1-7-85	466	12-10-84
RB 61	1-31-85	Floor	White	52921	0	0	62887	36027	1-7-85	466	12-10-84
RB 62	1-31-85	Floor	White	52921	0	0	62887	36027	1-7-85	466	12-10-84
RB 63	1-31-85	Floor	White	52921	0	7	62888	36027	1-7-85	466	12-10-84
RB 64	1-31-85	Floor	White	52921	0	0	62888	36027	1-7-85	466	12-10-84
RB 65	1-31-85	Floor	White	52921	0	0	62889	36027	1-7-85	466	12-10-84
RB 66	1-31-85	Floor	White	52921	0	0	62889	36027	1-7-85	466	12-10-84
RB 67	1-31-85	Floor	White	52921	0	3	62890	36027	1-7-85	466	12-10-84
RB 68	1-31-85	Floor	White	52921	0	7	62890	36027	1-7-85	466	12-10-84
RB 69	1-31-85	Floor	White	52921	0	0	62891	36027	1-7-85	466	12-10-84
RB 70	1-31-85	Floor	White	52921	0	145	62891	36027	1-7-85	466	12-10-84
RB 71	1-31-85	Floor	White	52921	0	24	62892	36027	1-7-85	466	12-10-84
RB 72	1-31-85	Floor	White	52921	0	0	62892	36027	1-7-85	466	12-10-84
RB 73	1-31-85	Floor	White	52921	0	1	62893	36027	1-7-85	466	12-10-84
RB 74	1-31-85	Floor	White	52921	0	0	62893	36027	1-7-85	466	12-10-84
RB 75	1-31-85	Floor	White	52921	0	0	62894	36027	1-7-85	466	12-10-84
RB 76	1-31-85	Floor	White	52921	0	4	62894	36027	1-7-85	466	12-10-84
RB 77	1-31-85	Floor	White	52921	0	0	62895	36027	1-7-85	466	12-10-84
RB 78	1-31-85	Floor	White	52921	0	0	62895	36027	1-7-85	466	12-10-84
RB 79	1-31-85	Floor	White	52921	0	0	62896	36027	1-7-85	466	12-10-84
RB 80	1-31-85	Floor	White	52921	0	1	62896	36027	1-7-85	466	12-10-84
RB 81	1-31-85	Floor	White	52921	0	15	62897	36027	1-7-85	466	12-10-84
RB 82	1-31-85	Floor	White	52921	0	102	62897	36027	1-7-85	466	12-10-84
RB 83	1-31-85	Floor	White	52921	5	5	62898	36027	1-7-85	466	12-10-84
RB 84	1-31-85	Floor	White	52921	0	3	62898	36027	1-7-85	466	12-10-84
RB 85	1-31-85	Floor	White	52921	0	6	62899	36027	1-7-85	466	12-10-84
RB 86	1-31-85	Floor	White	52921	0	2	62899	36027	1-7-85	466	12-10-84
RB 87	1-31-85	Floor	White	52921	2	14	62900	36027	1-7-85	466	12-10-84
RB 88	1-31-85	Floor	White	52921	0	21	62900	36027	1-7-85	466	12-10-84
RB 89	1-31-85	Floor	White	52922	0	0	62901	36027	1-7-85	466	12-10-84
RB 90	1-31-85	Floor	White	52922	0	6	62901	36027	1-7-85	466	12-10-84
RB 91	1-31-85	Floor	White	52922	0	0	62902	36027	1-7-85	466	12-10-84
RB 92	1-31-85	Floor	White	52922	0	12	62902	36027	1-7-85	466	12-10-84
RB 93	1-31-85	Floor	White	52922	0	0	62903	36027	1-7-85	466	12-10-84
RB 94	1-31-85	Floor	White	52922	0	1	62903	36027	1-7-85	466	12-10-84
RB 95	1-31-85	Floor	White	52922	0	0	62904	36027	1-7-85	466	12-10-84
RB 96	1-31-85	Floor	White	52922	0	0	62904	36027	1-7-85	466	12-10-84
RB 97	1-31-85	Floor	White	52922	0	6	62904	36027	1-7-85	466	12-10-84
RB 98	1-31-85	Floor	White	52922	0	7	62905	36027	1-7-85	466	12-10-84
RB 99	1-31-85	Floor	White	52922	0	13	62905	36027	1-7-85	466	12-10-84
RB 100	1-31-85	Floor	White	52922	0	5	62906	36027	1-7-85	466	12-10-84
RB 101	1-31-85	Floor	White	52922	0	0	62906	36027	1-7-85	466	12-10-84
RB 102	1-31-85	Floor	White	52922	0	11	62906	36027	1-7-85	466	12-10-84
RB 103	1-31-85	Floor	White	52922	0	1	62907	36027	1-7-85	466	12-10-84
RB 1[illegible]	1-31-85	Floor	White	52922		0	62907	36027	1-7-85	466	12-1[illegible]
RB 1[illegible]	1-31-85	Floor	White	52922		0	62908	36027	1-7-85	466	12-1[illegible]

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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
RB 52	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	56
RB 53	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	57
RB 54	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	58
RB 55	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	59
RB 56	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	60
RB 57	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	61
RB 58	1-28-85	Floor	White	423	2-14-85	3	0.34	0.40	0.42	62
RB 59	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	63
RB 60	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	64
RB 61	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	65
RB 62	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	66
RB 63	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	67
RB 64	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	68
RB 65	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	69
RB 66	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	70
RB 67	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	71
RB 68	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	72
RB 69	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	73
RB 70	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	74
RB 71	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	75
RB 72	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	76
RB 73	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	77
RB 74	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	78
RB 75	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	79
RB 76	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	80
RB 77	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	81
RB 78	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	82
RB 79	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	83
RB 80	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	84
RB 81	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	85
RB 82	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	86
RB 83	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	87
RB 84	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	88
RB 85	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	89
RB 86	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	90
RB 87	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	91
RB 88	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	92
RB 89	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	93
RB 90	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	94
RB 91	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	95
RB 92	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	96
RB 93	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	97
RB 94	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	98
RB 95	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	99
RB 96	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	100
RB 97	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	101
RB 98	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	102
RB 99	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	103
RB 100	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	104
RB 101	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	105
RB 102	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	106
RB 103	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	107
RB 104	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	108
RB 105	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	109

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
RB 106	1-31-85	Floor	White	0	75	50	50	50	Pt. 2	8	59	0.007
RB 107	1-31-85	Floor	White	50	50	0	0	100	Pt. 5	0	59	0.010
RB 108	1-31-85	Floor	White	75	100	75	50	75	Pt. 2	3	59	0.010
RB 109	1-31-85	Floor	White	50	50	50	75	50	Pt. 4	11	59	0.006
RB 110	1-31-85	Floor	White	100	75	75	50	75	Pt. 1	6	59	0.007
RB 111	1-31-85	Floor	White	75	75	75	75	50	Pt. 1	0	59	0.006
RB 112	1-31-85	Floor	White	0	0	50	50	50	Pt. 5	0	59	0.005
RB 113	1-31-85	Floor	White	0	50	50	0	50	Pt. 5	8	59	0.007
RB 114	1-31-85	Floor	White	50	75	50	75	100	Pt. 5	8	59	0.008
RB 115	1-31-85	Floor	White	50	50	50	75	50	Pt. 4	3	59	0.010
RB 116	1-31-85	Floor	White	50	100	0	0	75	Pt. 2	8	59	0.008
RB 117	1-31-85	Floor	White	50	100	100	75	50	Pt. 3	3	59	0.005
RB 118	1-31-85	Floor	White	75	75	50	50	50	Pt. 2	0	59	0.006
RB 119	1-31-85	Floor	White	50	50	50	50	50	Pt. 5	0	59	0.006
RB 120	1-31-85	Floor	White	50	50	75	75	50	Pt. 4	0	59	0.006
RB 121	1-31-85	Floor	White	75	50	50	50	75	Pt. 1	3	59	0.006
RB 122	1-31-85	Floor	White	100	0	0	50	0	Pt. 1	0	59	0.017
RB 123	1-31-85	Floor	White	100	75	75	75	75	Pt. 1	11	59	0.009
RB 124	1-31-85	Floor	White	50	100	75	50	50	Pt. 2	6	59	0.010
RB 125	1-31-85	Floor	White	50	100	50	50	75	Pt. 2	8	59	0.021
RB 126	1-31-85	Floor	White	25	0	0	50	75	Pt. 5	0	59	0.008
RB 127	1-31-85	Floor	White	75	50	0	100	0	Pt. 4	6	59	0.008
RB 128	1-31-85	Floor	White	100	100	50	50	50	Pt. 2	3	59	0.005
RB 129	1-31-85	Floor	White	50	75	50	50	75	Pt. 5	0	59	0.006
RB 130	1-31-85	Floor	White	50	75	100	100	75	Pt. 4	0	59	0.006
RB 131	1-31-85	Floor	White	100	75	50	50	75	Pt. 1	0	59	0.008
RB 132	1-31-85	Floor	White	0	0	100	75	0	Pt. 3	6	59	0.018
RB 133	1-31-85	Floor	White	0	75	0	0	0	Pt. 2	3	59	0.017
RB 134	1-31-85	Floor	White	0	100	100	0	0	Pt. 3	0	59	0.016
RB 135	1-31-85	Floor	White	0	100	125	0	0	Pt. 3	0	59	0.021
RB 136	1-31-85	Floor	White	0	75	75	0	0	Pt. 3	0	59	0.018
RB 137	1-31-85	Floor	White	100	200	125	0	0	Pt. 2	3	59	0.030
RB 138	2-1-85	Floor	White	50	25	0	0	0	Pt. 1	3	59	0.003
RB 139	2-1-85	Floor	White	50	0	0	50	0	Pt. 1	3	59	0.004
RB 140	2-1-85	Floor	White	50	75	75	50	75	Pt. 5	8	59	0.007
RB 141	2-1-85	Floor	White	75	75	50	75	75	Pt. 5	14	59	0.010
RB 142	2-1-85	Floor	White	50	75	0	0	50	Pt. 2	0	59	0.007
RB 143	2-1-85	Floor	White	25	50	50	50	25	Pt. 2	3	59	0.005
RB 144	2-1-85	Floor	White	25	25	25	25	50	Pt. 5	0	59	0.005
RB 145	2-1-85	Floor	White	50	25	50	75	25	Pt. 4	0	59	0.004
RB 146	2-1-85	Floor	White	50	50	25	25	50	Pt. 5	3	59	0.006
RB 147	2-1-85	Floor	White	50	50	50	25	25	Pt. 3	8	59	0.005
RB 148	2-1-85	Floor	White	25	25	25	25	25	Pt. 5	3	59	0.004
RB 149	2-1-85	Floor	White	25	25	25	25	50	Pt. 5	0	59	0.003
RB 150	2-1-85	Floor	White	25	0	0	50	50	Pt. 5	3	59	0.007
RB 151	2-1-85	Floor	White	50	0	0	75	25	Pt. 4	8	59	0.006
RB 152	2-1-85	Floor	White	75	0	0	100	50	Pt. 4	0	59	0.006
RB 153	2-1-85	Floor	White	25	0	0	75	25	Pt. 4	3	59	0.007
RB 154	2-1-85	Floor	White	50	0	0	50	75	Pt. 5	6	59	0.007
RB 155	2-1-85	Floor	White	25	50	0	0	25	Pt. 2	3	59	0.007
RB 158	2-1-85	Floor	White	50	50	0	0	50	Pt. 5	8	59	0.010
RB 156	2-1-85	Floor	White	75	50	50	50	50	Pt. 1	0	59	0.008
RB 157	2-1-85	Floor	White	50	100	50	75	50	Pt. 2	6	59	0.009
RB 159	2-1-85	Floor	White	25	50	25	25	25	Pt. 2	6	59	[illegible]06

RAD SURVEY REACTOR BLDG. 1111
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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
RB 106	1-31-85	Floor	White	52922	0	8	62908	36027	1-7-85	466	12-10-84
RB 107	1-31-85	Floor	White	52922	0	0	62909	36027	1-7-85	466	12-10-84
RB 108	1-31-85	Floor	White	52922	0	6	62909	36027	1-7-85	466	12-10-84
RB 109	1-31-85	Floor	White	52925	0	5	62910	36027	1-7-85	466	12-10-84
RB 110	1-31-85	Floor	White	52925	0	5	62910	36027	1-7-85	466	12-10-84
RB 111	1-31-85	Floor	White	52925	0	2	62911	36027	1-7-85	466	12-10-84
RB 112	1-31-85	Floor	White	52925	0	5	62911	36027	1-7-85	466	12-10-84
RB 113	1-31-85	Floor	White	52925	0	0	62912	36027	1-7-85	466	12-10-84
RB 114	1-31-85	Floor	White	52925	0	13	62912	36027	1-7-85	466	12-10-84
RB 115	1-31-85	Floor	White	52925	0	1	62913	36027	1-7-85	466	12-10-84
RB 116	1-31-85	Floor	White	52925	0	0	62913	36027	1-7-85	466	12-10-84
RB 117	1-31-85	Floor	White	52925	0	4	62914	36027	1-7-85	466	12-10-84
RB 118	1-31-85	Floor	White	52925	0	0	62914	36027	1-7-85	466	12-10-84
RB 119	1-31-85	Floor	White	52925	0	11	62915	36027	1-7-85	466	12-10-84
RB 120	1-31-85	Floor	White	52925	0	4	62915	36027	1-7-85	466	12-10-84
RB 121	1-31-85	Floor	White	52925	1	2	62916	36027	1-7-85	466	12-10-84
RB 122	1-31-85	Floor	White	52925	0	8	62916	36027	1-7-85	466	12-10-84
RB 123	1-31-85	Floor	White	52925	0	5	62917	36027	1-7-85	466	12-10-84
RB 124	1-31-85	Floor	White	52925	0	0	62917	36027	1-7-85	466	12-10-84
RB 125	1-31-85	Floor	White	52925	0	3	62918	36027	1-7-85	466	12-10-84
RB 126	1-31-85	Floor	White	52925	0	4	62918	36027	1-7-85	466	12-10-84
RB 127	1-31-85	Floor	White	52925	0	3	62919	36027	1-7-85	466	12-10-84
RB 128	1-31-85	Floor	White	52925	1	0	62919	36027	1-7-85	466	12-10-84
RB 129	1-31-85	Floor	White	52925	0	0	62920	36027	1-7-85	466	12-10-84
RB 130	1-31-85	Floor	White	52925	0	0	62920	36027	1-7-85	466	12-10-84
RB 131	1-31-85	Floor	White	52925	0	10	62921	36027	1-7-85	466	12-10-84
RB 132	1-31-85	Floor	White	52925	0	11	62921	36027	1-7-85	466	12-10-84
RB 133	1-31-85	Floor	White	52925	0	7	62921	36027	1-7-85	466	12-10-84
RB 134	1-31-85	Floor	White	52925	0	10	62921	36027	1-7-85	466	12-10-84
RB 135	1-31-85	Floor	White	52925	1	0	62922	36027	1-7-85	466	12-10-84
RB 136	1-31-85	Floor	White	52925	0	5	62922	36027	1-7-85	466	12-10-84
RB 137	1-31-85	Floor	White	52925	0	3	62922	36027	1-7-85	466	12-10-84
RB 138	2-1-85	Floor	White	52925	0	0	62923	36027	1-7-85	466	12-10-84
RB 139	2-1-85	Floor	White	52925	0	0	62923	36027	1-7-85	466	12-10-84
RB 140	2-1-85	Floor	White	52925	0	0	62923	36027	1-7-85	466	12-10-84
RB 141	2-1-85	Floor	White	52925	0	0	62924	36027	1-7-85	466	12-10-84
RB 142	2-1-85	Floor	White	52925	0	3	62924	36027	1-7-85	466	12-10-84
RB 143	2-1-85	Floor	White	52925	0	0	62925	36027	1-7-85	466	12-10-84
RB 144	2-1-85	Floor	White	52925	0	4	62925	36027	1-7-85	466	12-10-84
RB 145	2-1-85	Floor	White	52925	0	5	62926	36027	1-7-85	466	12-10-84
RB 146	2-1-85	Floor	White	52925	0	0	62926	36027	1-7-85	466	12-10-84
RB 147	2-1-85	Floor	White	52925	0	8	62927	36027	1-7-85	466	12-10-84
RB 148	2-1-85	Floor	White	52925	0	0	62927	36027	1-7-85	466	12-10-84
RB 149	2-1-85	Floor	White	52925	0	5	62928	36027	1-7-85	466	12-10-84
RB 150	2-1-85	Floor	White	52925	0	8	62928	36027	1-7-85	466	12-10-84
RB 151	2-1-85	Floor	White	52925	2	8	62929	36027	1-7-85	466	12-10-84
RB 152	2-1-85	Floor	White	52925	0	8	62929	36027	1-7-85	466	12-10-84
RB 153	2-1-85	Floor	White	52925	0	3	62929	36027	1-7-85	466	12-10-84
RB 154	2-1-85	Floor	White	52925	1	6	62930	36027	1-7-85	466	12-10-84
RB 155	2-1-85	Floor	White	52925	0	3	62930	36027	1-7-85	466	12-10-84
RB 158	2-1-85	Floor	White	52925	0	17	62930	36027	1-7-85	466	12-10-84
RB 156	2-1-85	Floor	White	52925	0	2	62931	36027	1-7-85	466	12-10-84
RB 157	2-1-85	Floor	White	52925	0	10	62931	36027	1-7-85	466	12-10-84
RB 159	2-1-85	Floor	White	52929	0	6	62932	36027	1-7-85	466	12-10-84

RAD SURVEY REACTOR BLDG. 1111
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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
RB 106	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	110
RB 107	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	111
RB 108	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	112
RB 109	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	113
RB 110	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	114
RB 111	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	115
RB 112	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	116
RB 113	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	117
RB 114	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	118
RB 115	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	119
RB 116	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	120
RB 117	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	121
RB 118	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	122
RB 119	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	123
RB 120	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	124
RB 121	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	125
RB 122	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	126
RB 123	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	127
RB 124	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	128
RB 125	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	129
RB 126	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	130
RB 127	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	131
RB 128	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	132
RB 129	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	133
RB 130	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	134
RB 131	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	135
RB 132	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	136
RB 133	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	137
RB 134	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	138
RB 135	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	139
RB 136	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	140
RB 137	1-31-85	Floor	White	423	2-14-85	4	0.34	0.37	0.42	141
RB 138	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	142
RB 139	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	143
RB 140	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	144
RB 141	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	145
RB 142	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	146
RB 143	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	147
RB 144	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	148
RB 145	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	149
RB 146	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	150
RB 147	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	151
RB 148	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	152
RB 149	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	153
RB 150	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	154
RB 151	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	155
RB 152	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	156
RB 153	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	157
RB 154	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	158
RB 155	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	159
RB 158	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	160
RB 156	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	161
RB 157	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	16[illegible]
R[illegible]	2-1-85	Floor	White	423	2-[illegible]	5	0.34	0.37	0.42	[illegible]

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
RB 160	2-1-85	Floor	White	25	50	0	0	50	Pt. 2	3	59	0.008
RB 161	2-1-85	Floor	White	75	100	50	50	50	Pt. 2	3	59	0.009
RB 162	2-1-85	Floor	White	75	50	0	0	50	Pt. 1	3	59	0.007
RB 163	2-1-85	Floor	White	25	25	25	50	50	Pt. 4	11	59	0.006
RB 164	2-1-85	Floor	White	50	50	0	0	50	Pt. 5	0	59	0.009
RB 165	2-1-85	Floor	White	75	25	50	25	50	Pt. 1	6	59	0.006
RB 166	2-1-85	Floor	White	50	50	0	0	50	Pt. 5	6	59	0.007
RB 175	2-1-85	Floor	White	100	100	150	50	1500	Pt. 5	8	59	0.065
RB 176	2-1-85	Floor	White	100	75	50	0	150	Pt. 5	3	59	0.009
E. AirLock	2-1-85	Floor	White	100	100	75	75	75	Pt. 2	6	59	0.007
E. AirLock	2-1-85	N. Wall	White	50	50	75	50	50	Pt. 3	0	59	0.006
E. AirLock	2-1-85	E. Wall	White	50	50	50	50	50	Pt. 2	8	59	0.006
E. AirLock	2-1-85	S. Wall	White	50	50	50	50	50	Pt. 5	6	59	0.005
E. AirLock	2-1-85	W. Wall	White	50	50	75	75	100	Pt. 5	6	59	0.007
E. AirLock	2-1-85	Ceiling	White	25	25	25	25	50	Pt. 5	6	59	0.005
W. AirLock	2-1-85	Floor	White	50	50	75	50	50	Pt. 3	6	59	0.003
W. AirLock	2-1-85	N. Wall	White	50	50	50	50	50	Pt. 5	8	59	0.004
W. AirLock	2-1-85	E. Wall	White	50	50	100	50	50	Pt. 3	6	59	0.003
W. AirLock	2-1-85	S. Wall	White	50	50	50	50	50	Pt. 5	3	59	0.003
W. AirLock	2-1-85	W. Wall	White	50	75	50	50	50	Pt. 2	8	59	0.003
W. AirLock	2-1-85	Ceiling	White	50	50	50	25	50	Pt. 1	3	59	0.003
RB 167	4-30-85	Floor	Magenta Yellow	0	1000	300	150	0	Pt. 2	15	59	0.230
RB 168	4-30-85	Floor	Magenta Yellow	150	100	100	100	250	Pt. 5	12	59	0.125
RB 169	4-30-85	Floor	Magenta Yellow	400	200	100	100	350	Pt. 1	9	59	0.140
RB 170	4-30-85	Floor	Magenta Yellow	100	100	100	75	400	Pt. 5	15	59	0.030
RB 167	4-30-85	N.Wall	Magenta Yellow	150	300	350	125	250	Pt. 3	3	59	0.200
RB 168	4-30-85	N.Wall	Magenta Yellow	125	300	150	100	150	Pt. 2	0	59	0.150
RB 170	4-30-85	W.Wall	Magenta Yellow	75	100	75	50	100	Pt. 2	15	59	0.020
RB 167	4-30-85	Ceiling	Magenta Yellow	75	75	75	100	125	Pt. 5	9	59	0.040
RB 170	4-30-85	S. Wall	Magenta Yellow	50	100	150	50	100	Pt. 3	6	59	0.032
RB 168	4-30-85	W. Wall	Magenta Yellow	50	100	100	75	100	Pt. 5	3	59	0.025
RB 169	4-30-85	E. Wall	Magenta Yellow	100	250	300	175	250	Pt. 3	9	59	0.130
RB 169	4-30-85	S. Wall	Magenta Yellow	75	100	200	75	200	Pt. 5	3	59	0.060
RB 171	4-30-85	Floor	White	0	50	75	50	0	Pt. 3	12	59	0.015
RB 172	4-30-85	Floor	White	50	100	75	75	75	Pt. 2	12	59	0.020
RB 173	4-30-85	Floor	White	100	50	125	150	100	Pt. 4	15	59	0.030
RB 174	4-30-85	Floor	White	100	125	75	75	100	Pt. 2	6	59	0.018
-25'RB 180	2-1-85	OuterShell	White	100	125	75	75	75	Pt. 2	6	59	0.008
-25'RB 210	2-1-85	OuterShell	White	75	50	100	125	75	Pt. 4	6	59	0.006
-25'RB 240	2-1-85	OuterShell	White	75	75	100	75	100	Pt. 5	0	59	0.007
-15'RB 0	2-1-85	OuterShell	White	50	50	75	100	75	Pt. 4	3	59	0.009
-15'RB 30	2-1-85	OuterShell	White	125	75	75	75	100	Pt. 1	3	59	0.005
-15'RB 60	2-1-85	OuterShell	White	100	75	75	100	75	Pt. 4	3	59	0.007
-15'RB 90	2-1-85	OuterShell	White	100	75	50	125	100	Pt. 4	3	59	0.023
-15'RB 270	2-1-85	OuterShell	White	100	50	100	125	50	Pt. 4	6	59	0.010
-15'RB 300	2-1-85	OuterShell	White	75	100	150	75	75	Pt. 3	3	59	0.012
-15'RB 330	2-1-85	OuterShell	White	75	75	100	50	75	Pt. 3	0	59	0.009
0'RB 0	2-1-85	OuterShell	White	75	75	75	50	75	Pt. 5	8	59	0.008
0'RB 30	2-1-85	OuterShell	White	75	75	75	75	0	Pt. 2	8	59	0.007
0'RB 60	2-1-85	OuterShell	White	50	75	50	50	75	Pt. 5	6	59	0.005
0'RB 90	2-1-85	OuterShell	White	50	50	50	50	0	Pt. 4	6	59	0.010
0'RB 120	2-1-85	OuterShell	White	75	100	75	75	100	Pt. 5	3	59	0.008
0'RB 150	2-1-85	OuterShell	White	100	50	100	75	75	Pt. 1	0	59	0.011
0'RB 180	2-1-85	OuterShell	White	75	100	100	50	75	Pt. 2	0	59	0.011

RAD SURVEY REACTOR BLDG. 1111
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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
RB 160	2-1-85	Floor	White	52929	0	16	62932	36027	1-7-85	466	12-10-84
RB 161	2-1-85	Floor	White	52929	0	6	62933	36027	1-7-85	466	12-10-84
RB 162	2-1-85	Floor	White	52929	0	12	62933	36027	1-7-85	466	12-10-84
RB 163	2-1-85	Floor	White	52929	0	8	62934	36027	1-7-85	466	12-10-84
RB 164	2-1-85	Floor	White	52929	1	2	62934	36027	1-7-85	466	12-10-84
RB 165	2-1-85	Floor	White	52929	0	10	62935	36027	1-7-85	466	12-10-84
RB 166	2-1-85	Floor	White	52929	0	0	62935	36027	1-7-85	466	12-10-84
RB 175	2-1-85	Floor	White	52929	0	9	62936	36027	1-7-85	466	12-10-84
RB 176	2-1-85	Floor	White	52929	0	10	62936	36027	1-7-85	466	12-10-84
E. AirLock	2-1-85	Floor	White	52930	0	15	62951	36027	1-7-85	466	12-10-84
E. AirLock	2-1-85	N. Wall	White	52930	0	4	62951	36027	1-7-85	466	12-10-84
E. AirLock	2-1-85	E. Wall	White	52930	0	14	62952	36027	1-7-85	466	12-10-84
E. AirLock	2-1-85	S. Wall	White	52930	0	20	62952	36027	1-7-85	466	12-10-84
E. AirLock	2-1-85	W. Wall	White	52930	0	5	62953	36027	1-7-85	466	12-10-84
E. AirLock	2-1-85	Ceiling	White	52930	0	8	62953	36027	1-7-85	466	12-10-84
W. AirLock	2-1-85	Floor	White	52930	0	11	62948	36027	1-7-85	466	12-10-84
W. AirLock	2-1-85	N. Wall	White	52930	0	3	62948	36027	1-7-85	466	12-10-84
W. AirLock	2-1-85	E. Wall	White	52930	0	4	62949	36027	1-7-85	466	12-10-84
W. AirLock	2-1-85	S. Wall	White	52930	0	14	62949	36027	1-7-85	466	12-10-84
W. AirLock	2-1-85	W. Wall	White	52930	0	6	62950	36027	1-7-85	466	12-10-84
W. AirLock	2-1-85	Ceiling	White	52930	0	6	62950	36027	1-7-85	466	12-10-84
RB 167	4-30-85	Floor	Magenta Yellow	53021	0	25	63404	36027	4-9-85	466	4-11-85
RB 168	4-30-85	Floor	Magenta Yellow	53021	0	27	63404	36027	4-9-85	466	4-11-85
RB 169	4-30-85	Floor	Magenta Yellow	53021	0	12	63405	36027	4-9-85	466	4-11-85
RB 170	4-30-85	Floor	Magenta Yellow	53021	0	100	63405	36027	4-9-85	466	4-11-85
RB 167	4-30-85	N.Wall	Magenta Yellow	53021	0	87	63406	36027	4-9-85	466	4-11-85
RB 168	4-30-85	N.Wall	Magenta Yellow	53021	0	16	63406	36027	4-9-85	466	4-11-85
RB 170	4-30-85	W.Wall	Magenta Yellow	53021	0	24	63409	36027	4-9-85	466	4-11-85
RB 167	4-30-85	Ceiling	Magenta Yellow	53021	0	12	63409	36027	4-9-85	466	4-11-85
RB 170	4-30-85	S. Wall	Magenta Yellow	53021	0	147	63408	36027	4-9-85	466	4-11-85
RB 168	4-30-85	W. Wall	Magenta Yellow	53021	0	42	63408	36027	4-9-85	466	4-11-85
RB 169	4-30-85	E. Wall	Magenta Yellow	53021	0	4	63407	36027	4-9-85	466	4-11-85
RB 169	4-30-85	S. Wall	Magenta Yellow	53021	0	25	63407	36027	4-9-85	466	4-11-85
RB 171	4-30-85	Floor	White	53021	0	12	63402	36027	4-9-85	466	4-11-85
RB 172	4-30-85	Floor	White	53021	0	10	63402	36027	4-9-85	466	4-11-85
RB 173	4-30-85	Floor	White	53021	0	12	63403	36027	4-9-85	466	4-11-85
RB 174	4-30-85	Floor	White	53021	0	25	63403	36027	4-9-85	466	4-11-85
-25'RB 180	2-1-85	OuterShell	White	52929	0	7	62937	36027	1-7-85	466	12-10-84
-25'RB 210	2-1-85	OuterShell	White	52929	0	6	62937	36027	1-7-85	466	12-10-84
-25'RB 240	2-1-85	OuterShell	White	52929	0	10	62938	36027	1-7-85	466	12-10-84
-15'RB 0	2-1-85	OuterShell	White	52929	0	8	62938	36027	1-7-85	466	12-10-84
-15'RB 30	2-1-85	OuterShell	White	52929	0	0	62939	36027	1-7-85	466	12-10-84
-15'RB 60	2-1-85	OuterShell	White	52929	0	6	62939	36027	1-7-85	466	12-10-84
-15'RB 90	2-1-85	OuterShell	White	52929	0	5	62940	36027	1-7-85	466	12-10-84
-15'RB 270	2-1-85	OuterShell	White	52929	0	5	62940	36027	1-7-85	466	12-10-84
-15'RB 300	2-1-85	OuterShell	White	52929	0	8	62941	36027	1-7-85	466	12-10-84
-15'RB 330	2-1-85	OuterShell	White	52929	0	4	62941	36027	1-7-85	466	12-10-84
0'RB 0	2-1-85	OuterShell	White	52929	0	17	62942	36027	1-7-85	466	12-10-84
0'RB 30	2-1-85	OuterShell	White	52929	0	8	62942	36027	1-7-85	466	12-10-84
0'RB 60	2-1-85	OuterShell	White	52929	0	9	62943	36027	1-7-85	466	12-10-84
0'RB 90	2-1-85	OuterShell	White	52929	0	0	62943	36027	1-7-85	466	12-10-84
0'RB 120	2-1-85	OuterShell	White	52929	0	12	62944	36027	1-7-85	466	12-10-84
0'RB 150	2-1-85	OuterShell	White	52929	0	0	62944	36027	1-7-85	466	12-10-84
0'R[illegible]90	2-1-85	OuterShell	White	52929	[illegible]	1	62945	36027	1-7-85	466	12-[illegible]84

RAD SURVEY REACTOR BLDG. 1111
09-12-85
01:07:30

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
RB 160	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	164
RB 161	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	165
RB 162	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	166
RB 163	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	167
RB 164	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	168
RB 165	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	169
RB 166	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	170
RB 175	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	171
RB 176	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	172
E. AirLock	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	173
E. AirLock	2-1-85	N. Wall	White	423	2-14-85	5	0.34	0.37	0.42	174
E. AirLock	2-1-85	E. Wall	White	423	2-14-85	5	0.34	0.37	0.42	175
E. AirLock	2-1-85	S. Wall	White	423	2-14-85	5	0.34	0.37	0.42	176
E. AirLock	2-1-85	W. Wall	White	423	2-14-85	5	0.34	0.37	0.42	177
E. AirLock	2-1-85	Ceiling	White	423	2-14-85	5	0.34	0.37	0.42	178
W. AirLock	2-1-85	Floor	White	423	2-14-85	5	0.34	0.37	0.42	179
W. AirLock	2-1-85	N. Wall	White	423	2-14-85	5	0.34	0.37	0.42	180
W. AirLock	2-1-85	E. Wall	White	423	2-14-85	5	0.34	0.37	0.42	181
W. AirLock	2-1-85	S. Wall	White	423	2-14-85	5	0.34	0.37	0.42	182
W. AirLock	2-1-85	W. Wall	White	423	2-14-85	5	0.34	0.37	0.42	183
W. AirLock	2-1-85	Ceiling	White	423	2-14-85	5	0.34	0.37	0.42	184
RB 167	4-30-85	Floor	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	185
RB 168	4-30-85	Floor	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	186
RB 169	4-30-85	Floor	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	187
RB 170	4-30-85	Floor	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	188
RB 167	4-30-85	N.Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	189
RB 168	4-30-85	N.Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	190
RB 170	4-30-85	W.Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	191
RB 167	4-30-85	Ceiling	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	192
RB 170	4-30-85	S. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	193
RB 168	4-30-85	W. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	194
RB 169	4-30-85	E. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	195
RB 169	4-30-85	S. Wall	Magenta Yellow	423	4-9-85	2	0.34	0.37	0.38	196
RB 171	4-30-85	Floor	White	423	4-9-85	2	0.34	0.37	0.38	197
RB 172	4-30-85	Floor	White	423	4-9-85	2	0.34	0.37	0.38	198
RB 173	4-30-85	Floor	White	423	4-9-85	2	0.34	0.37	0.38	199
RB 174	4-30-85	Floor	White	423	4-9-85	2	0.34	0.37	0.38	200
-25'RB 180	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	201
-25'RB 210	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	202
-25'RB 240	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	203
-15'RB 0	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	204
-15'RB 30	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	205
-15'RB 60	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	206
-15'RB 90	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	207
-15'RB 270	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	208
-15'RB 300	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	209
-15'RB 330	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	210
0'RB 0	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	211
0'RB 30	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	212
0'RB 60	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	213
0'RB 90	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	214
0'RB 120	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	215
0'RB 150	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	216
0'RB 180	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	217

RAD SURVEY REACTOR BLDG. 1111
09-12-85
00:35:27

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
O'RB 210	2-1-85	OuterShell	White	50	50	50	75	100	Pt. 5	3	59	0.006
O'RB 240	2-1-85	OuterShell	White	50	100	100	50	100	Pt. 5	3	59	0.007
O'RB 270	2-1-85	OuterShell	White	75	100	75	50	75	Pt. 2	0	59	0.007
O'RB 300	2-1-85	OuterShell	White	75	0	0	75	75	Pt. 5	3	59	0.006
O'RB 330	2-1-85	OuterShell	White	50	75	100	75	50	Pt. 3	3	59	0.005
Penthouse	8-9-85	Floor	White	100	0	0	0	0		0	59	0.006
Penthouse	8-9-85	N. Wall	White	<100	0	0	0	0		0	0	0.004
Penthouse	8-9-85	E. Wall	White	<100	0	0	0	0		0	0	0.004
Penthouse	8-9-85	S. Wall	White	<100	0	0	0	0		0	0	0.005
Penthouse	8-9-85	W. Wall	White	<100	0	0	0	0		0	0	0.005
Abs.Filter	8-9-85		White	100	0	0	0	0		0	0	0.000

PD235 Number of Records Read: 227
PD236 Number of Records Selected: 227

RAD SURVEY REACTOR BLDG. 1111
09-12-85
00:49:15

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
O'RB 210	2-1-85	OuterShell	White	52929	0	3	62945	36027	1-7-85	466	12-10-84
O'RB 240	2-1-85	OuterShell	White	52929	0	6	62946	36027	1-7-85	466	12-10-84
O'RB 270	2-1-85	OuterShell	White	52929	0	5	62946	36027	1-7-85	466	12-10-84
O'RB 300	2-1-85	OuterShell	White	52929	0	16	62947	36027	1-7-85	466	12-10-84
O'RB 330	2-1-85	OuterShell	White	52929	0	12	62947	36027	1-7-85	466	12-10-84
Penthouse	8-9-85	Floor	White	53196	0	9	63547				
Penthouse	8-9-85	N. Wall	White	53196	0	24	63547				
Penthouse	8-9-85	E. Wall	White	53196	0	0	63547				
Penthouse	8-9-85	S. Wall	White	53196	0	0	63547				
Penthouse	8-9-85	W. Wall	White	53196	0	0	63547				
Abs.Filter	8-9-85		White		<1	9	63547				

PD235 Number of Records Read: 227
PD236 Number of Records Selected: 227

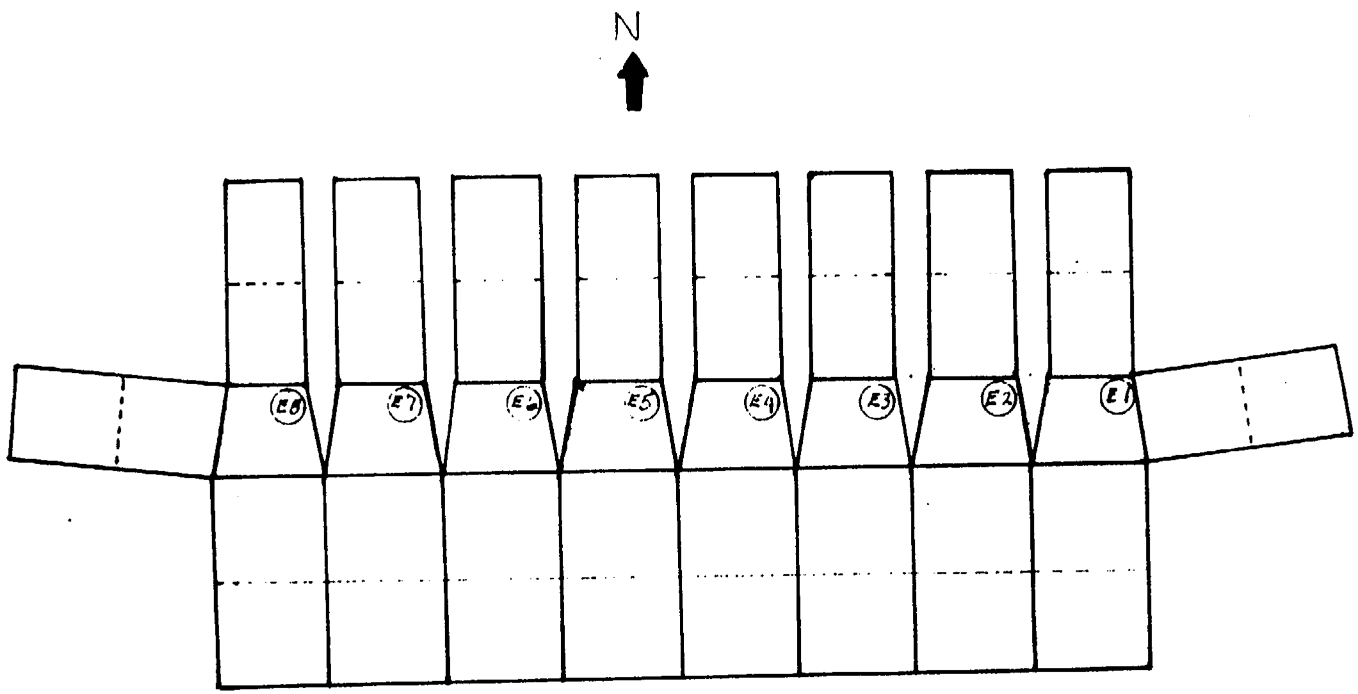
RAD SURVEY REACTOR BLDG. 1111
09-12-85
01:07:30

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
O'RB 210	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	218
O'RB 240	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	219
O'RB 270	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	220
O'RB 300	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	221
O'RB 330	2-1-85	OuterShell	White	423	2-14-85	5	0.34	0.37	0.42	222
Penthouse	8-9-85	Floor	White			1	0.00	0.38	0.37	223
Penthouse	8-9-85	N. Wall	White			1	0.00	0.38	0.37	224
Penthouse	8-9-85	E. Wall	White			1	0.00	0.38	0.37	225
Penthouse	8-9-85	S. Wall	White			1	0.00	0.38	0.37	226
Penthouse	8-9-85	W. Wall	White			1	0.00	0.38	0.37	227
Abs.Filter	8-9-85		White			1	0.00	0.38	0.37	228

PD235 Number of Records Read: 227
PD236 Number of Records Selected: 227

APPENDIX 3.12

Radiological Monitoring Data For The PBRF
Canals E Thru K



REACTOR BUILDING
CONTAINMENT AREA
CANAL "E"

RAD SURVEY CANAL E
09-12-85
01:42:12

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
E 1	4-24-85	Floor	Magenta Yellow	275	400	200	1100	200	Pt. 4	59	59	0.120
E 2	4-24-85	Floor	Magenta Yellow	400	225	300	250	150	Pt. 1	59	59	0.110
E 3	4-24-85	Floor	Magenta Yellow	200	225	400	275	275	Pt. 3	35	59	0.090
E 4	4-24-85	Floor	Magenta Yellow	300	3300	1250	3000	750	Pt. 2	47	59	0.230
E 5	4-24-85	Floor	Magenta Yellow	1100	900	1000	1000	1100	Pt. 1	79	59	0.130
E 6	4-24-85	Floor	Magenta Yellow	1700	900	1000	1500	1250	Pt. 1	32	59	0.110
E 7	4-24-85	Floor	Magenta Yellow	1000	1100	2000	1100	1200	Pt. 3	53	59	0.100
E 8	4-24-85	Floor	Magenta Yellow	1000	3500	600	800	600	Pt. 2	50	59	0.100
E 1	4-24-85	N. Wall L	Magenta Yellow	0	0	475	325	125	Pt. 3	48	59	0.090
E 1	4-24-85	N. Wall U	Magenta Yellow	0	0	225	150	125	Pt. 3	24	59	0.026
E 2	4-24-85	N. Wall L	Magenta Yellow	300	800	500	250	200	Pt. 2	41	59	0.090
E 2	4-24-85	N. Wall U	Magenta Yellow	150	200	200	150	200	Pt. 5	38	59	0.028
E 3	4-24-85	N. Wall L	Magenta Yellow	275	250	275	200	175	Pt. 3	53	59	0.060
E 3	4-24-85	N. Wall U	Magenta Yellow	300	250	150	275	175	Pt. 1	41	59	0.024
E 4	4-24-85	N. Wall L	Magenta Yellow	475	275	1600	200	400	Pt. 3	38	59	0.290
E 5	4-24-85	N. Wall L	Magenta Yellow	275	500	450	125	300	Pt. 2	48	59	0.130
E 5	4-24-85	N. Wall U	Magenta Yellow	175	175	125	175	150	Pt. 4	24	59	0.039
E 6	4-24-85	N. Wall L	Magenta Yellow	150	350	600	100	300	Pt. 3	38	59	0.065
E 6	4-24-85	N. Wall U	Magenta Yellow	125	100	100	125	125	Pt. 5	41	59	0.035
E 7	4-24-85	N. Wall L	Magenta Yellow	150	350	1000	275	475	Pt. 3	68	59	0.160
E 7	4-24-85	N. Wall U	Magenta Yellow	125	200	200	100	175	Pt. 3	32	59	0.044
E 8	4-24-85	N. Wall L	Magenta Yellow	200	750	250	200	300	Pt. 2	24	59	0.140
E 8	4-24-85	N. Wall U	Magenta Yellow	500	100	250	200	225	Pt. 1	32	59	0.032
E 1	4-24-85	E. Wall L	Magenta Yellow	125	175	125	150	100	Pt. 2	56	59	0.040
E 1	4-24-85	E. Wall U	Magenta Yellow	225	175	150	200	150	Pt. 1	38	59	0.019
E 8	4-24-85	W. Wall L	Magenta Yellow	300	300	275	225	350	Pt. 5	32	59	0.040
E 8	4-24-85	W. Wall U	Magenta Yellow	350	200	275	450	400	Pt. 4	53	59	0.024
E 1	4-24-85	S. Wall L	Magenta Yellow	250	150	0	0	150	Pt. 1	65	59	0.028
E 1	4-24-85	S. Wall U	Magenta Yellow	150	225	0	0	125	Pt. 2	38	59	0.028
E 2	4-24-85	S. Wall L	Magenta Yellow	250	200	250	225	125	Pt. 3	24	59	0.038
E 2	4-24-85	S. Wall U	Magenta Yellow	200	225	200	150	175	Pt. 2	24	59	0.030
E 3	4-24-85	S. Wall L	Magenta Yellow	200	275	150	250	225	Pt. 2	56	59	0.080
E 3	4-24-85	S. Wall U	Magenta Yellow	200	225	175	200	150	Pt. 2	41	59	0.032
E 4	4-24-85	S. Wall L	Magenta Yellow	275	750	350	150	350	Pt. 2	71	59	0.120
E 4	4-24-85	S. Wall U	Magenta Yellow	150	175	200	175	125	Pt. 3	29	59	0.044
E 5	4-24-85	S. Wall L	Magenta Yellow	225	450	600	200	300	Pt. 3	71	59	0.140
E 5	4-24-85	S. Wall U	Magenta Yellow	125	200	175	100	150	Pt. 2	29	59	0.040
E 6	4-24-85	S. Wall L	Magenta Yellow	200	750	350	175	250	Pt. 2	35	59	0.050
E 6	4-24-85	S. Wall U	Magenta Yellow	275	200	175	200	175	Pt. 1	35	59	0.036
E 7	4-24-85	S. Wall L	Magenta Yellow	150	475	400	150	350	Pt. 2	50	59	0.080
E 7	4-24-85	S. Wall U	Magenta Yellow	175	125	200	100	275	Pt. 5	44	59	0.037
E 8	4-24-85	S. Wall L	Magenta Yellow	325	400	450	150	300	Pt. 3	44	59	0.060
E 8	4-24-85	S. Wall U	Magenta Yellow	300	300	150	100	250	Pt. 1	27	59	0.028
E4	4-24-85	N. Wall U	Magenta Yellow	300	275	200	175	150	Pt. 1	15	59	0.310

PD235 Number of Records Read: 44
PD236 Number of Records Selected: 44

RAD SURVEY CANAL E
09-12-85
01:45:57

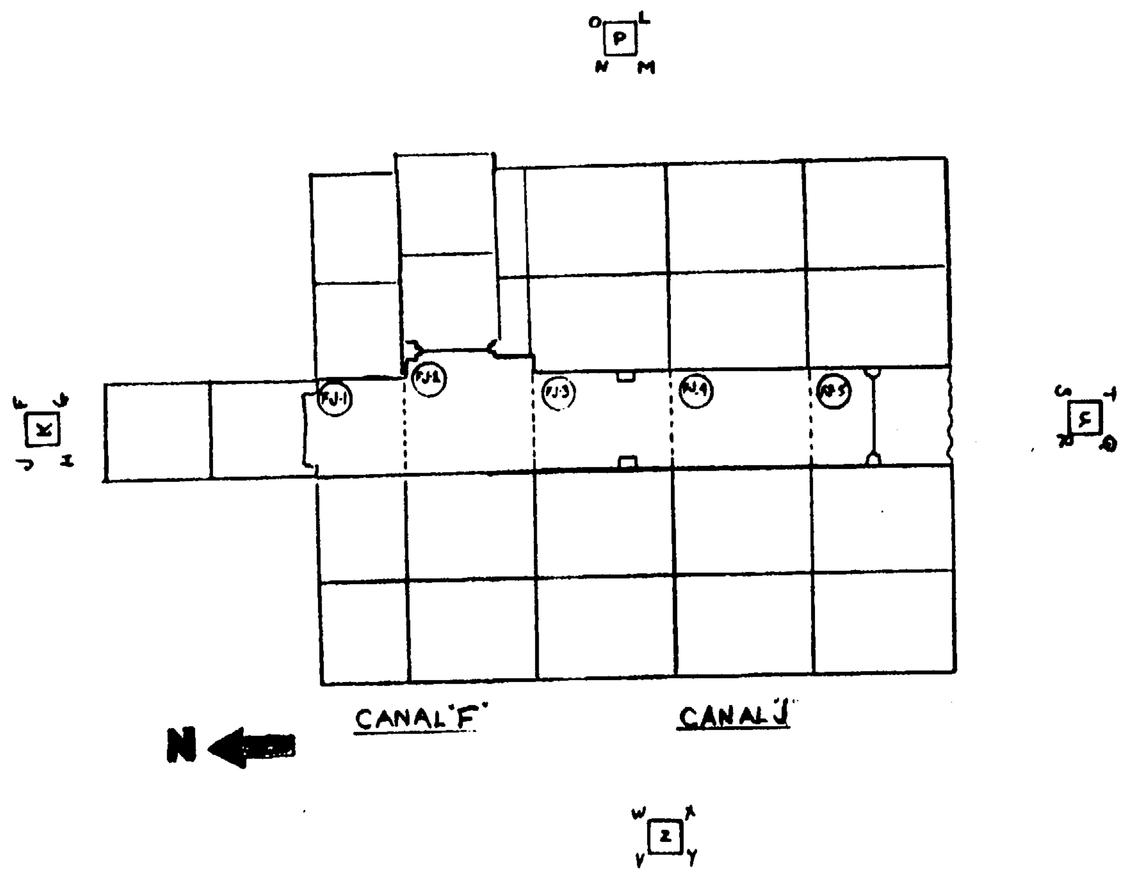
Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
E 1	4-24-85	Floor	Magenta Yellow	53009	1	220	63410	36027	4-9-85	466	4-11-85
E 2	4-24-85	Floor	Magenta Yellow	53009	2	110	63410	36027	4-9-85	466	4-11-85
E 3	4-24-85	Floor	Magenta Yellow	53009	2	224	63411	36027	4-9-85	466	4-11-85
E 4	4-24-85	Floor	Magenta Yellow	53009	2	372	63411	36027	4-9-85	466	4-11-85
E 5	4-24-85	Floor	Magenta Yellow	53009	1	1235	63412	36027	4-9-85	466	4-11-85
E 6	4-24-85	Floor	Magenta Yellow	53009	1	465	63412	36027	4-9-85	466	4-11-85
E 7	4-24-85	Floor	Magenta Yellow	53010	3	1765	63413	36027	4-9-85	466	4-11-85
E 8	4-24-85	Floor	Magenta Yellow	53010	7	9443	63413	36027	4-9-85	466	4-11-85
E 1	4-24-85	N. Wall L	Magenta Yellow	53009	2	313	63414	36027	4-9-85	466	4-11-85
E 1	4-24-85	N. Wall U	Magenta Yellow	53009	1	32	63414	36027	4-9-85	466	4-11-85
E 2	4-24-85	N. Wall L	Magenta Yellow	53009	1	148	63415	36027	4-9-85	466	4-11-85
E 2	4-24-85	N. Wall U	Magenta Yellow	53009	2	28	63415	36027	4-9-85	466	4-11-85
E 3	4-24-85	N. Wall L	Magenta Yellow	53009	1	168	63416	36027	4-9-85	466	4-11-85
E 3	4-24-85	N. Wall U	Magenta Yellow	53009	1	69	63416	36027	4-9-85	466	4-11-85
E 4	4-24-85	N. Wall L	Magenta Yellow	53009	0	48	63417	36027	4-9-85	466	4-11-85
E 5	4-24-85	N. Wall L	Magenta Yellow	53009	1	56	63418	36027	4-9-85	466	4-11-85
E 5	4-24-85	N. Wall U	Magenta Yellow	53009	4	1628	63418	36027	4-9-85	466	4-11-85
E 6	4-24-85	N. Wall L	Magenta Yellow	53009	1	165	63419	36027	4-9-85	466	4-11-85
E 6	4-24-85	N. Wall U	Magenta Yellow	53009	3	2103	63419	36027	4-9-85	466	4-11-85
E 7	4-24-85	N. Wall L	Magenta Yellow	53010	4	368	63420	36027	4-9-85	466	4-11-85
E 7	4-24-85	N. Wall U	Magenta Yellow	53010	3	1055	63420	36027	4-9-85	466	4-11-85
E 8	4-24-85	N. Wall L	Magenta Yellow	53010	3	5462	63421	36027	4-9-85	466	4-11-85
E 8	4-24-85	N. Wall U	Magenta Yellow	53010	6	2181	63421	36027	4-9-85	466	4-11-85
E 1	4-24-85	E. Wall L	Magenta Yellow	53009	1	475	63422	36027	4-9-85	466	4-11-85
E 1	4-24-85	E. Wall U	Magenta Yellow	53009	2	1603	63422	36027	4-9-85	466	4-11-85
E 8	4-24-85	W. Wall L	Magenta Yellow	53010	2	1128	63423	36027	4-9-85	466	4-11-85
E 8	4-24-85	W. Wall U	Magenta Yellow	53010	3	1843	63423	36027	4-9-85	466	4-11-85
E 1	4-24-85	S. Wall L	Magenta Yellow	53009	3	1737	64424	36027	4-9-85	466	4-11-85
E 1	4-24-85	S. Wall U	Magenta Yellow	53009	4	2393	64424	36027	4-9-85	466	4-11-85
E 2	4-24-85	S. Wall L	Magenta Yellow	53009	1	224	63425	36027	4-9-85	466	4-11-84
E 2	4-24-85	S. Wall U	Magenta Yellow	53009	0	703	63425	36027	4-9-85	466	4-11-85
E 3	4-24-85	S. Wall L	Magenta Yellow	53009	2	288	63426	36027	4-9-85	466	4-11-85
E 3	4-24-85	S. Wall U	Magenta Yellow	53009	3	496	63426	36027	4-9-85	466	4-11-85
E 4	4-24-85	S. Wall L	Magenta Yellow	53009	3	569	63427	36027	4-9-85	466	4-11-85
E 4	4-24-85	S. Wall U	Magenta Yellow	53009	2	2257	63427	36027	4-9-85	466	4-11-85
E 5	4-24-85	S. Wall L	Magenta Yellow	53009	2	165	63428	36027	4-9-85	466	4-11-85
E 5	4-24-85	S. Wall U	Magenta Yellow	53009	3	4108	63428	36027	4-9-85	466	4-11-85
E 6	4-24-85	S. Wall L	Magenta Yellow	53010	1	154	63429	36027	4-9-85	466	4-11-85
E 6	4-24-85	S. Wall U	Magenta Yellow	53010	5	1860	63429	36027	4-9-85	466	4-11-85
E 7	4-24-85	S. Wall L	Magenta Yellow	53010	1	205	63430	36027	4-9-85	466	4-11-85
E 7	4-24-85	S. Wall U	Magenta Yellow	53010	0	660	63430	36027	4-9-85	466	4-11-85
E 8	4-24-85	S. Wall L	Magenta Yellow	53010	2	842	63431	36027	4-9-85	466	4-11-85
E 8	4-24-85	S. Wall U	Magenta Yellow	53010	2	1599	63431	36027	4-9-85	466	4-11-85
E4	4-24-85	N. Wall U	Magenta Yellow	53009	2	668	63417	36027	4-9-85	466	4-11-85

PD235 Number of Records Read: 44
PD236 Number of Records Selected: 44

RAD SURVEY CANAL E
09-12-85
01:49:41

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
E 1	4-24-85	Floor	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	1
E 2	4-24-85	Floor	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	2
E 3	4-24-85	Floor	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	3
E 4	4-24-85	Floor	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	4
E 5	4-24-85	Floor	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	5
E 6	4-24-85	Floor	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	6
E 7	4-24-85	Floor	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	7
E 8	4-24-85	Floor	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	8
E 1	4-24-85	N. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	9
E 1	4-24-85	N. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	10
E 2	4-24-85	N. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	11
E 2	4-24-85	N. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	12
E 3	4-24-85	N. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	13
E 3	4-24-85	N. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	14
E 4	4-24-85	N. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	15
E 5	4-24-85	N. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	16
E 5	4-24-85	N. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	17
E 6	4-24-85	N. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	18
E 6	4-24-85	N. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	19
E 7	4-24-85	N. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	20
E 7	4-24-85	N. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	21
E 8	4-24-85	N. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	22
E 8	4-24-85	N. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	23
E 1	4-24-85	E. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	24
E 1	4-24-85	E. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	25
E 8	4-24-85	W. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	26
E 8	4-24-85	W. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	27
E 1	4-24-85	S. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	28
E 1	4-24-85	S. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	29
E 2	4-24-85	S. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	30
E 2	4-24-85	S. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	31
E 3	4-24-85	S. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	32
E 3	4-24-85	S. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	33
E 4	4-24-85	S. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	34
E 4	4-24-85	S. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	35
E 5	4-24-85	S. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	36
E 5	4-24-85	S. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	37
E 6	4-24-85	S. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	38
E 6	4-24-85	S. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	39
E 7	4-24-85	S. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	40
E 7	4-24-85	S. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	41
E 8	4-24-85	S. Wall L	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	42
E 8	4-24-85	S. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	43
E4	4-24-85	N. Wall U	Magenta Yellow	423	4-9-85	10	0.34	0.37	0.38	44

PD235 Number of Records Read: 44
PD236 Number of Records Selected: 44



3-311

RAD SURVEY CANALS F-J
09-13-85
00:29:29

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
FJ1	3-25-85	Floor	Magenta Yellow	900	1500	600	350	300	Pt. 2	9	59	0.100
FJ1 L	3-25-85	N. Wall	Magenta Yellow	300	400	350	250	300	Pt. 2	15	59	0.075
FJ1 L	3-25-85	E. Wall	Magenta Yellow	300	350	250	250	250	Pt. 2	3	59	0.100
FJ1 U	3-25-85	E. Wall	Magenta Yellow	300	400	300	300	350	Pt. 2	6	59	0.050
FJ1 L	3-25-85	W. Wall	Magenta Yellow	300	400	300	400	300	Pt. 2	9	59	0.060
FJ1 U	3-25-85	W. Wall	Magenta Yellow	350	350	450	275	400	Pt. 3	3	59	0.048
FJ2	3-25-85	Floor	Magenta Yellow	1500	1000	350	800	600	Pt. 1	15	59	0.160
FJ2 L	3-25-85	N. Wall	Magenta Yellow	300	400	0	0	0	Pt. 2	6	59	0.160
FJ2 U	3-25-85	N. Wall	Magenta Yellow	200	400	0	0	0	Pt. 2	15	59	0.045
FJ2 L	3-25-85	E. Wall	Magenta Yellow	300	300	1000	600	800	Pt. 3	6	59	0.190
FJ2 U	3-25-85	E. Wall	Magenta Yellow	250	200	300	200	250	Pt. 3	12	59	0.060
FJ2 L	3-25-85	S. Wall	Magenta Yellow	350	400	0	0	0	Pt. 2	12	59	0.060
FJ2 L	3-25-85	W. Wall	Magenta Yellow	250	350	400	300	350	Pt. 3	9	59	0.060
FJ2 U	3-25-85	W. Wall	Magenta Yellow	300	350	300	300	300	Pt. 2	0	59	0.040
FJ3	3-25-85	Floor	Magenta Yellow	300	250	800	300	1000	Pt. 5	18	59	0.100
FJ3 L	3-25-85	E. Wall	Magenta Yellow	250	350	500	250	250	Pt. 3	27	59	0.060
FJ3 U	3-25-85	E. Wall	Magenta Yellow	400	200	250	0	300	Pt. 1	21	59	0.060
FJ3 L	3-25-85	W. Wall	Magenta Yellow	350	300	800	1200	300	Pt. 4	0	59	0.060
FJ3 U	3-25-85	W. Wall	Magenta Yellow	0	300	400	800	350	Pt. 4	9	59	0.060
FJ4	3-25-85	Floor	Magenta Yellow	250	300	2200	10000	800	Pt. 4	429	59	0.125
FJ4 L	3-25-85	E. Wall	Magenta Yellow	500	700	1000	500	400	Pt. 3	53	59	0.060
FJ4 U	3-25-85	E. Wall	Magenta Yellow	1000	350	400	350	500	Pt. 1	9	59	0.100
FJ4 L	3-25-85	W. Wall	Magenta Yellow	600	1200	350	1800	1000	Pt. 4	15	59	0.070
FJ4 U	3-25-85	W. Wall	Magenta Yellow	900	400	1000	2500	1500	Pt. 4	15	59	0.700
FJ5	3-25-85	Floor	Magenta Yellow	500	300	300	800	1200	Pt. 5	21	59	0.110
FJ5 L	3-25-85	E. Wall	Magenta Yellow	500	350	700	50	500	Pt. 3	15	59	0.070
FJ5 U	3-25-85	E. Wall	Magenta Yellow	0	300	350	1000	900	Pt. 4	9	59	0.110
FJ5 L	3-25-85	W. Wall	Magenta Yellow	1000	1500	400	400	250	Pt. 2	50	59	0.080
FJ5 U	3-25-85	W. Wall	Magenta Yellow	1500	500	700	0	600	Pt. 1	21	59	0.100

PD235 Number of Records Read: 29
PD236 Number of Records Selected: 29

RAD SURVEY CANALS F-J
09-13-85
00:32:25

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
FJ1	3-25-85	Floor	Magenta Yellow	52986	2	129	63242	36027	1-7-85	466	12-10-84
FJ1 L	3-25-85	N. Wall	Magenta Yellow	52986	1	721	63242	36027	1-7-85	466	12-10-84
FJ1 L	3-25-85	E. Wall	Magenta Yellow	52986	1	263	63243	36027	1-7-85	466	12-10-84
FJ1 U	3-25-85	E. Wall	Magenta Yellow	52986	1	282	63243	36027	1-7-85	466	12-10-84
FJ1 L	3-25-85	W. Wall	Magenta Yellow	52986	0	4030	63244	36027	1-7-85	466	12-10-84
FJ1 U	3-25-85	W. Wall	Magenta Yellow	52986	0	199	63244	36027	1-7-85	466	12-10-84
FJ2	3-25-85	Floor	Magenta Yellow	52986	0	102	63245	36027	1-7-85	466	12-10-84
FJ2 L	3-25-85	N. Wall	Magenta Yellow	52986	2	455	63245	36027	1-7-85	466	12-10-84
FJ2 U	3-25-85	N. Wall	Magenta Yellow	52986	1	415	63245	36027	1-7-85	466	12-10-84
FJ2 L	3-25-85	E. Wall	Magenta Yellow	52986	1	211	63246	36027	1-7-85	466	12-10-84
FJ2 U	3-25-85	E. Wall	Magenta Yellow	52986	0	229	63246	36027	1-7-85	466	12-10-84
FJ2 L	3-25-85	S. Wall	Magenta Yellow	52987	2	878	63247	36027	1-7-85	466	12-10-84
FJ2 L	3-25-85	W. Wall	Magenta Yellow	52987	0	90	63247	36027	1-7-85	466	12-10-84
FJ2 U	3-25-85	W. Wall	Magenta Yellow	52987	2	377	63248	36027	1-7-85	466	12-10-84
FJ3	3-25-85	Floor	Magenta Yellow	52987	0	88	63248	36027	1-7-85	466	12-10-84
FJ3 L	3-25-85	E. Wall	Magenta Yellow	52987	2	2636	63249	36027	1-7-85	466	12-10-84
FJ3 U	3-25-85	E. Wall	Magenta Yellow	52987	1	496	63249	36027	1-7-85	466	12-10-84
FJ3 L	3-25-85	W. Wall	Magenta Yellow	52987	0	423	63250	36027	1-7-85	466	12-10-84
FJ3 U	3-25-85	W. Wall	Magenta Yellow	52987	1	715	63250	36027	1-7-85	466	12-10-84
FJ4	3-25-85	Floor	Magenta Yellow	52987	1	439	63251	36027	1-7-85	466	12-10-84
FJ4 L	3-25-85	E. Wall	Magenta Yellow	52987	2	957	63251	36027	1-7-85	466	12-10-84
FJ4 U	3-25-85	E. Wall	Magenta Yellow	52987	1	459	63252	36027	1-7-85	466	12-10-84
FJ4 L	3-25-85	W. Wall	Magenta Yellow	52987	1	663	63252	36027	1-7-85	466	12-10-84
FJ4 U	3-25-85	W. Wall	Magenta Yellow	52987	1	1000	63253	36027	1-7-85	466	12-10-84
FJ5	3-25-85	Floor	Magenta Yellow	52987	0	286	63253	36027	1-7-85	466	12-10-84
FJ5 L	3-25-85	E. Wall	Magenta Yellow	52987	2	356	63254	36027	1-7-85	466	12-10-84
FJ5 U	3-25-85	E. Wall	Magenta Yellow	52987	2	1182	63254	36027	1-7-85	466	12-10-84
FJ5 L	3-25-85	W. Wall	Magenta Yellow	52987	1	1188	63255	36027	1-7-85	466	12-10-84
FJ5 U	3-25-85	W. Wall	Magenta Yellow	52987	1	899	63255	36027	1-7-85	466	12-10-84

PD235 Number of Records Read: 29
PD236 Number of Records Selected: 29

RAD SURVEY CANALS F-J
09-13-85
00:26:38

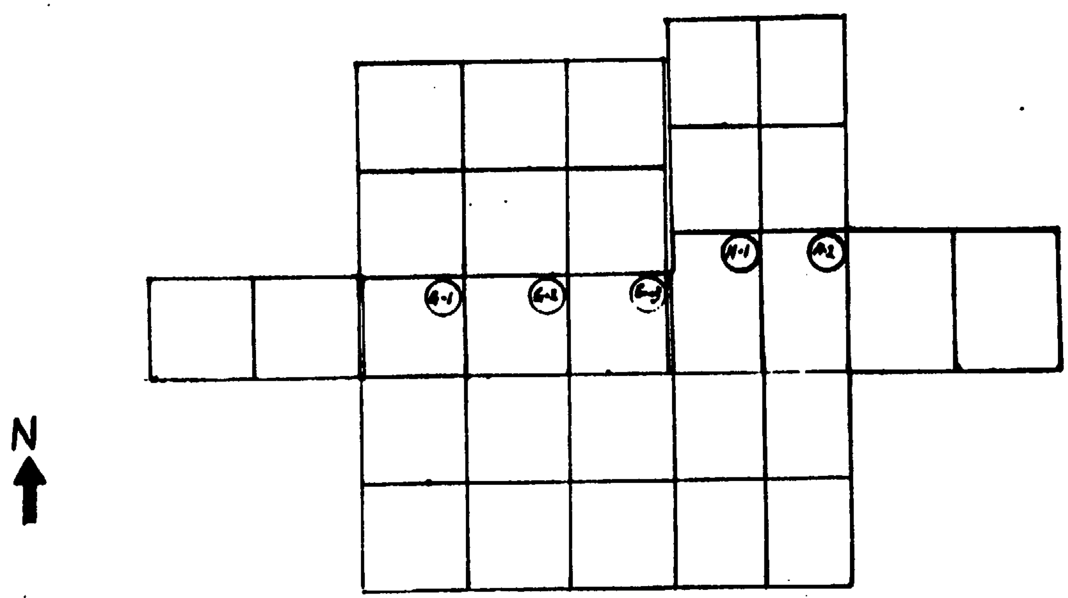
Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
FJ1	3-25-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	1
FJ1 L	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	2
FJ1 L	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	3
FJ1 U	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	4
FJ1 L	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	5
FJ1 U	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	6
FJ2	3-25-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	7
FJ2 L	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	8
FJ2 U	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	9
FJ2 L	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	10
FJ2 U	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	11
FJ2 L	3-25-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	12
FJ2 L	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	13
FJ2 U	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	14
FJ3	3-25-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	15
FJ3 L	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	16
FJ3 U	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	17
FJ3 L	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	18
FJ3 U	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	19
FJ4	3-25-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	20
FJ4 L	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	21
FJ4 U	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	22
FJ4 L	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	23
FJ4 U	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	24
FJ5	3-25-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	25
FJ5 L	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	26
FJ5 U	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	27
FJ5 L	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	28
FJ5 U	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	29

PD235 Number of Records Read: 29
PD236 Number of Records Selected: 29

RAD SURVEY CANAL G
09-13-85
00:36:22

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
G 1	4-8-85	Floor	Magenta Yellow	275	1000	1000	350	1200	Pt. 5	3	59	0.290
G 2	4-8-85	Floor	Magenta Yellow	250	750	600	400	900	Pt. 5	9	59	0.180
G 3	4-8-85	Floor	Magenta Yellow	500	600	375	1000	1100	Pt. 5	6	59	0.300
G 1 L	4-8-85	N. Wall	Magenta Yellow	250	250	200	475	300	Pt. 4	15	59	0.080
G 1 U	4-8-85	N. Wall	Magenta Yellow	200	250	225	150	225	Pt. 2	15	59	0.006
G 2 L	4-8-85	N. Wall	Magenta Yellow	450	275	400	425	300	Pt. 1	12	59	0.009
G 2 U	4-8-85	N. Wall	Magenta Yellow	275	350	400	225	275	Pt. 3	18	59	0.070
G 3 L	4-8-85	N. Wall	Magenta Yellow	450	350	800	800	300	Pt. 3	21	59	0.200
G 3 U	4-8-85	N. Wall	Magenta Yellow	275	300	500	275	250	Pt. 3	106	59	0.080
G 1 L	4-8-85	E. Wall	Magenta Yellow	300	200	300	1250	350	Pt. 4	44	59	0.080
G 1 U	4-8-85	E. Wall	Magenta Yellow	250	300	400	350	300	Pt. 3	9	59	0.075
G 1 L	4-8-85	S. Wall	Magenta Yellow	600	500	325	250	450	Pt. 1	12	59	0.105
G 1 U	4-8-85	S. Wall	Magenta Yellow	300	350	300	400	275	Pt. 4	0	59	0.040
G 2 L	4-8-85	S. Wall	Magenta Yellow	350	500	375	300	200	Pt. 2	3	59	0.130
G 2 U	4-8-85	S. Wall	Magenta Yellow	250	375	400	200	250	Pt. 3	0	59	0.080
G 3 L	4-8-85	S. Wall	Magenta Yellow	300	300	1500	250	400	Pt. 3	18	59	0.130
G 3 U	4-8-85	S. Wall	Magenta Yellow	175	250	300	400	225	Pt. 4	0	59	0.040
G 3 L	4-8-85	W. Wall	Magenta Yellow	800	1000	300	400	800	Pt. 2	12	59	0.200
G 3 U	4-8-85	W. Wall	Magenta Yellow	150	300	400	325	250	Pt. 3	29	59	0.060

PD235 Number of Records Read: 19
PD236 Number of Records Selected: 19



REACTOR BUILDING 1111
CANALS 'G' & (H) GRID
INDEX

RAD SURVEY CANAL G
09-13-85
00:38:28

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
G 1	4-8-85	Floor	Magenta Yellow	53000	0	235	63315	36027	4-9-85	466	12-10-84
G 2	4-8-85	Floor	Magenta Yellow	53000	0	153	63315	36027	4-9-85	466	12-10-84
G 3	4-8-85	Floor	Magenta Yellow	53000	0	202	63316	36027	4-9-85	466	12-10-84
G 1 L	4-8-85	N. Wall	Magenta Yellow	53000	2	4869	63316	36027	4-9-85	466	12-10-84
G 1 U	4-8-85	N. Wall	Magenta Yellow	53000	2	941	63317	36027	4-9-85	466	12-10-84
G 2 L	4-8-85	N. Wall	Magenta Yellow	53000	2	1981	63317	36027	4-9-85	466	12-10-84
G 2 U	4-8-85	N. Wall	Magenta Yellow	53000	3	2440	63318	36027	4-9-85	466	12-10-84
G 3 L	4-8-85	N. Wall	Magenta Yellow	53000	1	229	63318	36027	4-9-85	466	12-10-84
G 3 U	4-8-85	N. Wall	Magenta Yellow	53000	5	2616	63319	36027	4-9-85	466	12-10-84
G 1 L	4-8-85	E. Wall	Magenta Yellow	53000	0	1343	63319	36027	4-9-85	466	12-10-84
G 1 U	4-8-85	E. Wall	Magenta Yellow	53000	2	2284	63320	36027	4-9-85	466	12-10-84
G 1 L	4-8-85	S. Wall	Magenta Yellow	53000	4	1533	63320	36027	4-9-85	466	12-10-84
G 1 U	4-8-85	S. Wall	Magenta Yellow	53000	0	553	63321	36027	4-9-85	466	12-10-84
G 2 L	4-8-85	S. Wall	Magenta Yellow	53000	2	747	63321	36027	4-9-85	466	12-10-84
G 2 U	4-8-85	S. Wall	Magenta Yellow	53000	3	1399	63322	36027	4-9-85	466	12-10-84
G 3 L	4-8-85	S. Wall	Magenta Yellow	53000	1	605	63322	36027	4-9-85	466	12-10-84
G 3 U	4-8-85	S. Wall	Magenta Yellow	53000	3	1192	63323	36027	4-9-85	466	12-10-84
G 3 L	4-8-85	W. Wall	Magenta Yellow	53000	2	617	63323	36027	4-9-85	466	12-10-84
G 3 U	4-8-85	W. Wall	Magenta Yellow	53000	1	1121	63324	36027	4-9-85	466	12-10-84

PD235 Number of Records Read: 19
PD236 Number of Records Selected: 19

RAD SURVEY CANAL G
09-13-85
00:40:49

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
G 1	4-8-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	1
G 2	4-8-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	2
G 3	4-8-85	Floor	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	3
G 1 L	4-8-85	N. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	4
G 1 U	4-8-85	N. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	5
G 2 L	4-8-85	N. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	6
G 2 U	4-8-85	N. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	7
G 3 L	4-8-85	N. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	8
G 3 U	4-8-85	N. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	9
G 1 L	4-8-85	E. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	10
G 1 U	4-8-85	E. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	11
G 1 L	4-8-85	S. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	12
G 1 U	4-8-85	S. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	13
G 2 L	4-8-85	S. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	14
G 2 U	4-8-85	S. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	15
G 3 L	4-8-85	S. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	16
G 3 U	4-8-85	S. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	17
G 3 L	4-8-85	W. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	18
G 3 U	4-8-85	W. Wall	Magenta Yellow	423	4-9-85	6	0.34	0.37	0.38	19

PD235 Number of Records Read: 19
PD236 Number of Records Selected: 19

RAD SURVEY CANAL H
09-13-85
00:20:36

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
H 1	4-16-85	Floor	Magenta Yellow	250	100	300	450	300	Pt. 4	6	59	0.280
H 1 L	4-16-85	N. Wall	Magenta Yellow	175	200	425	275	275	Pt. 3	0	59	0.200
H 1 U	4-16-85	N. Wall	Magenta Yellow	0	175	200	0	100	Pt. 3	0	59	0.060
H 1 L	4-16-85	E. Wall	Magenta Yellow	150	150	175	125	125	Pt. 3	0	59	0.080
H 1 U	4-16-85	E. Wall	Magenta Yellow	0	100	100	0	100	Pt. 2	0	59	0.050
H 1 L	4-16-85	S. Wall	Magenta Yellow	175	200	150	125	100	Pt. 2	0	59	0.060
H 1 U	4-16-85	S. Wall	Magenta Yellow	0	125	125	0	100	Pt. 2	0	59	0.040
H 2	4-16-85	Floor	Magenta Yellow	325	300	175	200	400	Pt. 5	3	59	0.210
H 2 L	4-16-85	N. Wall	Magenta Yellow	225	300	250	200	300	Pt. 2	6	59	0.125
H 2 U	4-16-85	N. Wall	Magenta Yellow	0	125	150	0	175	Pt. 5	0	59	0.060
H 2 L	4-16-85	S. Wall	Magenta Yellow	75	150	175	100	75	Pt. 3	3	59	0.050
H 2 U	4-16-85	S. Wall	Magenta Yellow	0	100	75	0	75	Pt. 2	0	59	0.040
H 2 L	4-16-85	W. Wall	Magenta Yellow	250	325	200	175	300	Pt. 2	0	59	0.120
H 2 U	4-16-85	W. Wall	Magenta Yellow	125	225	100	75	175	Pt. 2	0	59	0.100

PD235 Number of Records Read: 14
PD236 Number of Records Selected: 14

RAD SURVEY CANAL H
09-13-85
00:22:38

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
H 1	4-16-85	Floor	Magenta Yellow	53002	0	28	63335	36027	4-9-85	466	12-10-84
H 1 L	4-16-85	N. Wall	Magenta Yellow	53002	0	28	63335	36027	4-9-85	466	12-10-84
H 1 U	4-16-85	N. Wall	Magenta Yellow	53002	0	13	63336	36027	4-9-85	466	12-10-84
H 1 L	4-16-85	E. Wall	Magenta Yellow	53002	0	12	63336	36027	4-9-85	466	12-10-84
H 1 U	4-16-85	E. Wall	Magenta Yellow	53002	2	20	63337	36027	4-9-85	466	12-10-84
H 1 L	4-16-85	S. Wall	Magenta Yellow	53002	2	22	63337	36027	4-9-85	466	12-10-84
H 1 U	4-16-85	S. Wall	Magenta Yellow	53002	0	26	63338	36027	4-9-85	466	12-10-84
H 2	4-16-85	Floor	Magenta Yellow	53002	0	2	63338	36027	4-9-85	466	12-10-84
H 2 L	4-16-85	N. Wall	Magenta Yellow	53002	0	8	63339	36027	4-9-85	466	12-10-84
H 2 U	4-16-85	N. Wall	Magenta Yellow	53002	0	9	63339	36027	4-9-85	466	12-10-84
H 2 L	4-16-85	S. Wall	Magenta Yellow	53002	0	14	63340	36027	4-9-85	466	12-10-84
H 2 U	4-16-85	S. Wall	Magenta Yellow	53002	0	2	63340	36027	4-9-85	466	12-10-84
H 2 L	4-16-85	W. Wall	Magenta Yellow	53002	0	28	63341	36027	4-9-85	466	12-10-84
H 2 U	4-16-85	W. Wall	Magenta Yellow	53002	3	18	63341	36027	4-9-85	466	12-10-84

PD235 Number of Records Read: 14
PD236 Number of Records Selected: 14

RAD SURVEY CANAL H
09-13-85
00:24:35

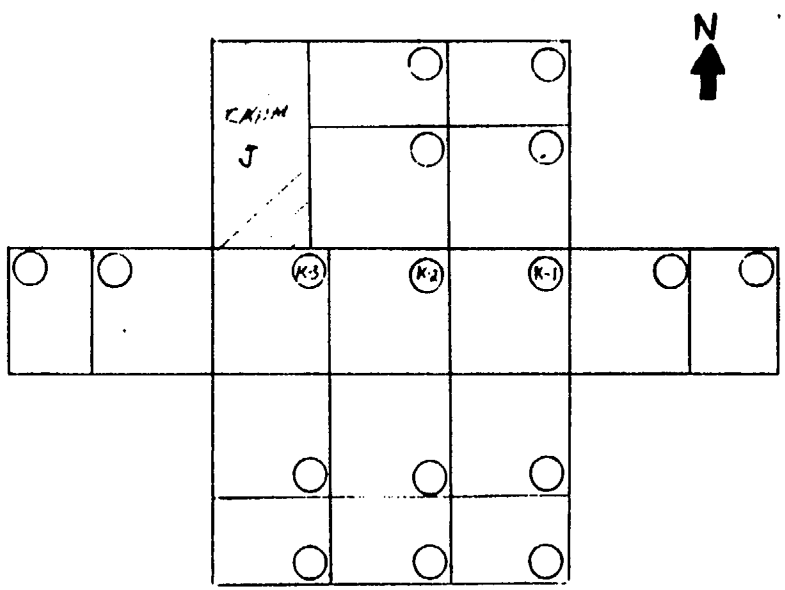
Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
H 1	4-16-85	Floor	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	1
H 1 L	4-16-85	N. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	2
H 1 U	4-16-85	N. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	3
H 1 L	4-16-85	E. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	4
H 1 U	4-16-85	E. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	5
H 1 L	4-16-85	S. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	6
H 1 U	4-16-85	S. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	7
H 2	4-16-85	Floor	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	8
H 2 L	4-16-85	N. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	9
H 2 U	4-16-85	N. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	10
H 2 L	4-16-85	S. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	11
H 2 U	4-16-85	S. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	12
H 2 L	4-16-85	W. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	13
H 2 U	4-16-85	W. Wall	Magenta Yellow	423	4-9-85	4	0.34	0.37	0.38	14

PD235 Number of Records Read: 14
PD236 Number of Records Selected: 14

RAD SURVEY CANAL K
09-13-85
00:43:13

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
K1	3-25-85	Floor	Magenta Yellow	150	150	200	250	175	Pt. 4	6	59	0.025
K1 L	3-25-85	N. Wall	Magenta Yellow	250	200	250	200	250	Pt. 5	9	59	0.022
K1 U	3-25-85	N. Wall	Magenta Yellow	0	175	275	275	200	Pt. 3	9	59	0.020
K1 L	3-25-85	E. Wall	Magenta Yellow	300	250	250	250	250	Pt. 1	6	59	0.025
K1 U	3-25-85	E. Wall	Magenta Yellow	0	250	150	0	200	Pt. 2	6	59	0.021
K1 L	3-25-85	S. Wall	Magenta Yellow	200	300	200	250	200	Pt. 2	9	59	0.025
K1 U	3-25-85	S. Wall	Magenta Yellow	300	500	250	0	300	Pt. 2	32	59	0.001
K2	3-25-85	Floor	Magenta Yellow	175	125	250	200	250	Pt. 5	9	59	0.030
K2 L	3-25-85	N. Wall	Magenta Yellow	250	300	400	200	300	Pt. 3	12	59	0.040
K2 U	3-25-85	N. Wall	Magenta Yellow	200	500	300	250	175	Pt. 2	44	59	0.026
K2 L	3-25-85	S. Wall	Magenta Yellow	300	200	250	250	350	Pt. 5	12	59	0.030
K2 U	3-25-85	S. Wall	Magenta Yellow	600	400	350	400	250	Pt. 1	9	59	0.032
K3	3-25-85	Floor	Magenta Yellow	300	1500	300	350	1800	Pt. 5	27	59	0.300
K3 L	3-25-85	N. Wall	Magenta Yellow	500	500	0	0	0	Pt. 2	9	59	0.070
K3 U	3-25-85	N. Wall	Magenta Yellow	450	300	0	325	0	Pt. 1	0	59	0.042
K3 L	3-25-85	S. Wall	Magenta Yellow	250	500	600	300	300	Pt. 3	6	59	0.060
K3 U	3-25-85	S. Wall	Magenta Yellow	600	200	350	450	375	Pt. 1	21	59	0.036
K3 L	3-25-85	W. Wall	Magenta Yellow	400	300	300	300	300	Pt. 1	24	59	0.060
K3 U	3-25-85	W. Wall	Magenta Yellow	300	750	350	450	300	Pt. 2	12	59	0.060

PD235 Number of Records Read: 19
PD236 Number of Records Selected: 19



CANAL K HOT LABORATORY BLDG 1112
GRID INDEX

RAD SURVEY CANAL K
09-13-85
00:44:47

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
K1	3-25-85	Floor	Magenta Yellow	52986	0	97	63232	36027	1-7-85	466	12-10-84
K1 L	3-25-85	N. Wall	Magenta Yellow	52986	0	760	63232	36027	1-7-85	466	12-10-84
K1 U	3-25-85	N. Wall	Magenta Yellow	52986	1	837	63233	36027	1-7-85	466	12-10-84
K1 L	3-25-85	E. Wall	Magenta Yellow	52986	0	515	63233	36027	1-7-85	466	12-10-84
K1 U	3-25-85	E. Wall	Magenta Yellow	52986	3	466	63234	36027	1-7-85	466	12-10-84
K1 L	3-25-85	S. Wall	Magenta Yellow	52986	0	248	63234	36027	1-7-85	466	12-10-84
K1 U	3-25-85	S. Wall	Magenta Yellow	52986	2	517	63235	36027	1-7-85	466	12-10-84
K2	3-25-85	Floor	Magenta Yellow	52986	2	171	63235	36027	1-7-85	466	12-10-84
K2 L	3-25-85	N. Wall	Magenta Yellow	52986	3	1126	63236	36027	1-7-85	466	12-10-84
K2 U	3-25-85	N. Wall	Magenta Yellow	52986	2	973	63236	36027	1-7-85	466	12-10-84
K2 L	3-25-85	S. Wall	Magenta Yellow	52986	2	240	63237	36027	1-7-85	466	12-10-84
K2 U	3-25-85	S. Wall	Magenta Yellow	52986	0	901	63237	36027	1-7-85	466	12-10-84
K3	3-25-85	Floor	Magenta Yellow	52986	2	224	63238	36027	1-7-85	466	12-10-84
K3 L	3-25-85	N. Wall	Magenta Yellow	52986	4	1233	63238	36027	1-7-85	466	12-10-84
K3 U	3-25-85	N. Wall	Magenta Yellow	52986	1	1089	63239	36027	1-7-85	466	12-10-84
K3 L	3-25-85	S. Wall	Magenta Yellow	52986	1	706	63239	36027	1-7-85	466	12-10-84
K3 U	3-25-85	S. Wall	Magenta Yellow	52986	2	1348	63240	36027	1-7-85	466	12-10-84
K3 L	3-25-85	W. Wall	Magenta Yellow	52986	5	1868	63240	36027	1-7-85	466	12-10-84
K3 U	3-25-85	W. Wall	Magenta Yellow	52986	1	615	63241	36027	1-7-85	466	12-10-84

PD235 Number of Records Read: 19
PD236 Number of Records Selected: 19

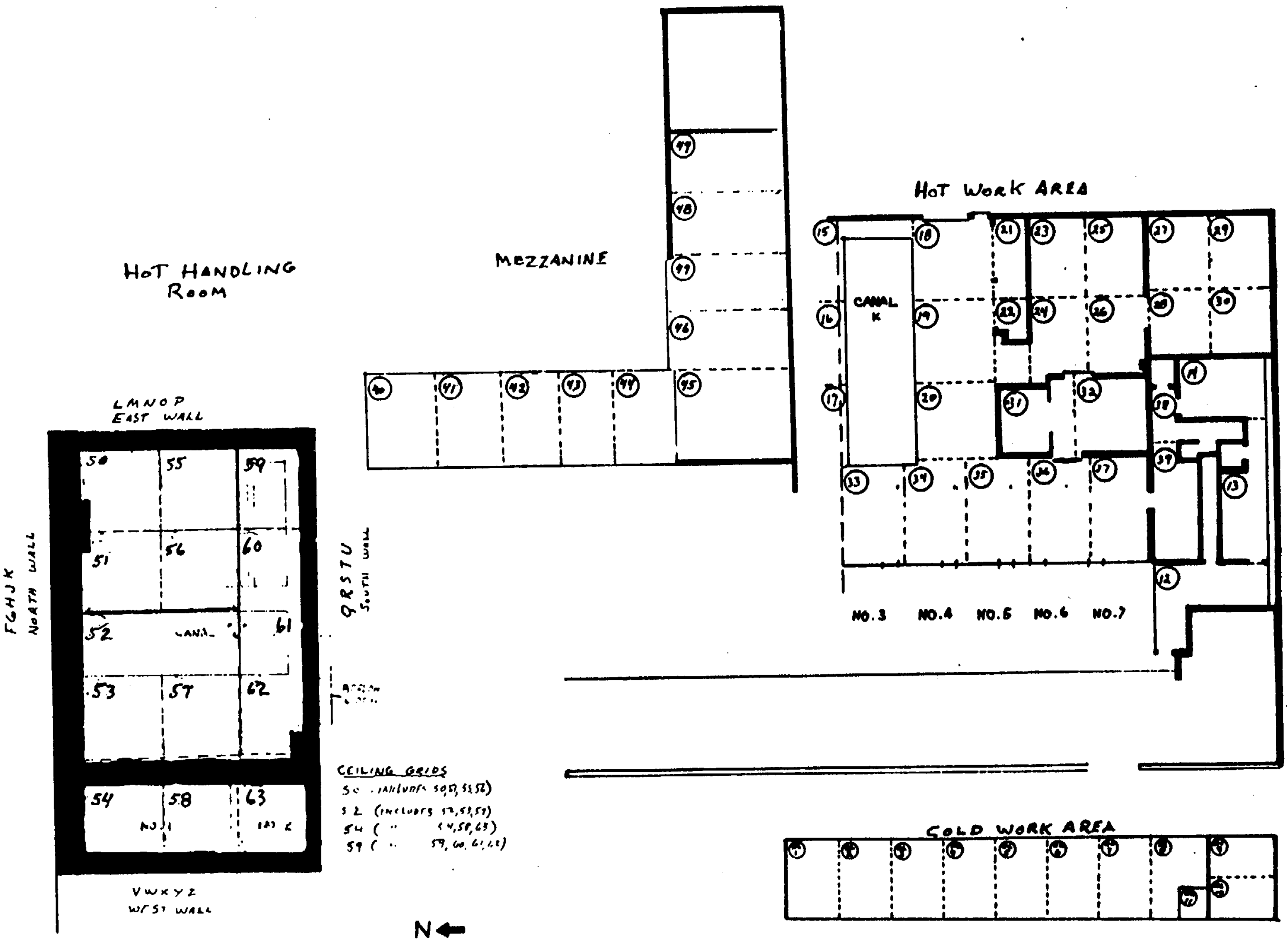
RAD SURVEY CANAL K
09-13-85
00:47:15

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
K1	3-25-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	1
K1 L	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	2
K1 U	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	3
K1 L	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	4
K1 U	3-25-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	5
K1 L	3-25-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	6
K1 U	3-25-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	7
K2	3-25-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	8
K2 L	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	9
K2 U	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	10
K2 L	3-25-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	11
K2 U	3-25-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	12
K3	3-25-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	13
K3 L	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	14
K3 U	3-25-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	15
K3 L	3-25-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	16
K3 U	3-25-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	17
K3 L	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	18
K3 U	3-25-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	19

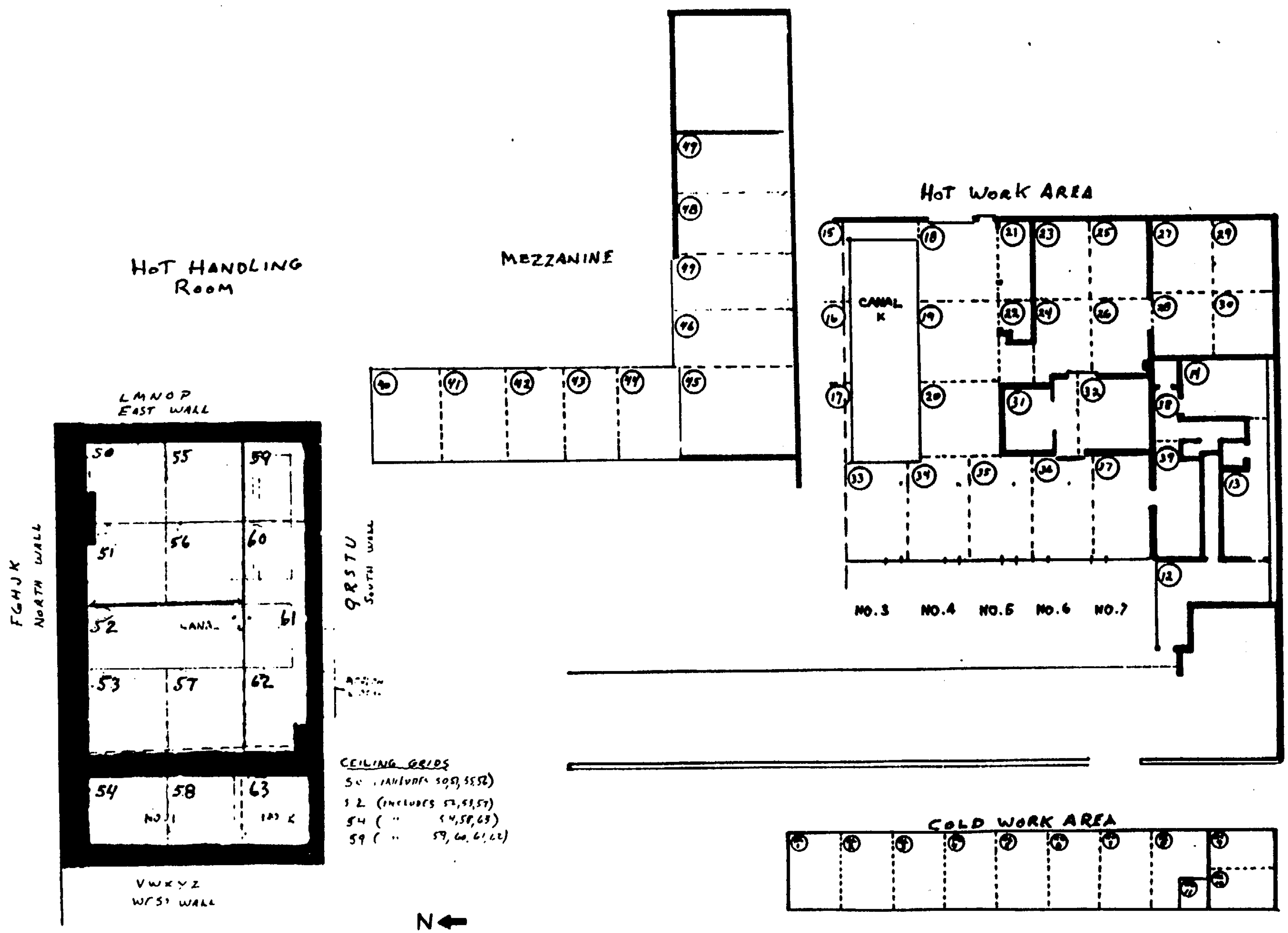
PD235 Number of Records Read: 19
PD236 Number of Records Selected: 19

APPENDIX 3.13

Radiological Monitoring Data For The PBRF
Building #1112 - Hot Laboratory & Hot Pipe Tunnel

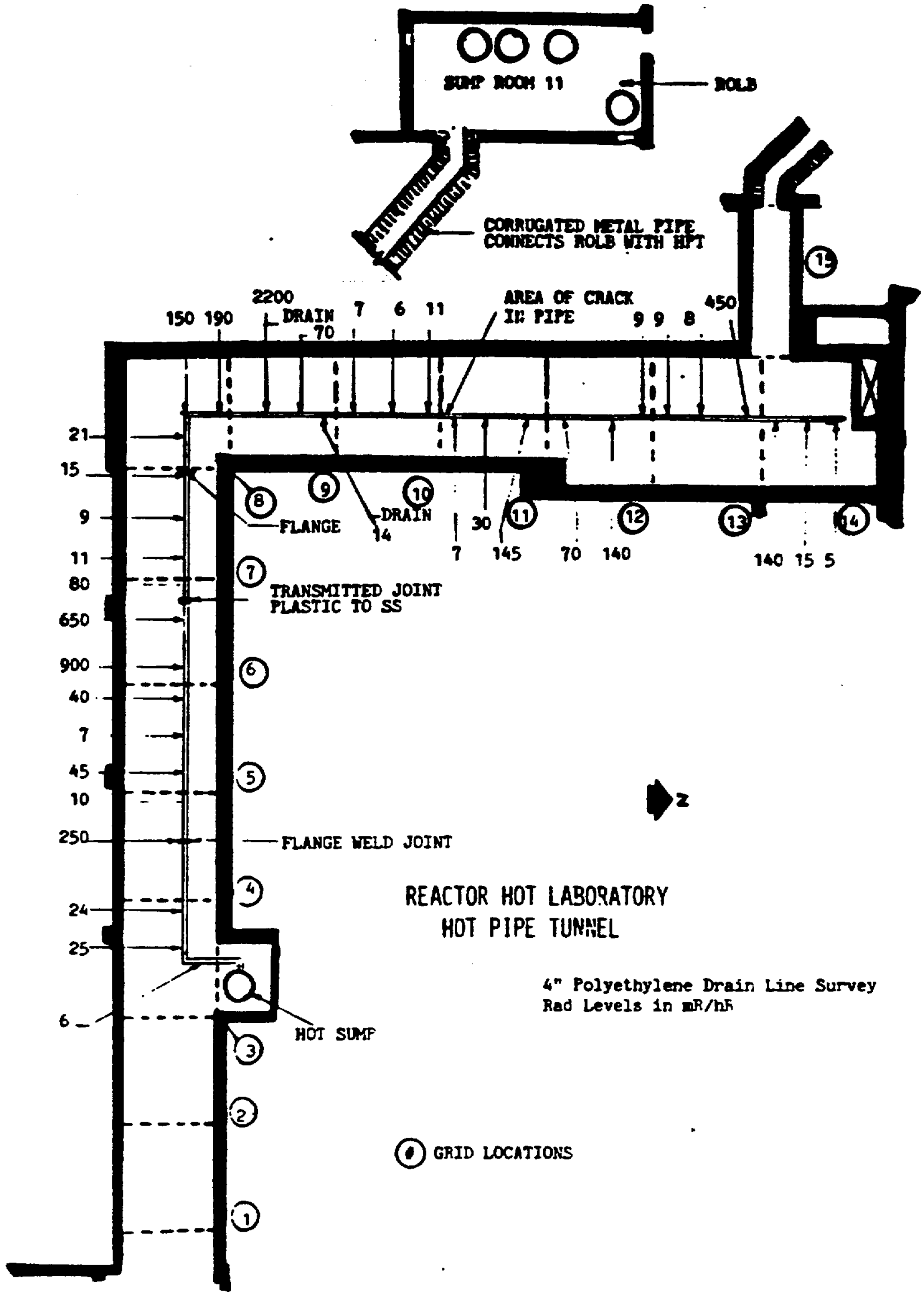


REACTOR HOT LABORATORY GRID INDEX



REACTOR HOT LABORATORY GRID INDEX

1112



REACTOR HOT LABORATORY
HOT PIPE TUNNEL

4" Polyethylene Drain Line Survey
Rad Levels in mR/hR

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
14:37:20

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
HL 1	2-5-85	Floor	White	50	50	25	100	75	Pt. 4	15	59	0.006
HL 1	2-5-85	N. Wall	White	75	25	50	50	75	Pt. 5	12	59	0.006
HL 1	2-5-85	E. Wall	White	100	50	25	25	50	Pt. 1	3	59	0.006
HL 1	2-5-85	W. Wall	White	50	25	50	50	75	Pt. 5	15	59	0.005
HL 2	2-5-85	Floor	White	50	50	25	25	25	Pt. 1	3	59	0.006
HL 2	2-5-85	E. Wall	White	50	25	50	50	75	Pt. 5	12	59	0.006
HL 2	2-5-85	W. Wall	White	25	75	25	50	75	Pt. 5	12	59	0.007
HL 3	2-5-85	Floor	White	75	75	75	25	50	Pt. 2	3	59	0.009
HL 3	2-5-85	E. Wall	White	50	75	75	75	75	Pt. 5	3	59	0.009
HL 3	2-5-85	W. Wall	White	75	75	75	50	50	Pt. 2	6	59	0.007
HL 4	2-5-85	Floor	White	100	50	50	75	100	Pt. 5	12	59	0.008
HL 4	2-5-85	E. Wall	White	75	75	100	50	75	Pt. 3	6	59	0.022
HL 4	2-5-85	W. Wall	White	50	25	50	25	75	Pt. 5	6	59	0.007
HL 5	2-5-85	Floor	White	50	75	100	25	50	Pt. 3	12	59	0.007
HL 5	2-5-85	E. Wall	White	50	50	100	125	50	Pt. 4	3	59	0.008
HL 5	2-5-85	W. Wall	White	50	50	50	75	25	Pt. 4	3	59	0.007
HL 6	2-5-85	Floor	White	50	50	25	50	25	Pt. 2	9	59	0.005
HL 6	2-5-85	E. Wall	White	75	75	50	25	75	Pt. 2	0	59	0.005
HL 6	2-5-85	W. Wall	White	50	50	75	50	100	Pt. 5	9	59	0.006
HL 7	2-5-85	Floor	White	50	100	25	50	75	Pt. 2	12	59	0.006
HL 7	2-5-85	E. Wall	White	75	25	50	75	50	Pt. 1	12	59	0.005
HL 7	2-5-85	W. Wall	White	75	50	100	50	25	Pt. 3	0	59	0.006
HL 8	2-5-85	Floor	White	75	100	50	25	50	Pt. 2	12	59	0.008
HL 8	2-5-85	E. Wall	White	50	75	50	50	75	Pt. 5	12	59	0.006
HL 8	2-5-85	W. Wall	White	50	50	75	25	75	Pt. 5	12	59	0.006
HL 9	2-5-85	Floor	White	50	75	100	75	50	Pt. 3	9	59	0.006
HL 9	2-5-85	N. Wall	White	50	75	50	50	75	Pt. 5	3	59	0.008
HL 9	2-5-85	E. Wall	White	50	75	50	75	50	Pt. 4	6	59	0.007
HL 9	2-5-85	S. Wall	White	75	50	50	50	75	Pt. 5	0	59	0.007
HL 10	2-5-85	Floor	White	100	125	75	100	50	Pt. 2	12	59	0.006
HL 10	2-5-85	N. Wall	White	50	25	50	50	0	Pt. 3	15	59	0.008
HL 10	2-5-85	S. Wall	White	75	25	50	50	25	Pt. 1	0	59	0.006
HL 10	2-5-85	W. Wall	White	75	50	50	75	25	Pt. 1	12	59	0.006
HL 11	2-5-85	Floor	White	75	75	75	75	75	Pt. 5	9	59	0.007
HL 11	2-5-85	N. Wall	White	75	75	75	50	50	Pt. 2	12	59	0.007
HL 11	2-5-85	E. Wall	White	50	50	25	50	50	Pt. 5	3	59	0.006
HL 11	2-5-85	S. Wall	White	50	100	100	75	100	Pt. 5	6	59	0.006
HL 11	2-5-85	W. Wall	White	25	75	50	50	50	Pt. 2	9	59	0.006
HL 11	2-5-85	Ceiling	White	50	25	50	75	25	Pt. 4	21	59	0.006
HL 12	2-28-85	Floor	White	50	50	0	50	0	Pt. 4	3	59	0.009
HL 12	2-28-85	Ceiling	White	25	25	0	75	0	Pt. 4	15	59	0.009
HL 13	2-28-85	Floor	White	100	75	75	75	100	Pt. 5	3	59	0.010
HL 13	2-28-85	N. Wall	White	100	150	100	125	100	Pt. 2	0	59	0.012
HL 13	2-28-85	E. Wall	White	0	0	100	75	0	Pt. 3	9	59	0.012
HL 13	2-28-85	S. Wall	White	75	75	100	75	75	Pt. 3	6	59	0.009
HL 13	2-28-85	W. Wall	White	100	100	0	0	0	Pt. 2	15	59	0.012
HL 13	2-28-85	Ceiling	White	125	50	50	75	50	Pt. 1	12	59	0.012
HL 14	2-28-85	Floor	White	75	100	100	75	125	Pt. 5	0	59	0.010
HL 14	2-28-85	N. Wall	White	75	0	100	75	100	Pt. 5	18	59	0.009
HL 14	2-28-85	E. Wall	White	75	75	100	75	75	Pt. 3	21	59	0.007
HL 14	2-28-85	S. Wall	White	50	50	50	50	50	Pt. 5	12	59	0.008
HL 14	2-28-85	Ceiling	White	75	50	50	75	50	Pt. 1	9	59	0.010
HL 15	3-12-85	E. Wall	Magenta Yellow	75	100	150	50	100	Pt. 3	0	59	0.010
HL 15	3-12-85	N. Wall	Magenta Yellow	50	150	100	50	100	Pt. 2	9	59	0.009

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
14:52:51

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
HL 1	2-5-85	Floor	White	52932	0	9	62955	36027	1-7-85	466	12-10-84
HL 1	2-5-85	N. Wall	White	52932	0	6	62955	36027	1-7-85	466	12-10-84
HL 1	2-5-85	E. Wall	White	52932	0	1	62956	36027	1-7-85	466	12-10-84
HL 1	2-5-85	W. Wall	White	52932	0	3	62956	36027	1-7-85	466	12-10-84
HL 2	2-5-85	Floor	White	52932	0	0	62957	36027	1-7-85	466	12-10-84
HL 2	2-5-85	E. Wall	White	52932	0	3	62957	36027	1-7-85	466	12-10-84
HL 2	2-5-85	W. Wall	White	52932	1	0	62958	36027	1-7-85	466	12-10-84
HL 3	2-5-85	Floor	White	52932	0	2	62958	36027	1-7-85	466	12-10-84
HL 3	2-5-85	E. Wall	White	52932	0	6	62959	36027	1-7-85	466	12-10-84
HL 3	2-5-85	W. Wall	White	52932	0	0	62959	36027	1-7-85	466	12-10-84
HL 4	2-5-85	Floor	White	52932	0	14	62960	36027	1-7-85	466	12-10-84
HL 4	2-5-85	E. Wall	White	52932	0	0	62960	36027	1-7-85	466	12-10-84
HL 4	2-5-85	W. Wall	White	52932	0	0	62961	36027	1-7-85	466	12-10-84
HL 5	2-5-85	Floor	White	52932	0	17	62961	36027	1-7-85	466	12-10-84
HL 5	2-5-85	E. Wall	White	52932	0	1	62962	36027	1-7-85	466	12-10-84
HL 5	2-5-85	W. Wall	White	52932	0	12	62962	36027	1-7-85	466	12-10-84
HL 6	2-5-85	Floor	White	52932	0	20	62963	36027	1-7-85	466	12-10-84
HL 6	2-5-85	E. Wall	White	52932	0	0	62963	36027	1-7-85	466	12-10-84
HL 6	2-5-85	W. Wall	White	52932	0	4	62964	36027	1-7-85	466	12-10-84
HL 7	2-5-85	Floor	White	52932	0	9	62964	36027	1-7-85	466	12-10-84
HL 7	2-5-85	E. Wall	White	52932	1	7	62965	36027	1-7-85	466	12-10-84
HL 7	2-5-85	W. Wall	White	52932	0	5	62965	36027	1-7-85	466	12-10-84
HL 8	2-5-85	Floor	White	52932	0	27	62966	36027	1-7-85	466	12-10-84
HL 8	2-5-85	E. Wall	White	52932	0	5	62966	36027	1-7-85	466	12-10-84
HL 8	2-5-85	W. Wall	White	52932	0	16	62967	36027	1-7-85	466	12-10-84
HL 9	2-5-85	Floor	White	52932	0	16	62967	36027	1-7-85	466	12-10-84
HL 9	2-5-85	N. Wall	White	52932	0	5	62968	36027	1-7-85	466	12-10-84
HL 9	2-5-85	E. Wall	White	52932	2	7	62968	36027	1-7-85	466	12-10-84
HL 9	2-5-85	S. Wall	White	52932	0	0	62969	36027	1-7-85	466	12-10-84
HL 10	2-5-85	Floor	White	52932	2	10	62969	36027	1-7-85	466	12-10-84
HL 10	2-5-85	N. Wall	White	52933	0	0	62970	36027	1-7-85	466	12-10-84
HL 10	2-5-85	S. Wall	White	52933	3	4	62970	36027	1-7-85	466	12-10-84
HL 10	2-5-85	W. Wall	White	52933	0	5	62971	36027	1-7-85	466	12-10-84
HL 11	2-5-85	Floor	White	52933	1	0	62972	36027	1-7-85	466	12-10-84
HL 11	2-5-85	N. Wall	White	52933	0	8	62972	36027	1-7-85	466	12-10-84
HL 11	2-5-85	E. Wall	White	52933	1	2	62973	36027	1-7-85	466	12-10-84
HL 11	2-5-85	S. Wall	White	52933	0	0	62973	36027	1-7-85	466	12-10-84
HL 11	2-5-85	W. Wall	White	52933	0	0	62974	36027	1-7-85	466	12-10-84
HL 11	2-5-85	Ceiling	White	52933	0	5	62974	36027	1-7-85	466	12-10-84
HL 12	2-28-85	Floor	White	52950	0	0	63083	36027	1-7-85	466	12-10-84
HL 12	2-28-85	Ceiling	White	52950	0	3	63083	36027	1-7-85	466	12-10-84
HL 13	2-28-85	Floor	White	52950	1	0	63084	36027	1-7-85	466	12-10-84
HL 13	2-28-85	N. Wall	White	52950	1	0	63084	36027	1-7-85	466	12-10-84
HL 13	2-28-85	E. Wall	White	52950	0	186	63085	36027	1-7-85	466	12-10-84
HL 13	2-28-85	S. Wall	White	52950	0	0	63085	36027	1-7-85	466	12-10-84
HL 13	2-28-85	W. Wall	White	52950	0	0	63086	36027	1-7-85	466	12-10-84
HL 13	2-28-85	Ceiling	White	52950	0	0	63086	36027	1-7-85	466	12-10-84
HL 14	2-28-85	Floor	White	52950	0	0	63087	36027	1-7-85	466	12-10-84
HL 14	2-28-85	N. Wall	White	52950	0	7	63087	36027	1-7-85	466	12-10-84
HL 14	2-28-85	E. Wall	White	52950	0	0	63088	36027	1-7-85	466	12-10-84
HL 14	2-28-85	S. Wall	White	52950	0	0	63088	36027	1-7-85	466	12-10-84
HL 14	2-28-85	Ceiling	White	52950	0	0	63089	36027	1-7-85	466	12-10-84
5	3-12-85	E. Wall	Magenta Yellow	52950	0	63	63134	36027	1-7-85	466	12-10-84
[illegible]	3-12-85	N. Wall	Magenta Yellow	52950	0	11	63134	36027	1-7-85	466	[illegible]-84

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
15:10:17

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Cutie Pie Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff
HL 1	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 1	2-5-85	N. Wall	White	423	2-14-85			3	0.34	0.37
HL 1	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 1	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 2	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 2	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 2	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 3	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 3	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 3	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 4	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 4	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 4	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 5	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 5	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 5	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 6	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 6	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 6	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 7	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 7	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 7	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 8	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 8	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 8	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 9	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 9	2-5-85	N. Wall	White	423	2-14-85			3	0.34	0.37
HL 9	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 9	2-5-85	S. Wall	White	423	2-14-85			3	0.34	0.37
HL 10	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 10	2-5-85	N. Wall	White	423	2-14-85			3	0.34	0.37
HL 10	2-5-85	S. Wall	White	423	2-14-85			3	0.34	0.37
HL 10	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 11	2-5-85	Floor	White	423	2-14-85			3	0.34	0.37
HL 11	2-5-85	N. Wall	White	423	2-14-85			3	0.34	0.37
HL 11	2-5-85	E. Wall	White	423	2-14-85			3	0.34	0.37
HL 11	2-5-85	S. Wall	White	423	2-14-85			3	0.34	0.37
HL 11	2-5-85	W. Wall	White	423	2-14-85			3	0.34	0.37
HL 11	2-5-85	Ceiling	White	423	2-14-85			3	0.34	0.37
HL 12	2-28-85	Floor	White	423	2-14-85			7	0.34	0.42
HL 12	2-28-85	Ceiling	White	423	2-14-85			7	0.34	0.42
HL 13	2-28-85	Floor	White	423	2-14-85			7	0.34	0.42
HL 13	2-28-85	N. Wall	White	423	2-14-85			7	0.34	0.42
HL 13	2-28-85	E. Wall	White	423	2-14-85			7	0.34	0.42
HL 13	2-28-85	S. Wall	White	423	2-14-85			7	0.34	0.42
HL 13	2-28-85	W. Wall	White	423	2-14-85			7	0.34	0.42
HL 13	2-28-85	Ceiling	White	423	2-14-85			7	0.34	0.42
HL 14	2-28-85	Floor	White	423	2-14-85			7	0.34	0.42
HL 14	2-28-85	N. Wall	White	423	2-14-85			7	0.34	0.42
HL 14	2-28-85	E. Wall	White	423	2-14-85			7	0.34	0.42
HL 14	2-28-85	S. Wall	White	423	2-14-85			7	0.34	0.42
HL 14	2-28-85	Ceiling	White	423	2-14-85			7	0.34	0.42
HL 15	3-12-85	E. Wall	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 15	3-12-85	N. Wall	Magenta Yellow	423	2-14-85			4	0.34	0.42

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
15:46:00

Grid	Date	Type	Zone	NC B Eff	REC#
HL 1	2-5-85	Floor	White	0.42	1
HL 1	2-5-85	N. Wall	White	0.42	2
HL 1	2-5-85	E. Wall	White	0.42	3
HL 1	2-5-85	W. Wall	White	0.42	4
HL 2	2-5-85	Floor	White	0.42	5
HL 2	2-5-85	E. Wall	White	0.42	6
HL 2	2-5-85	W. Wall	White	0.42	7
HL 3	2-5-85	Floor	White	0.42	8
HL 3	2-5-85	E. Wall	White	0.42	9
HL 3	2-5-85	W. Wall	White	0.42	10
HL 4	2-5-85	Floor	White	0.42	11
HL 4	2-5-85	E. Wall	White	0.42	12
HL 4	2-5-85	W. Wall	White	0.42	13
HL 5	2-5-85	Floor	White	0.42	14
HL 5	2-5-85	E. Wall	White	0.42	15
HL 5	2-5-85	W. Wall	White	0.42	16
HL 6	2-5-85	Floor	White	0.42	17
HL 6	2-5-85	E. Wall	White	0.42	18
HL 6	2-5-85	W. Wall	White	0.42	19
HL 7	2-5-85	Floor	White	0.42	20
HL 7	2-5-85	E. Wall	White	0.42	21
HL 7	2-5-85	W. Wall	White	0.42	22
HL 8	2-5-85	Floor	White	0.42	23
HL 8	2-5-85	E. Wall	White	0.42	24
HL 8	2-5-85	W. Wall	White	0.42	25
HL 9	2-5-85	Floor	White	0.42	26
HL 9	2-5-85	N. Wall	White	0.42	27
HL 9	2-5-85	E. Wall	White	0.42	28
HL 9	2-5-85	S. Wall	White	0.42	29
HL 10	2-5-85	Floor	White	0.42	30
HL 10	2-5-85	N. Wall	White	0.42	31
HL 10	2-5-85	S. Wall	White	0.42	32
HL 10	2-5-85	W. Wall	White	0.42	33
HL 11	2-5-85	Floor	White	0.42	34
HL 11	2-5-85	N. Wall	White	0.42	35
HL 11	2-5-85	E. Wall	White	0.42	36
HL 11	2-5-85	S. Wall	White	0.42	37
HL 11	2-5-85	W. Wall	White	0.42	38
HL 11	2-5-85	Ceiling	White	0.42	39
HL 12	2-28-85	Floor	White	0.37	40
HL 12	2-28-85	Ceiling	White	0.37	41
HL 13	2-28-85	Floor	White	0.37	42
HL 13	2-28-85	N. Wall	White	0.37	43
HL 13	2-28-85	E. Wall	White	0.37	44
HL 13	2-28-85	S. Wall	White	0.37	45
HL 13	2-28-85	W. Wall	White	0.37	46
HL 13	2-28-85	Ceiling	White	0.37	47
HL 14	2-28-85	Floor	White	0.37	48
HL 14	2-28-85	N. Wall	White	0.37	49
HL 14	2-28-85	E. Wall	White	0.37	50
HL 14	2-28-85	S. Wall	White	0.37	51
HL 14	2-28-85	Ceiling	White	0.37	52
HL 15	3-12-85	E. Wall	Magenta Yellow	0.37	53
H[illegible]	3-12-85	N. Wall	Magenta Yellow	0.37	54

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
HL 15	2-28-85	Floor	Magenta Yellow	100	100	250	125	0	Pt. 3	9	59	0.012
HL 16	2-28-85	Floor	Magenta Yellow	100	1250	50000	5000	0	Pt. 3	388	59	0.127
HL 16	3-12-85	N. Wall	Magenta Yellow	50	150	100	125	75	Pt. 2	0	59	0.012
HL 17	3-12-85	N. Wall	Magenta Yellow	50	150	75	100	75	Pt. 2	0	59	0.020
HL 17	2-28-85	Floor	Magenta Yellow	150	2800	250	100	0	Pt. 2	188	59	0.032
HL 18	2-28-85	Floor	Magenta Yellow	1000	150	200	150	3000	Pt. 5	27	59	0.100
HL 19	2-28-85	Floor	Magenta Yellow	250	200	200	150	250	Pt. 5	27	59	0.016
HL 20	2-28-85	Floor	Magenta Yellow	2500	900	300	350	1800	Pt. 1	59	59	0.046
HL 21	2-28-85	Floor	Magenta Yellow	100	150	100	100	150	Pt. 5	9	59	0.012
HL 21	2-28-85	E. Wall	Magenta Yellow	100	100	100	100	125	Pt. 5	9	59	0.013
HL 21	2-28-85	S. Wall	Magenta Yellow	100	100	100	100	125	Pt. 5	15	59	0.013
HL 21	2-28-85	Ceiling	Magenta Yellow	100	100	150	150	150	Pt. 5	15	59	0.010
HL 22	2-28-85	Floor	Magenta Yellow	200	250	175	500	200	Pt. 4	774	59	0.020
HL 22	2-28-85	E. Wall	Magenta Yellow	100	100	125	125	125	Pt. 5	9	59	0.020
HL 22	2-28-85	S. Wall	Magenta Yellow	0	0	100	100	125	Pt. 5	12	59	0.015
HL 22	2-28-85	W. Wall	Magenta Yellow	100	150	150	300	100	Pt. 4	21	59	0.022
HL 23	2-28-85	Floor	Magenta Yellow	150	100	100	100	200	Pt. 5	12	59	0.025
HL 23	2-28-85	N. Wall	Magenta Yellow	50	100	75	100	75	Pt. 4	3	59	0.017
HL 23	3-5-85	E. Wall L	Magenta Yellow	150	75	50	125	75	Pt. 1	3	59	0.013
HL 23	3-5-85	E. Wall U	Magenta Yellow	75	100	75	75	75	Pt. 2	12	59	0.010
HL 24	3-5-85	Floor	Magenta Yellow	150	150	125	1000	200	Pt. 4	65	59	0.030
HL 24	3-5-85	N. Wall	Magenta Yellow	50	100	0	0	75	Pt. 2	9	59	0.017
HL 24	3-5-85	W. Wall L	Magenta Yellow	150	125	225	200	300	Pt. 5	6	59	0.060
HL 24	3-5-85	W. Wall U	Magenta Yellow	100	150	50	150	75	Pt. 2	6	59	0.015
HL 25	3-5-85	Floor	Magenta Yellow	125	125	100	100	150	Pt. 5	9	59	0.012
HL 25	3-5-85	E. Wall L	Magenta Yellow	75	50	50	75	100	Pt. 5	15	59	0.006
HL 25	3-5-85	E. Wall U	Magenta Yellow	75	50	50	75	50	Pt. 4	9	59	0.004
HL 25	3-5-85	S. Wall L	Magenta Yellow	75	50	50	75	100	Pt. 5	3	59	0.015
HL 25	3-5-85	S. Wall U	Magenta Yellow	75	75	100	100	100	Pt. 3	0	59	0.010
HL 26	3-5-85	S. Wall L	Magenta Yellow	100	125	125	75	100	Pt. 3	3	59	0.015
HL 26	3-5-85	S. Wall U	Magenta Yellow	100	75	75	125	75	Pt. 4	21	59	0.012
HL 26	3-5-85	W. Wall L	Magenta Yellow	75	100	200	125	100	Pt. 3	3	59	0.030
HL 26	3-5-85	W. Wall U	Magenta Yellow	125	75	75	50	100	Pt. 1	9	59	0.013
HL 27	3-5-85	Floor	Magenta Yellow	100	100	100	200	100	Pt. 4	15	59	0.008
HL 27	3-5-85	N. Wall L	Magenta Yellow	50	75	50	100	50	Pt. 4	0	59	0.009
HL 27	3-5-85	N. Wall U	Magenta Yellow	100	50	50	75	100	Pt. 5	12	59	0.009
HL 27	3-5-85	E. Wall L	Magenta Yellow	100	125	75	50	100	Pt. 2	3	59	0.009
HL 27	3-5-85	E. Wall U	Magenta Yellow	100	75	100	50	50	Pt. 3	9	59	0.008
HL 28	3-5-85	Floor	Magenta Yellow	100	150	100	100	100	Pt. 2	6	59	0.025
HL 28	3-5-85	N. Wall L	Magenta Yellow	50	100	50	75	75	Pt. 2	15	59	0.011
HL 28	3-5-85	N. Wall U	Magenta Yellow	75	75	50	100	50	Pt. 4	9	59	0.007
HL 29	3-5-85	Floor	Magenta Yellow	100	125	150	100	125	Pt. 3	24	59	0.012
HL 29	3-5-85	E. Wall L	Magenta Yellow	100	150	75	75	125	Pt. 2	18	59	0.012
HL 29	3-5-85	E. Wall U	Magenta Yellow	75	100	75	75	125	Pt. 5	6	59	0.007
HL 29	3-5-85	S. Wall L	Magenta Yellow	50	75	75	75	100	Pt. 5	6	59	0.015
HL 29	3-5-85	S. Wall U	Magenta Yellow	75	150	50	50	75	Pt. 2	15	59	0.008
HL 30	3-5-85	Floor	Magenta Yellow	100	150	100	100	100	Pt. 2	12	59	0.010
HL 30	3-5-85	S. Wall L	Magenta Yellow	50	75	100	100	75	Pt. 3	9	59	0.010
HL 30	3-5-85	S. Wall U	Magenta Yellow	50	100	75	75	100	Pt. 2	9	59	0.008
HL 30	3-5-85	W. Wall L	Magenta Yellow	75	75	125	100	50	Pt. 3	15	59	0.009
HL 31	3-8-85	Floor	Magenta Yellow	400	500	200	1400	>50000	Pt. 5	558824	59	8850.000
HL 31	3-8-85	N. Wall	Magenta Yellow	250	300	300	200	300	Pt. 5	27	59	0.038
HL 31	3-8-85	E. Wall	Magenta Yellow	300	300	300	400	1000	Pt. 5	35	59	0.040
HL 31	3-8-85	W. Wall	Magenta Yellow	200	400	0	400	1500	Pt. 5	50	59	0.040

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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
HL 15	2-28-85	Floor	Magenta Yellow	52950	0	75	63090	36027	1-7-85	466	12-10-84
HL 16	2-28-85	Floor	Magenta Yellow	52950	0	764	63090	36027	1-7-85	466	12-10-84
HL 16	3-12-85	N. Wall	Magenta Yellow	52950	0	84	63135	36027	1-7-85	466	12-10-84
HL 17	3-12-85	N. Wall	Magenta Yellow	52950	0	5	63135	36027	1-7-85	466	12-10-84
HL 17	2-28-85	Floor	Magenta Yellow	52950	0	642	63091	36027	1-7-85	466	12-10-84
HL 18	2-28-85	Floor	Magenta Yellow	52950	0	14	63091	36027	1-7-85	466	12-10-84
HL 19	2-28-85	Floor	Magenta Yellow	52950	0	92	63092	36027	1-7-85	466	12-10-84
HL 20	2-28-85	Floor	Magenta Yellow	52950	0	158	63092	36027	1-7-85	466	12-10-84
HL 21	2-28-85	Floor	Magenta Yellow	52950	0	16	63093	36027	1-7-85	466	12-10-84
HL 21	2-28-85	E. Wall	Magenta Yellow	52950	0	0	63093	36027	1-7-85	466	12-10-84
HL 21	2-28-85	S. Wall	Magenta Yellow	52950	0	0	63094	36027	1-7-85	466	12-10-84
HL 21	2-28-85	Ceiling	Magenta Yellow	52950	0	4	63094	36027	1-7-85	466	12-10-84
HL 22	2-28-85	Floor	Magenta Yellow	52950	1	173	63095	36027	1-7-85	466	12-10-84
HL 22	2-28-85	E. Wall	Magenta Yellow	52951	0	0	63095	36027	1-7-85	466	12-10-84
HL 22	2-28-85	S. Wall	Magenta Yellow	52951	0	91	63096	36027	1-7-85	466	12-10-84
HL 22	2-28-85	W. Wall	Magenta Yellow	52951	0	717	63096	36027	1-7-85	466	12-10-84
HL 23	2-28-85	Floor	Magenta Yellow	52951	2	120	63097	36027	1-7-85	466	12-10-84
HL 23	2-28-85	N. Wall	Magenta Yellow	52951	2	88	63097	36027	1-7-85	466	12-10-84
HL 23	3-5-85	E. Wall L	Magenta Yellow	52951	1	426	63098	36027	1-7-85	466	12-10-84
HL 23	3-5-85	E. Wall U	Magenta Yellow	52951	0	24	63098	36027	1-7-85	466	12-10-84
HL 24	3-5-85	Floor	Magenta Yellow	52951	0	83	63099	36027	1-7-85	466	12-10-84
HL 24	3-5-85	N. Wall	Magenta Yellow	52951	0	47	63099	36027	1-7-85	466	12-10-84
HL 24	3-5-85	W. Wall L	Magenta Yellow	52951	0	49	63100	36027	1-7-85	466	12-10-84
HL 24	3-5-85	W. Wall U	Magenta Yellow	52951	1	14	63100	36027	1-7-85	466	12-10-84
HL 25	3-5-85	Floor	Magenta Yellow	52951	0	67	63101	36027	1-7-85	466	12-10-84
HL 25	3-5-85	E. Wall L	Magenta Yellow	52951	3	1687	63101	36027	1-7-85	466	12-10-84
HL 25	3-5-85	E. Wall U	Magenta Yellow	52951	0	78	63102	36027	1-7-85	466	12-10-84
HL 25	3-5-85	S. Wall L	Magenta Yellow	52951	0	35	63102	36027	1-7-85	466	12-10-84
HL 25	3-5-85	S. Wall U	Magenta Yellow	52951	0	57	63103	36027	1-7-85	466	12-10-84
HL 26	3-5-85	S. Wall L	Magenta Yellow	52951	0	35	63104	36027	1-7-85	466	12-10-84
HL 26	3-5-85	S. Wall U	Magenta Yellow	52951	1	69	63104	36027	1-7-85	466	12-10-84
HL 26	3-5-85	W. Wall L	Magenta Yellow	52951	4	39	63105	36027	1-7-85	466	12-10-84
HL 26	3-5-85	W. Wall U	Magenta Yellow	52951	0	12	63105	36027	1-7-85	466	12-10-84
HL 27	3-5-85	Floor	Magenta Yellow	52952	0	107	63106	36027	1-7-85	466	12-10-84
HL 27	3-5-85	N. Wall L	Magenta Yellow	52952	0	8	63106	36027	1-7-85	466	12-10-84
HL 27	3-5-85	N. Wall U	Magenta Yellow	52952	2	35	63107	36027	1-7-85	466	12-10-84
HL 27	3-5-85	E. Wall L	Magenta Yellow	52952	2	0	63107	36027	1-7-85	466	12-10-84
HL 27	3-5-85	E. Wall U	Magenta Yellow	52952	0	35	63108	36027	1-7-85	466	12-10-84
HL 28	3-5-85	Floor	Magenta Yellow	52952	0	122	63108	36027	1-7-85	466	12-10-84
HL 28	3-5-85	N. Wall L	Magenta Yellow	52952	0	0	63109	36027	1-7-85	466	12-10-84
HL 28	3-5-85	N. Wall U	Magenta Yellow	52952	0	6	63109	36027	1-7-85	466	12-10-84
HL 29	3-5-85	Floor	Magenta Yellow	52952	0	67	63110	36027	1-7-85	466	12-10-84
HL 29	3-5-85	E. Wall L	Magenta Yellow	52952	0	40	63110	36027	1-7-85	466	12-10-84
HL 29	3-5-85	E. Wall U	Magenta Yellow	52952	1	11	63111	36027	1-7-85	466	12-10-84
HL 29	3-5-85	S. Wall L	Magenta Yellow	52952	0	205	63111	36027	1-7-85	466	12-10-84
HL 29	3-5-85	S. Wall U	Magenta Yellow	52952	0	35	63112	36027	1-7-85	466	12-10-84
HL 30	3-5-85	Floor	Magenta Yellow	52952	0	15	63112	36027	1-7-85	466	12-10-84
HL 30	3-5-85	S. Wall L	Magenta Yellow	52952	1	34	63113	36027	1-7-85	466	12-10-84
HL 30	3-5-85	S. Wall U	Magenta Yellow	52952	0	0	63113	36027	1-7-85	466	12-10-84
HL 30	3-5-85	W. Wall L	Magenta Yellow	52952	0	0	63114	36027	1-7-85	466	12-10-84
HL 31	3-8-85	Floor	Magenta Yellow	52952	0	0	63077	36027	1-7-85	466	12-10-84
HL 31	3-8-85	N. Wall	Magenta Yellow	52952	2	619	63077	36027	1-7-85	466	12-10-84
[illegible]1	3-8-85	E. Wall	Magenta Yellow	52952	5	1998	63078	36027	1-7-85	466	12-10-84
[illegible]	3-8-85	W. Wall	Magenta Yellow	52952	9	1263	63078	36027	1-7-85	466	[illegible]0-84

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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Cutie Pie Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff
HL 15	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 16	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 16	3-12-85	N. Wall	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 17	3-12-85	N. Wall	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 17	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 18	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 19	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 20	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 21	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 21	2-28-85	E. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 21	2-28-85	S. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 21	2-28-85	Ceiling	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 22	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 22	2-28-85	E. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 22	2-28-85	S. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 22	2-28-85	W. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 23	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 23	2-28-85	N. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 23	3-5-85	E. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 23	3-5-85	E. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 24	3-5-85	Floor	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 24	3-5-85	N. Wall	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 24	3-5-85	W. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 24	3-5-85	W. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 25	3-5-85	Floor	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 25	3-5-85	E. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 25	3-5-85	E. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 25	3-5-85	S. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 25	3-5-85	S. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 26	3-5-85	S. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 26	3-5-85	S. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 26	3-5-85	W. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 26	3-5-85	W. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 27	3-5-85	Floor	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 27	3-5-85	N. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 27	3-5-85	N. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 27	3-5-85	E. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 27	3-5-85	E. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 28	3-5-85	Floor	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 28	3-5-85	N. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 28	3-5-85	N. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 29	3-5-85	Floor	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 29	3-5-85	E. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 29	3-5-85	E. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 29	3-5-85	S. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 29	3-5-85	S. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 30	3-5-85	Floor	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 30	3-5-85	S. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 30	3-5-85	S. Wall U	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 30	3-5-85	W. Wall L	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 31	3-8-85	Floor	Magenta Yellow	423	2-14-85	3899	1-7-85	1.5	0.34	0.42
HL 31	3-8-85	N. Wall	Magenta Yellow	423	2-14-85	3899	1-7-85	1.5	0.34	0.42
HL 31	3-8-85	E. Wall	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 31	3-8-85	W. Wall	Magenta Yellow	423	2-14-85			1.5	0.34	0.42

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Grid	Date	Type	Zone	NC B Eff	REC#
HL 15	2-28-85	Floor	Magenta Yellow	0.37	55
HL 16	2-28-85	Floor	Magenta Yellow	0.37	56
HL 16	3-12-85	N. Wall	Magenta Yellow	0.37	57
HL 17	3-12-85	N. Wall	Magenta Yellow	0.37	58
HL 17	2-28-85	Floor	Magenta Yellow	0.37	59
HL 18	2-28-85	Floor	Magenta Yellow	0.37	60
HL 19	2-28-85	Floor	Magenta Yellow	0.37	61
HL 20	2-28-85	Floor	Magenta Yellow	0.37	62
HL 21	2-28-85	Floor	Magenta Yellow	0.37	63
HL 21	2-28-85	E. Wall	Magenta Yellow	0.37	64
HL 21	2-28-85	S. Wall	Magenta Yellow	0.37	65
HL 21	2-28-85	Ceiling	Magenta Yellow	0.37	66
HL 22	2-28-85	Floor	Magenta Yellow	0.37	67
HL 22	2-28-85	E. Wall	Magenta Yellow	0.37	68
HL 22	2-28-85	S. Wall	Magenta Yellow	0.37	69
HL 22	2-28-85	W. Wall	Magenta Yellow	0.37	70
HL 23	2-28-85	Floor	Magenta Yellow	0.37	71
HL 23	2-28-85	N. Wall	Magenta Yellow	0.37	72
HL 23	3-5-85	E. Wall L	Magenta Yellow	0.37	73
HL 23	3-5-85	E. Wall U	Magenta Yellow	0.37	74
HL 24	3-5-85	Floor	Magenta Yellow	0.37	75
HL 24	3-5-85	N. Wall	Magenta Yellow	0.37	76
HL 24	3-5-85	W. Wall L	Magenta Yellow	0.37	77
HL 24	3-5-85	W. Wall U	Magenta Yellow	0.37	78
HL 25	3-5-85	Floor	Magenta Yellow	0.37	79
HL 25	3-5-85	E. Wall L	Magenta Yellow	0.37	80
HL 25	3-5-85	E. Wall U	Magenta Yellow	0.37	81
HL 25	3-5-85	S. Wall L	Magenta Yellow	0.37	82
HL 25	3-5-85	S. Wall U	Magenta Yellow	0.37	83
HL 26	3-5-85	S. Wall L	Magenta Yellow	0.37	84
HL 26	3-5-85	S. Wall U	Magenta Yellow	0.37	85
HL 26	3-5-85	W. Wall L	Magenta Yellow	0.37	86
HL 26	3-5-85	W. Wall U	Magenta Yellow	0.37	87
HL 27	3-5-85	Floor	Magenta Yellow	0.37	88
HL 27	3-5-85	N. Wall L	Magenta Yellow	0.37	89
HL 27	3-5-85	N. Wall U	Magenta Yellow	0.37	90
HL 27	3-5-85	E. Wall L	Magenta Yellow	0.37	91
HL 27	3-5-85	E. Wall U	Magenta Yellow	0.37	92
HL 28	3-5-85	Floor	Magenta Yellow	0.37	93
HL 28	3-5-85	N. Wall L	Magenta Yellow	0.37	94
HL 28	3-5-85	N. Wall U	Magenta Yellow	0.37	95
HL 29	3-5-85	Floor	Magenta Yellow	0.37	96
HL 29	3-5-85	E. Wall L	Magenta Yellow	0.37	97
HL 29	3-5-85	E. Wall U	Magenta Yellow	0.37	98
HL 29	3-5-85	S. Wall L	Magenta Yellow	0.37	99
HL 29	3-5-85	S. Wall U	Magenta Yellow	0.37	100
HL 30	3-5-85	Floor	Magenta Yellow	0.37	101
HL 30	3-5-85	S. Wall L	Magenta Yellow	0.37	102
HL 30	3-5-85	S. Wall U	Magenta Yellow	0.37	103
HL 30	3-5-85	W. Wall L	Magenta Yellow	0.37	104
HL 31	3-8-85	Floor	Magenta Yellow	0.37	105
HL 31	3-8-85	N. Wall	Magenta Yellow	0.37	106
HL 31	3-8-85	E. Wall	Magenta Yellow	0.37	107
31	3-8-85	W. Wall	Magenta Yellow	0.37	108

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
HL 32	3-8-85	Floor	Magenta Yellow	600	45000	3000	2000	4500	Pt. 2	1162	59	1.100
HL 32	3-8-85	E. Wall	Magenta Yellow	150	250	250	250	400	Pt. 5	15	59	0.042
HL 32	3-8-85	S. Wall	Magenta Yellow	800	0	800	400	600	Pt. 5	0	59	0.160
HL 32	3-8-85	W.Wall	Magenta Yellow	800	0	0	800	800	Pt. 5	18	59	0.125
HL 32	3-8-85	Ceiling	Magenta Yellow	200	300	250	350	350	Pt. 4	18	59	0.080
HL 32	3-8-85	W.SinkBack	Magenta Yellow	800	0	0	0	0	Pt. 1	0	59	0.375
HL 32	3-8-85	W.SinkBot.	Magenta Yellow	2000	0	0	0	0		0	59	0.375
HL 32	3-8-85	W.SinkFrt.	Magenta Yellow	1000	0	0	0	0		0	59	0.375
HL 32	3-8-85	S.SinkBack	Magenta Yellow	1200	0	0	0	0		0	59	0.000
HL 32	3-8-85	S.SinkBot.	Magenta Yellow	40000	0	0	0	0		0	59	0.000
HL 32	3-8-85	S.SinkFrt.	Magenta Yellow	1500	0	0	0	0		0	59	0.000
HL 32	3-8-85	SS Roof W.	Magenta Yellow	250	0	0	0	0		0	59	0.000
HL 32	3-8-85	SS Roof E.	Magenta Yellow	300	0	0	0	0		0	59	0.000
HL 20	3-12-85	S. Wall	Magenta Yellow	50	150	200	100	100	Pt. 3	6	59	0.015
HL 33	3-12-85	N.Wall U	Magenta Yellow	25	25	75	25	25	Pt. 3	9	59	0.010
HL 33	3-12-85	W.Wall L	Magenta Yellow	150	175	125	100	100	Pt. 2	0	59	0.030
HL 33	3-12-85	N. Wall L	Magenta Yellow	75	125	100	100	100	Pt. 2	0	59	0.017
HL 33	3-12-85	E.Wall U	Magenta Yellow	100	100	100	75	75	Pt. 1	3	59	0.006
HL 34	3-12-85	W.Wall L	Magenta Yellow	100	125	100	75	100	Pt. 5	15	59	0.022
HL 33	2-28-85	Floor	Magenta Yellow	200	300	300	250	100	Pt. 3	24	59	0.032
HL 34	2-28-85	Floor	Magenta Yellow	500	200	200	150	50000	Pt. 5	18	59	0.020
HL 34	3-12-85	W. Wall U	Magenta Yellow	50	75	75	50	100	Pt. 5	9	59	0.007
HL 35	3-12-85	W. Wall L	Magenta Yellow	75	125	75	75	150	Pt. 5	6	59	0.015
HL 35	3-12-85	E. Wall U	Magenta Yellow	25	125	100	75	125	Pt. 2	6	59	0.012
HL 35	3-12-85	E. Wall L	Magenta Yellow	100	200	0	0	0	Pt. 2	6	59	0.025
HL 35	2-28-85	Floor	Magenta Yellow	150	200	1500	10000	4000	Pt. 4	6	59	0.015
HL 36	2-28-85	Floor	Magenta Yellow	200	200	250	15000	500	Pt. 4	35	59	0.039
HL 36	3-12-85	W. Wall L.	Magenta Yellow	100	100	150	100	150	Pt. 5	0	59	0.018
HL 36	3-12-85	E. Wall U	Magenta Yellow	50	100	75	25	75	Pt. 2	6	59	0.013
HL 36	3-12-85	E. Wall L	Magenta Yellow	100	150	200	50	75	Pt. 3	6	59	0.035
HL 37	3-12-85	W. Wall L	Magenta Yellow	100	75	200	150	100	Pt. 3	6	59	0.080
HL 37	3-12-85	E. Wall U	Magenta Yellow	75	100	50	50	100	Pt. 2	0	59	0.009
HL 37	3-12-85	E. Wall L	Magenta Yellow	75	150	100	75	125	Pt. 2	6	59	0.060
HL 37	2-28-85	Floor	Magenta Yellow	200	200	200	300	200	Pt. 4	18	59	0.015
HL 38	2-28-85	Floor	Magenta Yellow	100	0	150	100	0	Pt. 3	21	59	0.017
HL 38	2-28-85	N. Wall	Magenta Yellow	100	100	150	125	150	Pt. 5	12	59	0.018
HL 38	2-28-85	E. Wall	Magenta Yellow	100	150	100	100	125	Pt. 2	15	59	0.016
HL 38	2-28-85	S. Wall	Magenta Yellow	100	200	150	100	100	Pt. 2	18	59	0.016
HL 38	2-28-85	W. Wall	Magenta Yellow	125	125	150	100	200	Pt. 5	18	59	0.018
HL 38	2-28-85	Ceiling	Magenta Yellow	100	0	150	100	0	Pt. 3	9	59	0.016
HL 39	2-28-85	Floor	Magenta Yellow	100	150	150	200	150	Pt. 4	6	59	0.012
HL 39	2-28-85	N. Wall	Magenta Yellow	150	150	100	100	200	Pt. 5	38	59	0.014
HL 39	2-28-85	E. Wall	Magenta Yellow	100	100	0	0	0	Pt. 2	29	59	0.020
HL 39	2-28-85	S. Wall	Magenta Yellow	200	100	100	100	200	Pt. 5	21	59	0.018
HL 39	2-28-85	W. Wall	Magenta Yellow	100	100	100	100	100	Pt. 5	27	59	0.012
HL 39	2-28-85	Ceiling	Magenta Yellow	125	125	125	125	200	Pt. 5	6	59	0.014
HL 40	2-28-85	Floor	Magenta Yellow	100	300	200	200	400	Pt. 5	18	59	0.060
HL 40	3-6-85	W. Wall L	Magenta Yellow	75	75	150	125	100	Pt. 3	0	59	0.018
HL 40	3-6-85	W. Wall U	Magenta Yellow	100	75	100	125	25	Pt. 4	9	59	0.007
HL 40	3-6-85	N. Wall L	Magenta Yellow	75	150	100	75	100	Pt. 2	6	59	0.017
HL 40	3-6-85	N. Wall U	Magenta Yellow	125	100	50	50	50	Pt. 1	6	59	0.007
HL 40	3-12-85	Ceiling	Magenta Yellow	75	75	50	75	75	Pt. 5	3	59	0.007
HL 41	3-12-85	Ceiling	Magenta Yellow	50	50	50	50	25	Pt. 2	3	59	0.005
HL 41	3-6-85	Floor	Magenta Yellow	1200	400	300	2000	200	Pt. 4	3	59	0.012

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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
HL 32	3-8-85	Floor	Magenta Yellow	52952	4	4191	63079	36027	1-7-85	466	12-10-84
HL 32	3-8-85	E. Wall	Magenta Yellow	52952	6	2358	63079	36027	1-7-85	466	12-10-84
HL 32	3-8-85	S. Wall	Magenta Yellow	52952	1	612	63080	36027	1-7-85	466	12-10-84
HL 32	3-8-85	W.Wall	Magenta Yellow	63080	8	955	52967	36027	1-7-85	466	12-10-84
HL 32	3-8-85	Ceiling	Magenta Yellow	52967	3	510	63081	36027	1-7-85	466	12-10-84
HL 32	3-8-85	W.SinkBack	Magenta Yellow	52967	0	1160	63081	36027	1-7-85	466	12-10-84
HL 32	3-8-85	W.SinkBot.	Magenta Yellow	52967	0	376	63081	36027	1-7-85	466	12-10-84
HL 32	3-8-85	W.SinkFrt.	Magenta Yellow	52967	3	1837	63081	36027	1-7-85	466	12-10-84
HL 32	3-8-85	S.SinkBack	Magenta Yellow	52967	2	3055	63082	36027	1-7-85	466	12-10-84
HL 32	3-8-85	S.SinkBot.	Magenta Yellow	52967	208	337638	63082	36027	1-7-85	466	12-10-84
HL 32	3-8-85	S.SinkFrt.	Magenta Yellow	52967	0	722	63082	36027	1-7-85	466	12-10-84
HL 32	3-8-85	SS Roof W.	Magenta Yellow	52967	0	587	63082	36027	1-7-85	466	12-10-84
HL 32	3-8-85	SS Roof E.	Magenta Yellow	52967	0	587	63082	36027	1-7-85	466	12-10-84
HL 20	3-12-85	S. Wall	Magenta Yellow	52950	0	143	63136	36027	1-7-85	466	12-10-84
HL 33	3-12-85	N.Wall U	Magenta Yellow	52967	0	36	63136	36027	1-7-85	466	12-10-84
HL 33	3-12-85	W.Wall L	Magenta Yellow	52967	8	43	63137	36027	1-7-85	466	12-10-84
HL 33	3-12-85	N. Wall L	Magenta Yellow	52967	2	97	63137	36027	1-7-85	466	12-10-84
HL 33	3-12-85	E.Wall U	Magenta Yellow	52967	1	11	63138	36027	1-7-85	466	12-10-84
HL 34	3-12-85	W.Wall L	Magenta Yellow	52967	0	56	63138	36027	1-7-85	466	12-10-84
HL 33	2-28-85	Floor	Magenta Yellow	52967	0	112	63115	36027	1-7-85	466	12-10-84
HL 34	2-28-85	Floor	Magenta Yellow	52967	0	281	63115	36027	1-7-85	466	12-10-84
HL 34	3-12-85	W. Wall U	Magenta Yellow	52967	0	56	63139	36027	1-7-85	466	12-10-84
HL 35	3-12-85	W. Wall L	Magenta Yellow	52967	2	104	63139	36027	1-7-85	466	12-10-84
HL 35	3-12-85	E. Wall U	Magenta Yellow	52967	0	36	63140	36027	1-7-85	466	12-10-84
HL 35	3-12-85	E. Wall L	Magenta Yellow	52967	0	317	63140	36027	1-7-85	466	12-10-84
HL 35	2-28-85	Floor	Magenta Yellow	52967	0	227	63116	36027	1-7-85	466	12-10-84
HL 36	2-28-85	Floor	Magenta Yellow	52967	0	279	63116	36027	1-7-85	466	12-10-84
HL 36	3-12-85	W. Wall L.	Magenta Yellow	52967	0	24	63142	36027	1-7-85	466	12-10-84
HL 36	3-12-85	E. Wall U	Magenta Yellow	52967	0	23	63142	36027	1-7-85	466	12-10-84
HL 36	3-12-85	E. Wall L	Magenta Yellow	52967	3	9	63143	36027	1-7-85	466	12-10-84
HL 37	3-12-85	W. Wall L	Magenta Yellow	52968	0	16	63143	36027	1-7-85	466	12-10-84
HL 37	3-12-85	E. Wall U	Magenta Yellow	52967	0	11	63144	36027	1-7-85	466	12-10-84
HL 37	3-12-85	E. Wall L	Magenta Yellow	52967	0	11	63144	36027	1-7-85	466	12-10-84
HL 37	2-28-85	Floor	Magenta Yellow	52967	0	140	63117	36027	1-7-85	466	12-10-84
HL 38	2-28-85	Floor	Magenta Yellow	52968	0	15	63117	36027	1-7-85	466	12-10-84
HL 38	2-28-85	N. Wall	Magenta Yellow	52968	0	0	63118	36027	1-7-85	466	12-10-84
HL 38	2-28-85	E. Wall	Magenta Yellow	52968	0	6	63118	36027	1-7-85	466	12-10-84
HL 38	2-28-85	S. Wall	Magenta Yellow	52968	0	0	63119	36027	1-7-85	466	12-10-84
HL 38	2-28-85	W. Wall	Magenta Yellow	52968	0	0	63119	36027	1-7-85	466	12-10-84
HL 38	2-28-85	Ceiling	Magenta Yellow	52968	0	10	63120	36027	1-7-85	466	12-10-84
HL 39	2-28-85	Floor	Magenta Yellow	52968	0	108	63120	36027	1-7-85	466	12-10-84
HL 39	2-28-85	N. Wall	Magenta Yellow	52968	0	0	63121	36027	1-7-85	466	12-10-84
HL 39	2-28-85	E. Wall	Magenta Yellow	52968	0	1	63121	36027	1-7-85	466	12-10-84
HL 39	2-28-85	S. Wall	Magenta Yellow	52968	0	29	63122	36027	1-7-85	466	12-10-84
HL 39	2-28-85	W. Wall	Magenta Yellow	52968	0	105	63122	36027	1-7-85	466	12-10-84
HL 39	2-28-85	Ceiling	Magenta Yellow	52968	0	0	63123	36027	1-7-85	466	12-10-84
HL 40	2-28-85	Floor	Magenta Yellow	52968	0	182	63123	36027	1-7-85	466	12-10-84
HL 40	3-6-85	W. Wall L	Magenta Yellow	52968	0	35	63125	36027	1-7-85	466	12-10-84
HL 40	3-6-85	W. Wall U	Magenta Yellow	52968	0	0	63125	36027	1-7-85	466	12-10-84
HL 40	3-6-85	N. Wall L	Magenta Yellow	52968	0	16	63124	36027	1-7-85	466	12-10-84
HL 40	3-6-85	N. Wall U	Magenta Yellow	52968	0	74	63124	36027	1-7-85	466	12-10-84
HL 40	3-12-85	Ceiling	Magenta Yellow	52968	0	64	63145	36027	1-7-85	466	12-10-84
HL 41	3-12-85	Ceiling	Magenta Yellow	52968	0	63	63145	36027	1-7-85	466	12-10-84
F[illegible]	3-6-85	Floor	Magenta Yellow	52968	0	1540	63126	36027	1-7-85	466	1[illegible]-84

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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Cutie Pie Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff
HL 32	3-8-85	Floor	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	E. Wall	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	S. Wall	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	W.Wall	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	Ceiling	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	W.SinkBack	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	W.SinkBot.	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	W.SinkFrt.	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	S.SinkBack	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	S.SinkBot.	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	S.SinkFrt.	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	SS Roof W.	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 32	3-8-85	SS Roof E.	Magenta Yellow	423	2-14-85			1.5	0.34	0.42
HL 20	3-12-85	S. Wall	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 33	3-12-85	N.Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 33	3-12-85	W.Wall L	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 33	3-12-85	N. Wall L	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 33	3-12-85	E.Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 34	3-12-85	W.Wall L	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 33	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 34	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 34	3-12-85	W. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 35	3-12-85	W. Wall L	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 35	3-12-85	E. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 35	3-12-85	E. Wall L	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 35	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 36	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 36	3-12-85	W. Wall L.	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 36	3-12-85	E. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 36	3-12-85	E. Wall L	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 37	3-12-85	W. Wall L	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 37	3-12-85	E. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 37	3-12-85	E. Wall L	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 37	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 38	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 38	2-28-85	N. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 38	2-28-85	E. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 38	2-28-85	S. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 38	2-28-85	W. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 38	2-28-85	Ceiling	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 39	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 39	2-28-85	N. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 39	2-28-85	E. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 39	2-28-85	S. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 39	2-28-85	W. Wall	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 39	2-28-85	Ceiling	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 40	2-28-85	Floor	Magenta Yellow	423	2-14-85			7	0.34	0.42
HL 40	3-6-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 40	3-6-85	W. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 40	3-6-85	N. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 40	3-6-85	N. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 40	3-12-85	Ceiling	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 41	3-12-85	Ceiling	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 41	3-6-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42

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Grid	Date	Type	Zone	NC B Eff	REC#
HL 32	3-8-85	Floor	Magenta Yellow	0.37	109
HL 32	3-8-85	E. Wall	Magenta Yellow	0.37	110
HL 32	3-8-85	S. Wall	Magenta Yellow	0.37	111
HL 32	3-8-85	W.Wall	Magenta Yellow	0.37	112
HL 32	3-8-85	Ceiling	Magenta Yellow	0.37	113
HL 32	3-8-85	W.SinkBack	Magenta Yellow	0.37	114
HL 32	3-8-85	W.SinkBot.	Magenta Yellow	0.37	115
HL 32	3-8-85	W.SinkFrt.	Magenta Yellow	0.37	116
HL 32	3-8-85	S.SinkBack	Magenta Yellow	0.37	117
HL 32	3-8-85	S.SinkBot.	Magenta Yellow	0.37	118
HL 32	3-8-85	S.SinkFrt.	Magenta Yellow	0.37	119
HL 32	3-8-85	SS Roof W.	Magenta Yellow	0.37	120
HL 32	3-8-85	SS Roof E.	Magenta Yellow	0.37	121
HL 20	3-12-85	S. Wall	Magenta Yellow	0.37	122
HL 33	3-12-85	N.Wall U	Magenta Yellow	0.37	123
HL 33	3-12-85	W.Wall L	Magenta Yellow	0.37	124
HL 33	3-12-85	N. Wall L	Magenta Yellow	0.37	125
HL 33	3-12-85	E.Wall U	Magenta Yellow	0.37	126
HL 34	3-12-85	W.Wall L	Magenta Yellow	0.37	127
HL 33	2-28-85	Floor	Magenta Yellow	0.37	128
HL 34	2-28-85	Floor	Magenta Yellow	0.37	129
HL 34	3-12-85	W. Wall U	Magenta Yellow	0.37	130
HL 35	3-12-85	W. Wall L	Magenta Yellow	0.37	131
HL 35	3-12-85	E. Wall U	Magenta Yellow	0.37	132
HL 35	3-12-85	E. Wall L	Magenta Yellow	0.37	133
HL 35	2-28-85	Floor	Magenta Yellow	0.37	134
HL 36	2-28-85	Floor	Magenta Yellow	0.37	135
HL 36	3-12-85	W. Wall L.	Magenta Yellow	0.37	136
HL 36	3-12-85	E. Wall U	Magenta Yellow	0.37	137
HL 36	3-12-85	E. Wall L	Magenta Yellow	0.37	138
HL 37	3-12-85	W. Wall L	Magenta Yellow	0.37	139
HL 37	3-12-85	E. Wall U	Magenta Yellow	0.37	140
HL 37	3-12-85	E. Wall L	Magenta Yellow	0.37	141
HL 37	2-28-85	Floor	Magenta Yellow	0.37	142
HL 38	2-28-85	Floor	Magenta Yellow	0.37	143
HL 38	2-28-85	N. Wall	Magenta Yellow	0.37	144
HL 38	2-28-85	E. Wall	Magenta Yellow	0.37	145
HL 38	2-28-85	S. Wall	Magenta Yellow	0.37	146
HL 38	2-28-85	W. Wall	Magenta Yellow	0.37	147
HL 38	2-28-85	Ceiling	Magenta Yellow	0.37	148
HL 39	2-28-85	Floor	Magenta Yellow	0.37	149
HL 39	2-28-85	N. Wall	Magenta Yellow	0.37	150
HL 39	2-28-85	E. Wall	Magenta Yellow	0.37	151
HL 39	2-28-85	S. Wall	Magenta Yellow	0.37	152
HL 39	2-28-85	W. Wall	Magenta Yellow	0.37	153
HL 39	2-28-85	Ceiling	Magenta Yellow	0.37	154
HL 40	2-28-85	Floor	Magenta Yellow	0.37	155
HL 40	3-6-85	W. Wall L	Magenta Yellow	0.37	156
HL 40	3-6-85	W. Wall U	Magenta Yellow	0.37	157
HL 40	3-6-85	N. Wall L	Magenta Yellow	0.37	158
HL 40	3-6-85	N. Wall U	Magenta Yellow	0.37	159
HL 40	3-12-85	Ceiling	Magenta Yellow	0.37	160
HL 41	3-12-85	Ceiling	Magenta Yellow	0.37	161
H[illegible]	3-6-85	Floor	Magenta Yellow	0.37	162

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
HL 41	3-6-85	W. Wall L	Magenta Yellow	100	75	100	25	75	Pt. 3	9	59	0.006
HL 41	3-6-85	W. Wall U	Magenta Yellow	75	50	50	50	125	Pt. 5	3	59	0.006
HL 42	3-6-85	Floor	Magenta Yellow	800	300	300	200	200	Pt. 1	3	59	0.008
HL 42	3-6-85	W. Wall L	Magenta Yellow	75	125	75	50	50	Pt. 2	12	59	0.006
HL 42	3-6-85	W. Wall U	Magenta Yellow	75	50	75	50	50	Pt. 3	15	59	0.005
HL 43	3-6-85	Floor	Magenta Yellow	150	150	200	150	150	Pt. 3	21	59	0.005
HL 43	3-6-85	W. Wall L	Magenta Yellow	50	75	50	50	100	Pt. 5	6	59	0.005
HL 43	3-6-85	W. Wall U	Magenta Yellow	50	75	50	100	75	Pt. 4	6	59	0.005
HL 44	3-6-85	Floor	Magenta Yellow	150	450	1500	200	150	Pt. 3	21	59	0.007
HL 43	3-12-85	Ceiling	Magenta Yellow	100	75	50	50	100	Pt. 5	3	59	0.005
HL 45	3-12-85	W. Wall U	Magenta Yellow	125	25	75	75	125	Pt. 5	6	59	0.003
HL 44	3-6-85	W. Wall L	Magenta Yellow	75	50	50	75	75	Pt. 5	18	59	0.004
HL 44	3-6-85	W. Wall U	Magenta Yellow	125	50	75	75	75	Pt. 1	9	59	0.005
HL 45	2-28-85	Floor	Magenta Yellow	150	100	100	150	0	Pt. 1	6	59	0.008
HL 45	3-6-85	W. Wall L	Magenta Yellow	75	50	75	50	75	Pt. 5	12	59	0.009
HL 45	3-6-85	S. Wall L	Magenta Yellow	75	75	100	50	50	Pt. 3	12	59	0.008
HL 45	3-12-85	Ceiling	Magenta Yellow	50	100	25	50	75	Pt. 2	6	59	0.004
HL 45	3-12-85	S. Wall U	Magenta Yellow	125	75	50	100	75	Pt. 1	9	59	0.004
HL 46	3-12-85	S. Wall U	Magenta Yellow	75	75	50	25	50	Pt. 2	0	59	0.006
HL 46	3-6-85	S. Wall L	Magenta Yellow	125	75	150	75	100	Pt. 3	3	59	0.021
NL 46	3-6-85	S. Wall U	Magenta Yellow	75	75	50	25	50	Pt. 2	0	59	0.006
HL 46	2-28-85	Floor	Magenta Yellow	150	200	100	150	1800	Pt. 5	6	59	0.010
HL 47	2-28-85	E. Wall U	Magenta Yellow	50	75	75	50	100	Pt. 5	3	59	0.004
HL 47	3-6-85	S. Wall L	Magenta Yellow	75	200	100	100	50	Pt. 2	15	59	0.070
HL 47	3-6-85	S. Wall U	Magenta Yellow	50	75	100	50	75	Pt. 3	0	59	0.005
HL 47	2-28-85	Floor	Magenta Yellow	100	500	1500	100	200	Pt. 3	35	59	0.035
HL 48	2-28-85	S. Wall	Magenta Yellow	50	125	100	125	100	Pt. 2	12	59	0.013
HL 49	2-28-85	Floor	Magenta Yellow	150	150	150	150	150	Pt. 5	6	59	0.008
HL 48	2-28-85	Floor	Magenta Yellow	100	100	300	150	200	Pt. 3	18	59	0.025
HL 49	3-12-85	Ceiling	Magenta Yellow	75	100	25	100	75	Pt. 4	3	59	0.008
HL 48	3-6-85	N. Wall	Magenta Yellow	75	50	25	75	75	Pt. 5	9	59	0.007
HL 49	3-6-85	S. Wall	Magenta Yellow	75	75	75	75	75	Pt. 5	6	59	0.007
Hl 49	3-6-85	N. Wall	Magenta Yellow	75	50	25	75	75	Pt. 5	15	59	0.006
HL 50	3-21-85	Floor	Magenta Yellow	700	1750	1000	2000	1250	Pt. 4	3	59	0.400
HL 50	3-21-85	N. Wall L	Magenta Yellow	250	350	0	0	700	Pt. 5	3	59	0.180
HL 50	3-21-85	N. Wall U	Magenta Yellow	200	250	400	200	250	Pt. 3	3	59	0.150
HL 50	3-21-85	E. Wall L	Magenta Yellow	225	400	250	150	200	Pt. 2	6	59	0.180
HL 50	3-21-85	E. Wall U	Magenta Yellow	0	200	125	0	150	Pt. 2	3	59	0.070
HL 50	3-21-85	Ceiling	Magenta Yellow	200	225	325	175	300	Pt. 3	9	59	0.048
HL 51	3-21-85	Floor	Magenta Yellow	1100	750	200	300	900	Pt. 1	9	59	0.340
HL 51	3-21-85	N. Wall L	Magenta Yellow	500	750	250	150	700	Pt. 2	3	59	0.280
HL 51	3-21-85	N. Wall U	Magenta Yellow	150	300	200	175	300	Pt. 2	0	59	0.110
HL 52	3-21-85	N. Wall L	Magenta Yellow	150	300	200	150	125	Pt. 2	6	59	0.080
HL 52	3-21-85	N. Wall U	Magenta Yellow	150	200	150	225	150	Pt. 4	3	59	0.051
HL 52	3-21-85	Ceiling	Magenta Yellow	150	200	225	200	175	Pt. 3	6	59	0.042
HL 53	3-21-85	Floor	Magenta Yellow	200	200	2000	350	900	Pt. 3	6	59	0.140
HL 53	3-21-85	N. Wall L	Magenta Yellow	250	125	200	250	100	Pt. 4	6	59	0.035
HL 53	3-21-85	N. Wall U	Magenta Yellow	175	200	200	250	225	Pt. 4	6	59	0.025
HL 53	3-21-85	W. Wall L	Magenta Yellow	200	200	300	200	150	Pt. 3	0	59	0.080
HL 54	3-21-85	Floor	Magenta Yellow	150	1200	500	100	1000	Pt. 2	12	59	0.140
HL 54	3-21-85	N. Wall	Magenta Yellow	125	100	200	125	200	Pt. 5	9	59	0.022
HL 54	3-21-85	W. Wall	Magenta Yellow	100	100	200	100	150	Pt. 3	3	59	0.027
HL 54	3-21-85	Ceiling	Magenta Yellow	125	175	150	100	150	Pt. 2	6	59	0.038
HL 55	3-21-85	Floor	Magenta Yellow	750	750	800	500	1000	Pt. 5	3	59	0.390

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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
HL 41	3-6-85	W. Wall L	Magenta Yellow	52968	2	23	63126	36027	1-7-85	466	12-10-84
HL 41	3-6-85	W. Wall U	Magenta Yellow	52968	1	82	63127	36027	1-7-85	466	12-10-84
HL 42	3-6-85	Floor	Magenta Yellow	52968	0	266	63127	36027	1-7-85	466	12-10-84
HL 42	3-6-85	W. Wall L	Magenta Yellow	52968	0	12	63128	36027	1-7-85	466	12-10-84
HL 42	3-6-85	W. Wall U	Magenta Yellow	52968	0	18	63128	36027	1-7-85	466	12-10-84
HL 43	3-6-85	Floor	Magenta Yellow	52968	0	86	63129	36027	1-7-85	466	12-10-84
HL 43	3-6-85	W. Wall L	Magenta Yellow	52968	0	29	63129	36027	1-7-85	466	12-10-84
HL 43	3-6-85	W. Wall U	Magenta Yellow	52969	0	0	63130	36027	1-7-85	466	12-10-84
HL 44	3-6-85	Floor	Magenta Yellow	52969	0	568	63130	36027	1-7-85	466	12-10-84
HL 43	3-12-85	Ceiling	Magenta Yellow	52969	0	76	63146	36027	1-7-85	466	12-10-84
HL 45	3-12-85	W. Wall U	Magenta Yellow	52969	0	63	63146	36027	1-7-85	466	12-10-84
HL 44	3-6-85	W. Wall L	Magenta Yellow	52969	0	169	63131	36027	1-7-85	466	12-10-84
HL 44	3-6-85	W. Wall U	Magenta Yellow	52969	1	22	63131	36027	1-7-85	466	12-10-84
HL 45	2-28-85	Floor	Magenta Yellow	52969	0	192	63162	36027	1-7-85	466	12-10-84
HL 45	3-6-85	W. Wall L	Magenta Yellow	52969	2	71	63147	36027	1-7-85	466	12-10-84
HL 45	3-6-85	S. Wall L	Magenta Yellow	52969	1	42	63147	36027	1-7-85	466	12-10-84
HL 45	3-12-85	Ceiling	Magenta Yellow	52969	1	47	63148	36027	1-7-85	466	12-10-84
HL 45	3-12-85	S. Wall U	Magenta Yellow	52969	0	55	63149	36027	1-7-85	466	12-10-84
HL 46	3-12-85	S. Wall U	Magenta Yellow	52969	0	31	63149	36027	1-7-85	466	12-10-84
HL 46	3-6-85	S. Wall L	Magenta Yellow	52969	0	80	63150	36027	1-7-85	466	12-10-84
NL 46	3-6-85	S. Wall U	Magenta Yellow	52969	0	31	63150	36027	1-7-85	466	12-10-84
HL 46	2-28-85	Floor	Magenta Yellow	52969	0	1088	63151	36027	1-7-85	466	12-10-84
HL 47	2-28-85	E. Wall U	Magenta Yellow	52969	1	11	63151	36027	1-7-85	466	12-10-84
HL 47	3-6-85	S. Wall L	Magenta Yellow	52969	1	140	63153	36027	1-7-85	466	12-10-84
HL 47	3-6-85	S. Wall U	Magenta Yellow	52969	0	15	63153	36027	1-7-85	466	12-10-84
HL 47	2-28-85	Floor	Magenta Yellow	52969	0	48	63154	36027	1-7-85	466	12-10-84
HL 48	2-28-85	S. Wall	Magenta Yellow	52969	0	143	63154	36027	1-7-85	466	12-10-84
HL 49	2-28-85	Floor	Magenta Yellow	52969	2	168	63157	36027	1-7-85	466	12-10-84
HL 48	2-28-85	Floor	Magenta Yellow	52969	0	68	63157	36027	1-7-85	466	12-10-84
HL 49	3-12-85	Ceiling	Magenta Yellow	52969	0	97	63158	36027	1-7-85	466	12-10-84
HL 48	3-6-85	N. Wall	Magenta Yellow	52969	0	22	63155	36027	1-7-85	466	12-10-84
HL 49	3-6-85	S. Wall	Magenta Yellow	52969	0	9	63155	36027	1-7-85	466	12-10-84
Hl 49	3-6-85	N. Wall	Magenta Yellow	52969	0	75	63156	36027	1-7-85	466	12-10-84
HL 50	3-21-85	Floor	Magenta Yellow	52982	1	5126	63209	36027	1-7-85	466	12-10-84
HL 50	3-21-85	N. Wall L	Magenta Yellow	52982	0	94	63209	36027	1-7-85	466	12-10-84
HL 50	3-21-85	N. Wall U	Magenta Yellow	52982	0	22	63210	36027	1-7-85	466	12-10-84
HL 50	3-21-85	E. Wall L	Magenta Yellow	52982	1	41	63210	36027	1-7-85	466	12-10-84
HL 50	3-21-85	E. Wall U	Magenta Yellow	52982	0	17	63211	36027	1-7-85	466	12-10-84
HL 50	3-21-85	Ceiling	Magenta Yellow	52982	0	54	63211	36027	1-7-85	466	12-10-84
HL 51	3-21-85	Floor	Magenta Yellow	52982	2	507	63212	36027	1-7-85	466	12-10-84
HL 51	3-21-85	N. Wall L	Magenta Yellow	52982	0	22	63212	36027	1-7-85	466	12-10-84
HL 51	3-21-85	N. Wall U	Magenta Yellow	52982	0	9	63213	36027	1-7-85	466	12-10-84
HL 52	3-21-85	N. Wall L	Magenta Yellow	52982	0	11	63213	36027	1-7-85	466	12-10-84
HL 52	3-21-85	N. Wall U	Magenta Yellow	52982	0	275	63214	36027	1-7-85	466	12-10-84
HL 52	3-21-85	Ceiling	Magenta Yellow	52982	0	27	63214	36027	1-7-85	466	12-10-84
HL 53	3-21-85	Floor	Magenta Yellow	52982	4	6183	63215	36027	1-7-85	466	12-10-84
HL 53	3-21-85	N. Wall L	Magenta Yellow	52982	0	0	63215	36027	1-7-85	466	12-10-84
HL 53	3-21-85	N. Wall U	Magenta Yellow	52982	0	127	63216	36027	1-7-85	466	12-10-84
HL 53	3-21-85	W. Wall L	Magenta Yellow	52982	0	66	63216	36027	1-7-85	466	12-10-84
HL 54	3-21-85	Floor	Magenta Yellow	52982	1	3536	63217	36027	1-7-85	466	12-10-84
HL 54	3-21-85	N. Wall	Magenta Yellow	52982	0	364	63217	36027	1-7-85	466	12-10-84
HL 54	3-21-85	W. Wall	Magenta Yellow	52982	0	226	63218	36027	1-7-85	466	12-10-84
HL 54	3-21-85	Ceiling	Magenta Yellow	52982	1	23	63218	36027	1-7-85	466	12-10-84
HL [illegible]	3-21-85	Floor	Magenta Yellow	52982	-	237	63219	36027	1-7-85	466	12-1[illegible]4

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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Cutie Pie Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff
HL 41	3-6-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 41	3-6-85	W. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 42	3-6-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 42	3-6-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 42	3-6-85	W. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 43	3-6-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 43	3-6-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 43	3-6-85	W. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 44	3-6-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 43	3-12-85	Ceiling	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 45	3-12-85	W. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 44	3-6-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 44	3-6-85	W. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 45	2-28-85	Floor	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 45	3-6-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 45	3-6-85	S. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 45	3-12-85	Ceiling	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 45	3-12-85	S. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 46	3-12-85	S. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 46	3-6-85	S. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
NL 46	3-6-85	S. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 46	2-28-85	Floor	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 47	2-28-85	E. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 47	3-6-85	S. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 47	3-6-85	S. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 47	2-28-85	Floor	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 48	2-28-85	S. Wall	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 49	2-28-85	Floor	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 48	2-28-85	Floor	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 49	3-12-85	Ceiling	Magenta Yellow	423	2-14-85			4	0.34	0.42
HL 48	3-6-85	N. Wall	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 49	3-6-85	S. Wall	Magenta Yellow	423	2-14-85			6	0.34	0.42
Hl 49	3-6-85	N. Wall	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 50	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 50	3-21-85	N. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 50	3-21-85	N. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 50	3-21-85	E. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 50	3-21-85	E. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 50	3-21-85	Ceiling	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 51	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 51	3-21-85	N. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 51	3-21-85	N. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 52	3-21-85	N. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 52	3-21-85	N. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 52	3-21-85	Ceiling	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 53	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 53	3-21-85	N. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 53	3-21-85	N. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 53	3-21-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 54	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 54	3-21-85	N. Wall	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 54	3-21-85	W. Wall	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 54	3-21-85	Ceiling	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 55	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42

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Grid	Date	Type	Zone	NC B Eff	REC#
HL 41	3-6-85	W. Wall L	Magenta Yellow	0.37	163
HL 41	3-6-85	W. Wall U	Magenta Yellow	0.37	164
HL 42	3-6-85	Floor	Magenta Yellow	0.37	165
HL 42	3-6-85	W. Wall L	Magenta Yellow	0.37	166
HL 42	3-6-85	W. Wall U	Magenta Yellow	0.37	167
HL 42	3-6-85	Floor	Magenta Yellow	0.37	168
HL 43	3-6-85	Floor	Magenta Yellow	0.37	169
HL 43	3-6-85	W. Wall L	Magenta Yellow	0.37	170
HL 43	3-6-85	W. Wall U	Magenta Yellow	0.37	171
HL 44	3-6-85	Floor	Magenta Yellow	0.37	172
HL 43	3-12-85	Ceiling	Magenta Yellow	0.37	173
HL 45	3-12-85	W. Wall U	Magenta Yellow	0.37	174
HL 44	3-6-85	W. Wall L	Magenta Yellow	0.37	175
HL 44	3-6-85	W. Wall U	Magenta Yellow	0.37	176
HL 45	2-28-85	Floor	Magenta Yellow	0.37	177
HL 45	3-6-85	W. Wall L	Magenta Yellow	0.37	178
HL 45	3-6-85	S. Wall L	Magenta Yellow	0.37	179
HL 45	3-12-85	Ceiling	Magenta Yellow	0.37	181
HL 45	3-12-85	S. Wall U	Magenta Yellow	0.37	182
HL 46	3-12-85	S. Wall U	Magenta Yellow	0.37	183
HL 46	3-6-85	S. Wall L	Magenta Yellow	0.37	184
NL 46	3-6-85	S. Wall U	Magenta Yellow	0.37	185
HL 46	2-28-85	Floor	Magenta Yellow	0.37	186
HL 47	2-28-85	E. Wall U	Magenta Yellow	0.37	187
HL 47	3-6-85	S. Wall L	Magenta Yellow	0.37	188
HL 47	3-6-85	S. Wall U	Magenta Yellow	0.37	189
HL 47	2-28-85	Floor	Magenta Yellow	0.37	190
HL 48	2-28-85	S. Wall	Magenta Yellow	0.37	191
HL 49	2-28-85	Floor	Magenta Yellow	0.37	192
HL 48	2-28-85	Floor	Magenta Yellow	0.37	193
HL 49	3-12-85	Ceiling	Magenta Yellow	0.37	194
HL 48	3-6-85	N. Wall	Magenta Yellow	0.37	195
HL 49	3-6-85	S. Wall	Magenta Yellow	0.37	196
HL 49	3-6-85	N. Wall	Magenta Yellow	0.37	197
HL 50	3-21-85	Floor	Magenta Yellow	0.37	198
HL 50	3-21-85	N. Wall L	Magenta Yellow	0.37	199
HL 50	3-21-85	N. Wall U	Magenta Yellow	0.37	200
HL 50	3-21-85	E. Wall L	Magenta Yellow	0.37	201
HL 50	3-21-85	E. Wall U	Magenta Yellow	0.37	202
HL 50	3-21-85	Ceiling	Magenta Yellow	0.37	203
HL 51	3-21-85	Floor	Magenta Yellow	0.37	204
HL 51	3-21-85	N. Wall L	Magenta Yellow	0.37	205
HL 51	3-21-85	N. Wall U	Magenta Yellow	0.37	206
HL 52	3-21-85	N. Wall L	Magenta Yellow	0.37	207
HL 52	3-21-85	N. Wall U	Magenta Yellow	0.37	208
HL 52	3-21-85	Ceiling	Magenta Yellow	0.37	209
HL 53	3-21-85	Floor	Magenta Yellow	0.37	210
HL 53	3-21-85	N. Wall L	Magenta Yellow	0.37	211
HL 53	3-21-85	N. Wall U	Magenta Yellow	0.37	212
HL 53	3-21-85	W. Wall L	Magenta Yellow	0.37	213
HL 54	3-21-85	Floor	Magenta Yellow	0.37	214
HL 54	3-21-85	N. Wall	Magenta Yellow	0.37	215
HL 54	3-21-85	W. Wall	Magenta Yellow	0.37	216
HL 54	3-21-85	Ceiling	Magenta Yellow	0.37	217
H[illegible]	3-21-85	Floor	Magenta Yellow		

RAD SURVEY HOT LAB BLDG. 1112
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14:37:20

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
HL 55	3-21-85	E. Wall L	Magenta Yellow	200	400	500	125	125	Pt. 3	3	59	0.200
HL 55	3-21-85	E. Wall U	Magenta Yellow	0	250	200	0	200	Pt. 2	6	59	0.080
HL 56	3-21-85	Floor	Magenta Yellow	600	900	175	150	900	Pt. 5	3	59	0.270
HL 57	3-21-85	Floor	Magenta Yellow	300	350	300	900	450	Pt. 4	6	59	0.080
HL 57	3-21-85	W. Wall L	Magenta Yellow	150	400	350	200	250	Pt. 2	6	59	0.100
HL 58	3-21-85	Floor	Magenta Yellow	150	200	100	600	250	Pt. 4	15	59	0.026
HL 58	3-21-85	W. Wall	Magenta Yellow	100	150	150	150	125	Pt. 2	3	59	0.023
HL 59	3-21-85	Floor	Magenta Yellow	400	125	400	800	250	Pt. 4	0	59	0.800
HL 59	3-21-85	E. Wall L	Magenta Yellow	150	200	350	225	400	Pt. 5	3	59	0.220
HL 59	3-21-85	E. Wall U	Magenta Yellow	0	150	250	0	150	Pt. 3	12	59	0.080
HL 59	3-21-85	S. Wall L	Magenta Yellow	250	200	200	150	200	Pt. 1	0	59	0.060
HL 59	3-21-85	S. Wall U	Magenta Yellow	175	250	150	150	200	Pt. 2	3	59	0.070
HL 59	3-21-85	Ceiling	Magenta Yellow	200	300	125	150	175	Pt. 2	3	59	0.070
HL 60	3-21-85	Floor	Magenta Yellow	750	75	175	150	125	Pt. 1	3	59	1.000
HL 60	3-21-85	S. Wall L	Magenta Yellow	250	225	200	175	200	Pt. 1	6	59	0.060
HL 60	3-21-85	S. Wall U	Magenta Yellow	200	250	250	250	200	Pt. 4	6	59	0.042
HL 61	3-21-85	S. Wall L	Magenta Yellow	175	250	100	300	150	Pt. 4	0	59	0.060
HL 61	3-21-85	S. Wall U	Magenta Yellow	200	150	200	200	150	Pt. 3	0	59	0.060
HL 62	3-21-85	Floor	Magenta Yellow	300	350	300	900	450	Pt. 4	6	59	0.080
HL 62	3-21-85	S. Wall L	Magenta Yellow	1000	250	100	200	100	Pt. 1	12	59	0.150
HL 62	3-21-85	S. Wall U	Magenta Yellow	150	300	200	125	175	Pt. 2	9	59	0.030
HL 62	3-21-85	W. Wall L	Magenta Yellow	100	250	150	200	200	Pt. 2	0	59	0.060
HL 63	3-21-85	Floor	Magenta Yellow	300	200	150	100	200	Pt. 1	9	59	0.042
HL 63	3-21-85	S. Wall	Magenta Yellow	150	125	200	150	175	Pt. 3	9	59	0.027
HL 63	3-21-85	W. Wall	Magenta Yellow	100	150	100	150	200	Pt. 5	6	59	0.016
HL 64	4-5-85	Roof	White	75	50	75	100	100	Pt. 5	0	59	0.006
HL 65	4-5-85	Roof	White	50	50	50	50	75	Pt. 5	0	59	0.006
HL 66	4-5-85	Roof	White	50	75	75	75	50	Pt. 3	0	59	0.006
HL 67	4-5-85	Roof	White	50	50	50	50	100	Pt. 5	0	59	0.007
HL 68	4-5-85	Roof	White	75	50	75	50	75	Pt. 1	0	59	0.008
HL 69	4-5-85	Roof	White	50	50	75	50	50	Pt. 3	0	59	0.005
HL 70	4-5-85	Roof	White	50	75	100	75	100	Pt. 5	0	59	0.012
HL 71	4-5-85	Roof	White	50	100	75	125	50	Pt. 4	0	59	0.016
HL 72	4-5-85	Roof	White	50	50	50	75	50	Pt. 4	0	59	0.013
HL 73	4-5-85	Roof	White	75	50	75	50	50	Pt. 1	0	59	0.007
HL 74	4-10-85	Roof	White	75	50	50	50	50	Pt. 1	0	59	0.002
HL 75	4-10-85	Roof	White	50	50	25	75	50	Pt. 4	0	59	0.001
HL 76	4-10-85	Roof	White	50	75	50	75	25	Pt. 4	0	59	0.001
HL 77	4-10-85	Roof	White	75	50	75	25	25	Pt. 3	0	59	0.001
HL 15	4-11-85	Ceiling	Magenta Yellow	50	50	25	0	100	Pt. 5	6	59	0.012
HL 17	4-11-85	Ceiling	Magenta Yellow	0	125	0	0	75	Pt. 2	12	59	0.017
HL 23	4-11-85	Ceiling	Magenta Yellow	75	75	100	100	75	Pt. 4	9	59	0.009
HL 27	4-11-85	Ceiling	Magenta Yellow	75	25	75	100	125	Pt. 5	0	59	0.006
HL 31	4-11-85	Ceiling	Magenta Yellow	100	150	150	150	150	Pt. 2	18	59	0.030
HL 14	02-28-85	W. Wall	White	100	50	100	50	75	Pt. 1	38	59	0.016
HL 26	3-5-85	Floor	Magenta Yellow	150	100	100	150	150	Pt. 5	29	59	0.012
HL 45	3-12-85	W. Wall U	Magenta Yellow	125	25	75	75	125	Pt. 5	6	59	0.003

PD235 Number of Records Read: 263
PD236 Number of Records Selected: 263

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14:52:51

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
HL 55	3-21-85	E. Wall L	Magenta Yellow	52982	2	34	63219	36027	1-7-85	466	12-10-84
HL 55	3-21-85	E. Wall U	Magenta Yellow	52982	1	55	63220	36027	1-7-85	466	12-10-84
HL 56	3-21-85	Floor	Magenta Yellow	52982	0	172	63220	36027	1-7-85	466	12-10-84
HL 57	3-21-85	Floor	Magenta Yellow	52982	8	18852	63221	36027	1-7-85	466	12-10-84
HL 57	3-21-85	W. Wall L	Magenta Yellow	52982	2	573	63221	36027	1-7-85	466	12-10-84
HL 58	3-21-85	Floor	Magenta Yellow	52982	1	2545	63222	36027	1-7-85	466	12-10-84
HL 58	3-21-85	W. Wall	Magenta Yellow	52982	2	237	63222	36027	1-7-85	466	12-10-84
HL 59	3-21-85	Floor	Magenta Yellow	52982	2	1596	63223	36027	1-7-85	466	12-10-84
HL 59	3-21-85	E. Wall L	Magenta Yellow	52982	0	36	63223	36027	1-7-85	466	12-10-84
HL 59	3-21-85	E. Wall U	Magenta Yellow	52983	0	6	63224	36027	1-7-85	466	12-10-84
HL 59	3-21-85	S. Wall L	Magenta Yellow	52983	0	22	63224	36027	1-7-85	466	12-10-84
HL 59	3-21-85	S. Wall U	Magenta Yellow	52983	0	40	63225	36027	1-7-85	466	12-10-84
HL 59	3-21-85	Ceiling	Magenta Yellow	52983	0	23	63225	36027	1-7-85	466	12-10-84
HL 60	3-21-85	Floor	Magenta Yellow	52983	2	346	63226	36027	1-7-85	466	12-10-84
HL 60	3-21-85	S. Wall L	Magenta Yellow	52983	0	62	63226	36027	1-7-85	466	12-10-84
HL 60	3-21-85	S. Wall U	Magenta Yellow	52983	0	9	63227	36027	1-7-85	466	12-10-84
HL 61	3-21-85	S. Wall L	Magenta Yellow	52983	0	73	63227	36027	1-7-85	466	12-10-84
HL 61	3-21-85	S. Wall U	Magenta Yellow	52983	0	101	63228	36027	1-7-85	466	12-10-84
HL 62	3-21-85	Floor	Magenta Yellow	52983	3	4992	63228	36027	1-7-85	466	12-10-84
HL 62	3-21-85	S. Wall L	Magenta Yellow	52983	0	23	63229	36027	1-7-85	466	12-10-84
HL 62	3-21-85	S. Wall U	Magenta Yellow	52983	2	435	63229	36027	1-7-85	466	12-10-84
HL 62	3-21-85	W. Wall L	Magenta Yellow	52983	0	150	63230	36027	1-7-85	466	12-10-84
HL 63	3-21-85	Floor	Magenta Yellow	52983	0	962	63230	36027	1-7-85	466	12-10-84
HL 63	3-21-85	S. Wall	Magenta Yellow	52983	0	42	63231	36027	1-7-85	466	12-10-84
HL 63	3-21-85	W. Wall	Magenta Yellow	52983	0	106	63231	36027	1-7-85	466	12-10-84
HL 64	4-5-85	Roof	White		0	0	63283	36027	1-7-85	466	12-10-84
HL 65	4-5-85	Roof	White		0	0	63283	36027	1-7-85	466	12-10-84
HL 66	4-5-85	Roof	White		0	0	63284	36027	1-7-85	466	12-10-84
HL 67	4-5-85	Roof	White		0	0	63284	36027	1-7-85	466	12-10-84
HL 68	4-5-85	Roof	White		0	0	63285	36027	1-7-85	466	12-10-84
HL 69	4-5-85	Roof	White		0	0	63285	36027	1-7-85	466	12-10-84
HL 70	4-5-85	Roof	White		0	0	63286	36027	1-7-85	466	12-10-84
HL 71	4-5-85	Roof	White		0	0	63286	36027	1-7-85	466	12-10-84
HL 72	4-5-85	Roof	White		0	0	63287	36027	1-7-85	466	12-10-84
HL 73	4-5-85	Roof	White		0	0	63287	36027	1-7-85	466	12-10-84
HL 74	4-10-85	Roof	White		0	0	63290	36027	4-9-85	466	12-10-84
HL 75	4-10-85	Roof	White		0	0	63290	36027	4-9-85	466	12-10-84
HL 76	4-10-85	Roof	White		0	0	63291	36027	4-9-85	466	12-10-84
HL 77	4-10-85	Roof	White		0	0	63291	36027	4-9-85	466	12-10-84
HL 15	4-11-85	Ceiling	Magenta Yellow	52997	0	15	63294	36027	4-9-85	466	12-10-84
HL 17	4-11-85	Ceiling	Magenta Yellow	52997	0	0	63294	36027	4-9-85	466	12-10-84
HL 23	4-11-85	Ceiling	Magenta Yellow	52997	0	270	63295	36027	4-9-85	466	12-10-84
HL 27	4-11-85	Ceiling	Magenta Yellow	52997	0	12	63295	36027	4-9-85	466	12-10-84
HL 31	4-11-85	Ceiling	Magenta Yellow	52997	0	13	63296	36027	4-9-85	466	12-10-84
HL 14	02-28-85	W. Wall	White	52950	0	0	63089	36027	01-07-85	466	12-10-84
HL 26	3-5-85	Floor	Magenta Yellow	52951	0	192	63103	36027	1-7-85	466	12-10-85
HL 45	3-12-85	W. Wall U	Magenta Yellow	52969	0	63	63148	36027	1-7-85	466	12-10-84

PD235 Number of Records Read: 263
PD236 Number of Records Selected: 263

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
15:10:17

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Cutie Pie Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff
HL 55	3-21-85	E. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 55	3-21-85	E. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 56	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 57	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 57	3-21-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 58	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 58	3-21-85	W. Wall	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 59	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 59	3-21-85	E. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 59	3-21-85	E. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 59	3-21-85	S. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 59	3-21-85	S. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 59	3-21-85	Ceiling	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 60	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 60	3-21-85	S. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 60	3-21-85	S. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 61	3-21-85	S. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 61	3-21-85	S. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 62	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 62	3-21-85	S. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 62	3-21-85	S. Wall U	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 62	3-21-85	W. Wall L	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 63	3-21-85	Floor	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 63	3-21-85	S. Wall	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 63	3-21-85	W. Wall	Magenta Yellow	423	2-14-85			6	0.34	0.42
HL 64	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 65	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 66	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 67	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 68	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 69	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 70	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 71	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 72	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 73	4-5-85	Roof	White	423	2-14-85			2	0.34	0.42
HL 74	4-10-85	Roof	White	423	4-9-85			2	0.34	0.42
HL 75	4-10-85	Roof	White	423	4-9-85			4	0.34	0.42
HL 76	4-10-85	Roof	White	423	4-9-85			4	0.34	0.42
HL 77	4-10-85	Roof	White	423	4-9-85			4	0.34	0.42
HL 15	4-11-85	Ceiling	Magenta Yellow	423	4-9-85			4	0.34	0.37
HL 17	4-11-85	Ceiling	Magenta Yellow	423	4-9-85			4	0.34	0.37
HL 23	4-11-85	Ceiling	Magenta Yellow	423	4-9-85			4	0.34	0.37
HL 27	4-11-85	Ceiling	Magenta Yellow	423	4-9-85			4	0.34	0.37
HL 31	4-11-85	Ceiling	Magenta Yellow	423	4-9-85			4	0.34	0.37
HL 14	02-28-85	W. Wall	White	423	2-14-85			7	0.34	0.42
HL 26	3-5-85	Floor	Magenta Yellow	423	2-14-85			5	0.34	0.42
HL 45	3-12-85	W. Wall U	Magenta Yellow	423	2-14-85			4	0.34	0.42

PD235 Number of Records Read: 263
PD236 Number of Records Selected: 263

RAD SURVEY HOT LAB BLDG. 1112
09-16-85
15:46:00

Grid	Date	Type	Zone	NC B Eff	REC#
HL 55	3-21-85	E. Wall L	Magenta Yellow	0.37	218
HL 55	3-21-85	E. Wall U	Magenta Yellow	0.37	219
HL 56	3-21-85	Floor	Magenta Yellow	0.37	220
~~HL 57~~	~~3-21-85~~	~~Floor~~	~~Magenta Yellow~~	~~0.37~~	~~221~~
HL 57	3-21-85	W. Wall L	Magenta Yellow	0.37	222
HL 58	3-21-85	Floor	Magenta Yellow	0.37	223
HL 58	3-21-85	W. Wall	Magenta Yellow	0.37	224
HL 59	3-21-85	Floor	Magenta Yellow	0.37	225
HL 59	3-21-85	E. Wall L	Magenta Yellow	0.37	226
~~HL 59~~	~~3-21-85~~	~~E. Wall U~~	~~Magenta Yellow~~	~~0.37~~	~~227~~
HL 59	3-21-85	S. Wall L	Magenta Yellow	0.37	228
HL 59	3-21-85	S. Wall U	Magenta Yellow	0.37	229
HL 59	3-21-85	Ceiling	Magenta Yellow	0.37	230
HL 60	3-21-85	Floor	Magenta Yellow	0.37	231
HL 60	3-21-85	S. Wall L	Magenta Yellow	0.37	232
~~HL 60~~	~~3-21-85~~	~~S. Wall U~~	~~Magenta Yellow~~	~~0.37~~	~~233~~
HL 61	3-21-85	S. Wall L	Magenta Yellow	0.37	234
HL 61	3-21-85	S. Wall U	Magenta Yellow	0.37	235
HL 62	3-21-85	Floor	Magenta Yellow	0.37	236
HL 62	3-21-85	S. Wall L	Magenta Yellow	0.37	237
HL 62	3-21-85	S. Wall U	Magenta Yellow	0.37	238
~~HL 62~~	~~3-21-85~~	~~W. Wall L~~	~~Magenta Yellow~~	~~0.37~~	~~239~~
HL 63	3-21-85	Floor	Magenta Yellow	0.37	240
HL 63	3-21-85	S. Wall	Magenta Yellow	0.37	241
HL 63	3-21-85	W. Wall	Magenta Yellow	0.37	242
HL 64	4-5-85	Roof	White	0.37	243
HL 65	4-5-85	Roof	White	0.37	244
~~HL 66~~	~~4-5-85~~	~~Roof~~	~~White~~	~~0.37~~	~~245~~
HL 67	4-5-85	Roof	White	0.37	246
HL 68	4-5-85	Roof	White	0.37	247
HL 69	4-5-85	Roof	White	0.37	248
HL 70	4-5-85	Roof	White	0.37	249
HL 71	4-5-85	Roof	White	0.37	250
~~HL 72~~	~~4-5-85~~	~~Roof~~	~~White~~	~~0.37~~	~~251~~
HL 73	4-5-85	Roof	White	0.37	252
HL 74	4-10-85	Roof	White	0.37	253
HL 75	4-10-85	Roof	White	0.37	254
HL 76	4-10-85	Roof	White	0.37	255
HL 77	4-10-85	Roof	White	0.37	256
~~HL 15~~	~~4-11-85~~	~~Ceiling~~	~~Magenta Yellow~~	~~0.38~~	~~257~~
HL 17	4-11-85	Ceiling	Magenta Yellow	0.38	258
HL 23	4-11-85	Ceiling	Magenta Yellow	0.38	259
HL 27	4-11-85	Ceiling	Magenta Yellow	0.38	260
HL 31	4-11-85	Ceiling	Magenta Yellow	0.38	262
HL 14	02-28-85	W. Wall	White	0.37	263
HL 26	3-5-85	Floor	Magenta Yellow	0.37	264
HL 45	3-12-85	W. Wall U	Magenta Yellow	0.37	265

PD235 Number of Records Read: 263
PD236 Number of Records Selected: 263

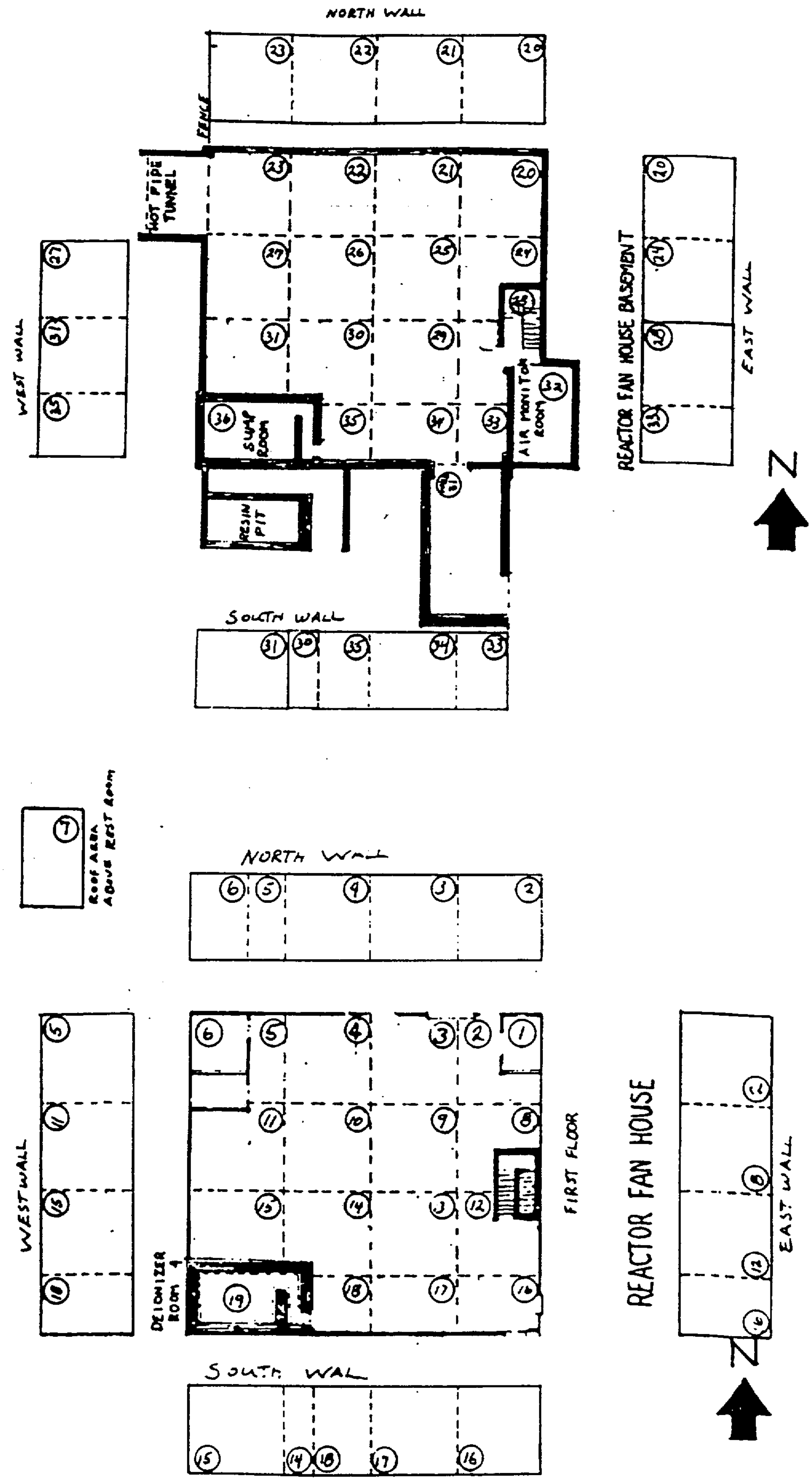
HOT PIPE TUNNEL RAD SURVEY
01-03-86
09:43:01

GRID	DATE	ZONE	TYPE	PT 1	PT 2	PT 3	PT 4	HI PT	DIST 1	MR HR	DIST 2	RSR NO	CP 740 NO	CP 740 CAL DATE	OS3W NO	OS3W CAL DATE	REC#
HPT 1	6-20-85	MAGENTA YELLOW	FLOOR	1500	9000	3200		3	CONT	2	1M	63638	3899	4-11-85	36027	4-9-85	1
HPT 1	6-20-85	MAGENTA YELLOW	CEILING				2500		CONT			63638			36027	4-9-85	2
HPT 2	6-20-85	MAGENTA YELLOW	FLOOR	1800	3000	3000		3	CONT	2	1M	63638	3899	4-11-85	36027	4-9-85	3
HPT 2	6-20-85	MAGENTA YELLOW	CEILING				3400		CONT			63638			36027	4-9-85	4
HPT 3	6-20-85	MAGENTA YELLOW	FLOOR	6000	5000	5500		3	CONT	5	1M	63639	3899	4-11-85	36027	4-9-85	5
HPT 3	6-20-85	MAGENTA YELLOW	CEILING				13000		CONT			63639			36027	4-9-85	6
HPT 4	6-20-85	MAGENTA YELLOW	FLOOR	6000	6000	6000		3	CONT	5	1M	63639	3899	4-11-85	36027	4-9-85	8
HPT 4	6-20-85	MAGENTA YELLOW	CEILING				10000		CONT			63639			36027	4-9-85	9
HPT 5	6-20-85	MAGENTA YELLOW	FLOOR	7500	9500	14000		3	CONT	4	1M	63640	3899	4-11-85	36027	4-9-85	10
HPT 5	6-20-85	MAGENTA YELLOW	CEILING				10000		CONT			63640			36027	4-9-85	11
HPT 6	6-20-85	MAGENTA YELLOW	FLOOR	26000	18000	40000		3	CONT	40	1M	63640	3899	4-11-85	36027	4-9-85	12
HPT 6	6-20-85	MAGENTA YELLOW	CEILING				>50000		CONT			63640			36027	4-9-85	13
HPT 7	6-20-85	MAGENTA YELLOW	FLOOR	14000	18000	17000		3	CONT	4	1M	63641	3899	4-11-85	36027	4-9-85	14
HPT 7	6-20-85	MAGENTA YELLOW	CEILING				15000		CONT			63641			36027	4-9-85	15
HPT 8	6-20-85	MAGENTA YELLOW	FLOOR	>50000	45000	>50000		3	CONT	85	1M	63641	3899	4-11-85	36027	4-9-85	16
HPT 8	6-20-85	MAGENTA YELLOW	CEILING				>50000		CONT			63641			36027	4-9-85	17
HPT 9	6-20-85	MAGENTA YELLOW	FLOOR	45000	>50000	35000		3	CONT	50	1M	63642	3899	4-11-85	36027	4-9-85	18
HPT 9	6-20-85	MAGENTA YELLOW	CEILING				>50000		CONT			63642			36027	4-9-85	19
HPT 10	6-20-85	MAGENTA YELLOW	FLOOR	18000	20000	14000		3	CONT	6	1M	63642	3899	4-11-85	36027	4-9-85	20
HPT 10	6-20-85	MAGENTA YELLOW	CEILING				16000		CONT			63642			36027	4-9-85	21
HPT 11	6-20-85	MAGENTA YELLOW	FLOOR	>50000	30000	33000		3	CONT	16	1M	63643	3899	4-11-85	36027	4-9-85	22
HPT 11	6-20-85	MAGENTA YELLOW	CEILING				28000		CONT			63643			36027	4-9-85	23
HPT 12	6-20-85	MAGENTA YELLOW	FLOOR	35000	47000	30000		3	CONT	14	1M	63643	3899	4-11-85	36027	4-9-85	24
HPT 12	6-20-85	MAGENTA YELLOW	CEILING				35000		CONT			63643			36027	4-9-85	25
HPT 13	6-20-85	MAGENTA YELLOW	FLOOR	25000	23000	40000		3	CONT	45	1M	63644	3899	4-11-85	36027	4-9-85	26
HPT 13	6-20-85	MAGENTA YELLOW	CEILING				>50000		CONT			63644			36027	4-9-85	27
HPT 14	6-20-85	MAGENTA YELLOW	FLOOR	25000	35000	25000		3	CONT	10	1M	63644	3899	4-11-85	36027	4-9-85	28
HPT 14	6-20-85	MAGENTA YELLOW	CEILING				26000		CONT			63644			36027	4-9-85	29
HPT 15	6-20-85	MAGENTA YELLOW	GENL FD							2	1M	63644	3899	4-11-85			30

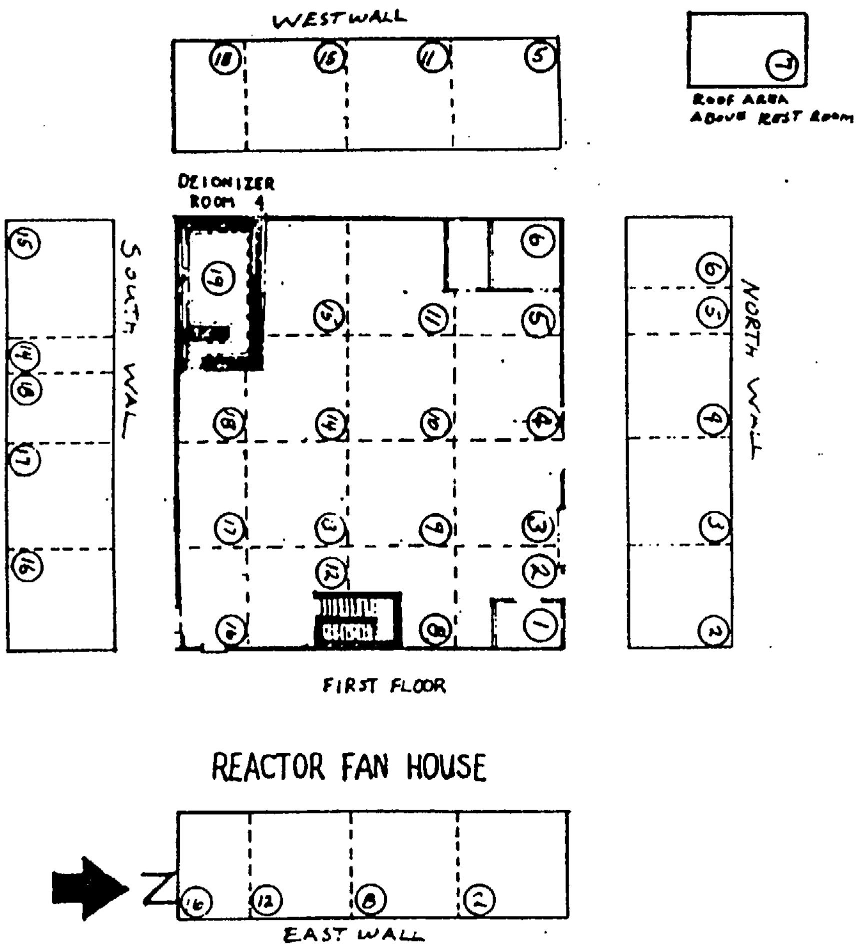
FD235 Number of Records Read: 29
FD236 Number of Records Selected: 29

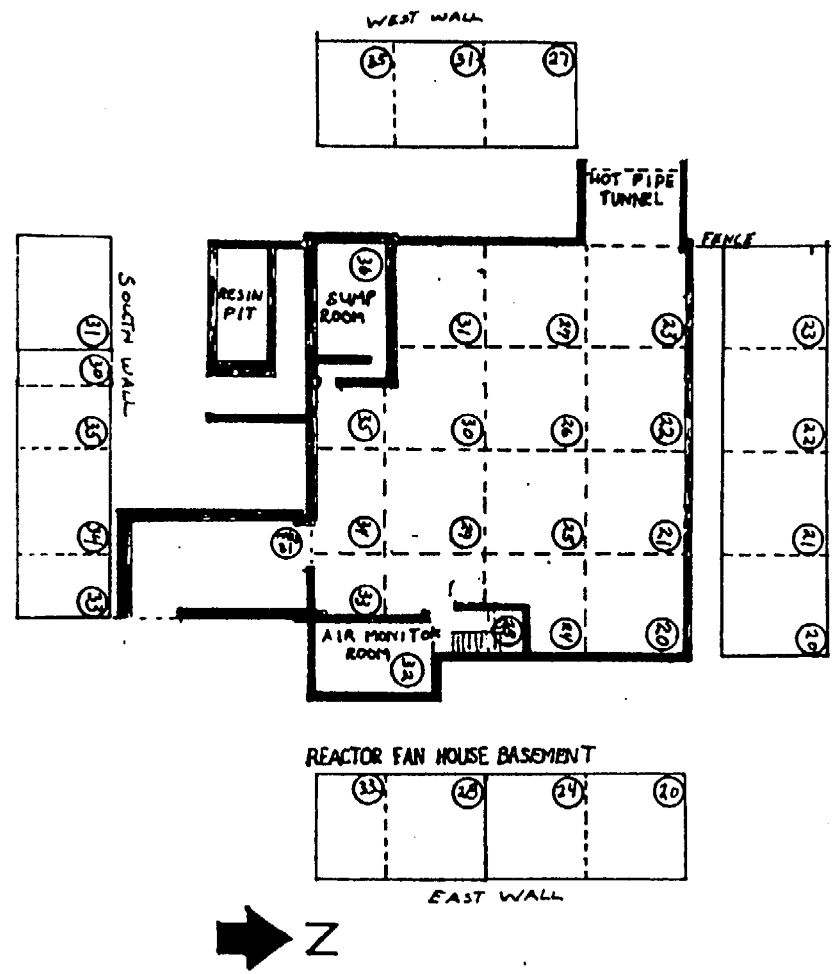
APPENDIX 3.14

Radiological Monitoring Data For The PBRF Building #1132 - Fan House



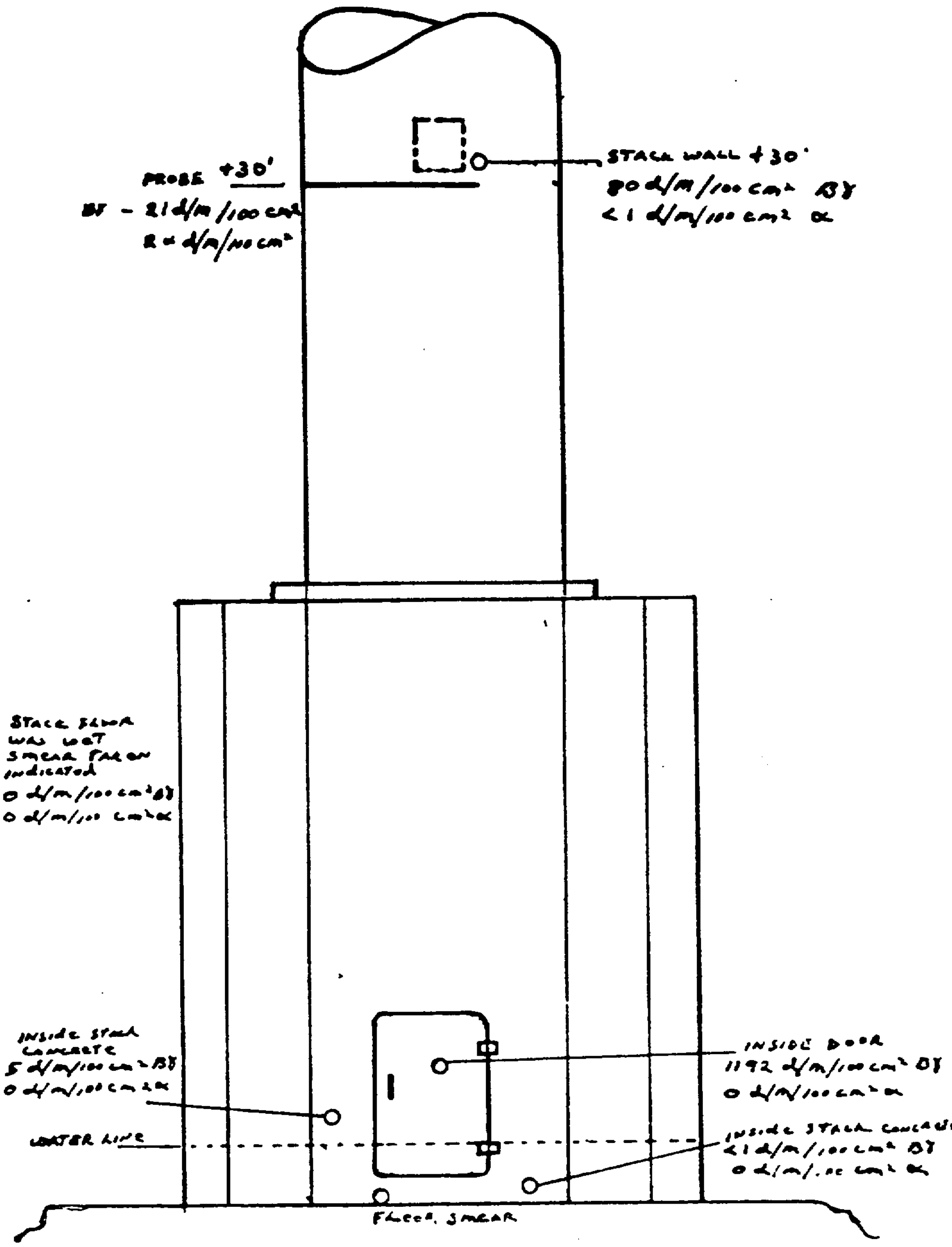
BUILDING 1132
GRID INDEX





BUILDING 1132
GRID INDEX

FAN HOUSE STACK 6-6-85



RAD SURVEY FANHOUSE BLDG. 1132
09-16-85
14:15:55

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
FH 1	2-8-85	Floor	White	50	50	50	50	50	Pt. 5	0	59	0.006
FH 1	2-8-85	N. Wall	White	50	50	50	50	50	Pt. 5	6	59	0.005
FH 1	2-15-85	E. Wall	White	50	75	50	50	50	Pt. 2	6	59	0.004
FH 1	2-15-85	S. Wall	White	50	50	50	50	100	Pt. 5	6	59	0.005
FH 1	2-15-85	W. Wall	White	50	50	100	50	50	Pt. 3	3	59	0.006
FH 1	2-15-85	Ceiling	White	75	75	50	50	75	Pt. 2	14	59	0.006
FH 2	2-8-85	Floor	White	0	50	75	50	50	Pt. 3	8	59	0.011
FH 2	2-8-85	N. Wall	White	50	25	50	25	25	Pt. 3	11	59	0.010
FH 2	2-15-85	E. Wall	White	50	100	75	75	75	Pt. 2	0	59	0.005
FH 3	2-15-85	Floor	White	75	100	75	100	200	Pt. 5	0	59	0.090
FH 3	2-15-85	N. Wall	White	75	75	100	75	50	Pt. 3	3	59	0.021
FH 4	2-15-85	Floor	White	125	125	125	200	150	Pt. 4	3	59	0.075
FH 4	2-15-85	N. Wall	White	50	125	125	100	75	Pt. 3	3	59	0.022
FH 4	2-15-85	Ceiling	White	125	75	150	50	25	Pt. 3	0	59	0.020
FH 5	2-8-85	Floor	White	200	200	200	0	200	Pt. 3	0	59	0.110
FH 5	2-8-85	N. Wall	White	75	100	0	0	0	Pt. 2	6	59	0.032
FH 5	2-8-85	W. Wall	White	0	75	0	0	50	Pt. 2	8	59	0.003
FH 6	2-8-85	Floor	White	125	150	150	100	200	Pt. 5	14	59	0.075
FH 6	2-8-85	N. Wall	White	75	100	100	75	100	Pt. 5	6	59	0.024
FH 6	2-15-85	E. Wall	White	75	75	100	75	150	Pt. 5	3	59	0.029
FH 6	2-15-85	S. Wall	White	75	125	75	125	125	Pt. 5	0	59	0.030
FH 6	2-15-85	W. Wall	White	100	100	75	75	100	Pt. 5	0	59	0.020
FH 6	2-15-85	Ceiling	White	50	100	50	100	75	Pt. 4	0	59	0.020
FH 7	2-8-85	Floor	White	50	100	75	50	50	Pt. 2	0	59	0.020
FH 7	2-8-85	N. Wall	White	50	0	0	75	0	Pt. 4	0	59	0.007
FH 7	2-8-85	W. Wall	White	50	0	0	75	0	Pt. 4	0	59	0.009
FH 8	2-8-85	Floor	White	75	0	50	50	100	Pt. 5	8	59	0.007
FH 8	2-8-85	E. Wall	White	0	50	75	50	75	Pt. 3	0	59	0.004
FH 9	2-8-85	Floor	White	75	75	125	0	125	Pt. 3	0	59	0.010
FH 10	2-8-85	Floor	White	0	75	75	100	50	Pt. 4	3	59	0.046
FH 11	2-8-85	Floor	White	150	150	200	175	200	Pt. 5	3	59	0.060
FH 11	2-8-85	N. Wall	White	0	0	150	0	100	Pt. 3	0	59	0.050
FH 11	2-15-85	W. Wall	White	75	200	100	100	75	Pt. 2	8	59	0.036
FH 12	2-15-85	Floor	White	50	50	100	100	100	Pt. 5	11	59	0.010
FH 12	2-15-85	E. Wall	White	50	75	50	50	75	Pt. 5	3	59	0.006
FH 12	2-15-85	Ceiling	White	25	50	125	100	50	Pt. 3	6	59	0.018
FH 13	2-8-85	Floor	White	100	75	300	100	125	Pt. 3	3	59	0.090
FH 14	2-8-85	Floor	White	150	1500	100	150	200	Pt. 2	3	59	0.360
FH 14	2-15-85	S. Wall	White	125	100	125	100	0	Pt. 1	0	59	0.033
FH 14	2-15-85	W. Wall	White	0	0	150	150	0	Pt. 3	8	59	0.035
FH 14	2-15-85	Ceiling	White	100	75	0	100	0	Pt. 2	8	59	0.022
FH 15	2-8-85	Floor	White	125	100	150	125	100	Pt. 3	0	59	0.030
FH 15	2-8-85	S. Wall	White	100	100	125	75	75	Pt. 3	6	59	0.027
FH 15	2-15-85	W. Wall	White	75	75	100	75	75	Pt. 3	3	59	0.020
FH 16	2-15-85	Floor	White	50	50	50	50	75	Pt. 5	0	59	0.006
FH 16	2-15-85	E. Wall	White	25	50	75	50	25	Pt. 3	3	59	0.005
FH 16	2-15-85	S. Wall	White	50	75	25	50	50	Pt. 2	11	59	0.009
FH 17	2-8-85	Floor	White	50	100	100	200	100	Pt. 4	3	59	0.050
FH 17	2-8-85	S. Wall	White	75	100	50	50	75	Pt. 2	8	59	0.017
FH 18	2-8-85	Floor	White	750	150	100	100	75	Pt. 1	8	59	0.180
FH 18	2-8-85	S. Wall	White	75	100	100	100	150	Pt. 5	6	59	0.016
FH 18	2-15-85	W. Wall	White	100	150	100	75	100	Pt. 2	3	59	0.032
FH 19	2-15-85	Floor	White	75	75	100	100	100	Pt. 5	8	59	0.018
[illegible]9	2-15-85	N. Wall	White	75	[illegible]	100	125	100	Pt. 4	17	59	[illegible]07

RAD SURVEY FANHOUSE BLDG. 1132
09-16-85
14:23:13

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
FH 1	2-8-85	Floor	White	52935	0	1	62975	36027	1-7-85	466	12-10-84
FH 1	2-8-85	N. Wall	White	52935	0	0	62975	36027	1-7-85	466	12-10-84
FH 1	2-15-85	E. Wall	White	52935	0	0	62976	36027	1-7-85	466	12-10-84
FH 1	2-15-85	S. Wall	White	52935	0	5	62976	36027	1-7-85	466	12-10-84
FH 1	2-15-85	W. Wall	White	52935	0	4	62977	36027	1-7-85	466	12-10-84
FH 1	2-15-85	Ceiling	White	52935	0	0	62977	36027	1-7-85	466	12-10-84
FH 2	2-8-85	Floor	White	52935	0	3	62978	36027	1-7-85	466	12-10-84
FH 2	2-8-85	N. Wall	White	52935	0	0	62978	36027	1-7-85	466	12-10-84
FH 2	2-15-85	E. Wall	White	52935	0	0	62979	36027	1-7-85	466	12-10-84
FH 3	2-15-85	Floor	White	52935	0	19	62979	36027	1-7-85	466	12-10-84
FH 3	2-15-85	N. Wall	White	52935	0	14	62980	36027	1-7-85	466	12-10-84
FH 4	2-15-85	Floor	White	52935	0	18	62980	36027	1-7-85	466	12-10-84
FH 4	2-15-85	N. Wall	White	52935	0	16	62981	36027	1-7-85	466	12-10-84
FH 4	2-15-85	Ceiling	White	52935	0	6	62981	36027	1-7-85	466	12-10-84
FH 5	2-8-85	Floor	White	52935	0	12	62982	36027	1-7-85	466	12-10-84
FH 5	2-8-85	N. Wall	White	52935	1	7	62982	36027	1-7-85	466	12-10-84
FH 5	2-8-85	W. Wall	White	52935	0	5	62982	36027	1-7-85	466	12-10-84
FH 6	2-8-85	Floor	White	52935	0	0	62983	36027	1-7-85	466	12-10-84
FH 6	2-8-85	N. Wall	White	52935	0	0	62983	36027	1-7-85	466	12-10-84
FH 6	2-15-85	E. Wall	White	52935	2	0	62984	36027	1-7-85	466	12-10-84
FH 6	2-15-85	S. Wall	White	52935	2	0	62984	36027	1-7-85	466	12-10-84
FH 6	2-15-85	W. Wall	White	52935	0	0	62985	36027	1-7-85	466	12-10-84
FH 6	2-15-85	Ceiling	White	52935	0	11	62985	36027	1-7-85	466	12-10-84
FH 7	2-8-85	Floor	White	52935	0	8	62986	36027	1-7-85	466	12-10-84
FH 7	2-8-85	N. Wall	White	52935	0	5	62986	36027	1-7-85	466	12-10-84
FH 7	2-8-85	W. Wall	White	52935	0	0	62986	36027	1-7-85	466	12-10-84
FH 8	2-8-85	Floor	White	52935	0	8	62987	36027	1-7-85	466	12-10-84
FH 8	2-8-85	E. Wall	White	52935	0	2	62987	36027	1-7-85	466	12-10-84
FH 9	2-8-85	Floor	White	52935	1	89	62988	36027	1-7-85	466	12-10-84
FH 10	2-8-85	Floor	White	52935	0	12	62988	36027	1-7-85	466	12-10-84
FH 11	2-8-85	Floor	White	52936	0	14	62989	36027	1-7-85	466	12-10-84
FH 11	2-8-85	N. Wall	White	52936	0	0	62989	36027	1-7-85	466	12-10-84
FH 11	2-15-85	W. Wall	White	52936	0	3	62990	36027	1-7-85	466	12-10-84
FH 12	2-15-85	Floor	White	52936	0	17	62990	36027	1-7-85	466	12-10-84
FH 12	2-15-85	E. Wall	White	52936	1	8	62991	36027	1-7-85	466	12-10-84
FH 12	2-15-85	Ceiling	White	52936	0	0	62991	36027	1-7-85	466	12-10-84
FH 13	2-8-85	Floor	White	52936	3	28	62992	36027	1-7-85	466	12-10-84
FH 14	2-8-85	Floor	White	52936	0	38	62992	36027	1-7-85	466	12-10-84
FH 14	2-15-85	S. Wall	White	52936	0	4	62993	36027	1-7-85	466	12-10-84
FH 14	2-15-85	W. Wall	White	52936	0	4	62993	36027	1-7-85	466	12-10-84
FH 14	2-15-85	Ceiling	White	52936	1	10	62993	36027	1-7-85	466	12-10-84
FH 15	2-8-85	Floor	White	52936	0	8	62994	36027	1-7-85	466	12-10-84
FH 15	2-8-85	S. Wall	White	52936	0	0	62994	36027	1-7-85	466	12-10-84
FH 15	2-15-85	W. Wall	White	52936	0	0	62995	36027	1-7-85	466	12-10-84
FH 16	2-15-85	Floor	White	52936	0	31	62995	36027	1-7-85	466	12-10-84
FH 16	2-15-85	E. Wall	White	52936	1	0	62996	36027	1-7-85	466	12-10-84
FH 16	2-15-85	S. Wall	White	52936	0	0	62996	36027	1-7-85	466	12-10-84
FH 17	2-8-85	Floor	White	52936	0	21	62997	36027	1-7-85	466	12-10-84
FH 17	2-8-85	S. Wall	White	52936	1	8	62997	36027	1-7-85	466	12-10-84
FH 18	2-8-85	Floor	White	52936	0	1	62998	36027	1-7-85	466	12-10-84
FH 18	2-8-85	S. Wall	White	52936	1	12	62998	36027	1-7-85	466	12-10-84
FH 18	2-15-85	W. Wall	White	52936	0	2	62999	36027	1-7-85	466	12-10-84
FH 19	2-15-85	Floor	White	52936	1	10	62999	36027	1-7-85	466	12-10-84
FH 19	2-15-85	N. Wall	White	52936	1	8	63000	36027	1-7-85	466	12-10-84

RAD SURVEY FANHOUSE BLDG. 1132
09-16-85
14:29:41

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
FH 1	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	1
FH 1	2-8-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	2
FH 1	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	3
FH 1	2-15-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	4
FH 1	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	5
FH 1	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	6
FH 2	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	7
FH 2	2-8-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	8
FH 2	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	9
FH 3	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	10
FH 3	2-15-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	11
FH 4	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	12
FH 4	2-15-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	13
FH 4	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	14
FH 5	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	15
FH 5	2-8-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	16
FH 5	2-8-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	17
FH 6	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	18
FH 6	2-8-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	19
FH 6	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	20
FH 6	2-15-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	21
FH 6	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	22
FH 6	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	23
FH 7	2-8-85	Floor	White	423	2-14-85	7	0.34	0.42	0.37	24
FH 7	2-8-85	N. Wall	White	423	2-14-85	7	0.34	0.42	0.37	25
FH 7	2-8-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	26
FH 8	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	27
FH 8	2-8-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	28
FH 9	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	29
FH 10	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	30
FH 11	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	31
FH 11	2-8-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	32
FH 11	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	33
FH 12	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	34
FH 12	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	35
FH 12	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	36
FH 13	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	37
FH 14	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	38
FH 14	2-15-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	39
FH 14	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	40
FH 14	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	41
FH 15	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	42
FH 15	2-8-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	43
FH 15	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	44
FH 16	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	45
FH 16	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	46
FH 16	2-15-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	47
FH 17	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	48
FH 17	2-8-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	49
FH 18	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	50
FH 18	2-8-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	51
FH 18	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	52
FH 1[illegible]	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	53
FH [illegible]	2-15-85	N. Wall	White	423	2-1[illegible]	5	0.34	0.42	0.37	5[illegible]

RAD SURVEY FANHOUSE BLDG. 1132
09-16-85
14:15:55

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
FH 19	2-15-85	E. Wall	White	25	100	75	50	50	Pt. 2	0	59	0.013
FH 19	2-15-85	S. Wall	White	50	100	25	25	50	Pt. 2	11	59	0.009
FH 19	2-15-85	W. Wall	White	75	100	75	50	75	Pt. 2	3	59	0.008
FH 19	2-15-85	Ceiling	White	50	50	25	50	25	Pt. 1	11	59	0.007
FH 20	2-11-85	E. Wall	White	50	100	75	100	75	Pt. 2	22	59	0.014
FH 20	2-11-85	Ceiling	White	50	50	150	300	100	Pt. 4	14	59	0.045
FH 20	2-11-85	Floor	White	100	125	100	75	125	Pt. 5	3	59	0.014
FH 20	2-11-85	N. Wall	White	75	75	75	100	100	Pt. 5	6	59	0.012
FH 21	2-11-85	Floor	White	150	100	200	450	200	Pt. 4	3	59	0.110
FH 21	2-11-85	N. Wall	White	150	150	400	300	200	Pt. 3	0	59	0.130
FH 22	2-11-85	Floor	White	300	350	1500	800	900	Pt. 3	6	59	0.420
FH 22	2-11-85	N. Wall	White	900	400	800	500	200	Pt. 1	8	59	0.140
FH 22	2-13-85	Ceiling	White	300	600	500	1000	1000	Pt. 5	3	59	0.250
FH 23	2-13-85	Floor	White	1000	800	10000	1500	200	Pt. 3	0	59	2.200
FH 23	2-11-85	N. Wall	White	600	500	800	500	500	Pt. 3	6	59	0.250
FH 24	2-11-85	Floor	White	100	75	100	150	100	Pt. 4	3	59	0.022
FH 24	2-11-85	E. Wall	White	75	100	50	100	100	Pt. 5	8	59	0.014
FH 26	2-11-85	Floor	White	300	200	[illegible]	1280	[illegible]	Pt. [illegible]	3	59	[illegible]
FH 27	2-11-85	Floor	White	2500	3500	9000	5000	0	Pt. 3	3	59	1.000
FH 27	2-11-85	W. Wall	White	800	1500	1500	1000	1200	Pt. 3	8	59	0.950
FH 28	2-11-85	Floor	White	100	100	150	75	100	Pt. 3	3	59	0.018
FH 28	2-11-85	E. Wall	White	100	100	125	100	100	Pt. 3	22	59	0.014
FH 28	2-11-85	Ceiling	White	50	150	125	150	100	Pt. 4	11	59	0.008
FH 29	2-11-85	Floor	White	100	75	75	175	150	Pt. 4	11	59	0.038
FH 30	2-11-85	Floor	White	150	2000	150	350	0	Pt. 2	0	59	0.090
FH 30	2-11-85	S. Wall	White	200	250	0	0	0	Pt. 2	14	59	0.100
FH 30	2-11-85	Ceiling	White	200	250	0	400	250	Pt. 4	6	59	0.250
FH 31	2-11-85	Floor	White	0	700	12000	9000	1000	Pt. 3	8	59	1.100
FH 31	2-11-85	S. Wall	White	800	1500	500	400	500	Pt. 2	8	59	0.600
FH 31	2-11-85	W. Wall	White	900	2000	1400	500	1000	Pt. 2	8	59	0.950
FH 32	2-11-85	Floor	White	75	75	50	50	100	Pt. 5	14	59	0.005
FH 32	2-11-85	N. Wall	White	50	50	0	50	50	Pt. 5	6	59	0.005
FH 32	2-11-85	E. Wall	White	50	75	50	50	100	Pt. 5	0	59	0.004
FH 32	2-11-85	S. Wall	White	50	50	50	50	75	Pt. 5	6	59	0.005
FH 32	2-11-85	W. Wall	White	50	50	50	75	75	Pt. 5	6	59	0.005
FH 33	2-11-85	Floor	White	0	0	75	100	75	Pt. 4	3	59	0.015
FH 33	2-11-85	E. Wall	White	75	100	125	50	125	Pt. 5	14	59	0.012
FH 33	2-11-85	S. Wall	White	50	75	75	75	100	Pt. 5	6	59	0.016
FH 34	2-11-85	Floor	White	100	100	150	100	150	Pt. 5	3	59	0.019
FH 34	2-11-85	S. Wall	White	125	100	125	100	125	Pt. 5	8	59	0.015
FH 35	2-11-85	Floor	White	900	175	125	75	150	Pt. 1	8	59	0.055
FH 35	2-11-85	S. Wall	White	125	125	150	100	125	Pt. 3	8	59	0.034
FH 35	2-11-85	W. Wall	White	125	150	150	125	150	Pt. 5	6	59	0.030
FH 36	2-11-85	Floor	White	350	450	2000	4500	100	Pt. 4	8	59	1.000
FH 36	2-11-85	N. Wall	White	700	500	3500	2400	600	Pt. 3	6	59	0.800
FH 36	2-11-85	E. Wall	White	600	400	250	300	350	Pt. 1	6	59	0.190
FH 36	2-11-85	S. Wall	White	1500	1000	500	900	900	Pt. 1	17	59	0.450
FH 36	2-11-85	W. Wall	White	1800	2000	1800	1800	2000	Pt. 5	11	59	0.550
FH 36	2-11-85	Ceiling	White	2000	1000	1900	1500	1200	Pt. 1	8	59	0.280

PD235 Number of Records Read: 104
PD236 Number of Records Selected: 104

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09-16-85
14:23:13

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
FH 19	2-15-85	E. Wall	White	52936	0	0	63000	36027	1-7-85	466	12-10-84
FH 19	2-15-85	S. Wall	White	52936	0	5	63001	36027	1-7-85	466	12-10-84
FH 19	2-15-85	W. Wall	White	52936	0	8	63001	36027	1-7-85	466	12-10-84
FH 19	2-15-85	Ceiling	White	52936	1	0	63002	36027	1-7-85	466	12-10-84
FH 20	2-11-85	E. Wall	White	52939	2	35	63004	36027	1-7-85	466	12-10-84
FH 20	2-11-85	Ceiling	White	52939	0	0	63004	36027	1-7-85	466	12-10-84
FH 20	2-11-85	Floor	White	52939	0	23	63003	36027	1-7-85	466	12-10-84
FH 20	2-11-85	N. Wall	White	52939	0	2	63003	36027	1-7-85	466	12-10-84
FH 21	2-11-85	Floor	White	52939	0	24	63005	36027	1-7-85	466	12-10-84
FH 21	2-11-85	N. Wall	White	52939	1	16	63005	36027	1-7-85	466	12-10-84
FH 22	2-11-85	Floor	White	52939	1	15	63006	36027	1-7-85	466	12-10-84
FH 22	2-11-85	N. Wall	White	52939	0	0	63006	36027	1-7-85	466	12-10-84
FH 22	2-13-85	Ceiling	White	52939	0	0	63007	36027	1-7-85	466	12-10-84
FH 23	2-13-85	Floor	White	52939	0	31	63007	36027	1-7-85	466	12-10-84
FH 23	2-11-85	N. Wall	White	52939	0	7	63008	36027	1-7-85	466	12-10-84
FH 24	2-11-85	Floor	White	52939	0	27	63008	36027	1-7-85	466	12-10-84
FH 24	2-11-85	E. Wall	White	52939	0	0	63009	36027	1-7-85	466	12-10-84
FH 25	2-11-85	Floor	White	52939	0	50	63009	36027	1-7-85	466	12-10-84
FH 26	2-11-85	Floor	White	52939	0	0	63010	36027	1-7-85	466	12-10-84
FH 27	2-11-85	Floor	White	52939	1	33	63010	36027	1-7-85	466	12-10-84
FH 27	2-11-85	W. Wall	White	52939	0	0	63011	36027	1-7-85	466	12-10-84
FH 28	2-11-85	Floor	White	52939	0	34	63011	36027	1-7-85	466	12-10-84
FH 28	2-11-85	E. Wall	White	52939	0	23	63012	36027	1-7-85	466	12-10-84
FH 28	2-11-85	Ceiling	White	52939	0	1	63012	36027	1-7-85	466	12-10-84
FH 29	2-11-85	Floor	White	52939	0	88	63013	36027	1-7-85	466	12-10-84
FH 30	2-11-85	Floor	White	52939	0	40	63013	36027	1-7-85	466	12-10-84
FH 30	2-11-85	S. Wall	White	52939	0	19	63014	36027	1-7-85	466	12-10-84
FH 30	2-11-85	Ceiling	White	52939	0	0	63014	36027	1-7-85	466	12-10-84
FH 31	2-11-85	Floor	White	52939	0	20	63015	36027	1-7-85	466	12-10-84
FH 31	2-11-85	S. Wall	White	52939	0	17	63015	36027	1-7-85	466	12-10-84
FH 31	2-11-85	W. Wall	White	52939	0	0	63016	36027	1-7-85	466	12-10-84
FH 32	2-11-85	Floor	White	52939	0	6	63016	36027	1-7-85	466	12-10-84
FH 32	2-11-85	N. Wall	White	52939	0	0	63017	36027	1-7-85	466	12-10-84
FH 32	2-11-85	E. Wall	White	52939	0	8	63017	36027	1-7-85	466	12-10-84
FH 32	2-11-85	S. Wall	White	52940	0	6	63018	36027	1-7-85	466	12-10-84
FH 32	2-11-85	W. Wall	White	52940	0	23	63018	36027	1-7-85	466	12-10-84
FH 33	2-11-85	Floor	White	52940	0	30	63019	36027	1-7-85	466	12-10-84
FH 33	2-11-85	E. Wall	White	52940	0	0	63019	36027	1-7-85	466	12-10-84
FH 33	2-11-85	S. Wall	White	52940	0	0	63020	36027	1-7-85	466	12-10-84
FH 34	2-11-85	Floor	White	52940	0	77	63020	36027	1-7-85	466	12-10-84
FH 34	2-11-85	S. Wall	White	52940	1	3	63021	36027	1-7-85	466	12-10-84
FH 35	2-11-85	Floor	White	52940	1	75	63021	36027	1-7-85	466	12-10-84
FH 35	2-11-85	S. Wall	White	52940	1	0	63022	36027	1-7-85	466	12-10-84
FH 35	2-11-85	W. Wall	White	52940	1	13	63022	36027	1-7-85	466	12-10-84
FH 36	2-11-85	Floor	White	52940	0	51	63023	36027	1-7-85	466	12-10-84
FH 36	2-11-85	N. Wall	White	52940	0	31	63023	36027	1-7-85	466	12-10-84
FH 36	2-11-85	E. Wall	White	52940	0	14	63024	36027	1-7-85	466	12-10-84
FH 36	2-11-85	S. Wall	White	52940	0	102	63024	36027	1-7-85	466	12-10-84
FH 36	2-11-85	W. Wall	White	52940	0	2	63025	36027	1-7-85	466	12-10-84
FH 36	2-11-85	Ceiling	White	52940	0	51	63025	36027	1-7-85	466	12-10-84

PD235 Number of Records Read: 104
PD236 Number of Records Selected: 104

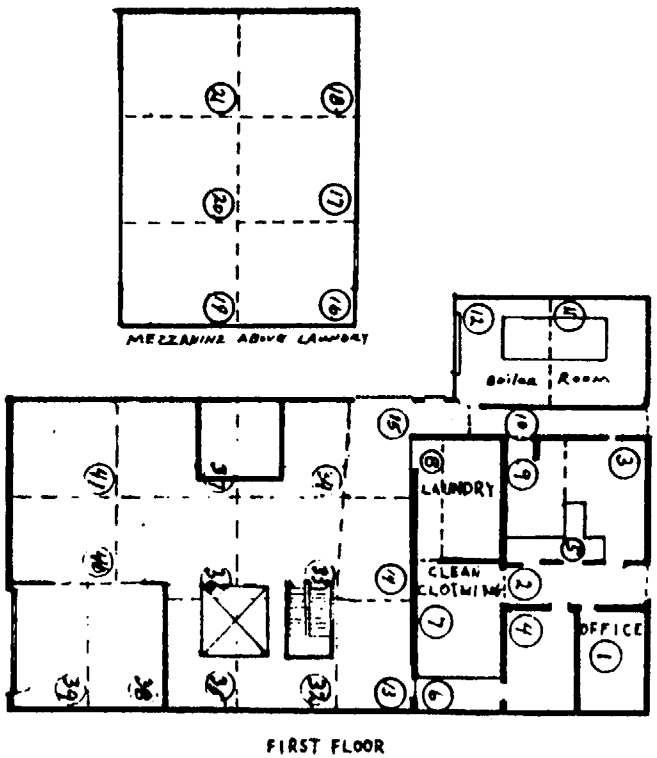
RAD SURVEY FANHOUSE BLDG. 1132
09-16-85
14:29:41

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
FH 19	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	55
FH 19	2-15-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	56
FH 19	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	57
FH 19	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	58
FH 20	2-11-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	59
FH 20	2-11-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	60
FH 20	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	61
FH 20	2-11-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	62
FH 21	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	63
FH 21	2-11-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	64
FH 22	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	65
FH 22	2-11-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	66
FH 22	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	67
FH 23	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	68
FH 23	2-11-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	69
FH 24	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	70
FH 24	2-11-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	71
FH 25	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	72
FH 26	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	73
FH 27	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	74
FH 27	2-11-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	75
FH 28	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	76
FH 28	2-11-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	77
FH 28	2-11-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	78
FH 29	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	79
FH 30	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	80
FH 30	2-11-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	81
FH 30	2-11-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	82
FH 31	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	83
FH 31	2-11-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	84
FH 31	2-11-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	85
FH 32	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	86
FH 32	2-11-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	87
FH 32	2-11-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	88
FH 32	2-11-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	89
FH 32	2-11-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	90
FH 33	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	91
FH 33	2-11-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	92
FH 33	2-11-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	93
FH 34	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	94
FH 34	2-11-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	95
FH 35	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	96
FH 35	2-11-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	97
FH 35	2-11-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	98
FH 36	2-11-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	99
FH 36	2-11-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	100
FH 36	2-11-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	101
FH 36	2-11-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	102
FH 36	2-11-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	103
FH 36	2-11-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	104

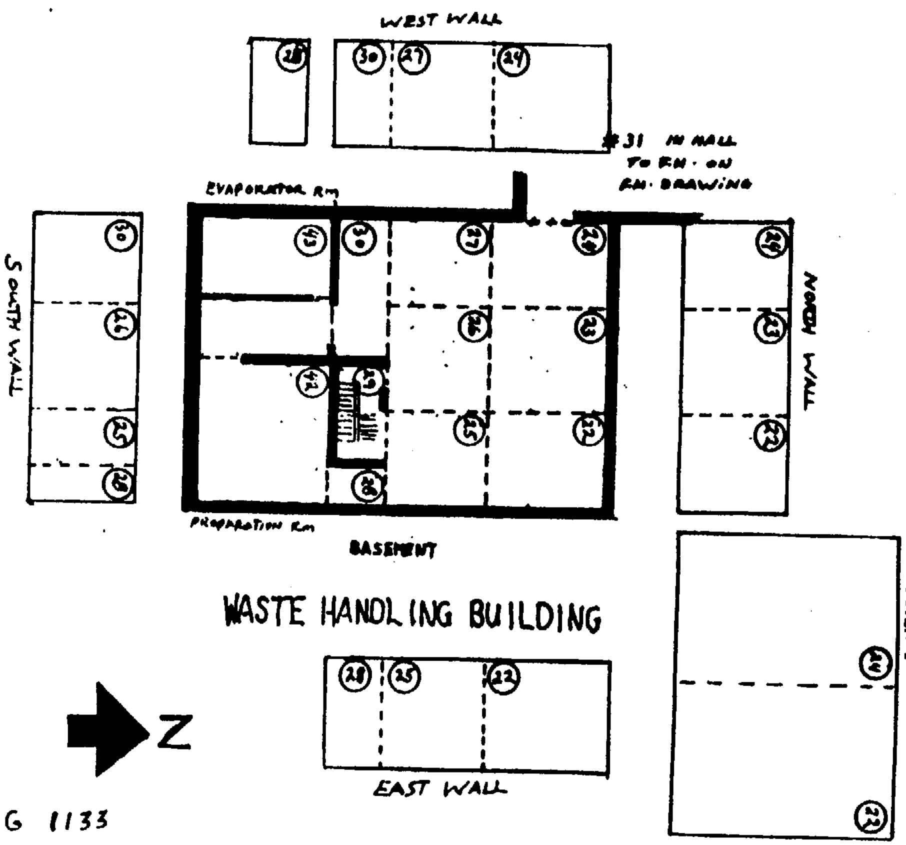
PD235 Number of Records Read: 104
PD236 Number of Records Selected: 104

APPENDIX 3.15

Radiological Monitoring Data For The PBRF
Building #1133 - Waste Handling Building

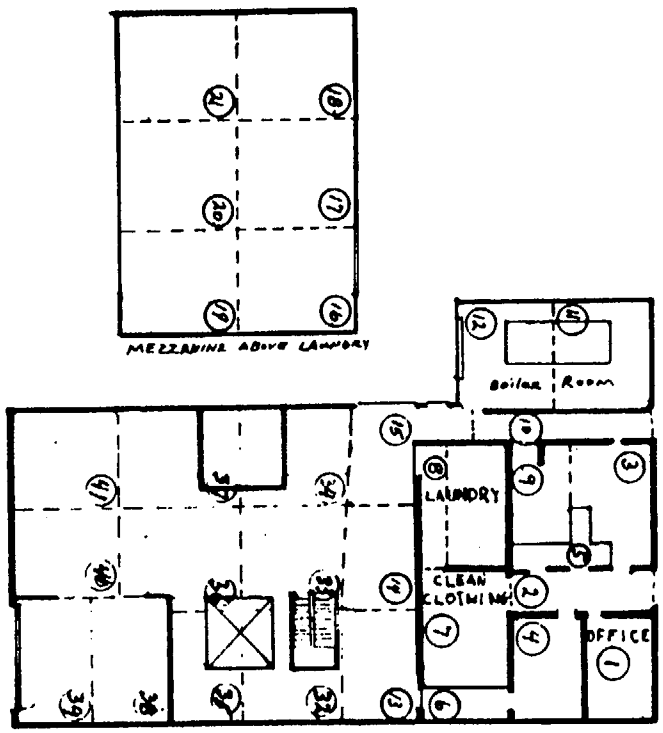


WASTE HANDLING BUILDING



WASTE HANDLING BUILDING

BUILDING 1133
GRID INDEX



WASTE HANDLING BUILDING

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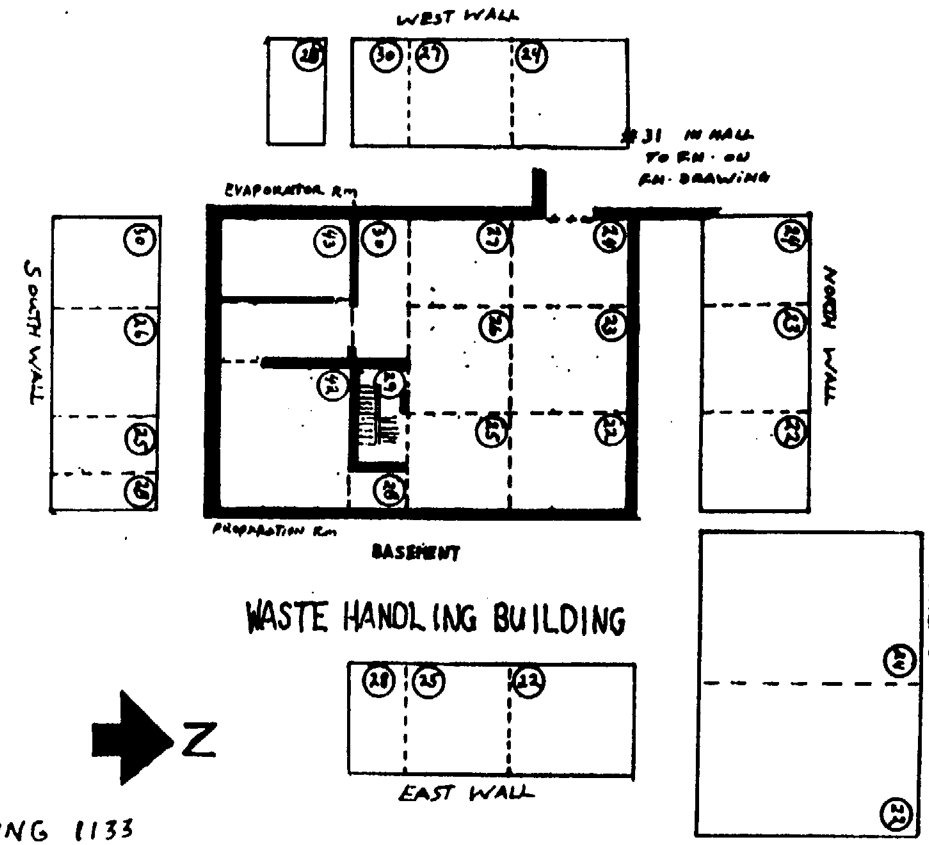

WASTE HANDLING BUILDING

Z

BUILDING 1133
GRID INDEX

RAD SURVEY WASTE HANDL BLDG 1133
10-02-85
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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
WHB 1	2-13-85	Floor	White	25	50	50	25	75	Pt. 5	8	59	0.004
WHB 1	2-13-85	N. Wall	White	25	50	50	50	50	Pt. 5	6	59	0.004
WHB 1	2-13-85	E. Wall	White	50	50	50	50	50	Pt. 5	6	59	0.005
WHB 1	2-13-85	S. Wall	White	75	50	50	50	100	Pt. 5	8	59	0.007
WHB 1	2-13-85	W. Wall	White	75	100	50	75	50	Pt. 2	0	59	0.005
WHB 1	2-13-85	Ceiling	White	50	50	75	50	25	Pt. 3	3	59	0.006
WHB 2	2-13-85	Floor	White	50	100	0	0	100	Pt. 5	27	59	0.021
WHB 2	2-13-85	N. Wall	White	50	100	50	75	75	Pt. 2	0	59	0.005
WHB 2	2-13-85	E. Wall	White	100	150	75	50	100	Pt. 2	6	59	0.018
WHB 2	2-13-85	S. Wall	White	150	150	100	125	100	Pt. 2	0	59	0.019
WHB 2	2-13-85	W. Wall	White	75	75	50	50	150	Pt. 5	11	59	0.018
WHB 2	2-13-85	Ceiling	White	50	50	25	25	75	Pt. 5	3	59	0.011
WHB 3	2-15-85	Floor	White	25	150	50	50	50	Pt. 2	0	59	0.040
WHB 3	2-15-85	N. Wall	White	50	75	50	50	50	Pt. 2	3	59	0.007
WHB 3	2-15-85	E. Wall	White	75	125	50	100	50	Pt. 2	0	59	0.017
WHB 3	2-15-85	S. Wall	White	50	50	75	50	50	Pt. 3	0	59	0.020
WHB 3	2-15-85	W. Wall	White	50	50	75	50	75	Pt. 3	0	59	0.011
WHB 3	2-15-85	Ceiling	White	25	50	50	75	50	Pt. 4	6	59	0.006
WHB 4	2-13-85	Floor	White	75	100	50	50	150	Pt. 5	0	59	0.045
WHB 4	2-13-85	N. Wall	White	75	100	75	50	75	Pt. 2	8	59	C.008
WHB 4	2-13-85	E. Wall	White	50	50	50	100	50	Pt. 4	8	59	0.006
WHB 4	2-13-85	S. Wall	White	0	0	100	100	125	Pt. 5	3	59	0.012
WHB 4	2-13-85	W. Wall	White	50	75	75	50	100	Pt. 5	8	59	0.010
WHB 4	2-13-85	Ceiling	White	25	50	25	50	25	Pt. 4	0	59	0.085
WHB 6	2-13-85	Floor	White	50	50	0	0	100	Pt. 5	8	59	0.016
WHB 6	2-13-85	N. Wall	White	0	0	100	75	0	Pt. 3	0	59	0.020
WHB 6	2-13-85	E. Wall	White	100	100	50	50	75	Pt. 2	0	59	0.007
WHB 6	2-13-85	S. Wall	White	100	100	75	75	50	Pt. 2	6	59	0.015
WHB 6	2-13-85	W. Wall	White	75	125	75	100	100	Pt. 2	3	59	0.022
WHB 6	2-13-85	Ceiling	White	75	75	50	50	50	Pt. 1	3	59	0.009
WHB 5	2-8-85	Floor	White	150	100	0	0	1500	Pt. 5	8	59	0.040
WHB 8	2-8-85	Floor	White	200	0	0	200	150	Pt. 4	6	59	0.050
WHB 7	2-13-85	Floor	White	100	100	100	125	150	Pt. 5	0	59	0.026
WHB 7	2-13-85	N. Wall	White	75	50	75	100	150	Pt. 5	0	59	0.020
WHB 7	2-13-85	E. Wall	White	100	75	100	75	100	Pt. 5	3	59	0.016
WHB 7	2-13-85	S. Wall	White	100	150	100	75	75	Pt. 2	3	59	0.024
WHB 7	2-13-85	W. Wall	White	125	150	150	100	225	Pt. 5	3	59	0.042
WHB 7	2-13-85	Ceiling	White	75	50	75	100	50	Pt. 4	2	59	0.015
WHB 9	2-15-85	Floor	White	100	100	100	100	100	Pt. 5	3	59	0.001
WHB 9	2-15-85	N. Wall	White	100	125	150	100	150	Pt. 5	6	59	0.022
WHB 9	2-15-85	E. Wall	White	150	200	150	125	175	Pt. 2	0	59	0.050
WHB 9	2-15-85	S. Wall	White	200	100	200	175	150	Pt. 3	14	59	0.060
WHB 9	2-15-85	W. Wall	White	75	75	100	125	100	Pt. 4	6	59	0.016
WHB 9	2-15-85	Ceiling	White	75	75	100	25	75	Pt. 3	3	59	0.017
WHB 10	2-15-85	Floor	White	75	100	0	0	125	Pt. 5	6	59	0.018
WHB 10	2-15-85	E. Wall	White	125	125	50	50	75	Pt. 2	8	59	0.032
WHB 10	2-15-85	W. Wall	White	50	50	75	75	75	Pt. 5	6	59	0.013
WHB 10	2-15-85	Ceiling	White	50	75	0	0	50	Pt. 2	6	59	0.030
WHB 11	2-8-85	Floor	White	50	75	50	50	50	Pt. 2	0	59	0.006
WHB 12	2-8-85	Floor	White	50	50	75	50	50	Pt. 3	0	59	0.007
WHB 8	3-20-85	Floor	Magenta Yellow	1000	0	0	150	300	Pt. 1	0	59	0.150
WHB 8	3-20-85	Ceiling	Magenta Yellow	100	150	200	75	150	Pt. 3	0	59	0.046
WHB 8	3-20-85	N. Wall	Magenta Yellow	200	375	125	125	225	Pt. 2	0	59	0.150
WHB 8	3-20-85	E. Wall	Magenta Yellow	150	200	300	100	200	Pt. 3	0	59	0.150

RAD SURVEY WASTE HANDL BLDG 1133
10-02-85
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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
WHB 1	2-13-85	Floor	White	52943	1	5	63029	36027	1-7-85	466	12-10-84
WHB 1	2-13-85	N. Wall	White	52943	1	0	63029	36027	1-7-85	466	12-10-84
WHB 1	2-13-85	E. Wall	White	52943	0	0	63030	36027	1-7-85	466	12-10-84
WHB 1	2-13-85	S. Wall	White	52943	0	5	63030	36027	1-7-85	466	12-10-84
WHB 1	2-13-85	W. Wall	White	52943	0	0	63031	36027	1-7-85	466	12-10-84
WHB 1	2-13-85	Ceiling	White	52943	0	0	63031	36027	1-7-85	466	12-10-84
WHB 2	2-13-85	Floor	White	52943	0	15	63032	36027	1-7-85	466	12-10-84
WHB 2	2-13-85	N. Wall	White	52943	0	0	63032	36027	1-7-85	466	12-10-84
WHB 2	2-13-85	E. Wall	White	52943	0	3	63033	36027	1-7-85	466	12-10-84
WHB 2	2-13-85	S. Wall	White	52943	0	0	63033	36027	1-7-85	466	12-10-84
WHB 2	2-13-85	W. Wall	White	52943	0	2	63034	36027	1-7-85	466	12-10-84
WHB 2	2-13-85	Ceiling	White	52943	0	1	63034	36027	1-7-85	466	12-10-84
WHB 3	2-15-85	Floor	White	52943	0	29	63035	36027	1-7-85	466	12-10-84
WHB 3	2-15-85	N. Wall	White	52943	0	10	63035	36027	1-7-85	466	12-10-84
WHB 3	2-15-85	E. Wall	White	52943	0	19	63036	36027	1-7-85	466	12-10-84
WHB 3	2-15-85	S. Wall	White	52943	1	2	63036	36027	1-7-85	466	12-10-84
WHB 3	2-15-85	W. Wall	White	52943	0	5	63037	36027	1-7-85	466	12-10-84
WHB 3	2-15-85	Ceiling	White	52943	0	10	63037	36027	1-7-85	466	12-10-84
WHB 4	2-13-85	Floor	White	52943	0	10	63038	36027	1-7-85	466	12-10-84
WHB 4	2-13-85	N. Wall	White	52943	0	16	63038	36027	1-7-85	466	12-10-84
WHB 4	2-13-85	E. Wall	White	52943	0	24	63039	36027	1-7-85	466	12-10-84
WHB 4	2-13-85	S. Wall	White	52943	0	0	63039	36027	1-7-85	466	12-10-84
WHB 4	2-13-85	W. Wall	White	52943	0	2	63040	36027	1-7-85	466	12-10-84
WHB 4	2-13-85	Ceiling	White	52943	0	0	63040	36027	1-7-85	466	12-10-84
WHB 6	2-13-85	Floor	White	52943	0	28	63041	36027	1-7-85	466	12-10-84
WHB 6	2-13-85	N. Wall	White	52943	0	0	63041	36027	1-7-85	466	12-10-84
WHB 6	2-13-85	E. Wall	White	52943	0	1	63042	36027	1-7-85	466	12-10-84
WHB 6	2-13-85	S. Wall	White	52943	0	0	63042	36027	1-7-85	466	12-10-84
WHB 6	2-13-85	W. Wall	White	52943	1	0	63043	36027	1-7-85	466	12-10-84
WHB 6	2-13-85	Ceiling	White	52943	0	0	63043	36027	1-7-85	466	12-10-84
WHB 5	2-8-85	Floor	White	52943	1	45	63044	36027	1-7-85	466	12-10-84
WHB 8	2-8-85	Floor	White	52944	0	25	63044	36027	1-7-85	466	12-10-84
WHB 7	2-13-85	Floor	White	52944	0	41	63045	36027	1-7-85	466	12-10-84
WHB 7	2-13-85	N. Wall	White	52944	0	0	63045	36027	1-7-85	466	12-10-84
WHB 7	2-13-85	E. Wall	White	52944	0	0	63046	36027	1-7-85	466	12-10-84
WHB 7	2-13-85	S. Wall	White	52944	1	6	63046	36027	1-7-85	466	12-10-84
WHB 7	2-13-85	W. Wall	White	52944	0	0	63047	36027	1-7-85	466	12-10-84
WHB 7	2-13-85	Ceiling	White	52944	0	5	63047	36027	1-7-85	466	12-10-84
WHB 9	2-15-85	Floor	White	52944	0	0	63048	36027	1-7-85	466	12-10-84
WHB 9	2-15-85	N. Wall	White	52944	0	7	63048	36027	1-7-85	466	12-10-84
WHB 9	2-15-85	E. Wall	White	52944	0	4	63049	36027	1-7-85	466	12-10-84
WHB 9	2-15-85	S. Wall	White	52944	0	0	63049	36027	1-7-85	466	12-10-84
WHB 9	2-15-85	W. Wall	White	52944	0	0	63050	36027	1-7-85	466	12-10-84
WHB 9	2-15-85	Ceiling	White	52944	0	7	63050	36027	1-7-85	466	12-10-84
WHB 10	2-15-85	Floor	White	52944	0	0	63051	36027	1-7-85	466	12-10-84
WHB 10	2-15-85	E. Wall	White	52944	0	6	63051	36027	1-7-85	466	12-10-84
WHB 10	2-15-85	W. Wall	White	52944	0	6	63052	36027	1-7-85	466	12-10-84
WHB 10	2-15-85	Ceiling	White	52944	0	17	63052	36027	1-7-85	466	12-10-84
WHB 11	2-8-85	Floor	White	52944	0	0	63053	36027	1-7-85	466	12-10-84
WHB 12	2-8-85	Floor	White	52944	0	11	63053	36027	1-7-85	466	12-10-84
WHB 8	3-20-85	Floor	Magenta Yellow	52976	0	82	63163	36027	1-7-85	466	12-10-84
WHB 8	3-20-85	Ceiling	Magenta Yellow	52976	0	9	63163	36027	1-7-85	466	12-10-84
WH[illegible]	3-20-85	N. Wall	Magenta Yellow	52976	0	27	63164	36027	1-7-85	466	12-10-84
WH[illegible]	3-20-85	E. Wall	Magenta Yellow	52976		15	63164	36027	1-7-85	466	12[illegible]84

RAD SURVEY WASTE HANDL BLDG 1133
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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
WHB 1	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	1
WHB 1	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	2
WHB 1	2-13-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	3
WHB 1	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	4
WHB 1	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	5
WHB 1	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	6
WHB 2	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	7
WHB 2	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	8
WHB 2	2-13-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	9
WHB 2	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	10
WHB 2	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	11
WHB 2	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	12
WHB 3	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	13
WHB 3	2-15-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	14
WHB 3	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	15
WHB 3	2-15-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	16
WHB 3	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	17
WHB 3	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	18
WHB 4	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	19
WHB 4	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	20
WHB 4	2-13-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	21
WHB 4	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	22
WHB 4	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	23
WHB 4	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	24
WHB 6	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	25
WHB 6	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	26
WHB 6	2-13-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	27
WHB 6	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	28
WHB 6	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	29
WHB 6	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	30
WHB 5	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	31
WHB 8	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	32
WHB 7	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	33
WHB 7	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	34
WHB 7	2-13-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	35
WHB 7	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	36
WHB 7	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	37
WHB 7	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	38
WHB 9	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	39
WHB 9	2-15-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	40
WHB 9	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	41
WHB 9	2-15-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	42
WHB 9	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	43
WHB 9	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	44
WHB 10	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	45
WHB 10	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	46
WHB 10	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	47
WHB 10	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	48
WHB 11	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	49
WHB 12	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	50
WHB 8	3-20-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	51
WHB 8	3-20-85	Ceiling	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	52
WHB 8	3-20-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	53
WHB 8	3-20-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	54

RAD SURVEY WASTE HANDL BLDG 1133
10-02-85
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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
WHB 8	3-20-85	S. Wall	Magenta Yellow	100	150	200	150	150	Pt. 3	0	59	0.038
WHB 8	3-20-85	W. Wall	Magenta Yellow	100	100	200	200	150	Pt. 3	0	59	0.050
WHB 11	3-20-85	Ceiling	White	125	75	100	75	75	Pt. 1	0	59	0.004
WHB 11	3-20-85	N. Wall	White	100	50	50	75	150	Pt. 5	0	59	0.008
WHB 11	3-20-85	E. Wall	White	75	50	50	75	75	Pt. 5	0	59	0.005
WHB 11	3-20-85	W. Wall	White	100	150	100	75	75	Pt. 2	3	59	0.007
WHB 12	3-20-85	E. Wall	White	100	125	50	100	100	Pt. 2	0	59	0.011
WHB 12	3-20-85	S. Wall	White	100	75	150	75	100	Pt. 3	6	59	0.012
WHB 12	3-20-85	W. Wall	White	100	75	50	100	125	Pt. 5	3	59	0.009
WHB 13	3-15-85	N. Wall L	White	0	150	100	0	100	Pt. 2	0	59	0.021
WHB 13	3-15-85	E. Wall L	White	100	75	75	100	50	Pt. 1	0	59	0.027
WHB 13	3-15-85	E. Wall U	White	0	100	25	0	100	Pt. 2	3	59	0.026
WHB 13	3-15-85	Ceiling	White	150	100	200	150	200	Pt. 3	9	59	0.065
WHB 14	3-15-85	N. Wall L	White	0	125	125	0	125	Pt. 5	0	59	0.036
WHB 15	3-15-85	N. Wall L	White	0	125	0	0	100	Pt. 2	0	59	0.046
WHB 15	3-15-85	W. Wall L	White	100	100	250	170	125	Pt. 3	6	59	0.080
WHB 15	3-15-85	W. Wall U	White	0	75	225	0	175	Pt. 3	3	59	0.070
WHB 15	3-15-85	Ceiling	White	175	250	300	100	250	Pt. 3	3	59	0.080
WHB 16	2-8-85	Floor	White	75	50	75	100	75	Pt. 4	0	59	0.006
WHB 16	2-8-85	N. Wall	White	75	0	0	75	50	Pt. 4	6	59	0.004
WHB 16	2-15-85	E. Wall	White	50	0	0	50	50	Pt. 5	6	59	0.004
WHB 16	2-15-85	Ceiling	White	50	50	200	75	125	Pt. 3	6	59	0.034
WHB 17	2-8-85	Floor	White	50	75	100	75	75	Pt. 3	0	59	0.013
WHB 17	2-8-85	N. Wall	White	75	0	0	50	75	Pt. 5	6	59	0.005
WHB 18	2-8-85	Floor	White	50	100	50	50	50	Pt. 2	0	59	0.010
WHB 18	2-8-85	N. Wall	White	50	0	0	50	50	Pt. 5	3	59	0.005
WHB 18	2-15-85	W. Wall	White	75	0	0	50	100	Pt. 5	6	59	0.006
WHB 18	2-15-85	Ceiling	White	100	200	0	0	75	Pt. 2	8	59	0.030
WHB 19	2-8-85	Floor	White	75	50	50	75	100	Pt. 5	3	59	0.010
WHB 19	2-8-85	E. Wall	White	50	0	0	75	50	Pt. 4	11	59	0.010
WHB 20	2-8-85	Floor	White	50	75	100	125	100	Pt. 4	11	59	0.028
WHB 21	2-8-85	Floor	White	125	100	100	75	100	Pt. 1	3	59	0.020
WHB 21	2-15-85	W. Wall	White	75	0	0	150	75	Pt. 4	3	59	0.020
WHB 22	2-15-85	Floor	White	150	150	200	150	225	Pt. 5	14	59	0.090
WHB 22	2-13-85	N. Wall	White	250	150	150	300	350	Pt. 5	11	59	0.090
WHB 22	2-13-85	E. Wall	White	175	200	100	150	200	Pt. 5	19	59	0.060
WHB 22	2-13-85	Ceiling	White	300	75	250	1200	200	Pt. 4	6	59	0.800
WHB 23	2-13-85	Floor	White	150	200	250	200	200	Pt. 3	14	59	0.105
WHB 23	2-13-85	N. Wall	White	175	100	200	200	200	Pt. 5	11	59	0.120
WHB 24	2-13-85	Floor	White	200	200	300	200	300	Pt. 5	11	59	0.100
WHB 24	2-13-85	N. Wall	White	150	300	200	75	200	Pt. 2	14	59	0.090
WHB 24	2-13-85	Ceiling	White	1500	600	0	0	800	Pt. 1	11	59	0.600
WHB 25	2-8-85	Floor	White	150	100	150	150	250	Pt. 5	25	59	0.050
WHB 25	2-8-85	E. Wall	White	150	175	150	100	125	Pt. 2	11	59	0.035
WHB 25	2-13-85	S. Wall	White	175	175	200	150	150	Pt. 3	8	59	0.038
WHB 26	2-13-85	Floor	White	200	200	400	250	300	Pt. 3	8	59	0.160
WHB 26	2-13-85	S. Wall	White	0	0	150	150	0	Pt. 3	8	59	0.100
WHB 27	2-13-85	Floor	White	200	400	200	350	300	Pt. 2	8	59	0.180
WHB 27	2-13-85	W. Wall	White	600	700	600	600	1000	Pt. 5	14	59	0.250
WHB 28	2-13-85	Floor	White	150	200	200	150	150	Pt. 3	14	59	0.060
WHB 28	2-13-85	E. Wall	White	175	150	150	125	200	Pt. 5	17	59	0.045
WHB 28	2-13-85	S. Wall	White	150	200	250	150	200	Pt. 3	6	59	0.060
WHB 28	2-13-85	W. Wall	White	150	150	200	175	150	Pt. 3	11	59	0.050
[illegible]29	2-13-85	Floor	White	100	[illegible]	150	200	100	Pt. 4	8	59	[illegible].075

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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
WHB 8	3-20-85	S. Wall	Magenta Yellow	52976	0	2	63165	36027	1-7-85	466	12-10-84
WHB 8	3-20-85	W. Wall	Magenta Yellow	52976	0	8	63165	36027	1-7-85	466	12-10-84
WHB 11	3-20-85	Ceiling	White	52976	1	0	63166	36027	1-7-85	466	12-10-84
WHB 11	3-20-85	N. Wall	White	52976	0	0	63166	36027	1-7-85	466	12-10-84
WHB 11	3-20-85	E. Wall	White	52976	0	16	63167	36027	1-7-85	466	12-10-84
WHB 11	3-20-85	W. Wall	White	52976	1	3	63167	36027	1-7-85	466	12-10-84
WHB 12	3-20-85	E. Wall	White	52976	0	15	63168	36027	1-7-85	466	12-10-84
WHB 12	3-20-85	S. Wall	White	52976	0	10	63168	36027	1-7-85	466	12-10-84
WHB 12	3-20-85	W. Wall	White	52976	0	9	63170	36027	1-7-85	466	12-10-84
WHB 13	3-15-85	N. Wall L	White	52976	0	2	63171	36027	1-7-85	466	12-10-84
WHB 13	3-15-85	E. Wall L	White	52976	0	0	63171	36027	1-7-85	466	12-10-84
WHB 13	3-15-85	E. Wall U	White	52976	0	30	63174	36027	1-7-85	466	12-10-84
WHB 13	3-15-85	Ceiling	White	52976	0	0	63174	36027	1-7-85	466	12-10-84
WHB 14	3-15-85	N. Wall L	White	52976	1	19	63175	36027	1-7-85	466	12-10-84
WHB 15	3-15-85	N. Wall L	White	52976	0	0	63175	36027	1-7-85	466	12-10-84
WHB 15	3-15-85	W. Wall L	White	52976	0	10	63176	36027	1-7-85	466	12-10-84
WHB 15	3-15-85	W. Wall U	White	52976	0	18	63176	36027	1-7-85	466	12-10-84
WHB 15	3-15-85	Ceiling	White	52976	0	24	63177	36027	1-7-85	466	12-10-84
WHB 16	2-8-85	Floor	White	52944	0	17	63054	36027	1-7-85	466	12-10-84
WHB 16	2-8-85	N. Wall	White	52944	0	9	63054	36027	1-7-85	466	12-10-84
WHB 16	2-15-85	E. Wall	White	52944	0	3	63055	36027	1-7-85	466	12-10-84
WHB 16	2-15-85	Ceiling	White	52944	0	6	63055	36027	1-7-85	466	12-10-84
WHB 17	2-8-85	Floor	White	52944	0	34	63056	36027	1-7-85	466	12-10-84
WHB 17	2-8-85	N. Wall	White	52944	0	6	63056	36027	1-7-85	466	12-10-84
WHB 18	2-8-85	Floor	White	52944	0	50	63057	36027	1-7-85	466	12-10-84
WHB 18	2-8-85	N. Wall	White	52945	0	9	63057	36027	1-7-85	466	12-10-84
WHB 18	2-15-85	W. Wall	White	52945	0	6	63058	36027	1-7-85	466	12-10-84
WHB 18	2-15-85	Ceiling	White	52945	0	3	63058	36027	1-7-85	466	13-10-84
WHB 19	2-8-85	Floor	White	52945	1	24	63059	36027	1-7-85	466	12-10-84
WHB 19	2-8-85	E. Wall	White	52945	0	19	63059	36027	1-7-85	466	12-10-84
WHB 20	2-8-85	Floor	White	52945	1	47	63060	36027	1-7-85	466	12-10-84
WHB 21	2-8-85	Floor	White	52945	0	23	63060	36027	1-7-85	466	12-10-84
WHB 21	2-15-85	W. Wall	White	52945	0	0	63061	36027	1-7-85	466	12-10-84
WHB 22	2-15-85	Floor	White	52945	0	39	63061	36027	1-7-85	466	12-10-84
WHB 22	2-13-85	N. Wall	White	52945	5	5	63062	36027	1-7-85	466	12-10-84
WHB 22	2-13-85	E. Wall	White	52945	0	1	63062	36027	1-7-85	466	12-10-84
WHB 22	2-13-85	Ceiling	White	52945	0	0	63063	36027	1-7-85	466	12-10-84
WHB 23	2-13-85	Floor	White	52945	0	136	63063	36027	1-7-85	466	12-10-84
WHB 23	2-13-85	N. Wall	White	52945	0	1	63064	36027	1-7-85	466	12-10-84
WHB 24	2-13-85	Floor	White	52945	0	60	63064	36027	1-7-85	466	12-10-84
WHB 24	2-13-85	N. Wall	White	52945	0	4	63065	36027	1-7-85	466	12-10-84
WHB 24	2-13-85	Ceiling	White	52945	1	0	63065	36027	1-7-85	466	12-10-84
WHB 25	2-8-85	Floor	White	52945	1	38	63066	36027	1-7-85	466	12-10-84
WHB 25	2-8-85	E. Wall	White	52945	0	4	63066	36027	1-7-85	466	12-10-84
WHB 25	2-13-85	S. Wall	White	52945	0	9	63067	36027	1-7-85	466	12-10-84
WHB 26	2-13-85	Floor	White	52945	0	108	63067	36027	1-7-85	466	12-10-84
WHB 26	2-13-85	S. Wall	White	52945	0	0	63068	36027	1-7-85	466	12-10-84
WHB 27	2-13-85	Floor	White	52945	0	141	63068	36027	1-7-85	466	12-10-84
WHB 27	2-13-85	W. Wall	White	52945	1	31	63069	36027	1-7-85	466	12-10-84
WHB 28	2-13-85	Floor	White	52945	0	267	63069	36027	1-7-85	466	12-10-84
WHB 28	2-13-85	E. Wall	White	52945	0	11	63070	36027	1-7-85	466	12-10-84
WHB 28	2-13-85	S. Wall	White	52945	0	1	63070	36027	1-7-85	466	12-10-84
WHB 28	2-13-85	W. Wall	White	52945	0	100	63071	36027	1-7-85	466	12-10-84
WHB 29	2-13-85	Floor	White	52945	0	19	63071	36027	1-7-85	466	12-10-84

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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
WHB 8	3-20-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	55
WHB 8	3-20-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	56
WHB 11	3-20-85	Ceiling	White	423	2-14-85	6	0.34	0.42	0.37	57
WHB 11	3-20-85	N. Wall	White	423	2-14-85	6	0.34	0.42	0.37	58
WHB 11	3-20-85	E. Wall	White	423	2-14-85	6	0.34	0.42	0.37	59
WHB 11	3-20-85	W. Wall	White	423	2-14-85	6	0.34	0.42	0.37	60
WHB 12	3-20-85	E. Wall	White	423	2-14-85	6	0.34	0.42	0.37	61
WHB 12	3-20-85	S. Wall	White	423	2-14-85	6	0.34	0.42	0.37	62
WHB 12	3-20-85	W. Wall	White	423	2-14-85	6	0.34	0.42	0.37	63
WHB 13	3-15-85	N. Wall L	White	423	2-14-85	6	0.34	0.42	0.37	64
WHB 13	3-15-85	E. Wall L	White	423	2-14-85	6	0.34	0.42	0.37	65
WHB 13	3-15-85	E. Wall U	White	423	2-14-85	6	0.34	0.42	0.37	66
WHB 13	3-15-85	Ceiling	White	423	2-14-85	6	0.34	0.42	0.37	67
WHB 14	3-15-85	N. Wall L	White	423	2-14-85	6	0.34	0.42	0.37	68
WHB 15	3-15-85	N. Wall L	White	423	2-14-85	6	0.34	0.42	0.37	69
WHB 15	3-15-85	W. Wall L	White	423	2-14-85	6	0.34	0.42	0.37	70
WHB 15	3-15-85	W. Wall U	White	423	2-14-85	6	0.34	0.42	0.37	71
WHB 15	3-15-85	Ceiling	White	423	2-14-85	6	0.34	0.42	0.37	72
WHB 16	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	73
WHB 16	2-8-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	74
WHB 16	2-15-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	75
WHB 16	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	76
WHB 17	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	77
WHB 17	2-8-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	78
WHB 18	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	79
WHB 18	2-8-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	80
WHB 18	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	81
WHB 18	2-15-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	82
WHB 19	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	83
WHB 19	2-8-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	84
WHB 20	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	85
WHB 21	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	86
WHB 21	2-15-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	87
WHB 22	2-15-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	88
WHB 22	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	89
WHB 22	2-13-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	90
WHB 22	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	91
WHB 23	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	92
WHB 23	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	93
WHB 24	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	94
WHB 24	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	95
WHB 24	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	96
WHB 25	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	97
WHB 25	2-8-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	98
WHB 25	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	99
WHB 26	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	100
WHB 26	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	101
WHB 27	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	102
WHB 27	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	103
WHB 28	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	104
WHB 28	2-13-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	105
WHB 28	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	106
W[illegible] [illegible]8	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	10[illegible]
[illegible]	2-13-85	Floor	White	423	2-[illegible]5	5	0.34	0.42	0.37	[illegible]

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
WHB 30	2-8-85	Floor	White	600	600	1100	1800	500	Pt. 4	6	59	0.700
WHB 30	2-8-85	E. Wall	White	600	500	700	250	700	Pt. 5	11	59	0.280
WHB 30	2-13-85	S. Wall	White	500	1200	1100	1100	1100	Pt. 2	8	59	0.460
WHB 30	2-13-85	W. Wall	White	450	500	800	500	500	Pt. 3	8	59	0.380
WHB 31	2-13-85	Floor	White	100	150	150	75	100	Pt. 3	6	59	0.075
WHB 31	2-13-85	N. Wall	White	75	100	100	75	100	Pt. 3	3	59	0.012
WHB 31	2-13-85	E. Wall	White	50	100	75	50	50	Pt. 2	8	59	0.045
WHB 31	2-13-85	S. Wall	White	100	100	150	125	125	Pt. 3	0	59	0.045
WHB 31	2-13-85	W. Wall	White	75	125	75	75	100	Pt. 2	11	59	0.007
WHB 31	2-13-85	Ceiling	White	50	100	75	50	75	Pt. 2	14	59	0.012
WHB 32	3-15-85	Floor	Magenta Yellow	100	100	225	0	150	Pt. 3	3	59	0.065
WHB 32	3-15-85	E. Wall L	Magenta Yellow	75	125	125	125	100	Pt. 3	3	59	0.012
WHB 32	3-15-85	E. Wall U	Magenta Yellow	0	100	125	0	75	Pt. 3	3	59	0.028
WHB 32	3-15-85	Ceiling	Magenta Yellow	125	100	250	250	100	Pt. 4	3	59	0.030
WHB 33	3-15-85	Floor	Magenta Yellow	0	1500	1800	450	300	Pt. 3	0	59	0.700
WHB 33	3-15-85	Ceiling	Magenta Yellow	100	100	150	150	200	Pt. 5	0	59	0.040
WHB 34	3-15-85	Floor	Magenta Yellow	1000	3500	0	250	0	Pt. 2	0	59	2.000
WHB 34	3-15-85	W. Wall L	Magenta Yellow	100	400	0	350	750	Pt. 5	0	59	0.240
WHB 34	3-15-85	W. Wall U	Magenta Yellow	0	300	250	0	300	Pt. 5	0	59	0.100
WHB 35	3-15-85	Floor	Magenta Yellow	100	0	0	150	75	Pt. 4	6	59	0.060
WHB 35	3-15-85	E. Wall L	Magenta Yellow	0	0	100	100	100	Pt. 5	0	59	0.026
WHB 35	3-15-85	E. Wall U	Magenta Yellow	0	0	150	0	125	Pt. 3	0	59	0.020
WHB 35	3-15-85	S. Wall L	Magenta Yellow	200	125	125	75	100	Pt. 1	0	59	0.080
WHB 35	3-15-85	S. Wall U	Magenta Yellow	150	0	100	0	175	Pt. 5	3	59	0.042
WHB 36	3-15-85	Floor	Magenta Yellow	250	0	350	500	250	Pt. 4	0	59	0.310
WHB 36	3-15-85	E. Wall L	Magenta Yellow	200	0	0	0	325	Pt. 5	3	59	0.070
WHB 36	3-15-85	E. Wall U	Magenta Yellow	0	150	0	0	150	Pt. 2	6	59	0.042
WHB 36	3-15-85	S. Wall L	Magenta Yellow	0	0	225	250	0	Pt. 4	9	59	0.080
WHB 36	3-15-85	S. Wall U	Magenta Yellow	0	0	0	250	0	Pt. 4	3	59	0.070
WHB 37	3-15-85	Floor	Magenta Yellow	1500	1000	200	1000	750	Pt. 1	0	59	0.700
WHB 37	3-15-85	W. Wall L	Magenta Yellow	175	1000	200	175	450	Pt. 2	0	59	0.400
WHB 37	3-15-85	W. Wall U	Magenta Yellow	0	350	200	0	300	Pt. 2	0	59	0.140
WHB 38	3-15-85	Floor	Magenta Yellow	300	125	125	125	2000	Pt. 5	6	59	0.160
WHB 38	3-15-85	N. Wall L	Magenta Yellow	100	125	175	175	125	Pt. 3	6	59	0.060
WHB 38	3-15-85	N. Wall U	Magenta Yellow	0	150	175	0	100	Pt. 3	0	59	0.045
WHB 38	3-15-85	E. Wall L	Magenta Yellow	50	100	100	50	50	Pt. 2	3	59	0.012
WHB 38	3-15-85	E. Wall U	Magenta Yellow	0	50	50	0	50	Pt. 2	0	59	0.012
WHB 38	3-15-85	W. Wall L	Magenta Yellow	150	75	0	225	75	Pt. 4	0	59	0.050
WHB 38	3-15-85	W. Wall U	Magenta Yellow	0	125	75	0	75	Pt. 2	0	59	0.044
WHB 38	3-15-85	Ceiling	Magenta Yellow	0	75	150	0	100	Pt. 3	0	59	0.023
WHB 39	3-15-85	Floor	Magenta Yellow	100	75	100	150	75	Pt. 4	3	59	0.035
WHB 39	3-15-85	E. Wall L	Magenta Yellow	75	75	75	50	50	Pt. 3	0	59	0.012
WHB 39	3-15-85	E. Wall U	Magenta Yellow	0	50	100	0	50	Pt. 3	0	59	0.014
WHB 39	3-15-85	W. Wall L	Magenta Yellow	125	175	125	50	125	Pt. 2	3	59	0.040
WHB 39	3-15-85	W. Wall U	Magenta Yellow	0	150	125	0	75	Pt. 2	3	59	0.040
WHB 39	3-15-85	S. Wall L	Magenta Yellow	50	100	100	25	75	Pt. 2	3	59	0.020
WHB 40	3-15-85	Floor	Magenta Yellow	150	50	100	125	125	Pt. 1	3	59	0.050
WHB 40	3-15-85	E. Wall L	Magenta Yellow	175	75	0	150	100	Pt. 1	3	59	0.026
WHB 40	3-15-85	E. Wall U	Magenta Yellow	0	175	100	0	175	Pt. 2	3	59	0.260
WHB 40	3-15-85	S. Wall L	Magenta Yellow	100	100	75	75	125	Pt. 5	3	59	0.019
WHB 40	3-15-85	S. Wall U	Magenta Yellow	0	200	100	0	125	Pt. 2	0	59	0.025
WHB 40	3-15-85	Ceiling	Magenta Yellow	100	250	200	250	225	Pt. 4	0	59	0.040
WHB 41	3-15-85	Floor	Magenta Yellow	225	75	75	175	200	Pt. 1	9	59	0.095
WHB 41	3-15-85	S. Wall L	Magenta Yellow	100	125	50	150	75	Pt. 4	0	59	0.020

RAD SURVEY WASTE HANDL BLDG 1133
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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
WHB 30	2-8-85	Floor	White	52946	0	148	63072	36027	1-7-85	466	12-10-84
WHB 30	2-8-85	E. Wall	White	52946	0	0	63072	36027	1-7-85	466	12-10-84
WHB 30	2-13-85	S. Wall	White	52946	0	5	63073	36027	1-7-85	466	12-10-84
WHB 30	2-13-85	W. Wall	White	52946	0	1	63073	36027	1-7-85	466	12-10-84
WHB 31	2-13-85	Floor	White	52946	0	95	63074	36027	1-7-85	466	12-10-84
WHB 31	2-13-85	N. Wall	White	52946	0	0	63074	36027	1-7-85	466	12-10-84
WHB 31	2-13-85	E. Wall	White	52946	0	19	63075	36027	1-7-85	466	12-10-84
WHB 31	2-13-85	S. Wall	White	52946	0	0	63075	36027	1-7-85	466	12-10-84
WHB 31	2-13-85	W. Wall	White	52946	0	0	63076	36027	1-7-85	466	12-10-84
WHB 31	2-13-85	Ceiling	White	52946	0	9	63076	36027	1-7-85	466	12-10-84
WHB 32	3-15-85	Floor	Magenta Yellow	52976	0	20	63179	36027	1-7-85	466	12-10-84
WHB 32	3-15-85	E. Wall L	Magenta Yellow	52976	0	8	63179	36027	1-7-85	466	12-10-84
WHB 32	3-15-85	E. Wall U	Magenta Yellow	52976	0	8	63180	36027	1-7-85	466	12-10-84
WHB 32	3-15-85	Ceiling	Magenta Yellow	52976	0	0	63180	36027	1-7-85	466	12-10-84
WHB 33	3-15-85	Floor	Magenta Yellow	52977	0	84	63181	36027	1-7-85	466	12-10-84
WHB 33	3-15-85	Ceiling	Magenta Yellow	52977	0	17	63181	36027	1-7-85	466	12-10-84
WHB 34	3-15-85	Floor	Magenta Yellow	52977	0	274	63182	36027	1-7-85	466	12-10-84
WHB 34	3-15-85	W. Wall L	Magenta Yellow	52977	0	26	63182	36027	1-7-85	466	12-10-84
WHB 34	3-15-85	W. Wall U	Magenta Yellow	52977	0	0	63183	36027	1-7-85	466	12-10-84
WHB 35	3-15-85	Floor	Magenta Yellow	52977	0	26	63183	36027	1-7-85	466	12-10-84
WHB 35	3-15-85	E. Wall L	Magenta Yellow	52977	0	8	63183	36027	1-7-85	466	12-10-84
WHB 35	3-15-85	E. Wall U	Magenta Yellow	52977	0	0	63184	36027	1-7-85	466	12-10-84
WHB 35	3-15-85	S. Wall L	Magenta Yellow	52977	0	0	63184	36027	1-7-85	466	12-10-84
WHB 35	3-15-85	S. Wall U	Magenta Yellow	52977	0	3	63184	36027	1-7-85	466	12-10-84
WHB 36	3-15-85	Floor	Magenta Yellow	52977	0	39	63185	36027	1-7-85	466	12-10-84
WHB 36	3-15-85	E. Wall L	Magenta Yellow	52977	0	11	63185	36027	1-7-85	466	12-10-84
WHB 36	3-15-85	E. Wall U	Magenta Yellow	52977	0	9	63186	36027	1-7-85	466	12-10-84
WHB 36	3-15-85	S. Wall L	Magenta Yellow	52977	0	15	63186	36027	1-7-85	466	12-10-84
WHB 36	3-15-85	S. Wall U	Magenta Yellow	52977	0	0	63186	36027	1-7-85	466	12-10-84
WHB 37	3-15-85	Floor	Magenta Yellow	52977	1	207	63186	36027	1-7-85	466	12-10-84
WHB 37	3-15-85	W. Wall L	Magenta Yellow	52977	1	41	63187	36027	1-7-85	466	12-10-84
WHB 37	3-15-85	W. Wall U	Magenta Yellow	52977	1	15	63187	36027	1-7-85	466	12-10-84
WHB 38	3-15-85	Floor	Magenta Yellow	52977	0	55	63188	36027	1-7-85	466	12-10-84
WHB 38	3-15-85	N. Wall L	Magenta Yellow	52977	0	1	63188	36027	1-7-85	466	12-10-84
WHB 38	3-15-85	N. Wall U	Magenta Yellow	52977	0	0	63189	36027	1-7-85	466	12-10-84
WHB 38	3-15-85	E. Wall L	Magenta Yellow	52977	0	6	63189	36027	1-7-85	466	12-10-84
WHB 38	3-15-85	E. Wall U	Magenta Yellow	52977	0	21	63190	36027	1-7-85	466	12-10-84
WHB 38	3-15-85	W. Wall L	Magenta Yellow	52977	0	6	63190	36027	1-7-85	466	12-10-84
WHB 38	3-15-85	W. Wall U	Magenta Yellow	52977	0	4	63192	36027	1-7-85	466	12-10-84
WHB 38	3-15-85	Ceiling	Magenta Yellow	52977	1	6	63192	36027	1-7-85	466	12-10-84
WHB 39	3-15-85	Floor	Magenta Yellow	52978	1	43	63193	36027	1-7-85	466	12-10-84
WHB 39	3-15-85	E. Wall L	Magenta Yellow	52978	0	2	63193	36027	1-7-85	466	12-10-84
WHB 39	3-15-85	E. Wall U	Magenta Yellow	52978	0	2	63195	36027	1-7-85	466	12-10-84
WHB 39	3-15-85	W. Wall L	Magenta Yellow	52978	0	6	63195	36027	1-7-85	466	12-10-84
WHB 39	3-15-85	W. Wall U	Magenta Yellow	52978	0	3	63196	36027	1-7-85	466	12-10-84
WHB 39	3-15-85	S. Wall L	Magenta Yellow	52978	0	12	63196	36027	1-7-85	466	12-10-84
WHB 40	3-15-85	Floor	Magenta Yellow	52978	0	23	63197	36027	1-7-85	466	12-10-84
WHB 40	3-15-85	E. Wall L	Magenta Yellow	52978	0	6	63197	36027	1-7-85	466	12-10-84
WHB 40	3-15-85	E. Wall U	Magenta Yellow	52978	1	15	63198	36027	1-7-85	466	12-10-84
WHB 40	3-15-85	S. Wall L	Magenta Yellow	52978	0	15	63198	36027	1-7-85	466	12-10-84
WHB 40	3-15-85	S. Wall U	Magenta Yellow	52978	0	8	63199	36027	1-7-85	466	12-10-84
WHB 40	3-15-85	Ceiling	Magenta Yellow	52978	0	29	63199	36027	1-7-85	466	12-10-84
WHB 41	3-15-85	Floor	Magenta Yellow	52978	0	15	63200	36027	1-7-85	466	12-10-84
WH[illegible]	3-15-85	S. Wall L	Magenta Yellow	52978	[illegible]	5	63200	36027	1-7-85	466	12-[illegible] 84

RAD SURVEY WASTE HANDL BLDG 1133
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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
WHB 30	2-8-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	109
WHB 30	2-8-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	110
WHB 30	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	111
WHB 30	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	112
WHB 31	2-13-85	Floor	White	423	2-14-85	5	0.34	0.42	0.37	113
WHB 31	2-13-85	N. Wall	White	423	2-14-85	5	0.34	0.42	0.37	114
WHB 31	2-13-85	E. Wall	White	423	2-14-85	5	0.34	0.42	0.37	115
WHB 31	2-13-85	S. Wall	White	423	2-14-85	5	0.34	0.42	0.37	116
WHB 31	2-13-85	W. Wall	White	423	2-14-85	5	0.34	0.42	0.37	117
WHB 31	2-13-85	Ceiling	White	423	2-14-85	5	0.34	0.42	0.37	118
WHB 32	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	119
WHB 32	3-15-85	E. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	120
WHB 32	3-15-85	E. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	121
WHB 32	3-15-85	Ceiling	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	122
WHB 33	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	123
WHB 33	3-15-85	Ceiling	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	124
WHB 34	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	125
WHB 34	3-15-85	W. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	126
WHB 34	3-15-85	W. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	127
WHB 35	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	128
WHB 35	3-15-85	E. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	129
WHB 35	3-15-85	E. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	130
WHB 35	3-15-85	S. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	131
WHB 35	3-15-85	S. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	132
WHB 36	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	133
WHB 36	3-15-85	E. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	134
WHB 36	3-15-85	E. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	135
WHB 36	3-15-85	S. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	136
WHB 36	3-15-85	S. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	137
WHB 37	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	138
WHB 37	3-15-85	W. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	139
WHB 37	3-15-85	W. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	140
WHB 38	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	141
WHB 38	3-15-85	N. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	142
WHB 38	3-15-85	N. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	143
WHB 38	3-15-85	E. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	144
WHB 38	3-15-85	E. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	145
WHB 38	3-15-85	W. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	146
WHB 38	3-15-85	W. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	147
WHB 38	3-15-85	Ceiling	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	148
WHB 39	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	149
WHB 39	3-15-85	E. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	150
WHB 39	3-15-85	E. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	151
WHB 39	3-15-85	W. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	152
WHB 39	3-15-85	W. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	153
WHB 39	3-15-85	S. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	154
WHB 40	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	155
WHB 40	3-15-85	E. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	156
WHB 40	3-15-85	E. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	157
WHB 40	3-15-85	S. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	158
WHB 40	3-15-85	S. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	159
WHB 40	3-15-85	Ceiling	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	160
WHB 41	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	161
WHB 41	3-15-85	S. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	162

RAD SURVEY WASTE HANDL BLDG 1133
10-02-85
00:01:29

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
WHB 41	3-15-85	S. Wall U	Magenta Yellow	0	175	0	175	125	Pt. 2	0	59	0.034
WHB 41	3-15-85	W. Wall L	Magenta Yellow	275	275	125	125	175	Pt. 2	0	59	0.035
WHB 41	3-15-85	W. Wall U	Magenta Yellow	0	175	125	0	200	Pt. 5	3	59	0.060
WHB 42	3-15-85	Floor	Magenta Yellow	350	400	2000	1000	1100	Pt. 3	6	59	1.000
WHB 42	3-20-85	Ceiling	Magenta Yellow	300	350	2800	1500	750	Pt. 3	3	59	1.500
WHB 42	3-20-85	N. Wall	Magenta Yellow	125	350	400	350	300	Pt. 3	9	59	0.240
WHB 42	3-20-85	E. Wall	Magenta Yellow	150	250	300	200	250	Pt. 3	14	59	0.100
WHB 42	3-20-85	S. Wall	Magenta Yellow	1200	1500	350	250	500	Pt. 2	11	59	0.600
WHB 42	3-20-85	W. Wall	Magenta Yellow	350	400	0	0	1000	Pt. 5	9	59	0.400
WHB 43	3-20-85	Floor	Magenta Yellow	1500	3500	4200	1800	1500	Pt. 3	63	59	5.000
WHB 43	3-20-85	N. Wall	Magenta Yellow	1500	1700	5000	0	3000	Pt. 3	6	59	1.000
WHB 43	3-20-85	E. Wall	Magenta Yellow	0	0	1200	1000	2000	Pt. 5	11	59	1.000
WHB 43	3-20-85	S. Wall	Magenta Yellow	2500	4000	3000	2000	4400	Pt. 5	6	59	2.000
WHB 43	3-20-85	W. Wall	Magenta Yellow	3500	4000	3500	0	3500	Pt. 2	3	59	2.500

PD235 Number of Records Read: 176
PD236 Number of Records Selected: 176

RAD SURVEY WASTE HANDL BLDG 1133
10-02-85
00:11:51

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
WHB 41	3-15-85	S. Wall U	Magenta Yellow	52978	1	10	63201	36027	1-7-85	466	12-10-84
WHB 41	3-15-85	W. Wall L	Magenta Yellow	52978	0	2	63201	36027	1-7-85	466	12-10-84
WHB 41	3-15-85	W. Wall U	Magenta Yellow	52978	2	2	63202	36027	1-7-85	466	12-10-84
WHB 42	3-15-85	Floor	Magenta Yellow	52978	0	416	63202	36027	1-7-85	466	12-10-84
WHB 42	3-20-85	Ceiling	Magenta Yellow	52978	0	75	63203	36027	1-7-85	466	12-10-84
WHB 42	3-20-85	N. Wall	Magenta Yellow	52978	1	29	63204	36027	1-7-85	466	12-10-84
WHB 42	3-20-85	E. Wall	Magenta Yellow	52978	0	32	63204	36027	1-7-85	466	12-10-84
WHB 42	3-20-85	S. Wall	Magenta Yellow	52978	1	116	63205	36027	1-7-85	466	12-10-84
WHB 42	3-20-85	W. Wall	Magenta Yellow	52978	0	108	63205	36027	1-7-85	466	12-10-84
WHB 43	3-20-85	Floor	Magenta Yellow	52978	2	11797	63206	36027	1-7-85	466	12-10-84
WHB 43	3-20-85	N. Wall	Magenta Yellow	52978	0	928	63206	36027	1-7-85	466	12-10-84
WHB 43	3-20-85	E. Wall	Magenta Yellow	52978	0	136	63207	36027	1-7-85	466	12-10-84
WHB 43	3-20-85	S. Wall	Magenta Yellow	52978	0	185	63207	36027	1-7-85	466	12-10-84
WHB 43	3-20-85	W. Wall	Magenta Yellow	52978	1	255	63208	36027	1-7-85	466	12-10-84

PD235 Number of Records Read: 176
PD236 Number of Records Selected: 176

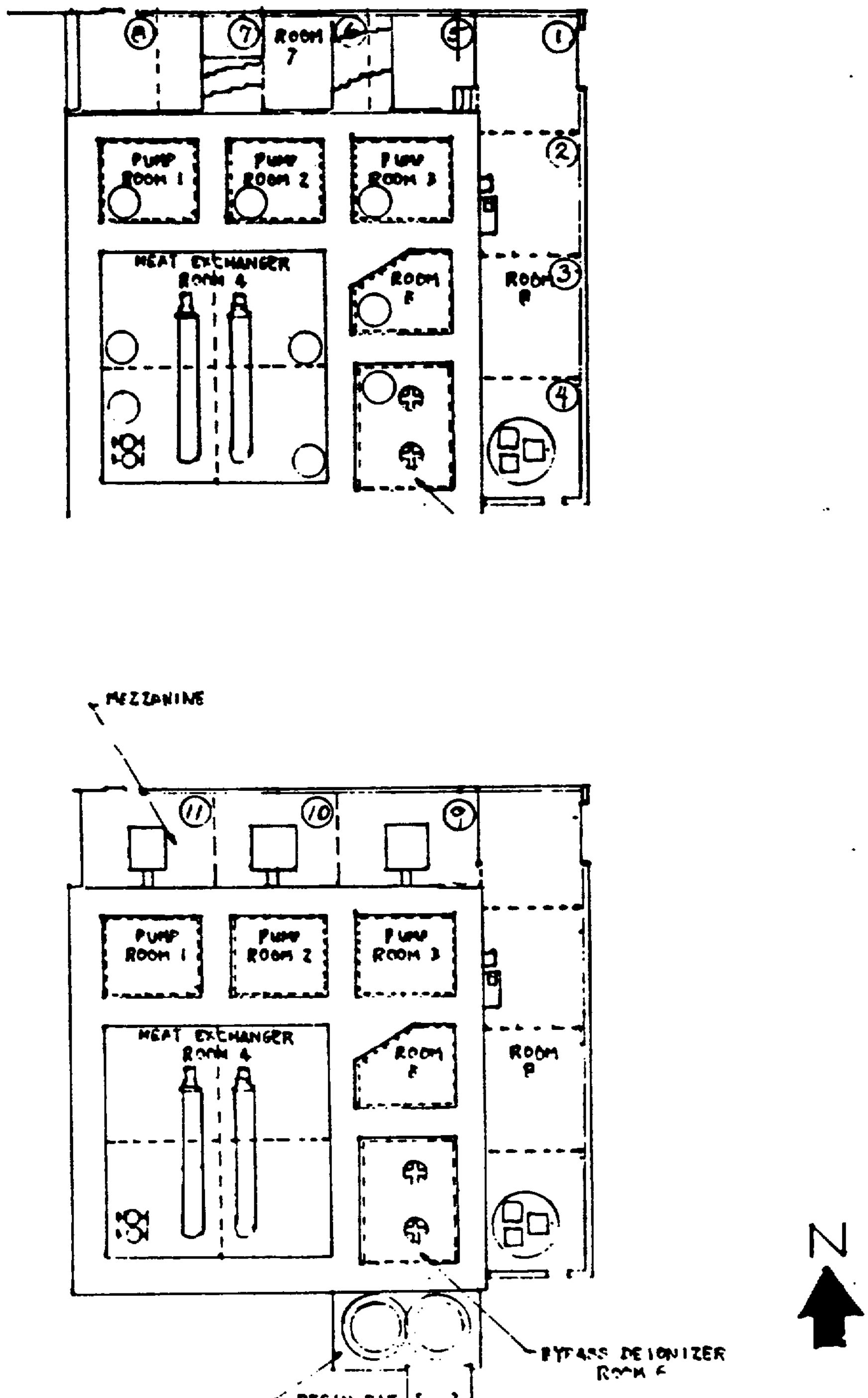
RAD SURVEY WASTE HANDL BLDG 1133
10-02-85
00:22:51

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
WHB 41	3-15-85	S. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	163
WHB 41	3-15-85	W. Wall L	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	164
WHB 41	3-15-85	W. Wall U	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	165
WHB 42	3-15-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	166
WHB 42	3-20-85	Ceiling	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	167
WHB 42	3-20-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	168
WHB 42	3-20-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	169
WHB 42	3-20-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	170
WHB 42	3-20-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	171
WHB 43	3-20-85	Floor	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	172
WHB 43	3-20-85	N. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	173
WHB 43	3-20-85	E. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	174
WHB 43	3-20-85	S. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	175
WHB 43	3-20-85	W. Wall	Magenta Yellow	423	2-14-85	6	0.34	0.42	0.37	176

PD235 Number of Records Read: 176
PD236 Number of Records Selected: 176

APPENDIX 3.16

Radiological Monitoring Data For The PBRF
Building #1134 - Primary Pump House



REACTOR PRIMARY PUMP HOUSE
BLDG. 1134 GRID INDEX

PPH RAD SURVEY GRIDS
12-19-85
12:55:39

GRID	TYPE	DATE	RSR NO	PT 1	PT 2	PT 3	PT 4	PT 5	HI PT	MR HR	DIST 2	ALPHA	AREA CM	DIST 1	SMEAR ADPM	SMEAR BDPM	SSR NO
PPH-1	FLOOR	4-1-85	63256	150	150	125	250	100	4	0.006	1M	5.9	59	CONT	2.1	15.1	52990
PPH-1	N. WALL	4-1-85	63256	125	50	100	75	100	1	0.005	1M	5.9	59	CONT	.95	14	52990
PPH-1	E. WALL	4-1-85	63257	50	150	100	100	75	2	0.005	1M	0	59	CONT	2.1	0	52990
PPH-2	FLOOR	4-1-85	63257	150	225	150	150	200	2	0.007	1M	5.9	59	CONT	0	6	52990
PPH-2	E. WALL	4-1-85	63258	75	150	125	100	100	2	0.005	1M	5.9	59	CONT	0	16.8	52990
PPH-2	W. WALL	4-1-85	63258	75	125	100	100	100	2	0.005	1M	11.8	59	CONT	.48	0	52990
PPH-3	FLOOR	4-1-85	63259	175	150	125	200	300	5	0.007	1M	8.8	59	CONT	0	11.4	52990
PPH-3	E. WALL	4-1-85	63259	75	100	100	75	75	2	0.006	1M	5.9	59	CONT	.48	4.3	52990
PPH-3	W. WALL	4-1-85	63260	75	100	175	75	100	3	0.007	1M	17.6	59	CONT	.71	2.8	52990
PPH-4	FLOOR	4-1-85	63260	150	250	225	150	200	2	0.007	1M	5.9	59	CONT	.71	4.9	52990
PPH-4	E. WALL	4-1-85	63261	100	150	100	50	75	2	0.007	1M	14.7	59	CONT	.24	2.8	52990
PPH-4	S. WALL	4-1-85	63261	100	100	100	75	100	2	0.006	1M	17.6	59	CONT	1.2	0	52990
PPH-4	W. WALL	4-1-85	63262	125	125	100	100	125	2	0.014	1M	2.9	59	CONT	.24	0	52990
PPH-5	FLOOR	4-1-85	63262	200	200	175	150	100	2	0.006	1M	11.8	59	CONT	1.2	0	52990
PPH-5	N. WALL	4-1-85	63263	50	100	50	125	100	4	0.005	1M	14.7	59	CONT	.48	8	52990
PPH-5	S. WALL	4-1-85	63263	75	150	150	100	100	2	0.006	1M	17.6	59	CONT	1.4	0	52990
PPH-5	CEILING	4-1-85	63264	75	100	75	100	150	5	0.007	1M	14.7	59	CONT	.24	6	52990
PPH-6	FLOOR	4-1-85	63264	150	200	200	175	225	5	0.007	1M	2.9	59	CONT	.24	8	52990
PPH-6	N. WALL	4-1-85	63265	75	100	100	0	100	2	0.007	1M	0	59	CONT	.24	6	52990
PPH-6	S. WALL	4-1-85	63265	75	75	125	50	125	3	0.006	1M	5.9	59	CONT	.24	3.8	52990
PPH-7	FLOOR	4-1-85	63266	100	200	100	100	200	2	0.007	1M	2.9	59	CONT	.24	2.8	52990
PPH-7	N. WALL	4-1-85	63266	75	75	100	100	75	3	0.006	1M	0	59	CONT	.48	4.3	52990
PPH-7	S. WALL	4-1-85	63267	75	150	150	100	125	2	0.007	1M	11.8	59	CONT	.71	0	52990
PPH-8	FLOOR	4-1-85	63267	150	250	150	150	175	2	0.007	1M	14.7	59	CONT	.95	0	52990
PPH-8	N. WALL	4-1-85	63268	50	75	100	50	25	3	0.006	1M	8.8	59	CONT	.48	0	52990
PPH-8	S. WALL	4-1-85	63268	75	100	125	100	150	5	0.006	1M	5.9	59	CONT	.48	0	52990
PPH-8	W. WALL	4-1-85	63269	100	100	100	150	100	4	0.006	1M	17.6	59	CONT	.48	0	52990
PPH-9	FLOOR	4-1-85	63269	200	100	100	150	175	1	0.007	1M	2.9	59	CONT	.48	9.2	52990
PPH-9	N. WALL	4-1-85	63270	125	100	150	75	50	3	0.009	1M	20.6	59	CONT	2.1	0	52990
PPH-9	S. WALL	4-1-85	63270	100	100	150	75	150	5	0.009	1M	14.7	59	CONT	0	11.9	52990
PPH-9	CEILING	4-1-85	63271	100	100	175	175	100	3	0.006	1M	5.9	59	CONT	.48	1.6	52991
PPH-10	FLOOR	4-1-85	63271	175	100	200	100	175	3	0.006	1M	17.6	59	CONT	0	0	52991
PPH-10	N. WALL	4-1-85	63272	150	125	100	100	75	1	0.015	1M	23.5	59	CONT	0	29.2	52991
PPH-10	S. WALL	4-1-85	63272	100	75	125	75	150	5	0.007	1M	14.7	59	CONT	.95	4.3	52991
PPH-11	FLOOR	4-1-85	63273	0	125	100	175	150	4	0.006	1M	8.8	59	CONT	0	.55	52991
PPH-11	N. WALL	4-1-85	63273	75	125	100	100	75	2	0.014	1M	29.4	59	CONT	0	0	52991
PPH-11	S. WALL	4-1-85	63274	50	100	150	100	150	3	0.005	1M	11.8	59	CONT	1.2	15.1	52991
PPH-12	ROOF	4-11-85	63300	50	25	50	50	50	5	0.005	1M	8.8	59	CONT	0	0	0
PPH-13	ROOF	4-11-85	63300	50	50	25	25	50	1	0.006	1M	14.7	59	CONT	0	0	0
PPH-14	ROOF	4-11-85	63301	25	50	25	25	75	5	0.006	1M	8.8	59	CONT	0	0	0
PPH-15	ROOF	4-11-85	63301	50	25	50	75	50	4	0.006	1M	11.8	59	CONT	0	0	0

FD235 Number of Records Read: 41
FD236 Number of Records Selected: 41

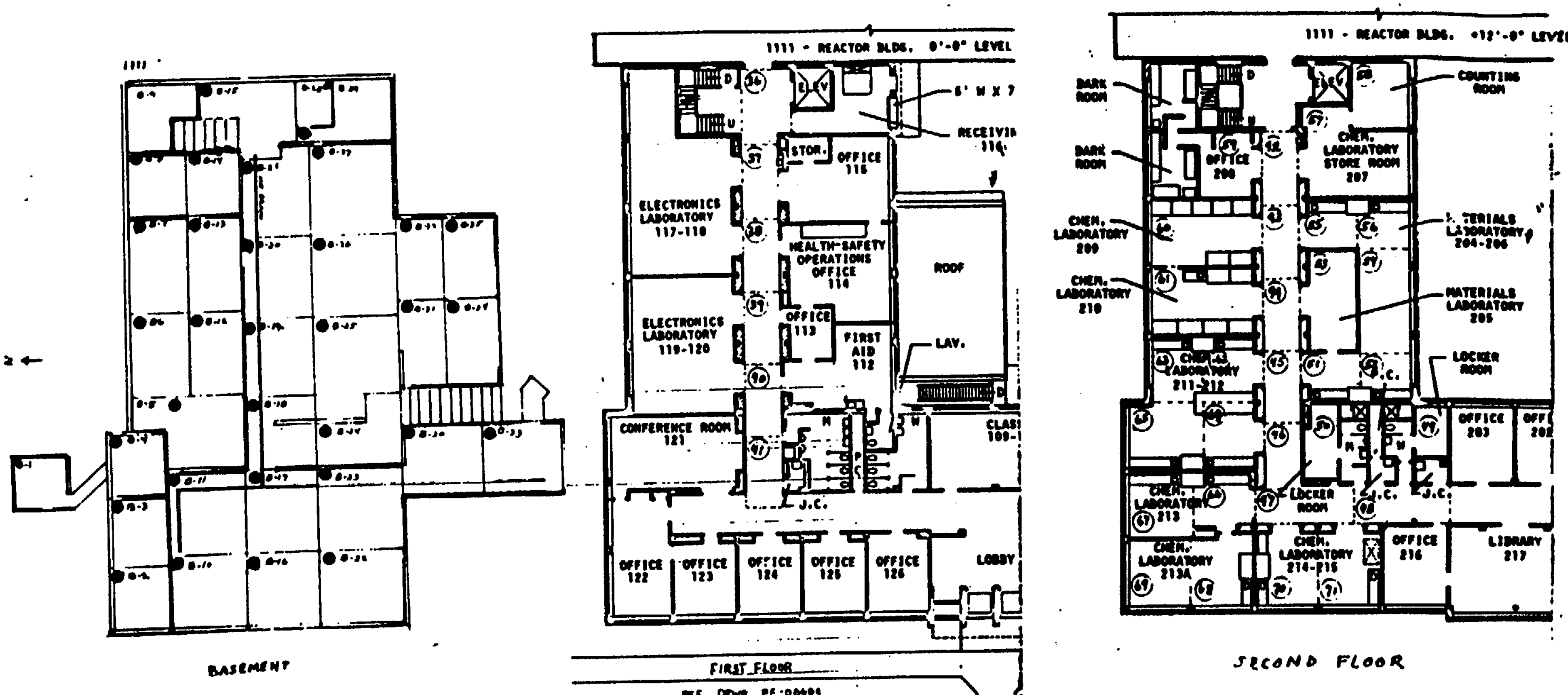
PPH RAD SURVEY GRIDS
12-19-85
12:59:23

GRID	TYPE	ZONE	GS3W NO	GS3W CAL DATE	PRM7 NO	PRM7 CAL DATE	PRS1 NO	PRS1 CAL DATE	PRS1 EFF	NC A EFF	NC B EFF	REC#
PPH-1	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	1
PPH-1	N. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	2
PPH-1	E. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	3
PPH-2	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	4
PPH-2	E. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	5
PPH-2	W. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	6
PPH-3	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	7
PPH-3	E. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	8
PPH-3	W. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	9
PPH-4	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	10
PPH-4	E. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	11
PPH-4	S. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	12
PPH-4	W. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	13
PPH-5	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	14
PPH-5	N. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	15
PPH-5	S. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	16
PPH-5	CEILING	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	17
PPH-6	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	18
PPH-6	N. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	19
PPH-6	S. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	20
PPH-7	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	21
PPH-7	N. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	22
PPH-7	S. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	23
PPH-8	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	24
PPH-8	N. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	25
PPH-8	S. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	26
PPH-8	W. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	27
PPH-9	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	28
PPH-9	N. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	29
PPH-9	S. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	30
PPH-9	CEILING	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	31
PPH-10	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	32
PPH-10	N. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	33
PPH-10	S. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	34
PPH-11	FLOOR	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	35
PPH-11	N. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	36
PPH-11	S. WALL	WHITE	36027	1-7-85	466	12-10-84	423	2-14-85	34	42	37	37
PPH-12	ROOF	WHITE	36027	4-9-85	466	12-10-84	423	4-9-85	34	42	37	38
PPH-13	ROOF	WHITE	36027	4-9-85	466	12-10-84	423	4-9-85	34	42	37	39
PPH-14	ROOF	WHITE	36027	4-9-85	466	12-10-84	423	4-9-85	34	42	37	40
PPH-15	ROOF	WHITE	36027	4-9-85	466	12-10-84	423	4-9-85	34	42	37	41

PD235 Number of Records Read: 41
PD236 Number of Records Selected: 41

APPENDIX 3.17

Radiological Monitoring Data For The PBRF
Building #1141 - Reactor Office & Lab Building



REACTOR OFFICE AND LABORATORY
BLDG 1141 GRID INDEX

RAD SURVEY ROLD BLDG 1141
10-02-85
13:01:31

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
OB 61	1-17-85	W. Wall	White	100	0	0	200	0	Pt. 4	14	59	0.017
OB 61	1-17-85	Ceiling	White	75	50	50	50	125	Pt. 5	3	59	0.009
OB 62	1-17-85	Floor	White	50	75	75	75	100	Pt. 5	33	59	0.007
OB 62	1-17-85	E. Wall	White	100	100	100	100	125	Pt. 5	8	59	0.013
OB 62	1-17-85	S. Wall	White	50	100	50	50	75	Pt. 2	0	59	0.006
OB 62	1-17-85	Ceiling	White	100	50	75	100	50	Pt. 1	6	59	0.008
OB 63	1-17-85	Floor	White	50	50	50	50	175	Pt. 5	17	59	0.006
OB 63	1-17-85	N. Wall	White	100	75	75	75	75	Pt. 1	6	59	0.007
OB 63	1-17-85	E. Wall	White	75	75	75	50	100	Pt. 5	8	59	0.007
OB 64	1-17-85	Floor	White	100	100	100	75	500	Pt. 5	6	59	0.007
OB 64	1-17-85	S. Wall	White	100	125	100	100	100	Pt. 2	6	59	0.005
OB 64	1-17-85	W. Wall	White	75	75	75	50	50	Pt. 1	8	59	0.006
OB 64	1-17-85	Ceiling	White	75	75	50	50	50	Pt. 1	6	59	0.006
OB 65	1-17-85	Floor	White	75	75	75	100	100	Pt. 5	31	59	0.006
OB 65	1-17-85	N. Wall	White	50	50	50	50	50	Pt. 5	11	59	0.005
OB 65	1-17-85	W. Wall	White	75	50	50	50	50	Pt. 1	11	59	0.005
OB 65	1-17-85	Ceiling	White	50	100	50	50	100	Pt. 5	17	59	0.006
OB 66	1-17-85	Floor	White	75	75	50	50	75	Pt. 5	25	59	0.005
OB 66	1-17-85	E. Wall	White	50	75	25	50	75	Pt. 5	17	59	0.004
OB 66	1-17-85	S. Wall	White	50	50	50	50	50	Pt. 5	8	59	0.004
OB 66	1-17-85	W. Wall	White	50	50	50	50	50	Pt. 5	3	59	0.004
OB 66	1-17-85	Ceiling	White	25	50	50	50	50	Pt. 2	8	59	0.005
OB 67	1-17-85	Floor	White	50	100	100	75	50	Pt. 3	3	59	0.005
OB 67	1-17-85	N. Wall	White	75	75	50	50	100	Pt. 5	0	59	0.005
OB 67	1-17-85	E. Wall	White	50	50	50	50	50	Pt. 5	6	59	0.004
OB 67	1-17-85	W. Wall	White	50	75	100	75	50	Pt. 3	3	59	0.004
OB 67	1-17-85	Ceiling	White	25	75	75	50	50	Pt. 3	14	59	0.004
OB 68	1-17-85	Floor	White	50	50	100	75	75	Pt. 3	61	59	0.005
OB 68	1-17-85	E. Wall	White	50	50	50	50	50	Pt. 5	8	59	0.005
OB 68	1-17-85	S. Wall	White	100	50	50	50	50	Pt. 1	19	59	0.005
OB 68	1-17-85	W. Wall	White	75	50	50	50	50	Pt. 1	6	59	0.005
OB 68	1-17-85	Ceiling	White	50	50	75	100	50	Pt. 4	6	59	0.004
OB 69	1-17-85	Floor	White	75	75	75	75	75	Pt. 5	44	59	0.004
OB 69	1-17-85	N. Wall	White	50	50	75	75	50	Pt. 3	19	59	0.005
OB 69	1-17-85	E. Wall	White	75	75	50	50	50	Pt. 1	11	59	0.005
OB 69	1-17-85	W. Wall	White	50	75	50	50	50	Pt. 2	6	59	0.005
OB 69	1-17-85	Ceiling	White	50	75	75	50	75	Pt. 2	3	59	0.005
OB 70	1-17-85	Floor	White	75	100	75	75	75	Pt. 2	336	59	0.006
OB 70	1-17-85	N. Wall	White	50	100	50	50	75	Pt. 2	14	59	0.006
OB 70	1-17-85	E. Wall	White	50	50	50	50	75	Pt. 4	8	59	0.005
OB 70	1-17-85	W. Wall	White	50	50	50	50	25	Pt. 2	6	59	0.006
OB 70	1-17-85	Ceiling	White	75	50	50	75	100	Pt. 5	8	59	0.006
OB 71	1-17-85	E. Wall	White	75	75	75	75	75	Pt. 5	8	59	0.005
OB 71	1-17-85	S. Wall	White	50	50	50	50	75	Pt. 5	11	59	0.005
OB 71	1-17-85	W. Wall	White	75	50	50	75	100	Pt. 5	6	59	0.006
OB 71	1-17-85	Ceiling	White	75	75	50	75	50	Pt. 4	14	59	0.005
OB 1	12-12-84	Floor	White	75	75	50	75	100	Pt. 5	0	59	0.005
OB 2	12-12-84	Floor	White	25	100	50	50	75	Pt. 2	0	59	0.004
OB 3	12-12-84	Floor	White	50	50	50	50	75	Pt. 5	3	59	0.006
OB 4	12-12-84	Floor	White	50	50	100	50	50	Pt. 3	3	59	0.006
OB 5	12-12-84	Floor	White	50	50	50	0	75	Pt. 5	6	59	0.005
OB 6	12-12-84	Floor	White	100	75	75	75	75	Pt. 1	1	59	0.005
OB 7	12-12-84	Floor	White	25	25	50	100	100	Pt. 5	3	59	0.005
OB 8	12-12-84	Floor	White	50	50	75	50	50	Pt. 3	6	59	0.004

RAD SURVEY ROLS BLDG 1141
10-02-85
13:10:30

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
OB 61	1-17-85	W. Wall	White	52912	0	0	62833	36027	1-7-85	466	12-10-84
OB 61	1-17-85	Ceiling	White	52912	0	0	62833	36027	1-7-85	466	12-10-84
OB 62	1-17-85	Floor	White	52912	0	13	62834	36027	1-7-85	466	12-10-84
OB 62	1-17-85	E. Wall	White	52912	1	10	62834	36027	1-7-85	466	12-10-84
OB 62	1-17-85	S. Wall	White	52912	0	4	62835	36027	1-7-85	466	12-10-84
OB 62	1-17-85	Ceiling	White	52912	0	0	62835	36027	1-7-85	466	12-10-84
OB 63	1-17-85	Floor	White	52912	0	0	62836	36027	1-7-85	466	12-10-84
OB 63	1-17-85	N. Wall	White	52912	0	0	62836	36027	1-7-85	466	12-10-84
OB 63	1-17-85	E. Wall	White	52912	0	12	62837	36027	1-7-85	466	12-10-84
OB 64	1-17-85	Floor	White	52912	0	137	62838	36027	1-7-85	466	12-10-84
OB 64	1-17-85	S. Wall	White	52912	0	13	62838	36027	1-7-85	466	12-10-84
OB 64	1-17-85	W. Wall	White	52912	0	0	62839	36027	1-7-85	466	12-10-84
OB 64	1-17-85	Ceiling	White	52912	0	6	62839	36027	1-7-85	466	12-10-84
OB 65	1-17-85	Floor	White	52912	0	12	62840	36027	1-7-85	466	12-10-84
OB 65	1-17-85	N. Wall	White	52912	0	10	62840	36027	1-7-85	466	12-10-84
OB 65	1-17-85	W. Wall	White	52912	0	8	62841	36027	1-7-85	466	12-10-84
OB 65	1-17-85	Ceiling	White	52912	0	9	62841	36027	1-7-85	466	12-10-84
OB 66	1-17-85	Floor	White	52912	0	17	62842	36027	1-7-85	466	12-10-84
OB 66	1-17-85	E. Wall	White	52912	0	18	62842	36027	1-7-85	466	12-10-84
OB 66	1-17-85	S. Wall	White	52912	0	8	62843	36027	1-7-85	466	12-10-84
OB 66	1-17-85	W. Wall	White	52912	0	9	62843	36027	1-7-85	466	12-10-84
OB 66	1-17-85	Ceiling	White	52912	1	10	62844	36027	1-7-85	466	12-10-84
OB 67	1-17-85	Floor	White	52912	0	6	62844	36027	1-7-85	466	12-10-84
OB 67	1-17-85	N. Wall	White	52912	1	0	62845	36027	1-7-85	466	12-10-84
OB 67	1-17-85	E. Wall	White	52912	0	6	62845	36027	1-7-85	466	12-10-84
OB 67	1-17-85	W. Wall	White	52912	0	14	62846	36027	1-7-85	466	12-10-84
OB 67	1-17-85	Ceiling	White	52912	0	19	62846	36027	1-7-85	466	12-10-84
OB 68	1-17-85	Floor	White	52912	1	3	62847	36027	1-7-85	466	12-10-84
OB 68	1-17-85	E. Wall	White	52913	2	17	62847	36027	1-7-85	466	12-10-84
OB 68	1-17-85	S. Wall	White	52913	1	1	62848	36027	1-7-85	466	12-10-84
OB 68	1-17-85	W. Wall	White	52913	1	29	62848	36027	1-7-85	466	12-10-84
OB 68	1-17-85	Ceiling	White	52913	0	10	62849	36027	1-7-85	466	12-10-84
OB 69	1-17-85	Floor	White	52913	0	13	62849	36027	1-7-85	466	12-10-84
OB 69	1-17-85	N. Wall	White	52913	0	8	62850	36027	1-7-85	466	12-10-84
OB 69	1-17-85	E. Wall	White	52913	0	0	62850	36027	1-7-85	466	12-10-84
OB 69	1-17-85	W. Wall	White	52913	0	3	62851	36027	1-7-85	466	12-10-84
OB 69	1-17-85	Ceiling	White	52913	0	20	62851	36027	1-7-85	466	12-10-84
OB 70	1-17-85	Floor	White	52913	3	31	62852	36027	1-7-85	466	12-10-84
OB 70	1-17-85	N. Wall	White	52913	0	3	62852	36027	1-7-85	466	12-10-84
OB 70	1-17-85	E. Wall	White	52913	0	0	62853	36027	1-7-85	466	12-10-84
OB 70	1-17-85	W. Wall	White	52913	0	7	62853	36027	1-7-85	466	12-10-84
OB 70	1-17-85	Ceiling	White	52913	0	0	62854	36027	1-7-85	466	12-10-84
OB 71	1-17-85	E. Wall	White	52913	0	7	62855	36027	1-7-85	466	12-10-84
OB 71	1-17-85	S. Wall	White	52913	0	9	62855	36027	1-7-85	466	12-10-84
OB 71	1-17-85	W. Wall	White	52913	0	6	62856	36027	1-7-85	466	12-10-84
OB 71	1-17-85	Ceiling	White	52913	0	11	62856	36027	1-7-85	466	12-10-84
OB 1	12-12-84	Floor	White	52905	0	9	62504	36024	10-10-84	466	12-10-84
OB 2	12-12-84	Floor	White	52905	0	0	62504	36024	10-10-84	466	12-10-84
OB 3	12-12-84	Floor	White	52905	0	10	62505	36024	10-10-84	466	12-10-84
OB 4	12-12-84	Floor	White	52905	1	0	62505	36024	10-10-84	466	12-10-84
OB 5	12-12-84	Floor	White	52905	0	4	62506	36024	10-10-84	466	12-10-84
OB 6	12-12-84	Floor	White	52905	0	0	62506	36024	10-10-84	466	12-10-84
OB 7	12-12-84	Floor	White	52905	1	1	62507	36024	10-10-84	466	12-10-84
OB 8	12-12-84	Floor	White	52905	0	0	62507	36024	10-10-84	466	12-10-84

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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
OB 61	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	1
OB 61	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	2
OB 62	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	3
OB 62	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	4
OB 62	1-17-85	S. Wall	White	423	2-14-85	4	0.34	0.40	0.42	5
OB 62	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	6
OB 63	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	7
OB 63	1-17-85	N. Wall	White	423	2-14-85	4	0.34	0.40	0.42	8
OB 63	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	9
OB 64	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	11
OB 64	1-17-85	S. Wall	White	423	2-14-85	4	0.34	0.40	0.42	12
OB 64	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	13
OB 64	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	14
OB 65	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	15
OB 65	1-17-85	N. Wall	White	423	2-14-85	4	0.34	0.40	0.42	16
OB 65	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	17
OB 65	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	18
OB 66	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	19
OB 66	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	20
OB 66	1-17-85	S. Wall	White	423	2-14-85	4	0.34	0.40	0.42	21
OB 66	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	22
OB 66	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	23
OB 67	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	24
OB 67	1-17-85	N. Wall	White	423	2-14-85	4	0.34	0.40	0.42	25
OB 67	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	26
OB 67	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	27
OB 67	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	28
OB 68	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	29
OB 68	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	30
OB 68	1-17-85	S. Wall	White	423	2-14-85	4	0.34	0.40	0.42	31
OB 68	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	32
OB 68	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	33
OB 69	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	34
OB 69	1-17-85	N. Wall	White	423	2-14-85	4	0.34	0.40	0.42	35
OB 69	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	36
OB 69	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	37
OB 69	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	38
OB 70	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	39
OB 70	1-17-85	N. Wall	White	423	2-14-85	4	0.34	0.40	0.42	40
OB 70	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	41
OB 70	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	42
OB 70	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	43
OB 71	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	45
OB 71	1-17-85	S. Wall	White	423	2-14-85	4	0.34	0.40	0.42	46
OB 71	1-17-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	47
OB 71	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	48
OB 1	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	49
OB 2	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	50
OB 3	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	51
OB 4	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	52
OB 5	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	53
OB 6	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	54
OB 7	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	55
OB 8	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	56

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Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
OB 9	2-19-85	Floor	White	25	25	25	50	75	Pt. 5	82	59	0.005
OB 9	2-19-85	N. Wall	White	50	50	25	50	50	Pt. 5	47	59	0.004
OB 9	2-19-85	E. Wall	White	75	50	50	25	50	Pt. 1	86	59	0.006
OB 9	2-19-85	S. Wall	White	75	50	50	50	100	Pt. 5	94	59	0.006
OB 9	2-19-85	W. Wall	White	75	25	50	25	125	Pt. 5	69	59	0.006
OB 9	2-19-85	Ceiling	White	100	50	75	50	50	Pt. 1	86	59	0.006
OB 10	12-12-84	Floor	White	100	75	50	50	50	Pt. 1	4	59	0.005
OB 11	12-12-84	Floor	White	75	50	50	75	75	Pt. 4	10	59	0.005
OB 12	12-12-84	Floor	White	100	100	75	75	75	Pt. 2	9	59	0.007
OB 13	12-12-84	Floor	White	25	100	75	75	75	Pt. 2	7	59	0.007
OB 14	12-12-84	Floor	White	25	25	25	25	25	Pt. 2	4	59	0.005
OB 15	12-12-84	Floor	White	75	50	50	100	75	Pt. 4	7	59	0.007
OB 16	12-12-84	Floor	White	75	125	75	50	50	Pt. 2	6	59	0.004
OB 17	12-12-84	Floor	White	75	75	75	75	100	Pt. 5	7	59	0.007
OB 18	12-12-84	Floor	White	75	50	100	75	100	Pt. 5	4	59	0.007
OB 19	12-12-84	Floor	White	75	75	75	100	75	Pt. 4	3	59	0.005
OB 20	12-12-84	Floor	White	50	50	50	50	100	Pt. 5	7	59	0.013
OB 21	12-12-84	Floor	White	75	75	75	75	100	Pt. 5	6	59	0.014
OB 22	12-12-84	Floor	White	50	75	75	50	0	Pt. 2	0	59	0.004
OB 23	12-12-84	Floor	White	50	100	75	50	75	Pt. 2	6	59	0.007
OB 24	12-12-84	Floor	White	0	75	75	0	75	Pt. 3	12	59	0.006
OB 25	12-12-84	Floor	White	50	75	50	75	50	Pt. 4	4	59	0.006
OB 26	12-12-84	Floor	White	75	125	75	75	100	Pt. 2	1	59	0.006
OB 27	12-12-84	Floor	White	75	75	100	75	75	Pt. 3	1	59	0.007
OB 28	12-12-84	Floor	White	75	75	75	75	75	Pt. 5	3	59	0.003
OB 29	12-12-84	Floor	White	0	50	50	75	50	Pt. 4	0	59	0.005
OB 30	12-12-84	Floor	White	75	125	150	75	100	Pt. 3	73	59	0.009
OB 31	12-12-84	Floor	White	100	75	75	75	75	Pt. 1	19	59	0.005
OB 32	12-12-84	Floor	White	75	100	100	75	100	Pt. 5	7	59	0.006
OB 33	12-12-84	Floor	White	125	100	100	150	200	Pt. 5	4	59	0.028
OB 34	12-12-84	Floor	White	75	75	100	75	75	Pt. 3	10	59	0.006
OB 35	12-12-84	Floor	White	75	100	50	75	75	Pt. 2	1	59	0.006
OB 36	1-16-85	Floor	White	50	0	0	50	50	Pt. 5	0	59	0.005
OB 37	1-16-85	Floor	White	75	0	0	100	75	Pt. 4	11	59	0.007
OB 38	1-16-85	Floor	White	50	0	0	75	50	Pt. 4	0	59	0.007
OB 39	1-16-85	Floor	White	75	0	0	75	75	Pt. 5	3	59	0.005
OB 40	1-16-85	Floor	White	100	0	0	100	75	Pt. 1	0	59	0.005
OB 41	1-16-85	Floor	White	50	0	0	75	50	Pt. 4	0	59	0.006
OB 42	1-16-85	Floor	White	50	0	0	50	100	Pt. 5	19	59	0.005
OB 43	1-16-85	Floor	White	75	0	0	125	75	Pt. 4	8	59	0.006
OB 44	1-16-85	Floor	White	50	0	0	50	50	Pt. 5	19	59	0.005
OB 45	1-16-85	Floor	White	50	0	0	50	25	Pt. 4	14	59	0.005
OB 46	1-16-85	Floor	White	25	0	0	75	25	Pt. 4	11	59	0.005
OB 47	1-16-85	Floor	White	50	50	0	0	25	Pt. 2	22	59	0.005
OB 48	1-16-85	Floor	White	50	50	0	0	25	Pt. 2	8	59	0.005
OB 49	1-16-85	Floor	White	50	50	50	50	50	Pt. 5	44	59	0.007
OB 50	1-16-85	Floor	White	50	50	50	50	50	Pt. 2	0	59	0.007
OB 51	1-16-85	Floor	White	50	50	0	0	50	Pt. 5	25	59	0.005
OB 52	1-16-85	Floor	White	50	75	0	0	50	Pt. 2	14	59	0.005
OB 53	1-16-85	Floor	White	50	0	0	75	50	Pt. 4	17	59	0.006
OB 54	1-16-85	Floor	White	50	0	0	50	50	Pt. 4	14	59	0.005
OB 55	1-16-85	Floor	White	50	50	0	0	100	Pt. 5	2	59	0.006
OB 56	1-16-85	Floor	White	50	50	0	0	50	Pt. 5	6	59	0.005
OB [illegible]	1-16-85	Floor	White	50	5[illegible]	50	50	50	Pt. 5	6	59	0.[illegible]

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Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
OB 9	2-19-85	Floor	White	52905	3	1	63026	36027	1-7-85	466	12-10-84
OB 9	2-19-85	N. Wall	White	52911	0	12	63026	36027	1-7-85	466	12-10-84
OB 9	2-19-85	E. Wall	White	52911	0	4	63027	36027	1-7-85	466	12-10-84
OB 9	2-19-85	S. Wall	White	52911	2	16	63027	36027	1-7-85	466	12-10-84
OB 9	2-19-85	W. Wall	White	52911	1	11	63028	36027	1-7-85	466	12-10-84
OB 9	2-19-85	Ceiling	White	52911	1	9	63028	36027	1-7-85	466	12-10-84
OB 10	12-12-84	Floor	White	52905	0	3	62508	36024	10-10-84	466	12-10-84
OB 11	12-12-84	Floor	White	52905	2	8	62508	36024	10-10-84	466	12-10-84
OB 12	12-12-84	Floor	White	52905	0	1	62509	36024	10-10-84	466	12-10-84
OB 13	12-12-84	Floor	White	52905	1	9	62509	36024	10-10-84	466	12-10-84
OB 14	12-12-84	Floor	White	52905	0	7	62510	36024	10-10-84	466	12-10-84
OB 15	12-12-84	Floor	White	52905	1	7	62510	36024	10-10-84	466	12-10-84
OB 16	12-12-84	Floor	White	52905	0	0	62511	36024	10-10-84	466	12-10-84
OB 17	12-12-84	Floor	White	52905	0	0	62511	36024	10-10-84	466	12-10-84
OB 18	12-12-84	Floor	White	52905	1	4	62512	36024	10-10-84	466	12-10-84
OB 19	12-12-84	Floor	White	52905	0	3	62512	36024	10-10-84	466	12-10-84
OB 20	12-12-84	Floor	White	52905	1	11	62513	36024	10-10-84	466	12-10-84
OB 21	12-12-84	Floor	White	52905	0	1	62513	36024	10-10-84	466	12-10-84
OB 22	12-12-84	Floor	White	52905	0	4	62514	36024	10-10-84	466	12-10-84
OB 23	12-12-84	Floor	White	52905	0	7	62514	36024	10-10-84	466	12-10-84
OB 24	12-12-84	Floor	White	52905	0	7	62515	36024	10-10-84	466	12-10-84
OB 25	12-12-84	Floor	White	52905	0	0	62515	36024	10-10-84	466	12-10-84
OB 26	12-12-84	Floor	White	52905	0	8	62516	36024	10-10-84	466	12-10-84
OB 27	12-12-84	Floor	White	52905	0	0	62516	36024	10-10-84	466	12-10-84
OB 28	12-12-84	Floor	White	52905	0	11	62517	36024	10-10-84	466	12-10-84
OB 29	12-12-84	Floor	White	52905	0	0	62517	36024	10-10-84	466	12-10-84
OB 30	12-12-84	Floor	White	52906	0	0	62518	36024	10-10-84	466	12-10-84
OB 31	12-12-84	Floor	White	52906	0	5	62518	36024	10-10-84	466	12-10-84
OB 32	12-12-84	Floor	White	52906	0	3	62519	36024	10-10-84	466	12-10-84
OB 33	12-12-84	Floor	White	52906	1	6	62519	36024	10-10-84	466	12-10-84
OB 34	12-12-84	Floor	White	52906	0	0	62520	36024	10-10-84	466	12-10-84
OB 35	12-12-84	Floor	White	52906	0	0	62520	36024	10-10-84	466	12-10-84
OB 36	1-16-85	Floor	White	52908	0	0	62818	36027	1-7-85	466	12-10-84
OB 37	1-16-85	Floor	White	52908	0	3	62818	36027	1-7-85	466	12-10-84
OB 38	1-16-85	Floor	White	52908	0	1	62818	36027	1-7-85	466	12-10-84
OB 39	1-16-85	Floor	White	52908	0	4	62819	36027	1-7-85	466	12-10-84
OB 40	1-16-85	Floor	White	52908	0	28	62819	36027	1-7-85	466	12-10-84
OB 41	1-16-85	Floor	White	52908	0	49	62819	36027	1-7-85	466	12-10-84
OB 42	1-16-85	Floor	White	52908	0	0	62820	36027	1-7-85	466	12-10-84
OB 43	1-16-85	Floor	White	52908	0	0	62820	36027	1-7-85	466	12-10-84
OB 44	1-16-85	Floor	White	52908	2	7	62820	36027	1-7-85	466	12-10-84
OB 45	1-16-85	Floor	White	52908	0	3	62821	36027	1-7-85	466	12-10-84
OB 46	1-16-85	Floor	White	52908	0	7	62821	36027	1-7-85	466	12-10-84
OB 47	1-16-85	Floor	White	52908	2	0	62821	36027	1-7-85	466	12-10-84
OB 48	1-16-85	Floor	White	52908	0	36	62822	36027	1-7-85	466	12-10-84
OB 49	1-16-85	Floor	White	52908	0	3	62822	36027	1-7-85	466	12-10-84
OB 50	1-16-85	Floor	White	52908	1	12	62823	36026	1-7-85	466	12-10-84
OB 51	1-16-85	Floor	White	52909	0	8	62823	36026	1-7-85	466	12-10-84
OB 52	1-16-85	Floor	White	52909	0	2	62824	36027	1-7-85	466	12-10-84
OB 53	1-16-85	Floor	White	52909	0	10	62824	36027	1-7-85	466	12-10-84
OB 54	1-16-85	Floor	White	52909	0	0	62824	36027	1-7-85	466	12-10-84
OB 55	1-16-85	Floor	White	52909	0	4	62825	36027	1-7-85	466	12-10-84
OB 56	1-16-85	Floor	White	52909	0	0	62825	36027	1-7-85	466	12-10-84
OB 57	1-16-85	Floor	White	52909	0	5	62826	36027	1-7-85	466	12-10-84

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Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
OB 9	2-19-85	Floor	White	423	2-14-85	1	0.34	0.40	0.42	57
OB 9	2-19-85	N. Wall	White	423	2-14-85	1	0.34	0.40	0.42	58
OB 9	2-19-85	E. Wall	White	423	2-14-85	1	0.34	0.40	0.42	59
OB 9	2-19-85	S. Wall	White	423	2-14-85	1	0.34	0.40	0.42	60
OB 9	2-19-85	W. Wall	White	423	2-14-85	1	0.34	0.40	0.42	61
OB 9	2-19-85	Ceiling	White	423	2-14-85	1	0.34	0.40	0.42	62
OB 10	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	63
OB 11	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	64
OB 12	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	65
OB 13	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	66
OB 14	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	67
OB 15	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	68
OB 16	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	69
OB 17	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	70
OB 18	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	71
OB 19	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	72
OB 20	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	73
OB 21	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	74
OB 22	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	75
OB 23	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	76
OB 24	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	77
OB 25	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	78
OB 26	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	79
OB 27	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	80
OB 28	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	81
OB 29	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	82
OB 30	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	83
OB 31	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	84
OB 32	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	85
OB 33	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	86
OB 34	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	87
OB 35	12-12-84	Floor	White	423	12-10-84	3	0.34	0.40	0.42	88
OB 36	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	89
OB 37	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	90
OB 38	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	91
OB 39	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	92
OB 40	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	93
OB 41	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	94
OB 42	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	95
OB 43	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	96
OB 44	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	97
OB 45	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	98
OB 46	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	99
OB 47	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	100
OB 48	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	101
OB 49	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	102
OB 50	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	103
OB 51	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	104
OB 52	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	105
OB 53	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	106
OB 54	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	107
OB 55	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	108
OB 56	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	109
OB 57	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	110

RAD SURVEY ROLO BLDG 1141
10-02-85
13:01:31

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
OB 58	1-16-85	Floor	White	50	50	50	50	50	Pt. 5	8	59	0.005
OB 59	1-16-85	Floor	White	50	50	50	50	50	Pt. 5	8	59	0.005
OB 60	1-16-85	Floor	White	100	100	75	100	100	Pt. 5	33	59	0.010
OB 60	1-16-85	N. Wall	White	50	50	100	50	50	Pt. 3	17	59	0.008
OB 60	1-16-85	E. Wall	White	50	0	0	50	0	Pt. 4	3	59	0.008
OB 60	1-16-85	S. Wall	White	50	100	50	75	75	Pt. 2	39	59	0.010
OB 60	1-16-85	W. Wall	White	75	50	0	50	100	Pt. 5	3	59	0.012
OB 60	1-16-85	Ceiling	White	50	75	25	25	75	Pt. 5	14	59	0.007
OB 61	1-17-85	Floor	White	75	100	100	200	150	Pt. 4	28	59	0.010
OB 61	1-17-85	N. Wall	White	75	50	50	50	50	Pt. 1	6	59	0.008
OB 61	1-17-85	E. Wall	White	50	0	100	50	75	Pt. 3	3	59	0.008
OB 61	1-17-85	S. Wall	White	50	100	75	50	50	Pt. 2	11	59	0.010
OB 63	1-17-85	Ceiling	White	100	125	50	50	50	Pt. 2	8	59	0.008
OB 71	1-17-85	Floor	White	75	75	75	75	100	Pt. 5	8	59	0.005

PD235 Number of Records Read: 122
PD236 Number of Records Selected: 122

RAD SURVEY ROLB BLDG 1141
10-02-85
13:10:30

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
OB 58	1-16-85	Floor	White	52909	0	8	62826	36027	1-7-85	466	12-10-84
OB 59	1-16-85	Floor	White	52909	0	0	62827	36027	1-7-85	466	12-10-84
OB 60	1-16-85	Floor	White	52909	0	24	62827	36027	1-7-85	466	12-10-84
OB 60	1-16-85	N. Wall	White	52909	1	60	62828	36027	1-7-85	466	12-10-84
OB 60	1-16-85	E. Wall	White	52909	0	18	62828	36027	1-7-85	466	12-10-84
OB 60	1-16-85	S. Wall	White	52909	4	98	62829	36027	1-7-85	466	12-10-84
OB 60	1-16-85	W. Wall	White	52909	0	5	62829	36027	1-7-85	466	12-10-84
OB 60	1-16-85	Ceiling	White	52909	0	3	62830	36027	1-7-85	466	12-10-84
OB 61	1-17-85	Floor	White	52912	0	86	62831	36027	1-7-85	466	12-10-84
OB 61	1-17-85	N. Wall	White	52912	0	10	62831	36027	1-7-85	466	12-10-84
OB 61	1-17-85	E. Wall	White	52912	0	18	62832	36027	1-7-85	466	12-10-84
OB 61	1-17-85	S. Wall	White	52912	1	11	62832	36027	1-7-85	466	12-10-84
OB 63	1-17-85	Ceiling	White	52912	0	19	62837	36027	1-7-85	466	12-10-84
OB 71	1-17-85	Floor	White	52913	0	19	62854	36027	1-7-85	466	12-10-84

PD235 Number of Records Read: 122
PD236 Number of Records Selected: 122

RAD SURVEY ROLB BLDG 1141
10-02-85
13:18:47

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
OB 58	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	111
OB 59	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	112
OB 60	1-16-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	113
OB 60	1-16-85	N. Wall	White	423	2-14-85	4	0.34	0.40	0.42	114
OB 60	1-16-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	115
OB 60	1-16-85	S. Wall	White	423	2-14-85	4	0.34	0.40	0.42	116
OB 60	1-16-85	W. Wall	White	423	2-14-85	4	0.34	0.40	0.42	117
OB 60	1-16-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	118
OB 61	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	119
OB 61	1-17-85	N. Wall	White	423	2-14-85	4	0.34	0.40	0.42	120
OB 61	1-17-85	E. Wall	White	423	2-14-85	4	0.34	0.40	0.42	121
OB 61	1-17-85	S. Wall	White	423	2-14-85	4	0.34	0.40	0.42	122
OB 63	1-17-85	Ceiling	White	423	2-14-85	4	0.34	0.40	0.42	123
OB 71	1-17-85	Floor	White	423	2-14-85	4	0.34	0.40	0.42	124

PD235 Number of Records Read: 122
PD236 Number of Records Selected: 122

ROLB HOOD RAD SURVEY
12-05-85
08:17:27

LOCATION	DATE	ZONE	A DPM	AREA CM	PRS1 NO	PRS1 CAL DATE	B CPM	DIST	GS3W	GS3W CAL DATE	MR HR	MRHR DIST	PRM7 NO	PRM7 CAL DATE
209 1E (MAXIMUM)	3-4-85	MAGENTA	43356	59	423	2-14-85	100	CONT	36027	1-7-85				
209 1E (GENERAL)	3-4-85	MAGENTA		59			<100	FIELD	36027	1-7-85	.005-.010	FIELD	466	12-10-84
209 1E (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85	.005-.010	CONT	466	12-10-84
209 2E (MAXIMUM)	3-4-85	MAGENTA	5000	59	423	2-14-85	150	CONT	36027	1-7-85	.010-.015	CONT	466	12-10-84
209 2E (GENERAL)	3-4-85	MAGENTA		59							.005-.010	FIELD	466	12-10-84
209 2E (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85				
209 3E (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	7000	CONT	36027	1-7-85	.360	CONT	466	12-10-84
209 3E (GENERAL)	3-4-85	MAGENTA		59			100-300	FIELD	36027	1-7-85				
209 3E (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	1200	CONT	36027	1-7-85	.035	CONT	466	12-10-84
209 4E (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	2000	CONT	36027	1-7-85	.015-.020	CONT	466	12-10-84
209 4E (GENERAL)	3-4-85	MAGENTA		59			50-150	FIELD	36027	1-7-85				
209 4E (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85	.005-.006	CONT	466	12-10-84
209 5E (MAXIMUM)	3-4-85	MAGENTA	376	59	423	2-14-85	300	CONT	36027	1-7-85				
209 5E (GENERAL)	3-4-85	MAGENTA		59			100-150	FIELD	36027	1-7-85	.005-.010	FIELD	466	12-10-84
209 5E (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85	.005-.010	CONT	466	12-10-84
209 6W (MAXIMUM)	3-4-85	MAGENTA	38	59	423	2-14-85	5000	CONT	36027	1-7-85	.010-.015	CONT	466	12-10-84
209 6W (GENERAL)	3-4-85	MAGENTA		59			150-200	CONT	36027	1-7-85				
209 6W (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	200	CONT	36027	1-7-85	.005-.010	CONT	466	12-10-84
209 6W (LEFT DRAWER)	3-4-85	MAGENTA		59			250	CONT	36027	1-7-85				
209 7W (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	20000	CONT	36027	1-7-85	.260-.300	CONT	466	12-10-84
209 7W (GENERAL)	3-4-85	MAGENTA		59			200	CONT	36027	1-7-85				
209 7W (MAXIMUM INSIDE)	3-4-85	MAGENTA		59			3500	CONG	36027	1-7-85				
209 7W (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	100-150	CONT	36027	1-7-85	.010-.015	CONT	466	12-10-84
210 1E (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85	.005-.010	CONT	466	12-10-84
210 1E (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85				
210 2E (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85	.005-.010	CONT	466	12-10-84
210 2E (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85	.005-.006	CONT	466	12-10-84
210 3W (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	300	CONT	36027	1-7-85	.025	CONT	466	12-10-84
210 3W (GENERAL)	3-4-85	MAGENTA		59			100-300	CONT	36027	1-7-85	.010-.015	CONT	466	12-10-84
210 3W (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	200-300	CONT	36027	1-7-85	.020-.030	CONT	466	12-10-84
210 4W (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	1200	CONT	36027	1-7-85	.080	CONT	466	12-10-84
210 4W (GENERAL)	3-4-85	MAGENTA		59			100-500	CONT	36027	1-7-85	.015	CONT	466	12-10-84
210 4W (FILTER HOUSING)	3-4-85	MAGENTA		59			500	CONT	36027	1-7-85	.100	CONT	466	12-10-84
210 5W (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	6000	CONT	36027	1-7-85	.005-.015	CONT	466	12-10-84
210 5W (GENERAL)	3-4-85	MAGENTA		59			100-250	CONT	36027	1-7-85				
210 5W (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85	.005-.010	CONT	466	12-10-84
210 6W (MAXIMUM)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	6000	CONT	36027	1-7-85	.030	CONT	466	12-10-84
210 6W (GENERAL)	3-4-85	MAGENTA		59			100-400	CONT	36027	1-7-85	.010-.020	CONT	466	12-10-84
210 6W (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	45000	1"	36027	1-7-85	.028	CONT	466	12-10-84
213 (MAXIMUM)	3-4-85	MAGENTA	3624	59	423	2-14-85	<100	CONT	36027	1-7-85	.005	CONT	466	12-10-84
213 (FILTER HOUSING)	3-4-85	MAGENTA	N.S.O.	59	423	2-14-85	<100	CONT	36027	1-7-85	.005	CONT	466	12-10-84

FD235 Number of Records Read: 41
FD236 Number of Records Selected: 41

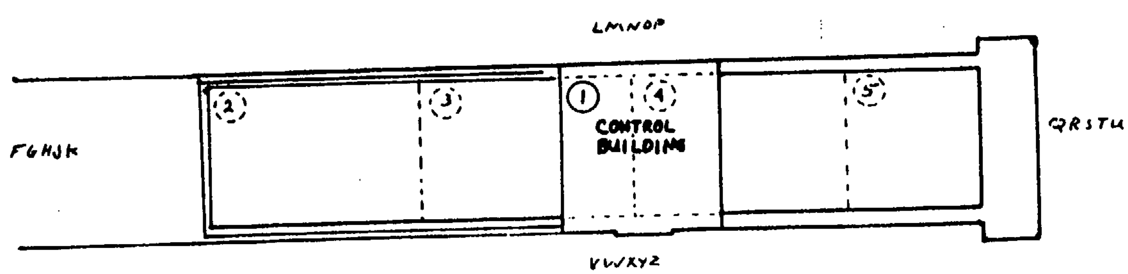
APPENDIX 3.18

Radiological Monitoring Data For The PBRF
Building #1192 - Effluent Metering Station

RAD SURVEY WEMS BLDG. 1192
09-18-85
00:02:54

Grid	Date	Type	Zone	Point 1	Point 2	Point 3	Point 4	Point 5	Hi Point	A DPM	Area cm	mr HR
WEM 1	4-11-85	Floor	White	150	50	75	75	125	Pt. 5	12	59	0.006
WEM 1	4-11-85	N. Wall	White	75	50	100	50	75	Pt. 3	0	59	0.004
WEM 1	4-11-85	E. Wall	White	150	125	100	100	75	Pt. 1	9	59	0.005
WEM 1	4-11-85	S. Wall	White	75	50	100	75	50	Pt. 3	9	59	0.005
WEM 1	4-11-85	W. Wall	White	50	50	50	25	25	Pt. 2	9	59	0.005
WEM 1	4-11-85	Ceiling	White	75	50	50	50	100	Pt. 5	0	59	0.004
WEM 2	4-11-85	Floor	White	50	0	0	75	100	Pt. 5	9	59	0.009
WEM 3	4-11-85	Floor	White	100	175	100	75	125	Pt. 2	3	59	0.010
WEM 4	4-11-85	Floor	White	100	150	150	100	100	Pt. 3	3	59	0.026
WEM 5	4-11-85	Floor	White	50	0	0	75	0	Pt. 4	12	59	0.010
WEM 2	4-11-85	N. Wall	White	50	100	50	75	50	Pt. 2	3	59	0.008
WEM 2	4-11-85	E. Wall	White	75	125	50	50	100	Pt. 2	6	59	0.008
WEM 3	4-11-85	E. Wall	White	100	100	75	100	125	Pt. 5	15	59	0.008
WEM 4	4-11-85	E. Wall	White	100	100	150	75	125	Pt. 3	3	59	0.012
WEM 5	4-11-85	E. Wall	White	25	75	75	50	50	Pt. 3	9	59	0.014
WEM 5	4-11-85	S. Wall	White	50	125	150	75	25	Pt. 3	3	59	0.011
WEM 2	4-11-85	W. Wall	White	50	75	75	150	100	Pt. 4	9	59	0.009
WEM 3	4-11-85	W. Wall	White	75	100	75	75	100	Pt. 2	12	59	0.010
WEM 4	4-11-85	W. Wall	White	100	150	150	100	150	Pt. 2	6	59	0.040
WEM 5	4-11-85	W. Wall	White	75	100	75	75	50	Pt. 2	3	59	0.018
WEM 2	4-11-85	Ceiling	White	25	50	50	75	25	Pt. 4	3	59	0.008
WEM 3	4-11-85	Ceiling	White	25	50	50	25	75	Pt. 5	3	59	0.007
WEM 4	4-11-85	Ceiling	White	50	100	100	75	100	Pt. 5	0	59	0.007
WEM 5	4-11-85	Ceiling	White	75	50	25	50	25	Pt. 1	6	59	0.009

PD235 Number of Records Read: 24
PD236 Number of Records Selected: 24



EFFLUENT METERING STATION
BLDG. 1192 - GRID INDEX
N

○ ABOVE GRADE
◌ BELOW GRADE

RAD SURVEY WEMS BLDG. 1192
09-18-85
00:04:48

Grid	Date	Type	Zone	SSR No	Smear A DPM	Smear B DPM	RSR No	GS3W Ser No	Cal Date	PRM7 Ser No	Cal Date
WEM 1	4-11-85	Floor	White	52998	0	4	63297	36027	4-9-85	466	12-10-84
WEM 1	4-11-85	N. Wall	White	52998	0	2	63297	36027	4-9-85	466	12-10-84
WEM 1	4-11-85	E. Wall	White	52998	0	5	63298	36027	4-9-85	466	12-10-84
WEM 1	4-11-85	S. Wall	White	52998	0	8	63298	36027	4-9-85	466	12-10-84
WEM 1	4-11-85	W. Wall	White	52998	0	4	63299	36027	4-9-85	466	12-10-84
WEM 1	4-11-85	Ceiling	White	52998	0	0	63299	36027	4-9-85	466	12-10-84
WEM 2	4-11-85	Floor	White	52998	0	8	63302	36027	4-9-85	466	12-10-84
WEM 3	4-11-85	Floor	White	52998	0	5	63302	36027	4-9-85	466	12-10-84
WEM 4	4-11-85	Floor	White	52998	0	15	63304	36027	4-9-85	466	12-10-84
WEM 5	4-11-85	Floor	White	52998	0	18	63304	36027	4-9-85	466	12-10-84
WEM 2	4-11-85	N. Wall	White	52998	0	21	63305	36027	4-9-85	466	12-10-84
WEM 2	4-11-85	E. Wall	White	52998	0	23	63305	36027	4-9-85	466	12-10-84
WEM 3	4-11-85	E. Wall	White	52998	0	6	63306	36027	4-9-85	466	12-10-84
WEM 4	4-11-85	E. Wall	White	52998	2	35	63306	36027	4-9-85	466	12-10-84
WEM 5	4-11-85	E. Wall	White	52998	0	12	63307	36027	4-9-85	466	12-10-84
WEM 5	4-11-85	S. Wall	White	52998	0	48	63307	36027	4-9-85	466	12-10-84
WEM 2	4-11-85	W. Wall	White	52998	0	11	63308	36027	4-9-85	466	12-10-84
WEM 3	4-11-85	W. Wall	White	52998	0	0	63308	36027	4-9-85	466	12-10-84
WEM 4	4-11-85	W. Wall	White	52998	0	33	63309	36027	4-9-85	466	12-10-84
WEM 5	4-11-85	W. Wall	White	52998	0	32	63309	36027	4-9-85	466	12-10-84
WEM 2	4-11-85	Ceiling	White	52998	0	0	63310	36027	4-9-85	466	12-10-84
WEM 3	4-11-85	Ceiling	White	52998	0	0	63310	36027	4-9-85	466	12-10-84
WEM 4	4-11-85	Ceiling	White	52998	0	12	63311	36027	4-9-85	466	12-10-84
WEM 5	4-11-85	Ceiling	White	52998	0	2	63311	36027	4-9-85	466	12-10-84

PD235 Number of Records Read: 24
PD236 Number of Records Selected: 24

RAD SURVEY WEMS BLDG. 1192
09-18-85
00:08:26

Grid	Date	Type	Zone	PRS1 Ser No	Cal Date	Time Hours	PRS1 Eff	NC A Eff	NC B Eff	REC#
WEM 1	4-11-85	Floor	White	423	4-9-85	4	0.34	0.37	0.38	1
WEM 1	4-11-85	N. Wall	White	423	4-9-85	4	0.34	0.37	0.38	2
WEM 1	4-11-85	E. Wall	White	423	4-9-85	4	0.34	0.37	0.38	3
WEM 1	4-11-85	S. Wall	White	423	4-9-85	4	0.34	0.37	0.38	4
WEM 1	4-11-85	W. Wall	White	423	4-9-85	4	0.34	0.37	0.38	5
WEM 1	4-11-85	Ceiling	White	423	4-9-85	4	0.34	0.37	0.38	6
WEM 2	4-11-85	Floor	White	423	4-9-85	4	0.34	0.37	0.38	7
WEM 3	4-11-85	Floor	White	423	4-9-85	4	0.34	0.37	0.38	8
WEM 4	4-11-85	Floor	White	423	4-9-85	4	0.34	0.37	0.38	9
WEM 5	4-11-85	Floor	White	423	4-9-85	4	0.34	0.37	0.38	10
WEM 2	4-11-85	N. Wall	White	423	4-9-85	4	0.34	0.37	0.38	11
WEM 2	4-11-85	E. Wall	White	423	4-9-85	4	0.34	0.37	0.38	12
WEM 3	4-11-85	E. Wall	White	423	4-9-85	4	0.34	0.37	0.38	13
WEM 4	4-11-85	E. Wall	White	423	4-9-85	4	0.34	0.37	0.38	14
WEM 5	4-11-85	E. Wall	White	423	4-9-85	4	0.34	0.37	0.38	15
WEM 5	4-11-85	S. Wall	White	423	4-9-85	4	0.34	0.37	0.38	16
WEM 2	4-11-85	W. Wall	White	423	4-9-85	4	0.34	0.37	0.38	17
WEM 3	4-11-85	W. Wall	White	423	4-9-85	4	0.34	0.37	0.38	18
WEM 4	4-11-85	W. Wall	White	423	4-9-85	4	0.34	0.37	0.38	19
WEM 5	4-11-85	W. Wall	White	423	4-9-85	4	0.34	0.37	0.38	20
WEM 2	4-11-85	Ceiling	White	423	4-9-85	4	0.34	0.37	0.38	21
WEM 3	4-11-85	Ceiling	White	423	4-9-85	4	0.34	0.37	0.38	22
WEM 4	4-11-85	Ceiling	White	423	4-9-85	4	0.34	0.37	0.38	23
WEM 5	4-11-85	Ceiling	White	423	4-9-85	4	0.34	0.37	0.38	24

PD235 Number of Records Read: 24
PD236 Number of Records Selected: 24

APPENDIX 3.19

Report From Affiliated Environmental Services, Inc.
On
Asbestos Abatement At The PBRF

AFFILIATED ENVIRONMENTAL SERVICES, Inc.

219 FREMONT AVENUE, SANDUSKY, OHIO 44870 (419) 627-1976

REPORT TO TELEDYNE ISOTOPES
PLUM BROOK OP.

ON

ASBESTOS ABATEMENT

SUBMITTED BY

AFFILIATED ENVIRONMENTAL SERVICES, INC.
219 FREMONT AVE.
SANDUSKY, OH 44870

WORK PERFORMED UNDER WORK ORDER PB 15041

DATE OF REPORT: June 28, 1985

FIELD TEST ENGINEER

Affiliated Environmental Services, inc.

Summary

An estimate of asbestos and asbestos contaminated insulation is presented for the reactor site. It is further broken down by building and by special systems.

Set up equipment requirements, expendable supplies, labor requirements, disposal costs and locations are presented such that a price can be calculated for each building or subsystem. A price is calculated for the total job. Labor rates are based on prevailing rates as of 8-1-85. A 9 page outline of a control procedure for asbestos removal on pipe with encapsulation is attached as are copies of forms for EPA notification, OEPA asbestos removal summary workers qualification sheet, list of landfills and a check list. At a minimum any contractor who performs this work should be able to list at least 3 similar jobs. No specific cost estimate is included for radiological clearance as 1 full time industrial hygiene technician is built into this job.

A visual survey of the reactor complex buildings was performed on 6-21 & 6-24 to estimate the amount of asbestos insulation and the amount of fiber glass (where asbestos mud was used on pipe at joints, valves, hangers and where an asbestos paste was used on the fiberglass then covered with canvas). The total material estimation is belived to be accurate within 15 to 20%. The purpose of this survey was to estimate costs of removal and disposal. The attached work sheets present the amount of material present in units. A unit is the outside square footage for vents, tanks and pipe insulation greater than 8" O.D. It is the linear footage for pipe $<$8" O.D. When pipe is over 8" O.D. the linear footage is presented in (). The following values were used to estimate costs:

Labor Rate

	Basic	Fringe	Total*	Final
Asbestos Worker	19.40	2.89	22.29	26.75
Removal Helper	7.76	2.89	10.65	12.78

(4 helpers to 1 worker

*Does not include FICA, W.C., Unenp etc.
Normally this adds 18 to 21 %

Disposal Costs - 70 units/yd^3; 12 units/drum

Bagged Waste	\$10.00/yd^3
Drums	\$10.00/drum
Shipping	\$240.00/dumpster

20 yard of bags

84 drums

Protective Equipment

Protective Equipment (per man day) \$20.93

3 coveralls x \$2.40 = \$7.20

3 hoods x \$ .26 = \$ .78

4 gloves x \$ .65 = \$1.95

4 resp. cartridges (2/change) x \$2.40 = 9.60

4 Towels x \$ .35 = \$1.40

Affiliated Environmental Services, inc.

Equipment Rental Costs & Maintenance	Rent/mo each	Daily*
3 HEPA Filtration Air Units	400	16.00
6 HEPA Vacuums	100 to 200	5.00
1 Change Room	400 to 1000	8.00
1 Port - a - Pot	50	-
1 Water Filter System	100	12.50

*Based on expendable filters

Based on 10 man crew:

rental $2850.00/month

expendable $2000.00/20 work days

Plastic, Tape, Bags, Signs

Based on past jobs of this size it will run $.40/unit

Encapsulation

Material $.03/unit

Labor Requirements	Man Days
Initial Set up	4 each area
Removal	
includes set up, removal etc	1 per 80 unit A
	1 per 120 unit F/A
Encapsulation	1 per 600 units

Air Monitoring

1 Technician/day (helper rate)

4 air samples/day @ $20.00 each

Daily Labor Costs for 10 man crew

2	Asbestos Workers	$214.00/day	$428.00
7	Removal Helpers	$102.24/day	$715.68
1	Industrial Hygiene Tech.	$102.24/day	$102.24
1	Supervisor	$275.00/day	$275.00
			$1520.92

Affiliated Environmental Services, inc.

Costs Based per Unit

Assume crew reoves 720 units asbestos or 1080 unit F/A per crew day

	A	F/A
Labor - Removal	$2.11	$1.41
Disposal & Hauling (Bagged)	.31	.31
Protective Clothing	.32	.21
Equipment Rental	.20	.13
Equipment Expendables	.14	.09
Plastic, Tape, Bags, Signs	.40	.40
Encapsulation		
Material	.03	.03
Labor	.24	.24
Total	$3.75	$2.82

Additional Costs to Be Considered

1. Liability Insurance 15% of gross
2. Physicals ($120.00/man), Training (1 day ea 3 months) in overhead
3. S&A and overhead rates; typically for field jobs S&A*
   10 to 12%
   O.H. 25 to 40%

   *insurance separate
4. Initial Set-Up costs per area (change rooms, trucking etc); normally $600.00 to $1000.00 per set up

Based on the above data I would estimate the costs as follows:

Total Job

Labor 30 work days		$45,627.60
Overhead (.35)		15,969.66
Disposal		5,927.20
Equip. (Rental & Expendables)		6,146.20
Protective Clothing		5,839.10
Expendables (plastic, tape, bags etc)		9,844.00
Encapsulation Material		984.40
	Sub total	$90,338.16
	S&A (.11)	9,937.20
		$100,275.35
insurance .15 of total		19,534.16
profit .08 of total		10,418.21
	Total	$130,227.72

Affiliated Environmental Services, inc.

Using the unit costs you can figure any single component if you add $1000.00 for initial set up.

Attachments

A. Removal Check List
B. EPA Notification Form
C. List of Landfills
D. Asbestos Information
E. OEPA Asbestos Removal Summary
F. Worker Qualification Certification
G. General (9 page) Asbestos Control Procedure

~~Units~~ Of Asbestos By Buildings ~~P1/3~~

*

Bldg	Elevation ~~Level~~	Type	F/A Units (feet)	A Units (feet)
ROLB (1101)	-15'	Pipe = P	2100	605
	↓	Vent = V	1100	..
		Tanks = T		210
	elevators 0' pipe	P	170	180
	+10' Heating	P	700	
RB	+12'	P	1650	
	0'	P	800	60
	-15'	(16") P-HPS	500 (190)	50 (20)
		(12") P-CAR		180 (60)
		(24") P-Ex Air		720 (120)
	↓	P-Mix	800	80
	-25'	V	640	
	-25'	chiller		250
HL (1112)	Back side	P	1625	40
	"	V	1250	
	Front side	P	560	
	Pipe Tunnel	Ex Air	60 (20)	1470 (245)
CV (1111)	0'	P	520	50
	Minus levels	P		500
	" "	P-Waste Air		1170 (195)

* Note Units are in Square feet for pipes larger than 8" Dia. and tanks & Vents
Units are in linear feet for pipe less than 8" Dia
for larger pipe the number of linear feet is listed in parentheses ( ).

Bldg	Level	Type	F/A	A
FH	0	P	175	45
1123	-15'	P-Misc	120	
		P-Ex Air*	750 (50)	

* includes pipe & filter unit

Bldg	Level	Type	F/A	A
WHB	0'	P-Boiler Rm	140	50
(1183)	0'	T " "		300
	0'	P	830	
	+12'	P	450	
	+12'	V	1200	
	-15'	P	390	

WHB - Probably Contaminated - Not Included Above

Bldg	Level	Type	F/A	A
(1133)	Evap System	P	100	260
	" "	T	370	
SEB	Inside	P	960	130
1131	Outside	P	70	
	Tunnel	P	480	

Units of Asbestos and Fiberglass/Asbestos

BLDG		F/A	A
ROLB	([illegible])	4070	995
RB	(1111)	4390	1090
HL	(1112)	3495	1510
CV	(1111)	520	1720
FH	(1132)	1045	45
WHB	([illegible]) non-c	3010	350
	contaminated	470	260
SEB	([illegible])	1510	130
Total		18510	6100

Subsystems – included	above	
Ex Air	810	2190
CAR		300
Waste Air		1170
HPS	500	365
Vents	4190	

ASBESTOS REMOVAL PROCEDURES CHECK LIST

1. Notify EPA - Contractors required to notify EPA 10 days before beginning work.

2. Sealing Off Area - Work area should be sealed off with plastic sheeting and negative air pressure maintained during removal period (4 air changes minimum/hr).

3. Protective Clothing - Employes working the removal area are to wear disposable protective clothing.

4. Respirator Program - Approved respirators are to be worn in the removal area and an established respirator program followed.

5. Wet Removal - All material is to be thoroughly saturated prior to removal.

6. Cleaning Rooms or Areas - Contractors to provide clean room or area for workers to change into protective clothing and masks.

7. Clean-up - The entire area should be wet cleaned using mops, rags, and sponges. After a 24 hour period to allow settling of dust the entire area should be mopped again.

8. Air Monitoring - Air monitoring is to be conducted during the removal and after the removal.

9. Caution Signs and Labels - Caution signs and labels required by OSHA and EPA are to be posted.

10. Disposal of Material - Contractor will dispose of materials at EPA approved disposal sites. All materials are to be bagged in double polyethlene bags ~~3~~ 6 mil thick, tightly sealed, labeled, washed and placed into metal or fiber drums for transportation.

11. Evidence of Training for Workers - Contractors should provide documentation that workers used to remove asbestos have been trained in the proper procedures.

12. Compliance With State, Federal, and Plant Regulations - Contractors expected to comply with all State, Federal and Plant safety regulations.

13. Verification of Insurance - Contractor must provide verification of workmen's compensation insurance and other insurance required.

14. No debris shall be left on floor at end of daily shift but shall be properly disposed of before completion of daily work.

B

ASBESTOS DEMOLITION/RENOVATION NOTIFICATION
(See submission instructions on back)

1. Check one only:

☐ Renovation involving at least 260 linear feet or 160 square feet of friable a[...] material (Notification required as soon as possible before renovation).

☐ Demolition involving at least 260 linear feet or 160 square feet of friable asb[...] material (10 day notification required, except for ordered demolition).

☐ Demolition involving less than 260 linear feet or 160 square feet of friable as[...] material (20 day notification required). Complete items (1) through (6) only.

---

2. Name of owner:

Address:

Phone: (   )

Name of operator (contractor):
Affiliated Environmental Services

Address:
219 Fremont Ave. Sandusky, OH 44[...]

Phone: (419) 627 1976

---

3. Facility location.

---

4. Facility description (include size, age and prior use).

---

5. Estimate of friable asbestos ________ linear ft. ________ square ft.
Explain estimation techniques if less than 260 linear ft. or 160 square ft.

---

6. Scheduled started date ________________ Completion date ________________

---

7. Nature of planned demolition or renovation and methods to be used.

---

8. Procedures to be used to insure compliance with 40 CFR §61.147.

---

9. Name and location of approved landfill where asbestos will be deposited.

Phone: (   )

---

10. If ordered demolition, the name, title and authority of state or local governmental representative who has ordered the demolition.

Phone: (   )

Number of days to demolish _____

=====================================OHIO EPA USE ONLY=====================================

Postmarked ____________

Reviewed by ____________

Inspected on ____________

Inspected by ____________

Delivered (date stamp)

DAPC 4/84

INSTRUCTIONS: Mail completed form to the address of the field office with jurisdiction in the county where the asbestos removal is taking place.

---

1. Delaware, Fairfield, Fayette, Franklin, Knox, Licking, Madison, Morrow, Pickaway and Union Counties:

   Ohio EPA, Central District Office
   Air Pollution Group
   361 East Broad Street
   Columbus, Ohio 43215

2. Ashtabula, Holmes, Lorain, and Wayne Counties:

   Ohio EPA, Northeast District Office
   Air Pollution Group
   2110 East Aurora Road
   Twinsburg, Ohio 44087

3. Allen, Ashland, Auglaize, Crawford, Defiance, Erie, Fulton, Hancock, Hardin, Henry, Huron, Marion, Mercer, Ottawa, Paulding, Putnam, Richland, Sandusky, Seneca, Van Wert, Williams, Wood and Wyandot Counties:

   Ohio EPA, Northwest District Office
   Air Pollution Group
   1035 Devlac Grove Drive
   Bowling Green, Ohio 43402

4. Athens, Coshocton, Gallia, Guernsey, Hocking, Jackson, Meigs, Morgan, Muskingum, Noble, Perry, Pike, Ross, Tuscarawas, Vinton and Washington Counties:

   Ohio EPA, Southeast District Office
   Air Pollution Group
   2195 Front Street
   Logan, Ohio 43138

5. Champaign, Clinton, Highland, Logan and Shelby Counties:

   Ohio EPA, Southwest District Office
   Air Pollution Group
   7 East Fourth Street
   Dayton, Ohio 45402

6. Medina, Portage and Summit Counties:

   Air Pollution Control
   177 South Broadway
   Akron, Ohio 44308

7. Stark County:

   [illegible] of Air Pollution Control

8. Butler, Clermont, Hamilton and Warren Counties:

   Southwestern Ohio Air Pollution Control Agency
   2400 Beekman Street
   Cincinnati, Ohio 45214

9. Cuyahoga County:

   Bureau of Engineering Services
   Division of Air Pollution Control
   2735 Broadway
   Cleveland, Ohio 44115

10. Clark, Darke, Greene, Miami, Montgomery and Preble Counties:

    Regional Air Pollution Control Agency
    451 West Third Street
    Dayton, Ohio 45402

11. Geauga and Lake Counties:

    Lake County General Health District
    Air Pollution Control
    105 Main Street
    P. O. Box 490
    Painesville, Ohio 44077

12. Adams, Brown, Lawrence and Scioto Counties:

    Portsmouth City Health Department
    728 Second Street
    Portsmouth, Ohio 45662

13. Belmont, Carroll, Columbiana, Harrison, Jefferson and Monroe Counties:

    North Ohio Valley Air Authority
    814 Adams Street
    Steubenville, Ohio 43952

14. Lucas County:

    Toledo Environmental Services Agency
    26 Main Street
    Toledo, Ohio 43505

15. Mahoning and Trumbull Counties:

    Mahoning-Trumbull Air Pollution Control
    Metropolitan Tower, Room 404
    1 Federal Plaza, West
    Youngstown, Ohio [illegible]

John Scripp
9 W. Front St
Rm 107
Y[illegible] OH
44503

C

Landfills That Have Accepted Asbestos Waste Within The Last Year In The Northwest District

1. Evergreen Landfill - Northwood (Toledo)
2. Fondessy Landfill - Oregon (Toledo)
3. Ashland County Landfill
4. BFI Landfill - Ottawa County
5. Ohio Sanitation Systems - Lima Landfill
6. City of St. Marys Landfill

Note: Only solid waste landfills having a valid license from the County Health Department and the Ohio EPA can take asbestos waste. These facilities must have their disposal procedure approved by Ohio EPA prior to accepting each project's waste. With this in mind, the landfills listed must still be approved by Ohio EPA each time they accept asbestos waste. Also, landfills not listed may be contacted to see if they are willing to accept asbestos waste after approval by Ohio EPA.

D

Asbestos Information

1. U.S. EPA
   Office of Toxic Substances
   Washington, DC 20460
   1-800-424-9065 or
   1-800-424-1002
   (202) 554-1404
   Asbestos in homes, contractors, general public

   1-800-334-8571 Ext. 6741
   Contractors Only

   a. Asbestos-Containing Materials in School Buildings Part 1 & Part 2

   b. Guidance for Controlling Friable Asbestos-Containing Materials in Buildings

2. National Cancer Institute
   Office of Cancer Communications
   Bldg. 31; Rm. 10A18
   9000 Rockville Pike
   Bethesda, Maryland 20014
   1-800-638-6694

   a. Asbestos Exposure: What it means, what to do

   b. Asbestos and Health Bibliography

   c. Asbestos-An Information Resource

3. National Assn. of Asbestos Abatement Contractors
   Lawrence, Kansas
   (913) 749-4032

E

National Emission Standard for Hazardous Air Pollutants: Asbestos Removal Summary

The following NESHAP summary is an informal discussion of the asbestos removal requirements and is not a complete or thorough description of the federal rules. Please refer to the National Emission Standard for Asbestos at 40 CFR, Part 61.2 for a comprehensive interpretation.

1. Applicability: Any demolition or renovation operation involving industrial, commercial or institutional facilities where friable asbestos material is being removed must comply with the following procedures (with few exceptions). "Friable asbestos material" is any substance containing one percent or more asbestos which can be crumbled or pulverized, when dry, by hand pressure.

2. Notification: A written notice of intention shall be provided to Ohio EPA by the owner or operator of the demolition or renovation operation at least 10 days prior to the commencement of the operation. Such notice shall include:

   i) Name of owner or operator.
   ii) Address of owner or operator.
   iii) Description of facility involved, including
      a) size
      b) age
      c) prior use
      d) approximate amount of asbestos material present
   iv) Address or location of facility.
   v) Starting and completion dates of demolition or renovation.
   vi) Nature and method of demolition or renovation.
   vii) Procedures to be employed to meet asbestos removal requirements.
   viii) Name and address of the waste disposal site where the asbestos material will be deposited.
   ix) Name, title and authority of the state/local government representative (if any) who ordered the demolition of a structure in danger of imminent collapse.

   All asbestos removal notifications shall be addressed to:

   Air Pollution Control Unit
   Ohio EPA - Northwest District Office
   1035 Devlac Grove Drive
   Bowling Green, OH 43402

3. Removal Procedures:

   i) Friable asbestos material shall be removed prior to any dismantling or wrecking of any portion of a structure which would break up or preclude access to such material.
   ii) All asbestos materials shall be thoroughly wetted prior to and during stripping and removal.

iii) All asbestos material shall be packed in leak-proof containers and sealed for shipping to an approved asbestos disposal site.

iv) There shall be no visible emissions to the outside air at any time during the collection, packaging, transportation or deposition of any asbestos material.

v) For renovation operations, a local exhaust collection and ventilation system may be used when damage would result from wetting the asbestos material.

4. Exemptions: Demolition operations involving asbestos containing material less than 80 meters (260 feet) of pipe insulation and less than 15 square meters (160 square feet) of other types of asbestos material are exempted from the removal procedures, (3) above. Notification of an exempted operation shall be made at least 20 days prior to commencement of the operation and shall include items i, ii, iv and v of (2) above and shall state the measured or estimated amount of asbestos material present.

5. Disposal of Asbestos Materials: Disposal of leak-proof containers of asbestos materials shall be made at a licensed landfill duly approved by the Ohio EPA, Division of Land Pollution Control to accept asbestos containing wastes. The landfill shall be given ample advance notice in order to prepare a site for the disposal. The containers shall be identified with a label which states:

CAUTION

Contains Asbestos

Avoid Opening or Breaking Container

Breathing Asbestos is Hazardous to Your Health

6. For a complete explanation of asbestos rules governing demolition and renovation, refer to U.S. EPA National Emission Standard for Asbestos, 40 CFR part 61.2, and OSHA Asbestos Regulations, 29 CFR 1910.1001. Several communities have local ordinances concerning demolition and renovation which also must be followed.

INTRODUCTION

The following guidelines are intended to adhere to the National Emission Standards for Hazardous Air Pollutants (NESHAP 40 CFR Part 61) and to comply with Ohio's Solid Waste Disposal Regulations (OAC 3745-27 & 37).

APPLICABILITY

For purposes of this policy, the term "asbestos containing waste material" as applied to demolition and renovation includes only friable asbestos waste and control device asbestos waste.

DEFINITIONS

1. "Adequately Wetted" means sufficiently mixed or coated with water to prevent dust emissions.

2. "Control Device Asbestos Waste" means any asbestos-containing waste material that is collected in a pollution control device (e.g. air pollution control device).

3. "Demolition" means the wrecking or taking out of any load-supporting structural member, and any related removing or stripping of friable asbestos materials.

4. "Friable Asbestos Waste" means any material that contains more than 1 percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder, when dry, by hand pressure.

5. "Renovation" means the removing or stripping of friable asbestos material used on any pipe, duct, boiler, tank, reactor, turbine, furnace or structural member.

SANITARY LANDFILL REQUIREMENTS

1. Asbestos containing waste material shall be disposed of at a licensed sanitary landfill that has satisfactorily demonstrated to the Ohio EPA the capability of adhering to this policy. Satisfactory demonstration shall be confirmed in writing by the Ohio EPA.

2. The landfill shall not accept asbestos containing waste material unless:

   a. It has been adequately wetted, double-bagged in plastic and/or placed into a sealable drum. The container must be leak tight.

   b. The drums have been properly identified with a label that states:

CAUTION
Contains Asbestos
Avoid Opening or Breaking Container
Breathing Asbestos is Hazardous to your Health

or labels specified by OSHA under 29 CFR 1910.93 a (g)(2)(ii) may be used.

3. There shall be no visible emissions to the outside air of asbestos containing waste material.

4. The landfill should be given notification prior to any delivery of wastes. Asbestos containing waste should be delivered to the landfill early in the day and placed at the toe of the operating slope so that additional refuse may be placed over the drums before compaction. Extreme care should be taken to prevent rupturing containers and a contingency plan available in case of such a rupture.

5. A well compacted layer of suitable non-asbestos containing cover material not less than six inches thick shall be placed over all such waste materials by the end of the working day.

6. The operator of the landfill must demonstrate the employees have had adequate instructions on the dangers of asbestos exposure, on respirator use, decontamination and OSHA regulations. Respirators (as required by OSHA) will be supplied to the workers unloading the drums and to machinery operators. Questions regarding OSHA requirements should be directed to the following local OSHA offices:

Industrial

Cleveland - (216)522-3819
Cincinnati - (513)684-3784
Toledo - (419)259-7542
Columbus - (614)469-5582

7. Receipts of asbestos containing waste material should be limited to that quantity the operator is capable of handling satisfactorily.

8. If operational difficulties occur, the acceptance of asbestos containing waste material shall cease until the problem is alleviated.

9. A letter from the Ohio EPA District Office should be obtained for each disposal project prior to the actual disposal of asbestos containing wastes at any landfill. District Office phone numbers are:

Central- (614)466-6450
Northeast - (216)425-9171
Northwest - (419)352-8461
Southeast - (614)385-8501
Southwest - (513)461-4670

F

WORKER QUALIFICATION CERTIFICATION

EMPLOYEE NAME: ______________________ SOC. SEC. NO.: ____________

EMPLOYEE ADDRESS: ____

____

TELEPHONE NO.: (___)____________ BIRTHDATE: ______________

PULMONARY FUNCTION TEST:

LATEST DATE: ____

PHYSICIAN: ____

ADDRESS: ____

MEDICAL EXAMS:

LATEST DATE: ____

PHYSICIAN: ____

ADDRESS: ____

X-RAY:

LATEST DATE: ____

PHYSICIAN: ____

ADDRESS: ____

ASBESTOS-RELATED TRAINING PROGRAMS ATTENDED:

______________________________________ DATE: ______________

______________________________________ DATE: ______________

EXPERIENCE AND DATES OF ASBESTOS-RELATED WORK:

____

____

____

____

Do you now have, or have you had, any respiratory problems? Yes [ ] No [ ]

Have you worked in the past with asbestos or fiberglass type materials? Yes [ ] No [ ]

This project involves the handling, removal and disposal of asbestos from the building. Asbestos is considered a health hazard.

I certify that my statements and answers are true and that I am familiar with all applicable OSHA and EPA regulations concerning the handling, removal and disposal of friable asbestos-containing materials.

Signed ______________________________ Date: ______________
Worker

I certify that the above information is true, to the best of my knowledge, and that this worker has had the necessary medical examination and training required for asbestos abatement work.

Signed ______________________________ Date: ______________
Contractor

AFFILIATED ENVIRONMENTAL SERVICES, inc.

219 FREMONT AVENUE, SANDUSKY, OHIO 44870 (419) 627-1976

ASBESTOS CONTROL

1.0 GENERAL

1.1 DESCRIPTION OF WORK

1.1.1 FURNISH ALL LABOR, MATERIALS, SERVICES, INSURANCE AND EQUIPMENT NECESSARY TO CARRY OUT REMOVAL, ENCAPSULATION AND/OR ENCLOSURE OF FRIABLE ASBESTOS IN ACCORDANCE WITH THE REGULATIONS CITED HEREAFTER.

1.1.2 CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING APPROVAL FOR TRANSPORTATION AND PROPER DISPOSAL OF WASTES, INCLUDING PLASTIC SHEETING, DISPOSABLE CLOTHING AND ASBESTOS WASTE.

1.1.3 CONTRACTOR SHALL HAVE PRIOR EXPERIENCE IN ASBESTOS REMOVAL (IF REMOVAL IS REQUIRED) AS DEMONSTRATED IN AT LEAST 3 COMPLETED ASBESTOS REMOVAL PROJECTS.

1.1.4 CONTRACTOR SHALL PROVIDE PROOF OF INSURANCE COVERING PERFORMANCE OF ASBESTOS WORK.

1.1.5 CONTRACTOR SHALL NOTIFY EPA BY PHONE AND SUBMIT THE "ASBESTOS DEMOLITION/RENOVATION NOTIFICATION" FORM TO THE EPA PRIOR TO STARTING REMOVAL OPERATIONS.

1.2 REGULATORY REQUIREMENTS

1.2.1 THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF U.S. EPA REGULATIONS, NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS, 40 CFR PART 61, SUBPART B, NATIONAL EMISSION STANDARDS FOR ASBESTOS; OSHA GENERAL INDUSTRY STANDARDS, 29 CFR 1910, SUBPART Z, TOXIC AND HAZARDOUS SUBSTANCES, SECTION 1910.1001, ASBESTOS; AND ANY APPLICABLE STATE AND LOCAL REGULATIONS.

1.2.2 CONTRACTOR SHALL HAVE A COPY OF THE ABOVE REFERENCED EPA AND OSHA REGULATIONS AT THE JOB SITE, AS WELL AS A COPY OF THE CONTRACTOR'S ASBESTOS TRAINING PROGRAM MANUAL AND RESPIRATOR PROGRAM.

219 FREMONT AVENUE, SANDUSKY, OHIO 44870 (419) 627-1976

1.3 JOB SITE CONDITIONS

1.3.1 CONTRACTOR WORKERS SHALL BE TRAINED IN SAFE WORK PRACTICES.

1.3.2 WORKERS SHALL BE PROVIDED WITH RESPIRATORS APPROVED BY THE BUREAU OF MINES, DEPARTMENT OF THE INTERIOR, OR THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH, DEPARTMENT OF HEALTH EDUCATION AND WELFARE, UNDER THE PROVISIONS OF 30 CFR PART 11 (37 FR 6244, MARCH 25, 1972).

1.3.3 A RESPIRATOR PROGRAM IN COMPLIANCE WITH OSHA 1910.143 SHALL BE FOLLOWED.

1.3.4 SUFFICIENT AMOUNT OF FILTERS APPROVED FOR ASBESTOS SHALL BE PROVIDED SO WORKERS CAN CHANGE FILTERS THROUGHOUT THE WORKDAY.

1.3.5 FILTERS SHALL NOT BE STORED AT THE JOB SITE, SO AS TO PROTECT AGAINST EXPOSURE TO ASBESTOS PRIOR TO USE.

1.3.6 ALL PERSONNEL IN THE WORK AREA SHALL BE REQUIRED TO WEAR PROPERLY FITTED RESPIRATORS.

1.3.7 ALL PERSONS MUST HAVE BEEN QUALITATIVELY FACE FITTED WITH THE TYPE OF MASK USED IN THE LAST 60 DAYS.

1.3.8 WORKERS SHALL BE INSTRUCTED AND TRAINED IN ASBESTOS HAZARDS AND PROPER RESPIRATOR USE.

1.3.9 ALL PERSONNEL SHALL WEAR PROTECTIVE, DISPOSABLE CLOTHING CONSISTING OF FULL-BODY COVERALLS AND DISPOSABLE HEAD COVERS, GLOVES AND RESPIRATORS IN THE WORK AREA. FOOTWARE MAY BE DISPOSABLE OR NON-DISPOSABLE. NON-DISPOSABLE FOOTWARE SHALL BE LEFT IN THE WORK AREA AT ALL TIMES UNTIL COMPLETION OF THE JOB AND SHALL THEN BE PROPERLY DISPOSED OF.

1.3.10 A CHANGE ROOM SHALL BE SET UP AS CLOSE AS POSSIBLE TO THE WORK AREA.

1.3.11 SHOWERS SHALL BE REQUIRED WHERE ASBESTOS DUST EXCEEDS ONE-HALF FIBER, LONGER THAN 5 MICROMETERS, PER CUBIC CENTIMETER OF AIR.

1.3.12 CONTRACTORS PERSONNEL REQUIREMENTS:

A. ALL STREET CLOTHING IS TO BE REMOVED AND STORED IN AN AREA SEPARATED FROM THE REMOVAL ZONE. CLEAN SETS OF PROTECTIVE CLOTHING WILL BE PUT ON AT THIS POINT AND WORN INTO THE ZONE; PROTECTIVE CLOTHING SHALL NOT BE WORN OUT OF THE ZONE AFTER INITIAL ENTRY.

B. PROTECTIVE CLOTHING SHALL BE REMOVED AT THE BUFFER AREA LOCATED BETWEEN THE STREET CLOTHES CHANGE ROOM AND THE SHOWER AREA. A CLEAN SET OF PROTECTIVE CLOTHING SHALL BE PUT ON TO TRAVEL INTO THE SHOWER AREA.

C. PERSONNEL SHALL PROCEED TO A WASH-UP AREA WHERE THEY SHALL, AFTER WASHING, DISINFECT AND CLEAN THEIR RESPIRATORS.

D. WHERE SHOWERS ARE REQUIRED, PERSONNEL SHALL PROCEED TO THE SHOWERS WEARING THEIR RESPIRATORS AND REMOVE THEM WHILE SHOWERING WITH SOAP AND WATER. RESPIRATORS SHALL BE CLEANED AT THIS TIME.

E. RESPIRATORS SHALL BE STORED IN A CLEAN AND SANITARY MANNER AFTER THEY HAVE BEEN CLEANED AND ARE NOT IN USE.

F. PERSONNEL SHALL NOT EAT, DRINK, SMOKE, OR CHEW GUM OR TOBACCO IN THE WORK AREA. TO EAT, DRINK OR SMOKE, WORKERS SHALL REMOVE DISPOSABLE WORK CLOTHES AND FOOTWARE IN THE WORK AREA. AFTER REMOVING THEIR RESPIRATORS, CONTRACTORS PERSONNEL SHALL PROCEED TO WASH-UP AREA, THEN DRESS IN NEW CLEAN DISPOSABLE COVERALLS BEFORE EATING, DRINKING OR SMOKING.

1.4.13 RESPIRATORS, DISPOSABLE COVERALLS, HEAD COVER AND FOOTWARE SHALL BE PROVIDED TO ALL PERSONS INSPECTING THE JOB SITE.

2.0 PRODUCTS

2.1 NOT APPLICABLE

3.0 EXECUTION

3.1 WORK AREA PREPARATION

3.1.1 IF WORK INVOLVES ONLY SMALL AREAS OF PIPE AND BOILER INSULATION, SPECIFICATIONS IN PARAGRAPH 3.3 MAY BE SUBSTITUTED FOR PARAGRAPH 3.1.

3.1.2 SET-UP FACILITIES OUTSIDE OF THE WORK AREA WHICH CONSIST OF A CHANGE ROOM, BUFFER AREA, WASH-UP AREA (OR SHOWERS WHERE REQUIRED) AND EQUIPMENT AREA.

3.1.3 ISOLATE THE WORK AREA BY COMPLETELY SEALING OFF WITH 4 MIL PLASTIC SHEETING, TAPED SECURELY IN PLACE, ALL OPENINGS AND FIXTURES IN THE WORK AREA INCLUDING, BUT NOT LIMITED TO, HEATING AND VENTILATION DUCTS, DOORWAYS, CORRIDORS, WINDOWS, SKYLIGHTS, AND LIGHTING.

3.1.4 ALL WALL SURFACES IN THE WORK AREA SHALL BE COVERED WITH, 4 MIL PLASTIC SHEETING TAPED SECURELY IN PLACE.

3.1.5 ALL FLOOR SURFACES SHALL BE COVERED WITH A DOUBLE LAYER OF 6 MIL PLASTIC SHEETING.

3.1.6 BUILD DOUBLE BARRIERS OF 4 MIL PLASTIC SHEETING AT ALL ENTRANCES AND EXITS TO THE WORK AREA SO THAT THE WORK AREA IS ALWAYS CLOSED OFF BY ONE BARRIER WHEN WORKERS ENTER OR EXIT. USE A CURTAIN TYPE DOOR TO ENTER AND EXIT TO ZONES.

3.1.7 A MICROTRAP FILTRATION SYSTEM (HEPA) SHALL BE PROVIDED TO SET UP A NEGATIVE AIR FLOW INSIDE THE SEALED OFF AREA.

3.1.8 BEFORE THE WORK BEGINS, WET CLEAN ALL REMOVABLE ITEMS AND EQUIPMENT NOT LOCATED ON THE ASBESTOS MATERIAL, REMOVE THEM FROM THE WORK AREA, AND THEN RETURN THESE ITEMS AND EQUIPMENT TO THE WORK AREA AFTER THE JOB HAS BEEN COMPLETED AND THE AREA HAS BEEN THOROUGHLY CLEANED.

3.1.9 COVER ALL NON-REMOVABLE ITEMS AND EQUIPMENT IN THE WORK AREA WITH PLASTIC SHEETING TAPED SECURELY IN PLACE.

3.1.10 AFTER WORK AREA ISOLATION, THE CONTRACTOR SHALL TAKE OUT ALL DETACHABLE ELECTRICAL, HEATING, AND VENTILATION EQUIPMENT, AND OTHER ITEMS LOCATED ON THE ASBESTOS MATERIAL, CLEAN THEM BEFORE COVERING WITH PLASTIC SHEETING TAPED SECURELY IN PLACE, AND RETURN THEM TO THEIR PROPER PLACE AFTER THE JOB HAS BEEN COMPLETED AND THE WORK AREA HAS BEEN DECONTAMINATED.

3.1.11 REMOVE ALL HEATING, VENTILATION, AND AIR CONDITIONING SYSTEM FILTERS, ENCLOSE THEM IN SEALABLE PLASTIC BAGS (6-MIL MINIMUM) FOR BURIAL IN AN APPROVED WASTE DISPOSAL SITE AND REPLACE THEM WITH NEW FILTERS.

3.1.12 ESTABLISH EMERGENCY AND FIRE EXITS FROM THE WORK AREA.

3.1.13 PLACE CAUTION SIGNS INSIDE AND IMMEDIATELY OUTSIDE THE WORK AREA ADVISING PEOPLE ENTERING THE AREA OF THE HAZARDS OF EXPOSURE TO ASBESTOS.

3.2 METHOD OF REMOVAL FOR TROWELED OR SPRAYED SURFACES

3.2.1 WHERE ASBESTOS MATERIAL DOES NOT MAINTAIN ITS BONDING INTEGRITY OR IT IS SATURATED WITH WATER, REMOVAL SHALL BE NECESSARY.

3.2.2 ASBESTOS MATERIAL SHALL BE SPRAYED WITH WATER CONTAINING A WETTING AGENT TO ENHANCE PENETRATION PRIOR TO START OF REMOVAL AND SHALL BE KEPT WETTED UNTIL SEALED IN 6 MIL PLASTIC BAGS. THE WETTING AGENT SHALL BE 50% POLYOXYETHYLENE ESTER AND 50% POLYOXYETHYLENE ETHER (AQUA-GRO), OR THE EQUIVALENT, IN A CONCENTRATION OF ONE (1) OUNCE IN FIVE (5) GALLONS OF WATER. A

FINE SPRAY OF THE AMENDED WATER SHALL BE APPLIED TO REDUCE FIBER RELEASE PRECEDING THE REMOVAL OF THE ASBESTOS MATERIAL. THE MATERIAL SHALL BE SUFFICIENTLY SATURATED TO PREVENT EMISSION OF AIRBORNE FIBERS IN EXCESS OF THE EXPOSURE LIMITS PRESCRIBED IN OSHA AND EPA REGULATIONS REFERENCED IN THESE SPECIFICATIONS.

3.2.3 DAMAGED ASBESTOS MATERIAL SHALL BE REMOVED IN SMALL SECTIONS. BEFORE BEGINNING THE NEXT SECTION, THE MATERIAL REMOVED SHALL BE PACKED WHILE STILL WET INTO SEALABLE PLASTIC BAGS (6-MIL MINIMUM) AND PLACED INTO FIBER OR METAL DRUMS OR SKIPS FOR TRANSPORT. BAGS, DRUMS AND SKIPS SHALL BE MARKED WITH THE APPLICABLE LABEL PRESCRIBED BY THE REGULATIONS. EXTERIOR SURFACE OF ALL CONTAINERS SHALL BE CLEAN BEFORE LEAVING THE WORK AREA.

3.2.4 ALL PLASTIC SHEETING, TAPE, CLEANING MATERIAL, CLOTHING AND ALL OTHER DISPOSABLE MATERIAL OR ITEMS USED IN THE WORK AREA SHALL BE PACKED INTO SEALABLE PLASTIC BAGS (6-MIL MINIMUM) AND PLACED INTO METAL OR FIBER DRUMS OR SKIPS FOR TRANSPORT. DRUMS AND SKIPS SHALL BE MARKED WITH THE APPLICABLE LABEL PRESCRIBED BY REFERENCED REGULATIONS WHICH STATES:

A. CAUTION
B. CONTAINS ASBESTOS FIBERS
C. AVOID CREATING DUST
D. BREATHING ASBESTOS MAY CAUSE SERIOUS BODILY HARM

3.2.5 CONTRACTOR SHALL BE RESPONSIBLE FOR TRANSPORTING THE SEALED DRUMS OR BAGS TO AN APPROVED WASTE DISPOSAL SITE. SEALED 6 MIL PLASTIC BAGS MAY BE REMOVED FROM DRUMS AND PLACED INTO BURIAL SITE IF BAGS HAVE NOT BEEN BROKEN OR DAMAGED. DAMAGED BAGS SHALL BE LEFT IN THE DRUM AND ENTIRE CONTAMINATED DRUM SHALL BE BURIED.

3.3 METHOD OF REMOVAL FOR PIPE AND BOILER INSULATION.

3.3.1 WHERE LARGE PORTIONS OF MATERIAL MUST BE REMOVED ALL THE PROTECTIVE MEASURES STATED ELSEWHERE IN THIS SPECIFICATION SHALL BE FOLLOWED.

3.3.2 WHERE SMALL AREAS OR SECTIONS OF MATERIAL MUST BE REMOVED OR REPAIRED, CONTAINMENT BAGS WITH SEALED HOLES FOR HAND ACCESS ARE ALTERNATIVES TO FULL ROOM OR FULL WORK AREA CONTAINMENT.

3.3.3 A PROFO-BAG BY ASBESTOS CONTROL TECHNOLOGY OR EQUIVALENT SHALL BE USED.

A. THESE BAGS ARE POSITIONED AROUND THE PIPE INSULATION TO BE REMOVED AND SEALED TO THE PIPE WITH TAPE. ARM HOLES AND AN

INSIDE POUCH FOR TOOLS LET THE WORKER REMOVE INSULATION WITHOUT RELEASING ASBESTOS FIBERS.

B. A SEALED SIDE PORT CAN BE CONSTRUCTED TO ALLOW WETTING OF THE ASBESTOS AND EVACUATION OF THE BAG WITH A MICROTRAP FILTRATION SYSTEM (HEPA-FILTERED VACUUM).

3.3.4 TO REMOVE INDIVIDUAL PIPE SECTIONS WITH ASBESTOS INSULATION INTACT, ABOUT AN INCH OF INSULATION SHALL BE REMOVED USING A PROFO-BAG OR EQUIVALENT.

A. THE PIPE SHALL THEN BE CUT INTO LENGTHS WHERE THE ASBESTOS INSULATION WAS REMOVED.

B. EXPOSED ENDS SHALL THEN BE SEALED WITH PLASTIC AND TAPED OR ENCAPSULATED.

C. ENTIRE PIPE AND PIPE INSULATION SHALL BE WRAPPED IN 6 MIL PLASTIC AND SECURED WITH TAPE IF THE REMAINING INSULATION ON PIPE IS NOT IN GOOD CONDITION.

3.3.5 REMOVED ASBESTOS AND PIPING MUST BE DISPOSED OF AS SPECIFIED IN PARAGRAPH 3.2, METHOD OF REMOVAL FOR SPRAYED OR TROWELED SURFACES.

3.4 METHOD OF ENCAPSULATION

3.4.1 ENCAPSULATION SHALL BE LIMITED TO ASBESTOS MATERIAL THAT STILL RETAINS ITS BONDING INTEGRITY, SINCE THE MATERIAL MUST SUPPORT THE ADDITIONAL WEIGHT OF THE SEALANT.

3.4.2 NON-ASBESTOS CONTAINING INSULATING MATERIAL MAY BE USED TO REPAIR REMOVED DAMAGED ASBESTOS BEFORE ENCAPSULATION. REMOVAL OF DAMAGED SECTIONS SHALL COMPLY WITH ALL PROTECTIVE MEASURES STATED ELSEWHERE IN THIS SPECIFICATION.

3.4.3 SPRAYED SEALANT SHALL BE APPLIED USING AIRLESS SPRAY EQUIPMENT AT A LOW PRESSURE SETTING, OR OTHER ACCEPTABLE METHODS TO MINIMIZE FIBER RELEASE DURING APPLICATION.

3.4.4 SPRAYED SEALANT SHALL ELIMINATE FIBER DISPERSAL BY ADHERING TO THE FIBROUS SUBSTRATE WITH SUFFICIENT PENETRATION TO PREVENT SEPARATION OF THE SEALANT FROM THE ASBESTOS MATERIAL.

3.4.5 FIBERGLASS CLOTH (OR EQUIVALENT) DIPPED IN A SEALANT MAY BE USED TO WRAP DUCTWORK AS AN ALTERNATIVE TO A SPRAY SEALANT METHOD.

3.4.6 SEALANT SHALL WITHSTAND MOST IMPACT AND PENETRATIONS WITHOUT LOSING ITS INTEGRITY.

3.4.7 SEALANT SHALL BE FLEXIBLE ENOUGH TO ACCOMMODATE ATMOSPHERIC CHANGES AND SETTLING OVER TIME.

3.4.8 SEALANT SHALL HAVE HIGH FLAME RETARDANT CHARACTERISTICS AND LOW TOXIC FUME AND SMOKE EMISSION RATINGS.

3.4.9 SEALANT SHALL BE EASY TO APPLY AND REPAIR BY NON-SPECIALIZED PERSONNEL.

3.4.10 SEALANT SHALL BE NEITHER NOXIOUS NOR TOXIC TO WORKERS OR USERS THEREAFTER.

3.4.11 SEALANT SHALL HAVE SOME PERMEABILITY TO WATER VAPOR TO PREVENT CONDENSATION ACCUMULATION.

3.4.12 SEALANT SHALL EXHIBIT STABILITY TO WEATHERING AND AGE.

3.4.13 ENCAPSULATION SHALL NOT BE PERFORMED WHERE SURFACES ARE ACCESSIBLE TO PHYSICAL DAMAGE.

3.5 METHOD OF ENCLOSURE

3.5.1 ENCLOSURE SHALL PLACE A BARRIER BETWEEN ASBESTOS MATERIAL AND ALL AREAS OF ACTIVITY. A SUSPENDED BARRIER OR AN ATTACHED LATH SYSTEM SHALL BE ACCEPTABLE.

3.5.2 BARRIER SYSTEM SHALL NOT CONNECT WITH AN AIR PLENUM SYSTEM.

3.5.3 ENCLOSED SPACE BEHIND THE BARRIER SHALL NOT COMMUNICATE WITH ANY OCCUPIED PORTIONS OF THE BUILDING.

3.5.4 INSTALLATION OF A BARRIER SYSTEM SHALL MEET ALL WORKER TRAINING, PROTECTION, CLEANUP AND DISPOSAL REQUIREMENTS CITED ELSEWHERE IN THIS SPECIFICATION.

3.5.5 ENCLOSURE SYSTEMS SHALL NOT BE USED IN HIGH ACTIVITY AREAS SUSCEPTIBLE TO DAMAGE.

3.6 CLEANING

3.6.1 AFTER REMOVAL WORK, ALL SURFACES IN THE WORK AREA SHALL BE CLEANED (SCRAPED, WIRE BRUSHED AND WASHED) AND VACUUMED WITH A HIGH EFFICIENCY PARTICULATE ABSOLUTE (HEPA) FILTERED VACUUM AFTER THE AREA COMPLETELY DRIES (HEPA VACUUMS WILL FAIL IF USED ON WET MATERIAL.) AFTER CLEANING THE WORK AREA, WAIT 24 HOURS TO ALLOW FOR SETTLEMENT OF DUST, AND THEN WET-CLEAN OR VACUUM ALL SURFACES IN THE WORK AREA AGAIN. AFTER COMPLETION OF THE SECOND CLEANING OPERATION, PERFORM A COMPLETE VISUAL INSPECTION OF THE WORK AREA TO ENSURE THAT THE WORK AREA IS

DUST FREE. IN LIEU OF SECOND CLEANING AFTER REMOVAL IS COMPLETE (SCRAPED, WIRE BRUSHED AND WASHED) AND NO VISIBLE ASBESTOS REMAINS, THE ENTIRE WORK AREA WHERE REMOVAL TOOK PLACE MAY BE SPRAYED USING AN ENCAPSULANT TO SEAL ANY REMAINING LOOSE FIBERS.

3.6.2 TAKE 3 AIR SAMPLES WITHIN 48 HOURS AFTER COMPLETION OF ALL CLEANING WORK. A MINIMUM VOLUME OF 1000 LITERS OF AIR IS REQUIRED FOR THE AIR SAMPLE AT A RATE OF NO MORE THAN 2 LITERS PER MINUTE. AIR SAMPLING SHALL BE PERFORMED IN ACCORDANCE WITH OSHA 1910.1001(F).

3.6.3 IF FOUND THAT THE AIRBORNE CONCENTRATION OF ASBESTOS IN THE WORK AREA EXCEED 0.1 FIBERS PER CUBIC CENTIMETER OF AIR, REPEAT THE CLEANING AND AIR MONITORING UNTIL THAT LEVEL IS ACHIEVED.

3.6.4 AFTER THE REQUIRED WORK AREA AIR CONCENTRATION IS ACHIEVED, THE MICROTRAP FILTRATION SYSTEM MAY BE SHUTDOWN. ALL ENTRANCES AND EXITS MAY BE UNSEALED AND THE PLASTIC SHEETING, TAPE, AND ANY OTHER TRASH AND DEBRIS MAY BE DISPOSED OF IN SEALABLE PLASTIC BAGS (6-MIL MINIMUM) AT AN APPROVED WASTE DISPOSAL SITE.

3.6.5 AFTER REMOVAL OF PLASTIC ALLOW A MINIMUM OF ONE ADDITIONAL HOUR THEN WIPE DOWN WALLS AND MOP FLOOR FOR FINAL TIME.

3.7 VISUAL INSPECTION

3.7.1 A VISUAL WORKSITE INSPECTION MUST BE CONDUCTED BY THE ARCHITECT DURING AND AFTER COMPLETION OF THE PROJECT.

3.7.2 INSPECTION BY THE ARCHITECT SHALL BE CONDUCTED DURING REMOVAL OPERATIONS TO INSURE COMPLIANCE WITH REGULATION.

3.7.3 INSPECTION BY THE ARCHITECT SHALL BE CONDUCTED BEFORE THE CONTAINMENT BARRIERS HAVE BEEN TAKEN DOWN, BUT AFTER THE PLASTIC SHEETING HAS BEEN CLEANED WITH DAMP MOPS AND CLOTHS.

3.8 AIR MONITORING

3.8.1 THROUGHOUT THE ENTIRE REMOVAL, ENCAPSULATION, CLEANING OPERATIONS, AIR MONITORING SHALL BE CONDUCTED TO ENSURE COMPLIANCE WITH EPA AND OSHA REGULATIONS AND ANY APPLICABLE STATE AND LOCAL GOVERNMENT REGULATIONS. THE CONTRACTOR SHALL PROVIDE AIR MONITORING AT THE JOB SITE AND FURNISH A COPY OF ALL RESULTS TO THE ARCHITECT.

3.8.2 AIR MONITORING SHALL BE CONDUCTED ACCORDING TO THE METHOD PRESCRIBED BY SECTION 1910.1001 (F) OF THE OSHA REGULATIONS.

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3.8.3 AIR MONITORING SHALL BE PERFORMED TO PROVIDE THE FOLLOWING SAMPLES DURING THE PERIOD OF ASBESTOS REMOVAL AND/OR ENCAPSULATION:

AREAS TO BE SAMPLED	MINIMUM SAMPLING TIME AT 2 LITERS PER MINUTE (HOURS)	VOLUME COLLECTED (LITERS)
WORK AREA (2 SAMPLES)	8	960
IMMEDIATELY OUTSIDE WORK AREA	8	960
OUTSIDE BUILDING	8	960

3.8.4 SAMPLES SHALL BE TAKEN ONLY AFTER ACTUAL REMOVAL OR ENCAPSULATION WORK HAS COMMENCED.

END OF SECTION

TELEDYNE ISOTOPES

AN EVALUATION OF THE PLUM BROOK REACTOR FACILITY AND DOCUMENTATION OF EXISTING CONDITIONS

VOLUME 4 - UPDATE OF THE 1978 COST ESTIMATE FOR THE PLUM BROOK REACTOR FACILITY DISMANTLING PROJECT

VOLUME 4 OF A 6 VOLUME SERIES

Prepared For

The National Aeronautics and Space Administration
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TELEDYNE ISOTOPES

This is Volume 4 of a series titled, "An Evaluation of the Plum Brook Reactor Facility and Documentation of Existing Conditions."

Following is a list of sub titles in the series:

Study Organization

Volume 1 - Review of Existing PBRF Data and Pertinent Regulatory Changes Since 1978 Which Would Affect Documentation of Present Conditions at the Plum Brook Reactor Facility

Volume 2 - Items of Radiological Significance Addressed in the 1978 PBRF Options Study for Which Additional Information is Needed

Volume 3 - Part 1 -Physical Characteriaztion of Radioactive/ Contaminated Areas at the PBRF
Part 2 - Appendices

Volume 4 - Update of the 1978 Cost Estimate for the Plum Brook Reactor Facility Dismantling Project

Volume 5 - Cost Estimates and Schedules to Maintain the Integrity of Barriers at the PBRF to Ensure Dry Safe Protective Storage for the Next 30 Years

Volume 6 - Plum Brook Reactor Facility Systems/Equipment Disposition Lists

TELEDYNE ISOTOPES

NOTICE

This report was prepared for the National Aeronautics and Space Administration for the purpose of documenting existing conditions at the Plum Brook Reactor Facility. Neither NASA, Teledyne Isotopes, or its subcontractors assumes liability for the use or accuracy of information contained herein for other than the above expressed purpose.

Requests for copies of this report must be submitted to:

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PREFACE

The National Aeronautics and Space Administration (NASA) owns the Plum Brook Reactor Facility (PBRF). This facility includes a 60 megawatt test reactor and a zero power pool type research reactor. The PBRF was mothballed in 1973 and placed in a dry safe configuration. NASA has made the decision to keep the PBRF in this safe storage configuration for an indefinite period. As a result of this decision it is important that NRC decommissioning regulations, methodology, technology, and activities be periodically tracked by NASA in order to optimize decision making and timing in the future. This report addresses further PBRF decommissioning in order to provide external feedback to NASA. The fact that PBRF decommissioning is discussed should in no way be interpreted to mean that such project plans are underway.

TELEDYNE ISOTOPES

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TELEDYNE ISOTOPES

4.0 TASK PRIORITY 4 - UPDATE THE 1978 COST ESTIMATE FOR THE PBRF DISMANTLING PROJECT BASED UPON THE NEW AND UPDATED INFORMATION OBTAINED FROM THIS STUDY

In 1978, Teledyne Isotopes prepared a report titled, "An Evaluation of the Options for Further Decommissioning of the Plum Brook Reactor Facility." That report was based on a preliminary study performed after the PBRF had been in a mothballed condition for five years following shutdown in 1973. As a result of that study Teledyne Isotopes presented preliminary cost estimates for five options. Prompt dismantling costs, continuing cost of surveillance and maintenance, and delayed dismantling costs were considered. Table 4.1 presents these options evaluated in 1978 with the estimated cost of each.

TABLE 4.1

Estimated Costs Of Various Options
For The Further Dismantling Of The Plum Brook Reactor Facility
Based On 1978 Study

		ALL STRUCTURES DEMOLISHED	RADIOACTIVELY CLEAN STRUCTURES REMAIN
1.	Mothballed/Delayed Dismantling (100 years)	$30,807,000	$23,016,000
2.	Mothballed/Reduced Acreage From 30 To 7/Delayed Dismantling (100 years)	$31,254,000	$24,463,000
3.	Temporary Entombment/Delayed Dismantling (100 years)	$26,768,000	$18,960,000
4.	Prompt Dismantling/Structures Removed	$14,108,000	NA
5.	Prompt Dismantling/Structures Remain	NA	$ 6,317,000 ($15,000,000 in 1981)

Mode 2 Delayed Dismantling with Reduced Acreage was not a viable option. The early cost of gaining the release of about 23 acres was $450,000. In addition to the fact that this was not a cost effective action, it was subsequently determined that the larger acreage would be needed for staging areas, property lay down and clearance procedures, property control and inventory and a number of other activities when the time came to commence decommissioning.

Mode 3 Temporary Entombment was subsequently determined not to be a viable alternative. Substantial prompt costs would be required to release most of the facility outside of entombment and to build an approved entombment structure. Once achieved the

NRC rules still would require some type of surveillance and continuation of a possession license. Although some facilities would be released, the main objective of NRC license termination would not be met.

Mode 4 Prompt Dismantling (with structures removed to 4 feet below grade and backfilled) also was not a truly viable option at that time. The structures themselves were not significantly contaminated and were not a complicating factor in license termination. Most were in excellent condition and could be renovated for alternate use, if needed, once NRC license termination was obtained.

This essentially left only Modes 1 and 5 as the clear choice for NASA management. Either continue the mothballed status and have a delayed decommissioning or enter into prompt decommissioning. Mode 5 was the most cost effective choice in the long run and NASA attempted to proceed towards that end in the 1979-81 period. The \$6.3M estimate of decommissioning operations by Teledyne was escalated to \$15M to allow for NASA planning, engineering, project management, and inflation. Funding could not be achieved and Mode 1 was selected (Mothballing with Delayed Decommissioning) for an indefinite extended period.

For purposes of this 1985 Study, Task 4 - Update of the 1978 Study, was limited to updating Modes 1 and 5 from the 1978 Study. In addition, an extended Mode 5 (Prompt Dismantling) was considered in order to utilize lower annual rates of funding over a longer time span. A preliminary review and evaluation was also made to consider two alternate nuclear uses of the facility. One as a Spent Fuel Storage Facility and the other as a Monitored Retrievable Waste Storage Facility.

Burns and Roe, Inc. of Oradell, New Jersey, was selected as a subcontractor to develop cost estimates for Prompt Dismantling, Decontamination Methods Report (see Appendix 2.1 of Volume 2), changes in radiation regulations (presented as part of Volume 1 of this series), and the feasibility of utilizing PBRF for alternate nuclear uses. Burns and Roe was selected because they had just recently completed the engineering plan for the Prompt Decommissioning of the Shippingport Reactor under contract to the U.S. Department of Energy. Shippingport is a power reactor, moderately larger than the Plum Brook Reactor, with many similar features and some similar problems to be addressed in dismantling. It was found that Burns and Roe's recent experience in developing the Shippingport Plan was extremely useful in the update of the PBRF dismantling costs.

4.1 Prompt Decommissioning

Burns and Roe's evaluation of Prompt PBRF Dismantling costs identified tasks, approaches, cost and pricing elements, organization, staffing, scheduling and sequencing, task efficiencies, and contingencies. A cost sensitivity analysis was also performed as well as a comparison with the Shippingport Decommissioning Plan Cost Estimate. Teledyne Isotopes personnel provided considerable base data because of their knowledge of the facility. They also reviewed and concurred in Burns and Roe's methodology. The Burns and Roe report on Prompt Dismantling of the PBRF appears in its entirety as Appendix 4.1 herein. The detailed pages of job costing/estimating sheets have not been included because of their volume. They have been separately secured in the PBRF Vital Records File because of their extreme value to future PBRF activities. Burns and Roe has retained one copy for contract purposes, as has Teledyne Isotopes.

The results of the Burns and Roe evaluation indicates that Prompt Dismantling would require an expenditure of $32,143,178 including a contingency of approximately 16.5%. A total time span of approximately 4.3 years would be required. One year would be required for decommissioning planning and selection of contractors. A half year would be required for NASA plan review and approval, submission of Decommissioning Request to the NRC, and receipt of NRC approval. Approximately 3 years would be required for actual decommissioning operations. Burns and Roe developed a work breakdown structure identifying various project tasks and then developed their costs and schedules in accordance with those work breakdown structures. Burns and Roe's complete report is included in Appendix 4.1.

4.2 Delayed Decommissioning

Teledyne Isotopes evaluated the comprehensive radiological data reported in Volume 3 in order to determine the time interval necessary to permit natural decay of the various isotopes present in the PBRF and its systems to license exempt quantities. Table 4.2 following summarizes this review.

TABLE 4.2

Time Interval For Various PBRF Isotopes To Decay To Exempt Quantities

ISOTOPE	T-1/2	PRESENT QTY (Ci)	LICENSE EXEMPT QTY (Ci)	YEARS TO ACHIEVE
H3	12.3 YR	91000	1 E-3	325 YR
CO 60	5.2 YR	713	1 E-6	153 YR
EU 152	12.8 YR	1	1 E-6	255 YR
EU 154	16.0 YR	1	1 E-6	320 YR
NI 59	8 E4 YR	0.5	1 E-4	1 MEGA YR
NI 63	92 YR	42	1 E-5	2014 YR
AL 26	7.4 E5 YR	1.4	1 E-7	10 MEGA YR
CS 137	30 YR	1	1 E-5	296 YR
SR 90	28 YR	1	1 E-7	651 YR

When reviewing Table 4.2, it should be remembered that Tritium is contained in the reactor Beryllum components only and when those items are removed the Tritium will go. Cobalt 60 and the Nickel isotopes 59 and 63 are present in the stainless steel portions of the reactor core plus the corrosion film on the reactor primary piping, heat exchanger, pumps, valves, etc. The Europium isotopes 152 and 154 are also present in the primary system corrosion film. Small quantities of all of the above isotopes (except Tritium) plus Sr 90 and Cs 137 are also widely distributed throughout the remaining facility systems.

The major point evident from Table 4.2 is that the isotopes still present at PBRF are going to be there for a long time and are not going away in the foreseeable future.

With this thought in mind a review and updating of the Mode 1, Continued Safe Storage with Delayed Dismantling, was conducted. The time period for the end of safe storage and beginning of delayed dismantling was chosen to be the year 2073. The reasons were threefold. First, the buildings and facilities will be approximately 113 years old at that time, and it is not likely their life will extend beyond that time even with a good planned maintenance program. Second, at that time radiation levels from penetrating gamma radiation will have diminished to a level which will permit more ordinary approaches to removal of the reactor core box. Third, the likelihood of environmental complications beyond that date escalate rapidly.

All tasks necessary for prompt dismantling will still need to be performed for delayed dismantling due to the presence of the long half-life isotopes. There will be a savings estimated to be approximately $1M because of:

1. More straightforward handling of in-tank items after a 100 year decay.

2. Use of lower cost LSA shipping containers for handling in-tank items under delayed decommissioning, vs the use of higher cost, leased, Type A, Type B, and large quantity shielded containers necessary if prompt dismantling were performed.

The delayed dismantling procedures, sequencing, and costs are otherwise the same in unescalated dollars as the costs for prompt dismantling. The net cost of delayed dismantling is therefore $31,143,178. To this sum it is necessary to add the continuing maintenance costs for the facility until 2073. This amount is estimated to be $22,937,899 as developed in Volume 5 of this series.

4.2

The total cost of delaying dismantling is therefore $54,081,077.

The major advantage of delayed dismantling is the reduced occupational radiation exposure resulting from the reduced radiation levels. Cobalt 60 is the main contributor to occupational exposures. Since it will have decayed to less than 1 Curie by 2073, the estimated occupational exposure will be approximately 10% of the 342 man-Rem total exposures resulting from prompt dismantling. At an additional cost of $23M, to maintain the facility until delayed dismantling, the $75,000 cost per man-Rem saved does not appear to be cost effective considering the miniscule risks associated with the higher exposures.

A second evaluation was performed using an earlier date for delayed dismantling. The year 2015 was selected because:

1. The quantity of 60 Cobalt will have decayed from its present level of nearly 1000 Curies to 22 Curies.

2. All of the Iron 55 and other isotopes with 2-3 year half lives will have decayed.

3. The facility will be approximately 55 years old at that time and facility equipment obsolence will be settling in by then.

4. There is no practical advantage to delaying dismantling beyond that time considering cost and occupational exposures.

All tasks necessary for prompt dismantling will still need to be performed for delayed dismantling in 2015 due to the presence of the long half-life isotopes. The total costs are $32,143,178 for dismantling plus continuing surveillance costs until 2015 estimated to be $7,920,292. Total costs for delayed dismantling beginning in 2015 are therefore $40,063,470.

The occupational radiation exposures are estimated to be approximately 68 man-Rem or 20% of the 342 man-Rem of exposure estimated for prompt dismantling.

4.3 Summary Cost Comparison For Prompt Dismantling vs Delayed Dismantling

Table 4.3 following summarizes the costs and occupational exposure estimates for prompt dismantling of the PBRF and the two delayed dismantling periods. It also includes the preliminary estimates from the 1978 Study for comparison, as well as the 1981 NRC Study as published in NUREG CR/1756.

TABLE 4.3

Comparison of PBRF Dismantling Costs
Prompt vs Delayed

PROMPT DISMANTLING

	TELEDYNE 1978	NASA 1980	NUREG CR/1756 1981	TELEDYNE/BURNS & ROE 1985
Cost ($000)	$6,317	$15,000	$15,600	$32,143
Occupational Exposure (Man-Rem)	134		322	342

DELAYED DISMANTLING

	100 YEAR DECAY TO 2073			42 YEAR DECAY TO 2015
	TELEDYNE STUDY 1978	NUREG CR/1756 1981	TELEDYNE STUDY 1985	TELEDYNE STUDY 1985
Continuing Costs ($000)	$20,358	$11,051	$22,938	$ 7,920
Delayed Costs ($000)	$ 5,360	$ 8,523	$31,143	$32,143
Total ($000)	$25,718	$19,574	$54,081	$40,063
Occupational Exposure (Man-Rem)	13	LT 1	34	68

4.4 Extended Rate Early Dismantling

It is clearly evident from Section 4.3 that prompt dismantling of the PBRF is substantially less expensive than delayed dismantling. Even though prompt dismantling is less expensive, a C of F project costing $32M over a period of 4.3 years is not likely to be approved under the present Federal budget deficit. An alternative approach is to extend the time period of a prompt dismantling project from 4.3 years to approximately 12 years.

Annual funding would range from a low of $0.61M in each of the first two years to a high of $5.2M in the fourth year. The overall costs could be controlled to be about the same in unescalated dollars, as those for the prompt decommissioning described in the Burns and Roe evaluation in Appendix 4.1. The dedicated staff of management and support personnel would be reduced from 51 to 14, but would be utilized for 12 years vs 4.3 years. Also a smaller task force of approximately 10 skilled, knowledgeable employees would perform most of the decommissioning operations over the extended 12 year mode. Subcontract labor would be utilized for specialized tasks. The same sequencing called for by the Burns and Roe approach would be used except that the time scale would be expanded. Discreet tasks would be approached so that the end point of each task would leave the facility in a safe configuration in the event funding was temporarily reduced or interrupted.

It is recognized that NASA has made the decision to continue PBRF Safe Storage and to dismantle in the distant future. Periodic re-evaluation or review of this decision is necessary to determine present conditions of the facility, and optimum times for going forward with dismantling. With renewed interest in other facilities at Plum Brook, there is a possibility that a skilled labor group will be involved in operating various research and test facilities. This labor group could be cross trained in the nuclear aspects of PBRF dismantling and utilized intermittently (during lulls in testing) for PBRF dismantling tasks. Substantial overall efficiencies could be realized.

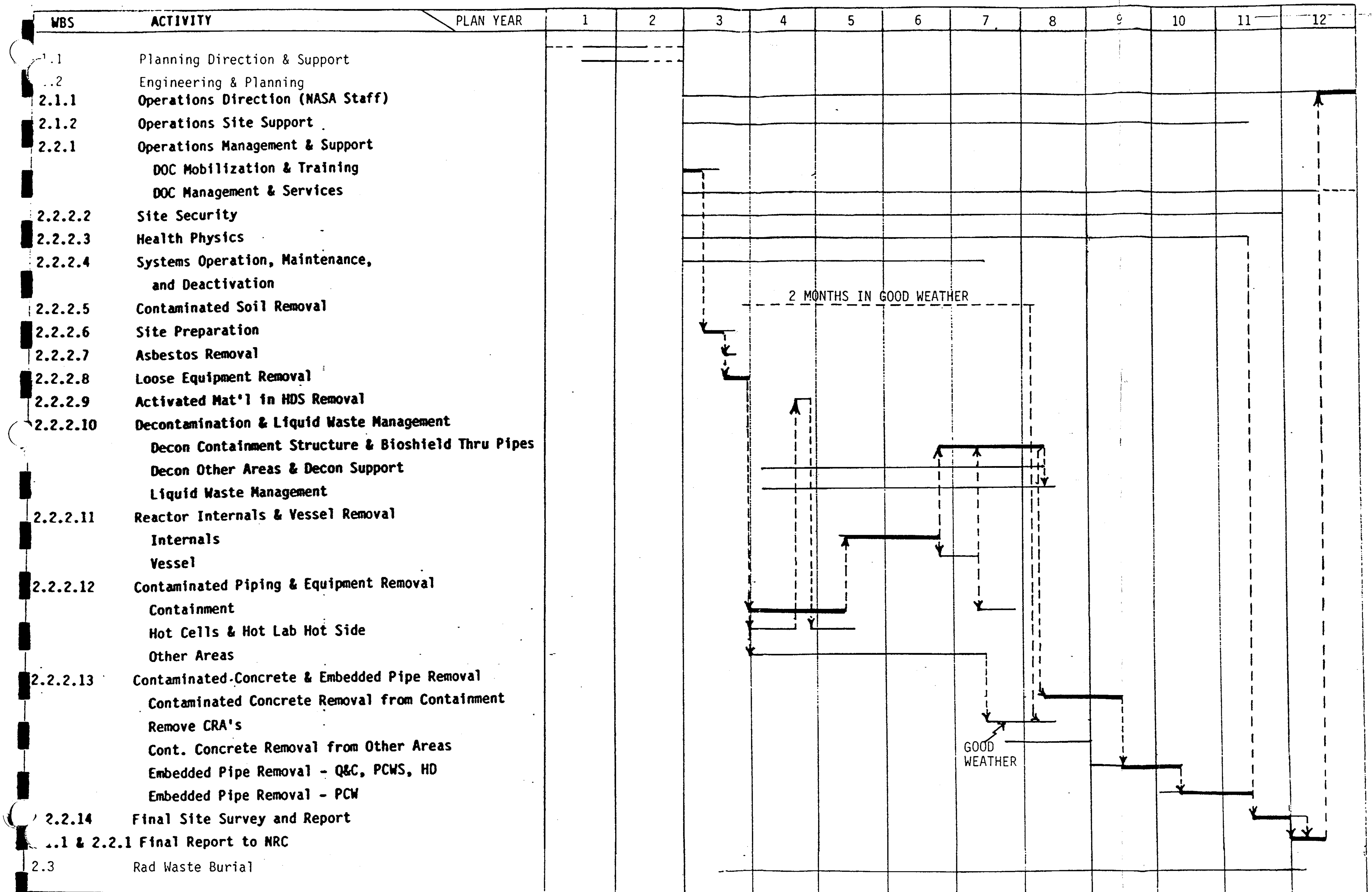
The use of other test site personnel intermittently could be scheduled so as to provide assistance during peak labor demand periods, and can also provide emergency back up if needed. Table 4.4 shows the annual funding schedule and Figure 4.1 presents a prospective schedule of the activities for a 12 year configuration.

TABLE 4.4

Annual Funding Rate for Extended Rate
Early Dismantling of the PBRF

YEAR	ANNUAL FUNDING
1	$ 609,157
2	$ 609,157
3	$ 3,257,715
4	$ 5,178,765
5	$ 4,569,420
6	$ 3,966,985
7	$ 3,783,644
8	$ 2,662,407
9	$ 2,362,316
10	$ 2,380,296
11	$ 2,036,448
12	$ 727,038
TOTAL	$32,143,336

FIGURE 4.1 - PROSPECTIVE SCHEDULE FOR PBRF DISMANTLING - USING A TWELVE YEAR EXTENDED RATE EARLY PLAN



The overall cost of extending prompt dismantling tasks over a longer period will result in somewhat higher costs if rad waste burial costs continue to escalate faster than inflation. Also, some continuing facility maintenance costs will be required during the 12 year extended mode. In addition, cost sensitivity studies for prompt dismantling are not likely to be accurate if extended over a 12 year period. Regulations, policies, practices, etc., could change drastically. For this reason Teledyne Isotopes' approach to an extended rate (12 year) early dismantling should not be viewed as precise as the Burns and Roe evaluation of prompt dismantling over a 4.3 year period. Instead, it should be viewed as a conceptual approach recognizing that some changes could occur during a 12 year project due to external factors.

If major external changes do not occur, then the following comparison of prompt dismantling costs with extended rate early dismantling costs may be appropriate.

	Prompt Dismantling	Extended Rate Early Dismantling
Project Period	4.3 Years	12 Years
Estimate Cost (1985 Unescalated)	$32,143,000	$34,228,264*
Precision of Estimate	High	Moderate

*Includes 8 years of additional maintenance costs of $2,085,264.

4.5 Review Of Alternate Uses Of The PBRF

Since 1978 there have been two major changes in United States Nuclear Policies. One involved termination of reprocessing of spent commercial nuclear fuels in the late 1970s. As an outgrowth of that policy, commercial nuclear power plants are now forced to store their spent fuel assemblies on-site. As time goes on and storage space on-site becomes limited there may be a need for special spent fuel storage facilities.

A second change in nuclear policy occurred as a result of the "Low Level Radioactive Waste Policy Act" of 1980. This act requires each state to provide for the disposal of the low level radioactive wastes generated in the state or by forming compacts with other nearby states to form regional disposal sites.

The above indicated Nuclear Policy changes led the review team to consider if the PBRF could be utilized as either a spent fuel storage facility or as a monitored retrievable low level waste storage site. These potential alternate uses of the PBRF might permit partial dismantling and re-licensing for the general benefit of the nation, at a cost reduction to NASA with possible future income revenues.

Burns and Roe, Inc. was asked to perform a preliminary evaluation of these possibilities. The results of their review indicated that alternate use as a spent fuel storage facility is not likely, and that alternate use as a low level radioactive waste storage site is possible but not likely at this time.

The Burns and Roe review follows in Sections 4.5.1 and 4.5.2.

4.5.1 Alternate Use Of The PBRF As A Spent Fuel Storage Facility

4.5.1.1 Impending Need For Spent Fuel Storage Facilities

At the Symposium on Waste Management at Tucson, Arizona in March of 1985, a session was devoted to spent fuel storage. The abstract to the paper, "Spent Fuel Storage Requirements," by R.A. Libby and B.M. Cole of PNL indicates the extent of the pending problem:

"Long before a permanent nuclear waste disposal system is available in the United States, several of the operating commercial nuclear power plants will exhaust their existing spent fuel storage capabilities. Studies to define the magnitude of this interim problem were conducted by the Department of Energy through the Commercial Spent Fuel Management (CSFM) Program at the Pacific Northwest Laboratory. Based on information supplied by the nuclear utilities, these studies indicate that if new storage concepts are not available by 1986, some reactors could encroach on their storage pool's full core reserve (FCR), and ultimately, be forced to shut down."

Utilities owning nuclear power plants will be significantly increasing the capacity of their on-site spent fuel storage facilities over the next several years. The Nuclear Waste Policy Act of 1982 provides for the DOE to begin taking responsibility for disposition of spent fuel in 1998, but there exists a great deal of uncertainty as to when a final repository or monitored retrievable storage facilities will actually be available.

4.5.1.2 Regulatory Requirements For A Spent Fuel Storage Facility

The abstract to the paper "Regulatory and Administrative Actions Impacting on Spent Fuel Storage Facilities," by H. Lowenberg, also presented at the 1984 Symposium on Waste Management, indicates how regulatory actions may affect the spent fuel storage problem:

"Interim or longer term storage of spent fuel by utilities or the Federal government that may be required prior to disposal in a deep geologic repository may be impacted in a variety of ways by regulatory and administrative actions. The Nuclear Waste Policy Act of 1982 (NWPA) provides for interim storage of spent fuel by both utilities and the Department of Energy (DOE). The Utilities owning spent fuel have primary responsibility for interim spent fuel storage at reactor sites. The Nuclear Regulatory Commission's (NRC) Waste Confidence Rulemaking addressed the environmental and safety implications of both onsite and offsite storage of spent fuel. This NRC decision makes findings that impact on both forms of spent fuel storage and amends its regulations, 10 CFR Parts 50 and 51, covering reactor licensing and environmental protection. NRC is carrying out reviews of topical reports for dry cask storage of spent fuel at utility sites under its regulation 10 CFR Part 72. Several such reviews are under way now and additional applications are expected in 1985. It is anticipated that cask vendors will also seek certificates of compliance for transportation purposes under 10 CFR Part 71.

When a utility cannot adequately store spent fuel and the NRC determines under 10 CFR Part 53 that away from reactor (AFR) storage is necessary, then DOE is required under NWPA to provide for up to 1900 metric tons of licensed capacity at

Federal facilities. Costs of interim storage and transportation by DOE will be obtained from an interim utility financed storage fund. NWPA also provides for longer term storage of spent fuel in NRC licensed monitored retrievable storage (MRS) facilities by DOE. DOE is to submit a proposal to Congress by June 1, 1985 for construction of one or more MRS facilities in accordance with NRC regulations. These and other regulatory and administrative actions will impact on activities to store spent fuel prior to its disposal."

For a spent fuel storage facility at the PBRF, the requirements of 10 CFR Part 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI), would have to be met. Included are design basis and criteria for site evaluation and design criteria for nuclear criticality safety, radiological protection, spent fuel and radioactive waste storage and handling, and decommissioning.

In addition to the requirements of 10 CFR Part 72, there are NRC Regulatory Guides that would be applicable depending on the type of facility and fuel enrichment level:

Reg. Guide 3.41, Rev. 1 - Validation of Calculational Methods for Nuclear Criticality Safety

Reg. Guide 3.42, Rev. 1 - Emergency Planning for Fuel Cycle Facilities and Plants Licensed under 10 CFR Parts 50 and 70

Reg. Guide 3.43, Rev. 1 - Nuclear Criticality Safety in the Storage of Fissile Materials

Reg. Guide 3.44, Rev. 1 - Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation - Water Basin Type

Reg. Guide 3.48 - Standard Format and Content for the Safety Analysis Report for Independent Spent Fuel Storage Installation - Dry Storage

Reg. Guide 3.49 - Design of an Independent Spent Fuel Storage Installation - Water Basin Type

Reg. Guide 3.50 - Guidance on Preparing a License Application to Store Spent Fuel in an Independent Spent Fuel Storage Installation

Reg. Guide 3.53 - Applicability of Existing Regulatory Guides to the Design and Operation of an Independent Spent Fuel Storage Installation

Reg. Guide 3.54 - Spent Fuel Heat Generation in an Independent Spent Fuel Storage Installation

4.5.1.3 Technical Requirements For A Spent Fuel Facility

There are three ANSI/ANS Standards that provide detailed criteria for an Independent Spent Fuel Storage Installation (ISFSI):

ANSI/ANS-2.19-1981, "Guidelines for Establishing Site-Related Parameters for Site Selection and Design of an Independent Spent Fuel Storage Installation (Water Pool Type)"

ANSI/ANS-57.7-1981, "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)"

ANSI/ANS-57.9-1984, "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)"

For the PBRF, extensive evaluation would be required to determine if the site would be suitable for spent fuel storage under current criteria. For water pool type storage, many of the criteria such as pool design to current design earthquake parameters and cask drop would be difficult or impossible to meet. Also, a requirement that there be no penetrations through the pool structures below the minimum level for proper shielding cannot be met. For power reactor fuel storage, a pool depth of approximately 37 feet is required, whereas the PBRF pools are only 25 feet deep.

The dry storage concept would also require seismic analysis to confirm the suitability of the existing structures. Many other criteria would have to be met including adequate ventilation systems to remove decay heat during fuel handling and storage.

4.5.1.4 Conclusions

Conversion of the PBRF to an ISFSI on a commercial basis is not considered practical due to the configuration and age of the PBRF structures and systems and the extensive and significant requirements for spent fuel storage facilities.

NASA could, however, determine if the DOE would consider using the PBRF to support a monitored retrievable storage (MRS) facility that could be constructed adjacent to or near the PBRF. DOE appears to be committed to the construction of several MRS facilities, and integrating portions of the PBRF, after decommissioning, into a MRS facility could result in a significant cost savings.

4.5.2 Alternate Use Of The PBRF For Radioactive Waste Storage

4.5.2.1 Impending Need For Low-Level Radioactive Waste Storage

The "Low-Level Radioactive Waste Policy Act" of 1980 (PL96-573) requires each state to provide for the disposal of the low-level radioactive wastes generated in the state. The act encourages the states to form "compacts" to establish regional disposal facilities, and allows these state compacts to restrict the use of regional facilities to the waste generators within the regions. Thus, for waste generators in regions without an existing disposal site, the possibility exists that the existing disposal sites will refuse to accept their waste starting on January 1, 1986. This potential for a cut-off in access to existing low level radioactive waste disposal sites applies to Ohio and the surrounding states. The nationwide scope of this problem was recently addressed in the article, "The Great State of Uncertainty in Low-Level Waste Disposal," published in the March, 1985 issue of the EPRI Journal.

The U.S. NRC summarized the impending need for low-level radioactive waste storage in Generic Letter 85-14 to all licensees on August 1, 1985:

"The Low-Level Radioactive Waste Policy Act of 1980 (P.L. 96-573) assigned to the states the responsibility to provide for disposal of commercial low-level radioactive waste (LLW) generated within each state. The Act envisioned that all states would be capable of providing for disposal of commercial LLW generated within their borders by 1986. Based on the current status of state efforts and the substantial time required to establish new disposal facilities, no new sites will be available for at least several years. Due to the uncertainty of this situation and statements made by some officials of states within which currently operating disposal sites are located, it appears possible that access to the existing sites may be restricted.

While some licensees have taken steps to temporarily store LLW generated at their sites to alleviate any impact that limiting of access to disposal capacity may have on licensed operations, provisions for storing LLW should be used only for interim contingency purposes. It is the policy of the NRC that licensees should continue to ship waste for disposal at existing sites to the maximum extent practicable.

In anticipation of possible curtailment of access to existing disposal facilities, interest is being expressed in some states in commercial storage of LLW generated within the states. While the NRC recognizes that storage may appear desirable in states which have not resolved their low-level waste disposal problems, commercial storage facilities, however, should not become de facto disposal sites. NRC will require for commercial storage under its jurisdiction that, in addition to safe siting and operation, commitments and assurances be made for eventual disposition of all waste stored at commercial storage locations. This includes provisions for repackaging (if necessary), transportation and disposal of the waste, as well as decommissioning of the facilities."

It is apparent that the NRC will permit the use of a low-level waste storage facility only if waste generators are not able to send their wastes to an approved disposal site. Thus, the developing situation regarding regional waste disposal compacts becomes critical. Ohio is a member of the Midwest compact. A management plan is presently being developed to select a host state and site, but a regional low-level radioactive waste disposal site was not in place by January, 1986, when, under current law, access to the present disposal sites may not be allowed.

To circumvent this situation, Congress is working on legislation that would extend the time for state compacts to establish operating disposal sites.

Congressional Bill HR 1083 would allow seven more years but would require specific milestones to be met. The most significant of these milestones is the submittal of an application for a disposal facility by January, 1990. If this date is not met, waste disposal surcharges at the existing disposal sites would increase significantly for waste generators in the truant states. If not met in six more months, the existing disposal sites would not be allowed to receive wastes from those states.

Therefore, unless the legislative process breaks down in Washington, the use of existing disposal sites should continue to be allowed until the regional compact disposal sites are available.

4.5.2.2 Regulatory Requirements For A Low-Level Radioactive Waste Storage Facility

The NRC's Generic Letter 85-14, "Commercial Storage at Power Reactor Sites of Low-Level Radioactive Waste Not Generated by the Utility," describes the licensing process as follows:

"Some of the concepts for commercial storage involve using nuclear power reactor sites as commercial storage locations for LLW not generated by the utility licensee. As a matter of policy, the NRC is opposed to any activity at a nuclear reactor site which is not generally supportive of activities authorized by the operating license or construction permit and which may divert the attention of licensee management from its primary task of safe operation or construction of the power reactor. Accordingly, interim storage of LLW within the exclusion area of a reactor site, as defined in 10 CFR 100.3 (a), will be subject to NRC jurisdiction regardless of whether or not the reactor is located in an Agreement State, pursuant to the regulatory policy expressed in 10 CFR 150.15(a)(1). Within Agreement States, for locations outside the exclusion areas, the licensing authority is in the Agreement State.

In order for NRC to consider any proposal for commercial storage at a reactor site, including commercial storage in existing low-level waste storage facilities, the NRC must be convinced that no significant environmental impact will result and that the commercial storage activities will be consistent with and not compromise safe operation of the licensee's activities, including diverting reactor management attention from the continued safety of reactor operations. A Part 30 license is required for the low-level waste storage and a Part 50 license amendment may also be required. The application must include:

By The Utility

- A determination by the utility licensee that the proposed low-level waste commercial storage activities do not involve a safety or environmental question, and that safe operation of the reactor will not be affected. In making this determination, the licensee shall consider:

  - Direct impacts of the commercial storage operation on reactor operations during normal and accident conditions;

  - Diversion of utility management and personnel attention from safe reactor operation;

  - Combined effects of onsite and offsite dose during normal and accident conditions;

  - Influence on effectiveness of reactor emergency plans;

  - Influence on effectiveness of reactor security plans;

  - Financial liability provisions, including impact on indemnity coverage; and

- Environmental impact of the storage facility, including potential interaction with the generating station.

<u>By The Applicant</u> (The Utility Or Other Person)

- Information relating to the safety of the commercial storage operation;

- Information relating to the environmental impact of the storage operation in sufficient detail to allow staff to establish the need for preparation of an Environmental Impact Statement;

- Financial assurance to provide for the commercial storage operation and decommissioning including any necessary repackaging, transportation and disposal of the waste; and

- Written agreement from the jurisdiction responsible for ultimate disposal, the State, that provisions are sufficient to assure ultimate disposal of the stored waste.

The Office of Nuclear Reactor Regulations (NRR) will conduct an environmental review and review the application to determine whether the low-level waste commercial storage activities on a reactor site impact the safe operation of the reactor. Following NRR review, the licensing authority for commercial storage on a reactor site under NRC jurisdiction (all locations in non-Agreement States and locations within reactor exclusion areas in Agreement States) is the Office of Nuclear Material Safety and Safeguards. The NRC will assess environmental impact and will issue an Environmental Impact Statement, if appropriate, in accordance with provisions of 10 CFR 51.20, 51.21, and 51.25. As part of the procedures, the NRC will provide notice in the FEDERAL REGISTER of receipt and availability of any application received for commercial storage activities. The public notice will also indicate the staff's intent regarding preparation of an environmental assessment and its circulation for public review and comment.

An Environmental Impact Statement will most likely be needed based on the environmental assessment.

Because the NRC has not yet received or reviewed an application for a centralized commercial low-level waste storage facility intended to store large amounts of LLW for five or more years, the NRC may consider applying the criteria described above to such commercial storage facilities whether they be on a reactor site or not.

Interim storage of utility licensee-generated LLW will continue to be considered according to the provisions stated in Generic Letter 81-38, dated November 10, 1981."

For the PBRF, the NRC would likely follow the licensing process described above.

4.5.2.3 Technical Requirements For A Low-Level Radioactive Waste Storage Facility

The principal sources of technical requirements are the U.S. NRC Generic Letter 81-38, "Storage of Low-Level Radioactive Wastes At Power Reactor Sites," dated November 10, 1981, and NUREG-0800, Appendix 11.4-A of Standard Review Plan 11.4, "Design Guidance for Temporary On-Site Storage of Low-Level Radioactive Waste," Rev. 0, dated July, 1981. The requirements of these two documents are essentially the same and are summarized in Table 4.5.

For the PBRF, the NRC probably would apply requirements similar to those for a power reactor site as summarized in Table 4.5. Since waste form could be restricted to low-level dry or solidified wastes, it would not be necessary to evaluate the PBRF against any new seismic criteria. It appears that the other requirements could be met without significant modifications to the PBRF, but the storage capacity limitation of 5 years of waste generation would probably have to be modified to make low-level waste storage economically feasible.

4.5.2.4 Low-Level Radioactive Waste Storage Concept For The PBRF

Metal containers containing solid or solidified waste would be delivered by truck and unloaded in the truck bay in south-west corner of the reactor building using the 20 ton bridge and trolley crane and in the hot laboratory truck bay using the 5 ton monorail hoist or the 15 ton bridge and trolley crane in Room 16. The waste would be stored dry in the quadrants, canals, hot cells, hot dry storage and off gas cleanup rooms. Concrete cover slabs would be made and used over the quadrants and canals for shielding. Containers with very low level wastes could also be stored in other locations in the containment, reactor building, hot laboratory and other buildings.

In the reactor building, the 20 ton crane may be used to handle cover slabs and move waste containers to storage in Canals F, G or H. A track gui ded dolly would be used to transfer waste containers from Canal F in the reactor building into Canal E in the containment. From there, the polar crane with 5 and 20 ton hooks may be used to handle cover slabs and move waste containers to storage locations in Canal E and Quadrants A, B, C and D.

In the hot laboratory, the 20 ton crane could be used to transfer high activity waste containers to Hot Cells 3 to 7 and the 5 ton monorail crane could be used to transfer waste containers into Canal K. A transfer dolly would be required to move waste containers and casks/liners from Canal K to J or from Room 16 to Room 17. The 5/20 ton crane would then be used to transfer waste containers from or to Canal J, Hot Cells 1 and 2, and hot dry storage and off gas cleanup rooms.

4.5.2.5 Conclusions

Although the PBRF could be adapted to store low-level radioactive waste with relative ease, the need for such a facility will not develop if the U.S. Congress passes legislation allowing continued use of existing disposal sites while the regional compacts develop new disposal sites. Therefore, this alternate use of the PBRF will become viable only if the legislative process now in motion should fail to extend the date for operating regional disposal sites or if the Midwest compact should fail to expeditiously establish a disposal site.

TABLE 4.5

Low-Level Radioactive Waste Storage Facility Design Criteria

TOPIC	NRC GUIDANCE/POSITION (REF. GENERIC LETTER 81-38, DATED 11/10/81
Security	Preferred location is inside plant protected area. Otherwise, on plant site and fenced, locked, alarmed entry points, periodic patrols.
Containers	Container materials are to be compatible with internal and external environmental effects; container integrity and design shall enable transportation and disposal without container breach; containers shall meet shipping regulations.
Seismic	Structure is not required to meet seismic criteria when storing solidified or low level dry wastes.
Liquid Waste Collection	Provide means for collecting and sampling all liquid drainage. Contaminated liquids should be routed to radwaste systems while uncontaminated liquids should be routed to normal discharge pathways. Drains and curbs should be used to contail spills.
Decontamination Capabilities	Decontamination capabilities should be developed.
Storage Capacity	Added storage capacity would typically accomodate no more than the waste generated during a nominal five-year period.

TABLE 4.5

Low-Level Radioactive Waste Storage
Facility Design Criteria
(Continued)

TOPIC	NRC GUIDANCE/POSITION (REF. GENERIC LETTER 81-38, DATED 11/10/81
Periodic Visual Inspection of Containers	A program of at least quarterly visual inspection of container integrity should be performed. The selection of representative types of waste containers and placing them in a specific location for inspection purposes is acceptable. Inspection procedures should keep exposures within ALARA intent.
Emergency Re-Packaging	Provision should be made for additional re-packaging due to container failure. Contamination isolation and decontamination capabilities should be developed.
ALARA and Health Physics Considerations	For low-level dry waste storage, all ALARA methodology should be incorporated as per Regulatory Guides 8.8 and 8.10 due to the anticipated increase in container handling.
Waste Isolation	All solidified and dry active waste should be located in restricted areas where effective material control and accountability can be maintained.
Inventory Records	Inventory records of waste types, contents, dates of storage, shipment, etc., should be maintained.
Ventilation	No specifically mentioned.
Radiation Monitoring	Potential release pathways shall be monitored.
Fire Protection	Storage areas should incorporate good engineering features and capabilities for handling accidents and provide safe-guard systems, such as fire detectors and suppression systems. Fire suppression devices may not be necessary if combustible materials are minimal in the area.
Radiation Shielding	The facility shielding shall be dictated by the dose rate criteria for both the site boundary and unrestricted areas onsite. Off-site doses from onsite storage must be sufficiently low to account for other uranium fuel cycle sources without exceeding the 40 CFR 190 limit of 25 mrem/year whole body dose. Other

TELEDYNE ISOTOPES

APPENDIX 4.1

REPORT OF BURNS & ROE, INC. ON THE COSTS OF PROMPT DECOMMISSIONING OF THE PLUM BROOK REACTOR FACILITY

Performed via Teledyne Isotopes, Inc.
Purchase Order No. PB14999
Under Contract NAS3-24359PB

By

Burns and Roe, Inc.
800 Kinderkamack Road
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Internal W.O. 3764-01
November 22, 1985

TELEDYNE ISOTOPES

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4.1 Prompt Decommissioning

This decommissioning alternative for the Plum Brook Reactor Facility (PBRF) is an update of decommissioning Mode 5-Prompt Dismantling/Structures Remain, presented in Section 4.5 of the 1978 study (Reference 1). This prompt dismantling alternative is based on performing the minimum work necessary to eliminate the possession only license. All required work would be completed in a expeditious manner after approval of the decommissioning plan and issuance of a decommissioning order by the NRC.

Removal of non-radioactive equipment, piping, electrical components and cabling, structures, etc. is not included. Such work could be accomplished at a later date, if desired, or the remaining non-radioactive facilities could be reconditioned for alternate use as discussed in Section 4.5.

4.1.1 Prompt Decommissioning End Condition

The end condition for the prompt decommissioning alternative is a facility and surrounding grounds free of all radioactive materials having activities above the unrestricted use activity levels given in Table I of U.S. NRC Regulatory Guide 1.86 (June 1974), "Termination of Operating Licenses for Nuclear Reactors", and with direct radiation below a limit previously imposed on the PBRF decommissioning by the NRC. These limits may be summarized for the PBRF as follows:

Direct Radiation: $<5\mu R/hr$ (<0.005 mR/hr) above natural background (about $5\mu R/hr$) at one meter from all surfaces.

Removable Contamination:

Alpha	<20 dpm/100 cm^2
Beta-gamma	<1000 dpm/100 cm^2

Average (Total*) Contamination:

Alpha	<100 dpm/100 cm^2
Beta-gamma	<5000 dpm/100 cm^2

*For PBRF, this was previously defined as "fixed", but "total" appears to be the proper interpretation of RG 1.86.

Maximum (Total) Contamination over 100 cm^2 or less:

Alpha	<3000 dpm/100 cm^2
Beta-gamma	<15,000 dpm/100 cm^2

Only the minimum required dismantling and demolition would be performed to meet these limits. This includes the removal from the site of all applicable radioactively contaminated soil, equipment, piping, and concrete, activated reactor internals, and decontamination wastes. Decontaminated items, however, would not be removed from the site if they meet the unrestricted use limits described above.

In addition to the limits specified in Table 1 of Regulatory Guide 1.86, the NRC has previously established the following release limits for the PBRF:

Direct Radiation:	<5 uR/hr above natural background at one meter from all surfaces
Silt and Soil:	<two times natural background
Emergency Retention Basin:	<5 pCi of 90 Sr/gm of soil

4.1.2 Prompt Decommissioning Approach

4.1.2.1 Work Breakdown Structure and Organizations

Prompt decommissioning of the PBRF would be accomplished in accordance with the Work Breakdown Structure (WBS) described in Appendix A. A NASA project team would direct and control the overall project. A Decommissioning Operations Contractor (DOC) would be contracted by NASA. The DOC would be responsible to NASA for decommissioning planning and operations and would be responsible for all subcontracts required to complete the decommissioning operations. The PBRF site operator is also included in the organization to provide expert knowledge of the facilities history and existing conditions.

Each WBS element represents a definite work scope and also is the cost account for that work. For planning purposes, the WBS has been extended to Level 4 where necessary as shown on Figure 1 of Appendix A. Level 0 is the total project including planning and operations. Level 1 has separate WBS elements for the two distinct decommissioning phases, 1.0, Decommissioning Planning and 2.0, Decommissioning Operations. All costs from project inception through receipt of a decommissioning order are included in WBS element 1.0, whereas all costs from the receipt of the decommissioning order through the termination of the procession only license are included in WBS element 2.0.

Level 2 breaks the project into general work categories for each of the two decommissioning phases. It also includes a special account for all radioactive waste buried costs for payment directly by NASA, thereby avoiding contractors' pass through charges in this large and volatile cost item.

The major organizations may be associated with the Level 3 WBS elements. NASA's project team performs WBS elements 1.1.1. and 2.1.1. The site operator's staff performs WBS elements 1.1.2 and 2.1.2. The DOC performs all of the work under WBS elements 1.2.1, 1.2.2, 1.2.3 and 2.2.1. The DOC is also responsible for all the work under WBS element 2.2.2, whether performed by the DOC or subcontracted.

Level 4 of the WBS serves to break the engineering and planning, operations management and decommissioning activities into discrete work categories. WBS elements 1.2.2.1 through 1.2.2.14 cover the preparation of the activity specifications that form a part of the decommissioning plan (WBS element 1.2.2.18) that would be submitted to the NRC to obtain a decommissioning order. The activity specifications are also used as bidding documents for the work to be subcontracted under WBS element 2.2.2. WBS elements 1.2.2.15 through 1.2.2.19 cover the preparation of all the documents that are required by the NRC for review and approval. The final cost estimate and schedule are prepared under WBS elements 1.2.3.2 and 1.2.3.3 based on the additional engineering and planning conducted under WBS element 1.2.

Level 4 WBS elements 2.2.1.1 through 2.2.1.5 cover the DOC's staff and the DOC's procurement and utility costs. The level of effort staffs for site security, health physics and systems operation, maintenance and deactivation are covered by WBS elements 2.2.2.2 through 2.2.2.4. WBS elements 2.2.2.5 through 2.2.2.13 cover the actual work to prepare for and remove all radioactive materials from the PBRF, as demonstrated by an extensive final site radiological survey, covered by WBS element 2.2.2.14. WBS elements 2.2.2.2 through 2.2.2.14 may be performed by the DOC or subcontracted, depending on the DOC's overall capabilities, which may be enhanced by a company team approach.

4.1.2.2 Decontamination vs Removal of Components and Systems

To establish the site end condition summarized in 4.1.1 above, radioactively contaminated components and systems may be internally decontaminated to the applicable radiological release limits or may be removed, packaged and shipped to a low level radioactive waste disposal facility. Appendix C, Decontamination and Dismantling Methods Report, evaluates both the internal decontamination and removal approaches for radioactively contaminated components and systems. It was concluded that contaminated piping and components should be removed rather than decontaminated. This also applies to piping embedded deep in concrete. There are several factors that lead to this conclusion: thorough decontamination of complex piping systems and valves, pumps, heat exchangers, etc. is difficult, if not impossible, without major disassembly; verification that all surfaces of decontaminated objects meet the release limits is time consuming and subject to error; and the estimated cost of internal decontamination generally exceeds the cost for the removal approach. Therefore, internally contaminated components and systems are to be removed and shipped to the closest low-level radioactive waste disposal facility at Barnwell, S.C.

However, structures and other items externally contaminated with low-level radioactivity are to be decontaminated to the maximum possible extent to minimize the amount of radioactive waste that must be packaged, shipped and disposed. The fiberglass cloth/epoxy coating on the quandrant and canal walls and floors is to be stripped from the quadrants and canals to assure that the concrete surface below meets the release limits. Where contamination has been absorbed into concrete, a surface layer will be removed so as to allow the bulk of the concrete to remain in place. Items with only minimal external contamination will generally be cleaned using various decontamination agents to permit the items to remain in place.

4.1.2.3 Technical Assumptions

4.1.2.3.1 Existing vs Temporary Air Handling and Radwaste Systems

The Plum Brook Reactor Facility has been in a mothballed state for approximately twelve years. Consequently, there is no experienced staff available to operate the complex air handling and liquid processing systems. Many of these systems were extensively decontaminated prior to mothballing. These systems would require extensive maintenance and operational checkout before they could be used to support decommissioning. It therefore appears more economically feasible to use temporary, portable systems for liquid waste processing and solidification during decommissioning activities. It also appears more feasible to have portable or semi-portable air handling systems available to provide exhaust ventilation in the local areas where decommissioning activities are taking place. This approach appears to be preferable to the extensive refurbishing of systems, training and certification of new employees to operate these complex systems, and eventually decontaminating them again. It is, therefore, assumed that temporary air handling and liquid waste processing systems will be installed to satisfy localized decommissioning activities as opposed to utilizing existing systems.

However, the use of existing fans, pumps and other equipment available at Plum Brook should be maximized in order to minimize the costs. For example, connections to the decontamination tank in the reactor building are to be modified to receive any decontamination shower waste water as well as other decontamination wastes. Other modifications will be made to transfer these decontamination wastes to portable radwaste processing equipment.

Substantial use of portable HEPA filter/fan units is anticipated during the extensive cutting and disassembly operations in order to provide local control of airborne contaminants. Because of this, respiratory protective equipment will be required only for operations with a potential for unusually high airborne release.

4.1.2.3.2 Use of Existing Loose Equipment

There are a significant number of items such as shield casks, extension tools, power saws, material handling equipment, ventilating units, etc. that may be useful during decommissioning. A list of such items has been prepared for future reference.

4.1.2.3.3 Reactor Internals Disassembly

Disassembly and removal of in-tank reactor components during prompt dismantling is based upon remote underwater operations and the use of deionized water. Deionized water is used primarily to maintain optical clarity for remote operations and to facilitate decontamination of waste water utilizing ion exchange techniques. Flooding of the quadrants, however, will not be required.

Disassembly and removal of highly activated reactor internal components is based upon remote, underwater mechanical disassembly and cutting techniques. Although most of the core box components are bolted together and can be disassembled using reach rod tools, cutting will be required to remove some pieces and to section some pieces for packaging. The high temperature plasma-arc torch can be effectively utilized for underwater cutting, but precautions must be taken to assure that extremely high temperatures are not applied to lockalloy and beryllium pieces within the reactor core structure. This is because of the high inventory of tritium entrapped within the metal matrices and the likelyhood that high temperature cutting would release significant quantities of tritium. With appropriate precautions to avoid the beryllium and lockalloy portions of the reactor core structure, high temperature cutting techniques then can be utilized safely.

A shielded cask/liner loading area is to be constructed in Quadrant A. This will minimize the dose to personnel when highly activated core box components are removed from the reactor for packaging.

4.1.2.3.4 Removal vs Decontamination

As discussed in 4.1.2.2 internally contaminated piping and components are generally to be removed and disposed of as radioactive waste. Externally contaminated items, especially massive items such as the hot cell doors and roof slabs and canal doors and the surfaces of structures, will be decontaminated to avoid the high cost of disposing of such items.

It is assumed that both Cold Retention Area No. 1 and 2 will have to be removed to expose any contamination beneath the structures, but extensive removal of contaminated soil is assumed necessary only under Unit 2. This is based on the sound appearance of the concrete in Unit 1 as opposed to the cracking observed in Unit 2.

4.1.2.3.5 Occupational Radiation Exposure

It is assumed that the present occupational radiation exposure limits will remain in effect for the duration of radiological activities. A significant reduction in the present limits could require substantial additional shielding for certain activities, additional personnel, and could result in increased costs of further decommissioning.

The occupational man-rem exposures have been based on recent dose rate measurements in the various areas of the PBRF.

4.1.2.3.6 Radioactive Waste Shipment

A maximum payload per shipment of 42,000 pounds corresponding to a legal weight limit of 73,280 pounds is assumed.

The shipping casks required for the activated reactor internals and items in hot dry storage are assumed to be available when required.

The DOC will provide for miscellaneous radioactive waste collection, compaction as applicable, packaging and shipping. However to minimize organizational interfaces and to place the responsibility for a total work package on the contractors, each contractor is responsible to package and ship all radioactive items removed under his work scope.

4.1.2.3.7 Radioactive Waste Disposal

It is assumed that all radioactive wastes will be disposed of at the Barnwell Low-Level Radioactive Waste Disposal Facility at Barnwell, South Carolina.

4.1.2.3.8 Final Site Survey

It is assumed that the data obtained in the 1985 survey can be used to limit the scope of the final radiological survey, especially as related to the extensive grounds around the PBRF which have been demonstrated to be within release criteria and should not be affected by the decommissioning activities.

4.1.3 Prompt Decommissioning Schedule

Prompt decommissioning is estimated to require 52 months or approximately 4.3 years. Of this, the planning and approval phase is estimated at 18 months (1.5 years) based on the following sequence of activities:

Activity	Months	
NASA prepare and issue a request for proposal for DOC	1	3
Bid period	2	
NASA evaluate bids and select DOC	1	
Decommissioning planning by DOC	8	
NASA/DOC prepare and submit Decommissioning Request	1	
NRC review and issue Decommissioning Order	5	
	18	

The decommissioning operations from decommissioning order to license termination are estimated to require 34 months as shown on the schedule presented in Figure 4.1-1. The critical path flows through the DOC's initial mobilization activities and the major site preparation activities, especially access control modifications and crane certification activities. Loose equipment removal to improve access for decontamination and pipe and equipment removal operations in the containment and in the hot cells then becomes the critical activity. Asbestos removal may begin as soon as access control modifications are completed. Since asbestos removal is a short term activity in a limited number of locations, it may proceed in parallel with ongoing site preparation and loose equipment removal activities, and is not on the critical path. Contaminated soil removal is also not on the critical path. It can be scheduled during dry weather conditions any time after site preparation but before work on the cold retention area backfill since soil from the emergency retention area dike is needed as fill.

After completion of loose equipment removal from the containment and hot cells, the critical path shifts to piping and equipment removal from the containment. Decontamination operations would also begin in support of the pipe and equipment removal activities. Decontamination of the building surfaces would begin after completion of pipe and equipment removal in a given area (except embedded piping), but decontamination is not initially on the critical path since as many low-skill crews may be used as necessary.

As soon as the loose equipment stored on the HDS cover slabs are removed and the hot cell needed to support operations to remove items from hot dry storage is cleared, the HDS removal operations can begin. This work is not on the critical path.

When pipe and equipment removal in the containment vessel is complete, except for those systems required to support in-tank work, the critical path becomes the removal of the reactor internals. During the reactor internals removal period, most other work in the containment vessel must be suspended because of potentially high radiation levels when internals are lifted out of the biological shield to a quadrant for packaging. In other areas, however, work on pipe and equipment removal, decontamination, and liquid waste management may proceed.

As soon as the reactor internal transfer operations are complete and the reactor tank is drained, decontamination operations of containment structures may begin. This work includes the removal of the fiberglass cloth/epoxy coating from the walls and floors of the quadrants and Canal E. Since surface decontamination should be completed in each area before contaminated concrete removal operations begin in that area (see Appendix B), it is on the critical path. After surface decontamination, contaminated concrete removal from the contaminant becomes the critical path. Concrete surfaces that cannot be surface decontaminated are to be removed as well as gate frames and other embedded items to verify that concrete to steel interfaces are not contaminated. This must be completed before embedded pipe removal so that the large volumes of concrete to be removed to expose the piping need not be handled as contaminated.

Removal of the quadrant and canal embedded piping in the containment followed by removal of the more deeply embedded primary cooling water piping then become critical. Upon completion of this work, the radioactivity in all areas should be below the release limits. The critical path then flows through the final survey, final report, and the NRC's review and license termination actions.

The duration of the various activities shown in Figure 4.1-1 are based on the total man hours estimated for the various activities and a judgement as to the size of the average work force for that activity. The duration and the average and peak manning estimated for each of the major decommissioning activities is shown in Table 4.1-1.

4.1.4 Prompt Decommissioning Cost Estimate

4.1.4.1 Cost Estimate Summary

The total cost for the prompt decommissioning of the PBRF is estimated to be $32,143,378 (1985), unescalated with contingency. Table 4.1-2 provides a summary of the estimated costs from WBS Level 0 to 4.

4.1.4.2 Cost Estimate Organization

The cost estimate was made using the WBS described in Appendix A as an organizational framework. The various applicable cost elements were then defined for each WBS element as given in Appendix D, Prompt Decommissioning Cost Estimating Scope and Guidelines. Appendix D provided an overall checklist to assure that all of the applicable basic cost elements were included. It was decided, however, not to spread the dollars and apply escalation and contingency by fiscal year as indicated in Appendix D, but rather to summarize all costs in 1985 dollars with contingency.

4.1.4.3 Cost Estimate Basis and Assumptions

The basis of the prompt decommissioning cost estimate and the main assumptions that were made are given in Appendix E. For this study, NASA directed that the estimated cost be as accurate as possible and that there be a high degree of certainty that the decommissioning could be accomplished within the total estimated cost. Therefore, where necessary, the basis and assumptions were made such that the resulting costs would tend to be conservatively high. For this reason, all of the decommissioning activities under WBS element 2.2.2 were assumed to be separate subcontracts since this should result in a higher cost estimate than would be the case if the DOC performed some of those activities directly.

4.1.4.4 Cost Sensitivity

4.1.4.4.1 Decommissioning Operations Contractor's Staff

An evaluation was performed to determine the percentage contribution of the various WBS elements to the total estimated cost for both the Plum

Brook and Shippingport Station decommissioning cost estimates. The percentage contribution for comparable work scopes appear to be consistent between the two estimates except that the DOC staff in the Plum Brook estimate contributes approximately 14% more to the total cost than does the DOC staff in the Shippingport Station decommissioning estimate.

Part of this discrepancy may be due to an underestimate of the DOC contract amount for Shipingport since it is understood that the contract negotiated between the DOC and the DOE exceeded the estimate by approximately 8 million dollars. This would reduce the discrepancy to approximately 8.6%. It is also reasonable for the DOC's costs on Plum Brook to account for a larger percentage of the total project cost because the total Plum Brook Project cost is less than half of that for Shippingport but some minimum staffing level is required to cover all of the functions needed for an efficient and safe project.

It also appears, however, that the DOC staff for Plum Brook could be reduced somewhat since only three major contractors require management and administration at any one time as indicated in Figure 4.1-1. To estimate the maximum reduction in estimated project cost that could be achieved by reducing the DOC's staff, the DOC staff as indicated in Figure 1 of Appendix D was reduced to a minimum consistent with performing the various tasks necessary for an efficient and safe project. The staff of WBS 2.2.1.1 was reduced from 27 to 14, and the staff of WBS 2.2.1.2 was reduced from 24 to 18. The cost for 2.2.1.1 was reduced from $4,449,500 to $2,846,256, and the cost for 2.2.1.2 was reduced from $3,933,700 to $3,228,816. The discrepancy relative to the Shippingport estimate is thereby reduced to approximately 4% which probably represents the effect of a minimum staffing to cover the required functions regardless of the smaller scope.

The total cost estimate for the Plum Brook prompt decommissioning would be $29,364,532, a reduction of 8.6 percent. If this lower value is used, however, the essentially 100 percent certainty that the decommissioning can be done within the cost estimate (after including the effects of escalation) could be compromised.

4.1.4.4.2 Schedule Duration

During the planning phase of the project, expenditures are approximately $100,000 per month. Of this, 74% is due to WBS 1.2, Engineering and Planning, which should be a fixed price contract, and therefore should not result in increased cost due to a schedule extension. The costs under WBS 1.1, Planning Direction and Support would however increase project costs at approximately $26,000 per month of schedule extension. For a conservative schedule extension of 4 months, the cost increase would be limited to approximately $104,000, which is less than the contingency of $158,838 provided for WBS 1.0.

During the operations phase, most of the subcontracts would be fixed price. However the DOC's contract as well as those for site security (WBS 2.2.2.2), health physics (WBS 2.2.2.3) and systems operations, maintenance and deactivation (WBS 2.2.2.4) would likely be cost plus fixed fee or similar type of contract. The expenditure rate for WBS elements 2.1.1, 2.1.2, 2.2.1.1, 2.2.1.2, 2.2.2.2, 2.2.2.3, and 2.2.2.4 is approximately $500,000 per month. Thus, a six month schedule savings or slippage would decrease or increase the project cost by approximately $3,000,000. The overall contingency for WBS 2.0 is $4,394,826.

The effect of escalation is not included in the above.

4.1.4.4.3 Cold Retention Areas

The Cold Retention Areas were both assumed to be removed to uncover any contaminated soil beneath the structures, and it was assumed that contaminated soil would have to be removed only under Unit No. 2 since cracks are apparent in Unit No. 2 but not in Unit No. 1. Core sampling is recommended to determine the extent of any contamination beneath these structures.

If no contamination above release limits is detected, it may be possible to leave both units in place, in which case approximately $627,000 could be deleted from the estimate. Alternatively, contamination may be found beneath both units, in which case costs would increase by approximately $382,000. Much of this increase ($270,000) is due to additional radioactive waste disposal costs which would consume 65% of the contingency provided in WBS 2.3.

The cost of core sampling is not included above.

4.1.4.4.4 Subcontracting Costs

There are costs that could be avoided by not subcontracting much of the work under WBS 2.2.2, Decommissioning Activities. Costs for subcontractors' overhead and profit, Ohio franchise taxes, and performance bonds could be eliminated.

Site security, health physics and asbestos removal would likely be subcontracted in any case. The estimated subcontracting costs that could be eliminated by not subcontracting the other work under WBS 2.2.2 is approximately 1.9 million, and when the DOC's fee, Ohio franchise tax and performance bond costs are adjusted, the savings would be approximately 2 million. However, doing this work under a cost plus fixed fee contract would be more susceptible to schedule slippage, and the 2 million dollar savings would be offset by a 4 month slippage.

4.1.4.4.5 Radioactive Waste Disposal

As discussed elsewhere, Ohio is a member of the Mid-west compact, and a regional radioactive waste disposal site will not be available for several years. Also, the rates that will be charged by the new regional disposal site is unknown but could be quite high.

The rates for disposing of radioactive wastes at the existing disposal sites is expected to escalate much more than the general escalation rate applicable to other decommissioning cost elements. The rates have been recently escalating at about 20% per year. On January 1, 1986, the base disposal charge at Barnwell, which is presently $25.112 per cubic foot, is likely to increase to $30 per cubic foot or more. Also, a new surcharge of up to $40 per cubic foot has been rumored. Thus, the cost of radioactive waste disposal could soon increase to $70 per cubic foot or 2.8 times the present rate. With continued increased well above the general escalation rate, a disposal rate of $100 per cubic foot is conceivable. This would increase disposal costs by a factor of four. Without contingency, this would increse disposal costs from $2,068,667 to $8,274,668 and would increase the total prompt decommissioning cost estimate by $6,206,001 to $38,349,379, a 19.3% increase.

4.1.5 Prompt Decommissioning Occupational Radiation Exposure Estimate

Occupational radiation exposures were estimated for direct task personnel based on estimated task manhours and on dose rates measured during 1985 as a part of this study. Where these dose rates would be reduced or otherwise altered as a result of previous decommissioning work in a given area, judgement was used to estimate the dose rates for the modified configurations. Where practical, exposures were estimated separately for work in the general area radiation field and for "contact" work close to radioactive components. Exposure estimates for staff and support personnel not directly involved in work in radiation areas, were made by estimating the manhours spent in an average general area radiation field.

Table 4.1-3 provides a summary of the estimated radiation exposures. The total occupational exposure is estimated to be 342 man-rem. The exposure estimates are probably conservatively high, and the accuracy is not likely to be better than 50%.

The highest per person exposure is expected to result from the reactor internals and vessel removal work. With an average of 21 personnel performing the work over 6.5 months, they would average approximately 67% and 87% of their maximum permissible quarterly and yearly dose limits, respectively. Since a total of 35 personnel have been assumed for this work, these dose commitments would be 40% and 52% of the quarterly and yearly limits assuming uniform dose rate and distribution.

It is assumed that essentially all occupational radiation exposure will occur through direct external exposure to ionizing radiation. Exposure due to radioactively contaminated airborne material or due to inhalation of radioactive material will be held to less than 1% of the permissible concentration or dose by:

1. Implementation of a Safe Work Permit System to require detailed procedures for all work activities, to require health physics input to and approval of the detailed procedures, and to control personnel access to radiation areas.

2. Continuous air monitoring in all active work areas prior to, during and following all activities.

3. Use of appropriate radiological control features for specific tasks such as local HEPA exhaust filter/fan units, respirators, or contamination control envelopes for pipe cutting; wetting of contaminated soil; and fog/mist spray for controlled blasting.

It is likely that actual exposure will be significantly less than the estimated exposures due to the implementation of an ALARA (As Low as Reasonably Achievable) Program. For instance, the estimated exposure estimates do not take credit for local shielding that should be evaluated for use on a case by case basis. Also, the wide use of equipment that will allow less time to be spent near radioactive components such as counter weight operated power hacksaws could be effective in reducing exposure. Special training such as disassembling the very low activity mockup reactor core box to work out procedures and equipment prior to work on the main reactor core box should help to minimize occupational exposure.

4.1.6 Prompt Decommissioning Radioactive Waste Estimate

Miscellaneous compacted dry active waste (DAW) and contaminated trash quantities were estimated based on an expected generation rate for a project of this magnitude and the estimated duration of the project. Other radioactive waste quantities were based on the estimated volume of material to be removed during the various decommissioning activities. In the case of the cold retention areas, it was necessary to make assumptions regarding the extent of contamination exceeding release limits that may be found under these units after removal.

The total estimated radioactive waste burial volume is 63,378 cubic feet. Table 4.1-4 provides a summary of radioactive wastes by WBS element and waste type. The overall packaging efficiency included in this estimate is 50%. Thus, extra container volume is available as a contingency to cover any additional radwastes, and the potential exists to reduce container, shipping and disposal costs by more efficient packaging. This could however be somewhat offset by higher weight surcharges and the extra time required for packaging operations.

The associated total costs for radioactive waste packaging, shipping and disposal are as follows:

	1985 Dollars[(1)]	1985 Dollars/ Waste Burial Volume (CF)
Containers and Cask/Liners	525,124	8.29
Shipping (Including Delivery and Demurage)	211,023	3.33
Disposal (WBS 2.3)	2,068,662	32.64
Total	2,804,809	44.26

(1) Before contingency, overhead, profit, Ohio tax & performance bond where applicable

The disposal cost estimate is based on the Barnwell rate schedule effective April 14, 1985. Although not included above, a contingency of 20% or $413,733 is included in the cost estimate for WBS 2.3. Since the low packaging efficiency should provide contingency for any under estimate in radwaste volume, this dollar contingency should be available to offset future disposal site cost increases up to 20%. However, disposal rates could increase significantly more than 20% over general escalation in the next few years.

4.1.7 References

1. "An Evaluation of the Options for Further Decommissioning of the Plum Brook Reactor Facility", prepared for NASA by Teledyne Isotopes, July, 1978.

2. "Decommissioning Plan", Shippingport Station Decommissioning Project, Doc. No. RL/SFM-83-4 by Burns and Roe Industrial Services Corporation with Nuclear Energy Services, Inc., Rev. 1, September 1983.

Appendices

A. Work Breakdown Structure

B. Criteria and Procedure for Unrestricted Release of Potentially Contaminated Concrete

C. Decontamination and Dismantling Methods Report

D. Prompt Decommissioning Cost Estimating Scope and Guidelines

E. Prompt Decommissioning Cost Estimating Basis and Assumptions

Table 4.1-1

Major PBRF Prompt Decommissioning Activities Durations and Manning

WBS Element	Description	Estimated Duration	Estimated Manning Average	Peak
2.2.2.5	Contaminated Soil Removel	1 month	10	10
2.2.2.6	Site Preparation	3 months	3	6
2.2.2.7	Asbestos Removal	0.5 month	14	14
2.2.2.8	Loose Equipment Removal	2 months	15	15
2.2.2.9	Activated Material in Hot Dry Storage Removal	1.5 months	11	12
2.2.2.10	Decontamination and Liquid Waste Management	15 months	4.5	8
2.2.2.11	Reactor Internals and Vessel Removal	6.5 months	21	30
2.2.2.12	Contaminated Piping and Equipment Removal	13 months	30	40
2.2.2.13	Contaminated Concrete and Embedded Pipe Removal	9 months	18	20
2.2.2.14	Final Site Survey	2 months	10	10

TABLE 4.1-2

PBRF Decommissioning Cost Estimate

Level 0 to 3 WBS Elements	Description	1985 Dollars
0.0	Plum Brook Reactor Decommissioning Project	32,143,178
1.0	Decommissioning Planning	1,218,313
1.1	Planning Direction and Support	441,150
1.1.1	Planning Direction	257,150
1.1.2	Planning Site Support	184,000
1.2	Engineering and Planning	777,163
1.2.1	Engineering and Planning Management	413,627
1.2.2	Engineering	272,392
1.2.3	Scheduling and Cost Estimating	91,144
2.0	Decommissioning Operations	30,925,065
2.1	Operations Direction and Support	1,848,602
2.1.1	Operations Direction	1,361,602
2.1.2	Operations Site Support	487,000
2.2	Operations Management and Decommissioning Activities	26,594,063
2.2.1	Operations Management and Support	9,690,478
2.2.2	Decommissioning Activities	14,424,887
2.3	Radioactive Waste Burial	2,482,400

TABLE 4.1-2 (Cont'd)

PBRF Decommissioning Cost Estimate

Level 4 WBS Elements	Description	1985 Dollars
1.2.1.1	Management and Administration	317,636
1.2.1.2	Quality Assurance	28,240
1.2.1.3	Technical and Safety Review Committee	13,800
1.2.2.1	Decommissioning Operations Contractor (DOC) Activities	Included in 1.2.1.1
1.2.2.2	Site Security	Included in 1.2.1.1 & 1.1.2
1.2.2.3	Health Physics	3,760
1.2.2.4	System Operation, Maintenance & Deactivation	3,588
1.2.2.5	Contaminated Soil Removal	2,925
1.2.2.6	Site Preparation	2,650
1.2.2.7	Asbestos Removal	2,950
1.2.2.8	Loose Equipment Removal	2,400
1.2.2.9	Activated Material in Hot Dry Storage Removal	2,975
1.2.2.10	Decontamination & Liquid Waste Management	4,600
1.2.2.11	Reactor Internals & Vessel Removal	4,750
1.2.2.12	Contaminated Piping & Equipment Removal	10,325
1.2.2.13	Contaminated Concrete & Embedded Pipe Removal	5,850
1.2.2.14	Final Site Survey	3,850
1.2.2.15	Regulatory Requirements & Permitting Plan	4,000
1.2.2.16	Radiological Release Limits & Pathway Analysis	7,300

TABLE 4.1-2 (Cont'd)

PBRF Decommissioning Cost Estimate

Level 4 WBS Elements	Description	1985 Dollars
1.2.2.17	Safety Assessment & Radiation Exposure Estimate Summary	12,100
1.2.2.18	Decommissioning Plan	Included in 1.2.1.1
1.2.2.19	Environmental Report	8,300
1.2.2.20	General Engineering Support	1,650
1.2.3.1	WBS Update	Included in 1.2.1.1
1.2.3.2	Scheduling	19,800
1.2.3.3	Cost Estimating	10,800
1.2.3.4	General Scheduling & Cost Estimating Support	532
2.2.1.1	DOC Site Management & Administration	4,449,500
2.2.1.2	DOC Site Staff	3,933,700
2.2.1.3	DOC Home Office Management & Engineering Support	115,200
2.2.1.4	DOC Procurement	712,078
2.2.1.5	Utilities	250,000
2.2.2.2	Site Security	648,173
2.2.2.3	Health Physics	2,075,082
2.2.2.4	System Operation, Maintenance & Deactivation	1,287,432
2.2.2.5	Contaminated Soil Removal	132,626
2.2.2.6	Site Preparation	109,566
2.2.2.7	Asbestos Removal	53,228

TABLE 4.1-2 (Cont'd)

PBRF Decommissioning Cost Estimate

Level 4 WBS Elements	Description	1985 Dollars
2.2.2.8	Loose Equipment Removal	427,598
2.2.2.9	Activated Material in Hot Dry Storage Removal	353,126
2.2.2.10	Decontamination & Liquid Waste Management	962,179
2.2.2.11	Reactor Internals & Vessel Removal	1,722,320
2.2.2.12	Contaminated Piping & Equipment Removal	4,698,435
2.2.2.13	Contaminated Concrete & Embedded Pipe Removal	1,801,299
2.2.2.14	Final Site Survey	153,823

TABLE 4.1-3

PBRF Prompt Decommissioning Occupational Exposure Estimate

WBS Element	Description	Total Exposure (1) man-rem	Average Exposure man-rem/man	Percent of 10CFR20 Limit (3) Qtr. (4)	Yr. (4)
2.0	Total Decommissioning Operations	342	-	-	-
2.1.1	Operations Direction	2.5	0.31	1.1	2.7
2.1.2	Operations Site Support	4	1	4.7	11.3
2.2.1.1	DOC Site Management and Admin.	3.5	0.44	1.6	3.8
2.2.1.2	DOC Site Staff	9.6	0.53	2.4	5.8
2.2.2.2	Site Security	1.5	0.21	0.79	1.9
2.2.2.3	Health Physics	16.9	1.88	7.8	18.8
2.2.2.4	Systems Ops., Maint., & Deact.	8.5	0.85	4.0	9.6
2.2.2.5	Contaminated Soil Removal	0.04	4×10^{-3}	0.13	0.08
2.2.2.6	Site Preparation	2.3	0.77	26	15
2.2.2.7	Asbestos Removal	4	0.29	9.7	5.8
2.2.2.8	Loose Equipment Removal	26.6	1.77	59	35
2.2.2.9	Activated Mat'l. in HDS Removal	14.0	1.27	42	25
2.2.2.10	Decontamination and Liquid Waste Management	20.3	4.51	30	72
2.2.2.11	Reactor Vessel Internals and Vessel Removal	91.3	4.35	67	87
2.2.2.12	Contaminated Piping and Equipment Removal	105.2	3.51	27	65
2.2.2.13	Contaminated Concrete and Embedded Pipe Removal	31.3	1.74	17	35
2.2.2.14	Final Site Survey	0	0	0	0

(1) Above background
(2) Based on average crew size
(3) Assuming uniform distribution of exposure over activity duration per Table 3.4-1.
(4) 3 Rem per year
(5) [illegible]em per year

TABLE 4.1-4

PBRF Prompt Decommissioning Radioactive Waste Estimate

WBS Element	WBS Description	Waste Type	Waste Category	Waste Volume (ft^3)	Container Quantity	Container Capacity (ft^3)	Truck Loads	Waste Burial Volume (ft^3)
2.0	Decommissioning Operations	Total for all types	-	32,096	-	-	96	63,378
2.2.1.2/ 2.2.1.4	DOC Site Staff	Misc. Compacted DAW & Misc. Contaminated Trash	LSA	3300	500	7.5	4	4600
2.2.2.5	Contaminated Soil Removal	Soil & Paving Materials	LSA	1052	14	90	3.5	1372
2.2.2.7	Asbestos Removal	Contaminated Asbestos Thermal Insulation	LSA	183	4	90	1	392
2.2.2.8	Loose Equipment Removal	Contaminated Equipment	LSA	4682	87	90	3	8526
			LSA	705	-	-	3	705
2.2.2.9	Activated Material in HDS Removal	Activated and/or Contaminated Components:						
		Cask/Liner #1	Type B	3.2	1	115	1	120
		Cask/Liner #2	Type A,B & LSA	53.3	1	115	1	120
		Cask/Liner #3	Type B	0.4	1	10	1	13
		Container #4	LSA	109	1	432	1	536
		Containers #5 to #10	LSA	1325	6	245	1.5	1862

TABLE 4.1-4 (Cont'd)

PBRF Prompt Decommissioning Radioactive Waste Estimate

WBS Element	WBS Description	Waste Type	Waste Category	Waste Volume (ft^3)	Container Quantity	Container Capacity (ft^3)	Truck Loads	Waste Burial Volume (ft^3)
2.2.2.10	Decontamination & Liquid Waste Management	Solidified Decontamination Wastes	LSA	1122[1]	336[1]	7.5	8	3091
2.2.2.11	Reactor Internals and Vessel Removal	Activated and/or Contaminated Reactor Internals or Vessel Pieces:		2178				
		Trailer #1	LSA & Type A	(6)	5	90	1	510
		Trailer #2	Type B	(6)	1	10	1	13
		Trailer #3	Type B	(6)	1	10	1	13
		Trailer #4	Type B	(6)	1	115	1	120
		Trailer #5	Type A	(6)	3	90	1	306
					1	432		536
		Trailer #6	Type A	(6)	5	90	1	510
		Trailer #7	Type A	(6)	5	90	1	510
		Trailer #8	Type A	(6)	2	90	1	204

PBRF Prompt Decommissioning Radioactive Waste Estimate

WBS Element	WBS Description	Waste Type	Waste Category	Waste Volume (ft^3)	Container Quantity	Container Capacity (ft^3)	Truck Loads	Waste Burial Volume (ft^3)
2.2.2.12	Contaminated Piping and Equipment Removal	Hot Sampling Storage Cave	LSA	200	1	210	1	221
		Contaminated Valves & Equipment	LSA	6811	127	90	17	12446
		Contaminated Piping	LSA	921(4)	67	90	12	6566
		Large Sealed Contaminated Components	LSA	9012	-	-	7	9012
2.2.2.13	Contaminated Concrete & Embedded Pipe Removal	Contaminated Concrete	LSA	26	10	90	17	980
		Contaminated Gravel & Soil from CRA Unit 2	LSA	225	84	90	2	8232
		Contaminated PCW Pipe	LSA	82(2)	12(3)	90	1.5	1176
		Contaminated PCWS, Q&C, and HDS Pipe	LSA	106(4)	7(5)	90	2.1	686

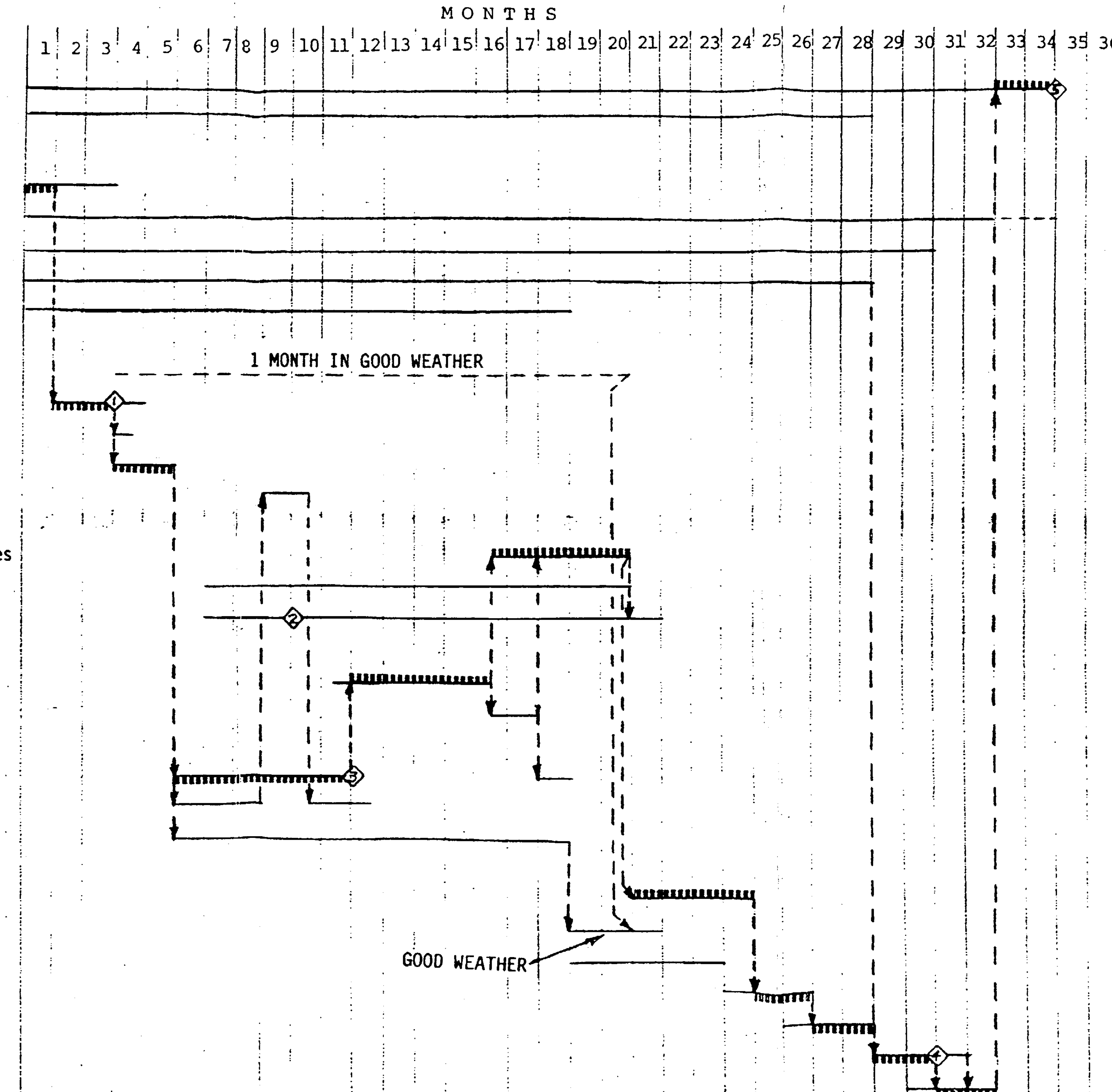
(1) Based on 14,300 gallons of decontamination waste solution concentrated to 8412 gallons (1122 ft^3) and 25 gallons of concentrate per drum.
(2) Metal volume based on 320 feet of 24" stainless steel pipe with 1/2" wall.
(3) Container loading based on sectioning PCW pipes lengthwise.
(4) Metal volume.
(5) Container loading based on nesting pipe.
(6) Not estimated, assumed to be 80% of burial volume in waste volume total (2722X0.8=2178).

FIGURE 4.1 - 1

PBRF PROMPT DECOMMISSIONING SCHEDULE FOR DECOMMISSIONING OPERATIONS
(WBS Element 2.0)

1 COMPLETE SITE ACCESS MODS. & CRANE CERTIFICATION
2 START PROCESSING LIQUID WASTES
3 COMPLETE CONTAINMENT EXCEPT SUPPORT SYSTEMS
4 COMPLETE SURVEY
5 LICENSE TERMINATION

WBS	ACTIVITY
2.1.1	Operations Direction (NASA Staff)
2.1.2	Operations Site Support
2.2.1	Operations Management & Support
	DOC Mobilization & Training
	DOC Management & Services
2.2.2.2	Site Security
2.2.2.3	Health Physics
2.2.2.4	Systems Operation, Maintenance, and Deactivation
2.2.2.5	Contaminated Soil Removal
2.2.2.6	Site Preparation
2.2.2.7	Asbestos Removal
2.2.2.8	Loose Equipment Removal
2.2.2.9	Activated Mat'l in HDS Removal
2.2.2.10	Decontamination & Liquid Waste Management
	Decon Containment Structure & Bioshield Thru Pipes
	Decon Other Areas & Decon Support
	Liquid Waste Management
2.2.2.11	Reactor Internals & Vessel Removal
	Internals
	Vessel
2.2.2.12	Contaminated Piping & Equipment Removal
	Containment
	Hot Cells & Hot Lab Hot Side
	Other Areas
2.2.2.13	Contaminated Concrete & Embedded Pipe Removal
	Contaminated Concrete Removal from Containment
	Remove CRA's
	Cont. Concrete Removal from Other Areas
	Embedded Pipe Removal - Q&C, PCWS, HD
	Embedded Pipe Removal - PCW
2.2.2.14	Final Site Survey and Report
2.1.1 & 2.2.1	Final Report to NRC



Form BR 8002-2A

TELEDYNE ISOTOPES

APPENDIX A

TO

APPENDIX 4.1

WORK BREAKDOWN STRUCTURE

Work Breakdown Structure

The Work Breakdown Structure (WBS) elements of the Plum Brook Reactor Facility (PBRF) Decommissioning Project (PBRFDP) as shown on Figure 1 includes the activities and other cost items as described below. The PBRFDP cost estimate accumulates all of the decommissioning costs in accordance with this WBS. The WBS elements will be conducted as indicated in Figure 2.

0.0 Plum Brook Reactor Facility Decommissioning Project

Perform all necessary functions to place the PBRF in a radiologically safe condition in accordance with the NRC regulations and to terminate the possession only licenses.

1.0 Decommissioning Planning

Provide the overall direction in accordance with NASA policies and direction, site support in terms of data collection and expertise on facility history and status, and engineering and planning to develop the activity specification, plans, schedules, and costs for the decommissioning operations.

1.1 Planning Direction and Support

Provide overall direction and control to assure that NASA's policies and direction are implemented in the planning. Also provide site information and data to support the engineering and planning effort.

1.1.1 Planning Direction

Provide overall direction and control to assure NASA's policies and direction are efficiently implemented during the planning phase. The NASA staff performing this function is responsible for all reports required by NASA. This NASA staff would select the contractor to prepare the engineering and planning documents under WBS element 1.2 and to manage the decommissioning activities under WBS element 2.2.1.

1.1.2 Planning Site Support

Provide information and data as required by the engineering and planning contractor. Work under this WBS element will be performed by Teledyne Isotopes on-site caretaker staff and subcontractor personnel. The costs to be included in this WBS element are those that may be required for personnel, equipment, supplies and subcontracts that would not be covered by the continuing funding for the caretaker function. Radiation and contamination surveys and reactor inventory calculation (computer) updates are included.

1.2 Engineering and Planning

Perform the engineering and planning for the decommissioning operations to be conducted under WBS element 2.0. For maximum efficiency and continuity, the organization that performs this WBS element should also perform the Decommissioning Operations Contractor's (DOC's) activities under WBS element 2.2.1. Costs for direct material and subcontracts, direct labor and overhead including taxes, insurance, and holiday and vacation adjustment, travel including per diem or subsistence, consultants and other direct costs including computer usage, reproduction, communications and postage, and fee will be included in the following WBS elements as appropriate.

1.2.1 Engineering and Planning Management

Perform the required management and support functions for the engineering and planning activities.

1.2.1.1 Management and Administration

Perform the management and administration activities to plan, monitor and control the engineering and planning activities. Staffing includes a full time project manager, project engineer, project control engineer and a secretary. A Project Plan will be prepared to document the approach to be followed, the project procedures, and basic criteria to be implemented.

1.2.1.2 Quality Assurance

Verify that the activities affecting the quality of the engineering and planning are conducted in accordance with the project procedures and criteria. A part time QA Engineer will perform this function.

1.2.1.3 Technical and Safety Review Committee

Perform periodic reviews to assure that the technical approach is optimum and that safety aspects are adequately incorporated into the engineering and planning documents.

1.2.2 Engineering

Prepare studies as required to support the preparation of activity specifications, prepare activity specifications in a suitable bidding format, prepare permitting plans, pathway analysis, safety assessment and exposure estimate, decommissioning plan, and environmental report, and provide general engineering support as defined in the following WBS elements. All work will be performed by an engineering staff coordinated by the project engineer included in WBS element 1.2.1.1.

1.2.2.1 Decommissioning Operations Contractor (DOC) Activities

Prepare Activity Specification (AS) 1 to define the DOC's work and services to be provided under WBS element 2.2.1.

1.2.2.2 Site Security

Prepare AS 2 to define the site security work to be performed under WBS element 2.2.2.2.

1.2.2.3 Health Physics

Prepare AS 3 to define the health physics work to be performed under WBS element 2.2.2.3 in support of the work being done by other decommissioning personnel. The final site survey is not included (see WBS element 1.2.2.14).

1.2.2.4 System Operation, Maintenance and Deactivation

Prepare AS 4 to define the work required under WBS element 2.2.2.4 to operate and maintain existing or temporary systems and to deactivate systems, including draining and deenergizing, as required to support decommissioning operations.

1.2.2.5 Contaminated Soil Removal

Prepare AS 5 to define the work required under WBS element 2.2.2.5 to remove contaminated soil based on surveys conducted by Teledyne Isotopes. The scope will include removal of a few inches from the surface of the emergency retention basins and effluent ditch, backfill of any deep excavations, and packaging and shipping.

1.2.2.6 Site Preparation

Prepare AS 6 to define the work required under WBS element 2.2.2.6 to ready the site and facility for decommissioning. This includes the requirements for any modifications needed for site security and contractor's access control, office trailers, parking, inside or outside storage areas, refurbishing existing offices, installation of temporary support systems such as construction type electric power and lighting, compressed air, water, steam, and change, shower and sanitary facilities. Provisions for temporary space heating and cooling may also be required in selected offices and areas.

1.2.2.7 Asbestos Removal

Prepare AS 7 to define the work required under WBS element 2.2.2.7 to remove asbestos. Asbestos identified as contaminated will be specified for removal and for disposal at a radwaste burial ground, and non-contaminated asbestos will be specified for removal only from radioactive components and piping for burial at a hazardous waste disposal site.

Packaging and disposal of non-radioactive asbestos and packaging and shipping costs of radioactive asbestos shall be specified in this WBS element.

1.2.2.8 Loose Equipment Removal

Prepare AS 8 to define the work required under WBS element 2.2.2.8 to remove loose equipment primarily from the quadrants, canals and hot cells. Included in "loose" equipment are experimental systems which may have a few connections to permanent systems that are readily disconnected. The scope will include packaging and shipping.

1.2.2.9 Activated Material in Hot Dry Storage Removal

Prepare AS 9 to define the work required under WBS element 2.2.2.9 to remove activated material from hot dry storage. The scope will include the packaging and shipping including Type A or Type B containers and casks that may be required.

1.2.2.10 Decontamination and Liquid Waste Management

Prepare AS 10 to define the work required under WBS element 2.2.2.10 to decontaminate the surfaces of components, piping, walls, floors, sumps, etc., as identified by contamination survey. This may include the inside surface of the embedded primary piping. Also to be specified is the processing of all waste liquids generated during system draining and decontamination operations and packaging and shipping of radioactive resins and solidified wastes.

1.2.2.11 Reactor Internals and Reactor Vessel Removal

Prepare AS 11 to define work required under WBS element 2.2.2.11 to remove the reactor internals and reactor vessel. The approach to the work will be based on Teledyne Isotopes' disassembly sequence and methods defined in the 1978 report and updated radioactivity calculations and data. Responsibility for procuring shipping casks, liners and containers as well as transportation to the waste burial site shall be specified.

1.2.2.12 Contaminated Piping and Equipment Removal

Prepare AS 12 to define work required under WBS element 2.2.2.12 to remove contaminated piping and components as defined by survey data taken by Teledyne Isotopes.

Prior to removal, all components will be deenergized and the system will be drained and tagged out as specified under WBS element 1.2.2.4. Electric power and instrumentation cables will then be cut as specified per this WBS element. Piping and large volume components shall be cut to suitable size, loaded into containers, together with smaller components, and shipped as specified under this WBS. Certain larger components shall be externally decontaminated as specified per WBS element 1.2.2.10 and sealed for direct shipment as specified per this WBS element. Certain tanks may be specified for use as shipping containers for other LSA material.

As part of this WBS element, supplementary requirements for welding shall be specified, and any actions required to assure long term site safety following removal of radioactive systems shall be specified.

On-site handling, final packaging and shipping shall be specified in this WBS element.

1.2.2.13 Contaminated Concrete and Embedded Pipe Removal

Prepare AS 13 to define the work required under WBS element 2.2.2.13 to remove contaminated concrete and embedded pipe based on surveys conducted by Teledyne Isotopes. The scope may include removal of activated concrete surrounding the reactor vessel and removal of concrete surfaces contaminated by radioactive fluids such as in the quadrant pools, canals and various radioactive sumps. Embedded pipe removal may include contaminated primary coolant piping and various drain piping if decontamination and verification are evaluated to be impractical or non-economic. Embedded pipe removal would require the removal of clean concrete, but clean concrete would not be removed from the site. Fencing or covering such areas will be specified to maintain site safety. Packaging and shipment of contaminated concrete and embedded piping shall be specified under this WBS element.

1.2.2.14 Final Site Survey

Prepare AS 14 to define work required under WBS element 2.2.2.14 to plan and conduct the final site radiological survey under the direction of a certified health physicist.

1.2.2.15 Regulatory Requirements and Permitting Plan

Prepare a summary of applicable regulatory requirements on the federal, state and local levels and define a general plan for obtaining the required permits and authorizations with responsibilities for implementation assigned to the applicable project organizations.

1.2.2.16 Radiological Limits and Pathway Analysis

Prepare a summary of applicable radiological limits for both items to be disposed of off site as non-radioactive (e.g., clean asbestos) and for materials to be left on site at the end of decommissioning. The pathway analysis should demonstrate that these release limits will result in subsequent exposure within NRC limitations.

1.2.2.17 Safety Assessment and Radiation Exposure Estimate Summary

Prepare an assessment of the project operations to demonstrate that an acceptable level of safety will be implemented. This should include a radiation exposure estimate for all activities based on the contact and general area dose rate data taken by Teledyne Isotopes for all applicable plant areas.

1.2.2.18 Decommissioning Plan

Prepare a Decommissioning Plan to describe the approach and plans for the decommissioning operations phase under WBS element 2.0. This plan will include the activity specifications prepared under WBS elements 1.2.2.1 through 1.2.2.14, the plans, analyses and assessments prepared in WBS elements 1.2.2.15 through 1.2.2.17, and the WBS and schedules prepared in WBS elements 1.2.3.1 and 1.2.3.2.

1.2.2.19 Environmental Report

Prepare an environmental report for the decommissioning operations by updating the environmental report prepared in 1981. For each decommissioning alternative being considered, environmental information and consequences shall be presented and evaluated.

1.2.2.20 General Engineering Support

Provide general engineering support in response to requests from NASA. This WBS element should be funded at a small percentage of the cost for the rest of WBS element 1.2.2.

1.2.3 Scheduling and Cost Estimating

Provide a detailed schedule and cost estimate based on the engineering accomplished in WBS element 1.2.2.

1.2.3.1 WBS Update

Prepare an update of this WBS based on new information generated during implementation of WBS element 1.0.

1.2.3.2 Scheduling

Prepare updated milestones and critical path schedules for the overall decommissioning project and schedules for each activity specification prepared in WBS elements 1.2.2.1 through 1.2.2.14. These computer generated schedules should be resource loaded and leveled.

1.2.3.3 Cost Estimating

Prepare updated manhours and cost estimates based on the engineering work performed in WBS elements 1.2.2 and the scheduling performed in WBS elements 1.2.3.2. Contingency should be reduced from earlier estimates to reflect the increased definition of the work and escalation should reflect the latest predictions accepted by NASA.

1.2.3.4 General Scheduling and Cost Estimating Support

Provide general support for scheduling and cost estimating in response to requests from NASA. This WBS element should be funded at a small percentage of the cost for the rest of WBS element 1.2.3.

2.0 Decommissioning Operations

Provide the direction, site support, overall project management, engineering, procurement and utilities, and decommissioning activity functions required to decommission the Plum Brook Reactor Facility.

2.1 Operations Direction and Support

Perform the function of project manager, providing overall direction and control for the decommission activities. Site support is also included in this WBS element.

2.1.1 Operations Direction

NASA staff to provide overall direction and control to assure NASA's policies and direction are efficiently implemented during the operations phase. Included is all interface and reporting within NASA and responsibility to terminate all facility licenses with the NRC. The NASA staff performing this function should include the staff that performed WBS element 1.1.1.

2.1.2 Operations Site Support

Provide continuity in the knowledge of the Plum Brook Reactor Facility in support of the Decommissioning Operations Contractor (WBS element 2.2.1). This WBS element will be performed by Teledyne Isotopes on-site caretaker staff and subcontractor personnel.

2.2 Operations Management and Decommissioning Activities

Provide management, administration, engineering, procurement, and utilities as required to execute and coordinate all decommissioning activities. This WBS element is performed by the Decommissioning Operations Contractor (DOC) and subcontractors. Costs for direct material including computer for data processing, subcontracts, direct labor and overhead including taxes and insurance, holiday and vacation adjustment, relocation and travel, including per diem or subsistance, consultants and other direct costs including computer usage, reproduction, communication and postage will be included in the following WBS elements as appropriate. DOC's contract will be based on a fixed fee based on the total cost of WBS elements 2.2.1 and 2.2.2.

2.2.1 Operations Management and Support

Perform the operations management and support functions for the decommissioning operations as defined in AS-1.

2.2.1.1 DOC Site Management and Administration

Provide the key site management and administration functions required to manage and coordinate the decommissioning operations. This includes the DOC's project manager, functional managers, and secretaries. General site plans such as the QA Plan, HP Plan, Site Security Procedures, Work Authorization Procedure and Detailed Procedures Preparation Guide will be prepared under this WBS element.

2.2.1.2 DOC Site Staff

Provide the site staff support required to procure, direct, and administer the subcontractors required to implement WBS element 2.2.2, to procure other equipment, materials and services, to provide on-site engineering, to provide health, safety and environmental protection functions, to dispose of non-radioactive salvage material, scrap and trash, to collect, compact, package and ship miscellaneous radioactive wastes, to coordinate all radioactive shipments with the radwaste burial site(s), to allocate and manage the use of inside and outside storage areas by contractors, and to provide for supply and cleaning of protective clothing and equipment for all site operations.

2.2.1.3 DOC Home Office Management and Engineering Support

Provide for the DOC's part time home office management and support and any home office engineering that may be required to support contractor bid package preparation and/or evaluation, material procurement requirements, such as waste shipping containers, and review of contractors' detailed procedures.

2.2.1.4 DOC Procurement

Provide funds for purchase of miscellaneous waste shipping containers and funds for lease, rental or purchase of other general materials, equipment and services required to support WBS element 2.0.

2.2.1.5 Utilities

Provide the utilities necessary to support operation activities such as fuel oil, electric power, and water.

2.2.2 Decommissioning Activities

Provide all activities to physically decommission the Plum Brook Reactor Facility. The following WBS elements are to be performed by competitively awarded fixed price contractors to the maximum practical extent. Detailed procedures will be prepared under the following WBS elements for approval by the DOC. The DOC may also choose to perform some of the following WBS elements directly, but for this cost estimate, each of the following WBS elements will be considered to be a separate subcontract.

2.2.2.1 (Not Used)

2.2.2.2 Site Security

Provide the necessary staff to perform AS 2 as defined in WBS element 1.2.2.2. This includes site security training and drills, access control, and on-site security monitoring in accordance with the DOC's procedures.

2.2.2.3 Health Physics

Provide the necessary staff to perform AS 3 as defined in WBS element 1.2.2.3 in accordance with the DOC's HP Plan. This includes preparing HP procedures, health physics training for all on-site personnel as applicable to their job function, reviewing work plans per ALARA criteria, monitoring, controlling, recording and notifying personnel exposures, monitoring, recording and marking radiation and contamination areas, rad-chemistry and all other aspects of health physics. A certified health physicist shall be responsible for all work under this WBS element.

2.2.2.4 Systems Operation, Maintenance and Deactivation

Provide the necessary staff, tools, equipment, materials, plans and procedures to perform AS 4 as defined in WBS element 1.2.2.4. Systems to be operated and maintained may include existing cranes and hoists and existing and/or temporary systems for electric power and lighting, compressed air, water, steam and space heating. Training the staff shall be included.

Systems have been drained, but low points without installed drains may have to be tapped to completely drain the piping or component. Electric power must be positively and permanently disconnected from all components prior to dismantlement. A tag out procedure shall be initiated and maintained.

2.2.2.5 Contaminated Soil Removal

Provide the necessary work force, tools, equipment, materials including waste shipping containers, plans and procedures to perform AS 5. The potential general scope is described under WBS element 1.2.2.5. Watering and/or dewatering equipment may be required in addition to excavating and container loading equipment. Packaging and transportation of wastes to the burial site are included, but burial costs shall be in a separate account under WBS element 2.3 for direct payment by NASA.

2.2.2.6 Site Preparation

Provide the necessary work force, tools, equipment, materials, plans and procedures to perform AS 6. Potential general scope is described under WBS element 1.2.2.6.

2.2.2.7 Asbestos Removal

Provide the necessary work force, tools, equipment, materials including waste shipping containers, plans and procedures to perform AS 7 as defined in WBS element 1.2.2.7. Contractor is responsible for the safe removal and disposal of the asbestos and for placing the facility in a safe condition relative to asbestos contamination during subsequent decommissioning operations. Packaging and transportation of waste to a hazardous waste and/or radioactive waste burial sites are included, but burial costs for radioactive asbestos shall be in a separate account under WBS element 2.3 for direct payment by NASA.

2.2.2.8 Loose Equipment Removal

Provide the necessary work force, tools, equipment, materials including waste shipping containers, plans and procedures to perform AS 8 as defined in WBS element 1.2.2.8. Some experimental systems may have to be disconnected from permanent systems and some disassembly may be desirable to facilitate packaging. Packaging and transportation to a radioactive waste burial site are included, but burial costs shall be in a separate account under WBS element 2.3 for direct payment by NASA.

2.2.2.9 Activated Material in Hot Dry Storage Removal

Provide the necessary work force, tools, equipment, materials including waste shipping containers and casks, plans and procedures to perform AS 9 as defined in WBS element 1.2.2.9. Packaging and transportation of wastes to the burial site are included, but burial costs shall be in a separate account under WBS element 2.3 for direct payment by NASA.

2.2.2.10 Decontamination and Liquid Waste Management

Provide the necessary work force, tools, equipment, materials including waste shipping containers, supplies, plans and procedures to perform AS 10. Potential general work scope is described under WBS element 1.2.2.10. Equipment may include decontamination rigs, waste collection tanks, disposable filters and ion exchangers and portable evaporator and solidification systems. Packaging and transportation of waste to the burial site are included, but costs for burial shall be in a separate account under WBS element 2.3 for direct payment by NASA.

2.2.2.11 Reactor Internals and Vessel Removal

Provide the necessary work force, tools, equipment, materials including waste shipping containers, plans and procedures to perform AS 11 as defined in WBS element 1.2.2.11. Packaging and transportation of wastes to the burial site are included, but burial costs shall be in a separate account under WBS element 2.3 for direct payment by NASA.

2.2.2.12 Contaminated Piping and Equipment Removal

Provide the necessary work force, tools, equipment, materials including waste shipping containers, plans and procedures to perform AS 12 as defined in WBS element 1.2.2.12. Packaging and transportation of wastes to the burial site are included, but burial costs shall be in a separate account under WBS 2.3 for direct payment by NASA.

2.2.2.13 Contaminated Concrete and Embedded Pipe Removal

Provide the necessary work force, tools, equipment, materials including waste shipping containers, plans and procedures to perform AS 13 as defined in WBS 1.2.2.13. Equipment for concrete surface removal as well as for removal of piping embedded several feet in concrete will be required. Expertise in controlled blasting will be required. Packaging and transportation of contaminated concrete and pipe to the burial site are included, but burial costs shall be in a separate account under WBS element 2.3 for direct payment by NASA.

2.2.2.14 Final Site Survey

Provide the necessary work force, tools, equipment, materials, plans and procedures to perform AS 14 as defined in WBS element 1.2.2.14. A final report certified by a licensed health physicist shall be provided.

2.3 Radioactive Waste Burial

Provide a budget for the direct payment of all radioactive waste disposal costs by NASA. This approach avoids the markups that would be experienced if these costs were included in the various subcontracts.

TELEDYNE ISOTOPES

APPENDIX B

TO

APPENDIX 4.1

CRITERIA AND PROCEDURE FOR UNRESTRICTED RELEASE OF POTENTIALLY CONTAMINATED CONCRETE

B1.1 Scope

This Appendix addresses the monitoring of potentially contaminated concrete from the initial survey to final release of areas that require surface decontamination and/or removal of contaminated concrete. Bare and covered concrete surfaces are considered. Procedures are also given for locations where cracking has occurred or where embedments or joints, etc., form a crevice, since surface scanning and conventional sampling methods cannot be directly applied to such locations.

The procedure covers initial concrete surface surveying of any potentially contaminated areas, surveying after any surface decontamination operations, and surveying after concrete removal operations. The procedures are flexible to allow decisions to be made based on survey results and experience so that the most cost effective contamination removal technique for a given situation can be selected. For example, surface decontamination or paint removal, if given a reasonable chance for success based on surveys and experience, should be done rather than removal of concrete.

The procedure includes contingency steps where, for example, an attempt to surface decontaminate proves unsuccessful and removal of paint or contaminated concrete becomes necessary.

The flexibility included in this procedure results in a rather complex network, but in practice, the logic allows the easiest and most cost effective methods to be employed.

A logic diagram of the procedure is given in Figure B1. The numbers in parentheses on Figure B1 correspond to the steps in the procedure (Section B1.3).

The procedure does not apply to concrete that has been activated by neutron bombardment since the highest radioactivity level of activated concrete could occur at some depth into the concrete and therefore surface radiation/contamination survey methods used in this procedure would not be appropriate. For the PBRF, the only potentially activated concrete is a small amount of concrete around the thermal column and a beam tube penetrating the reactor biological shield, and plans call for removing this concrete as contaminated concrete regardless of surface radiation/contamination levels.

B1.2 Criteria For Unrestricted Release

In accordance with U.S. NRC Regulatory Guide 1.86, June 1974, any residual surface contamination shall be less than the following:

TELEDYNE ISOTOPES

NUCLIDE (a)	DPM BETA-GAMMA/100 SQ CM (b) AVERAGE (c) FIXED	MAXIMUM (d) FIXED	REMOVABLE (e)
BETA-GAMMA EMITTERS	5,000	15,000	1,000

a. For alpha emitting nuclides and more restrictive fission products (e.g., SR 90), the appropriate limits from Table I of U.S. NRC Regulatory Guide 1.86 shall apply.

b. DPM (disintegrations per minute) is the actual disintegration rate as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrument as well as radiation source characteristics.

c. Measurements of average contamination should not be averaged over more than one (1) square meter. If the area to be measured is less than one (1) square meter, the average should be for the total area.

d. Maximum contamination level applies to an area not more than 100 square centimeters.

e. The amount of removable radioactive material per 100 square centimeters of surface area shall be determined by wiping that area with a dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. If less than 100 square centimeters is wiped, the acceptable contamination level should be reduced proportionately.

B1.3 Procedure For Unrestricted Release Of Potentially Contaminated Concrete

1. Perform direct radiation survey (DRS -- direct method) of potentially contaminated concrete surfaces.

2. Perform representative smear survey (RSS -- indirect method) of potentially contaminated concrete surfaces.

3. For those surface areas where DRS is less than (<) 5000 dpm/100 sq cm (units are the same throughout) and RSS < 1000, go to steps 4 and 5. For areas where DRS is greater than (>) 5000 or RSS > 1000, go to step 6.

4. Prepare records of areas qualifying for unrestricted release.

TELEDYNE ISOTOPES

5. Those surface areas that qualify for unrestricted release that are not painted and for which future contamination potential exists due to other operations that will be done in the area should be painted with a cost effective sealer or strippable coating to close pores and make any subsequent surface decontamination easier and less costly. (If subsequent contamination of areas is suspected, this procedure must be repeated.)

6. Smear survey (SS) those surface areas where DRS > 5000 (this smear survey is conducted within areas where DRS > 5000 which may not have been covered by the representative smear survey conducted in 2. above).

7. Examine surface areas where either DRS > 5000 or RSS > 1000 for cracks in the concrete and for joints and crevices where items are embedded in the concrete and for surface porosity.

8. Mark areas where the average DRS > 5000, maximum DRS > 15,000, RSS or SS > 1000 and locations of cracks, joints, crevices and porosity.

9. For locations of cracks, joints, crevices or porosity, go to step 10 unless previous samples in essentially identical situations have shown that such cracks, etc., are not contaminated, in which case, go to step 15. This would tend to be the case in areas with fine cracks, etc., exposed only to airborne contamination. For areas that are sound, continuous and nonporous, go to step 15.

10. For contaminated areas with cracks, joints, crevices, or porosity obtain chips to expose the discontinuity in the concrete.

11. Perform DRS and SS of exposed surfaces of crack, joint, crevice or porosity at one or more depths from the original concrete surface.

12. If DRS < 5000 and SS < 1000, release per steps 4 and 5. If DRS > 5000 or SS > 1000, go to step 13.

13. Remove concrete from area of crack, joint, crevice, or porosity to depth of indicated contamination or completely remove crack, joint, crevice, or porous concrete as appropriate.

14. If crack, joint, crevice, or porous concrete is not completely removed, repeat procedure starting with step 10. If crack, joint, crevice, or porous concrete is completely eliminated, go to step 39.

15. For contaminated areas (marked per step 8) with loose paint or in areas where contamination has been painted over, go to step 16. For contaminated areas without loose paint, go to step 17.

16. Remove all loose paint from contaminated areas marked in step 8 and any areas where contamination has been painted over. For

those areas which are affected by paint removal operations, repeat procedure starting with steps 1 and 2.

17. Determine if surface decontamination methods would be expected to reduce contamination below unrestricted release limits based on the DRS and SS levels and previous surface decontamination experience. If surface decontamination is expected to be effective, go to step 18. If not, go to step 27.

18. Perform surface decontamination.

19. Perform DRS of areas subjected to surface decontamination.

20. Perform RSS of areas subjected to surface decontamination.

21. For surface areas where DRS $<$ 5000 and RSS $<$ 1000, go to step 22. For areas where DRS $>$ 5000 or RSS $>$ 1000, go to step 24.

22. If there is no reason to suspect leaching of activity back to the surface (e.g., if a tightly adherent painted surface, or if contamination is only airborne), release area per steps 4 and 5. If there is a potential for leaching, go to step 23. If the area has been re-surveyed after a waiting period and no leaching has occurred, go to steps 4 and 5.

23. Wait approximately 14 days to allow any leaching of activity to the surface. Then repeat procedure starting with steps 19 and 20.

24. SS those areas where DRS $>$ 5000.

25. Re-mark areas as indicated in step 8.

26. Based on survey results and experience, if additional surface decontamination is expected to be effective, repeat procedure starting with step 18. If further surface decontamination does not appear to be justified, go to step 27.

27. If the concrete surface is painted or otherwise covered, and if removing the paint or other covering is expected to reduce contamination below releasable levels, go to step 28. If not, go to step 39.

28. Remove paint or other covering (or remove by chemical methods if appropriate) from small representatively spaced sample areas. (Method of removal should be the same method that would be used to remove entire surface coating if that should prove desirable.)

29. Perform DRS of sample areas using shielded probe, if necessary, to obtain sufficiently localized measurements.

30. Perform SS of sample areas.

31. If removing coating has reduced sample area DRS < 5000 and SS < 1000, go to step 32. If not, go to step 33.

32. Remove all coating from areas marked in step 8 using same method of removal used in step 28, and repeat procedure starting with steps 1 and 2.

33. Determine if surface decontamination after coating removal would be expected to reduce contamination below unrestricted release limits based on sample area survey results and previous experience. If paint removal followed by surface decontamination is expected to be effective, go to step 34. If not, go to step 39.

34. Perform surface decontamination of representative sample areas made in step 28.

35. Perform DRS of decontaminated surface areas per step 29.

36. Perform SS of decontaminated surface areas.

37. If DRS < 5000 and SS < 1000, go to step 38. If not, go to step 39.

38. Remove all coating, using same method used in step 28 and repeat procedure starting at step 18 using same decontamination method used in step 34.

39. For surfaces which cannot be decontaminated by removing coating and/or by surface decontamination methods, obtain representative samples of contaminated concrete (chips or cores) for analysis.

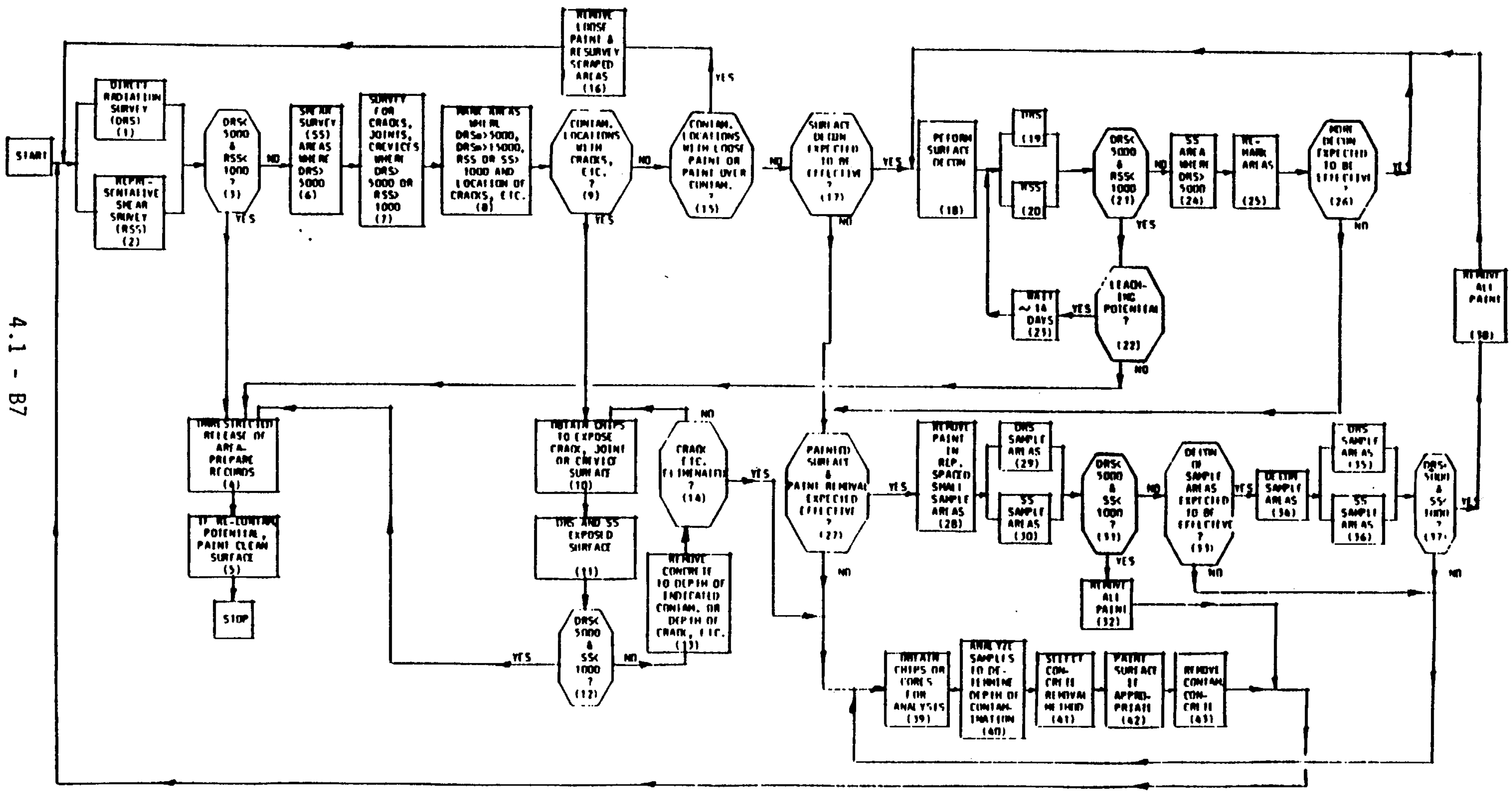
40. Analyze samples to determine depth of contamination.

41. Select method for removal of contaminated concrete based on physical conditions (access, wall or floor), depth of contamination, and extent of surface area to be removed.

42. If appropriate for selected removal methods, seal concrete surface to minimize contamination spread. For example, sealing might be appropriate, depending on SS results, if drill and spall method is to be used, but sealing would not be appropriate for the vacu-blast method.

43. Remove contaminated concrete closely monitoring the effectiveness of method. Modify methods as necessary and appropriate to achieve maximum effectiveness and to minimize contamination spread and solid and liquid waste generation. Repeat procedure on surfaces from which concrete has been removed starting with steps 1 and 2.

FIGURE B1 - LOGIC DIAGRAM FOR UNRESTRICTED RELEASE OF POTENTIALLY CONTAMINATED CONCRETE



APPENDIX C

TO

APPENDIX 4.1

PLUM BROOK REACTOR FACILITY

ENGINEERING STUDY

DECONTAMINATION AND DISMANTLING METHODS REPORT

REV. 0

SEPTEMBER, 1985

Prepared by

BURNS AND ROE, INCORPORATED

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1.0 INTRODUCTION

1.1 Purpose

The purposes of this report are as follows:

1. To compare in-situ decontamination vs. removal of the primary cooling water system and quadrant and canal piping systems in terms of methods, verification of decontamination to the applicable release limits, decontamination success probability, cost, duration, radiation exposure, and radwaste generation,

2. To evaluate the decontamination methods and costs for other systems and structures, and

3. To characterize decontamination wastes.

1.2 Background

The NASA Plum Brook Reactor Facility (PBRF) operated for ten years prior to shutdown in 1973. Upon shutdown, the facility was placed in a safe protective storage condition. All fuel and special nuclear and source materials were removed, and liquid radwastes were processed and discharged.

In 1978, under contract to NASA, Teledyne Isotopes performed a preliminary investigation entitled, "An Evaluation of the Options for Further Decommissioning of the Plum Brook Reactor Facility". This report is a part of a study being performed by Teledyne

Isotopes and Burns and Roe, Inc. to update that document in view of any pertinent regulatory changes or changes in the physical plant or on the basis of more in-depth radiological classification. Cost estimates are to be updated based on current methods and techniques, and radiologically significant items needing additional study are to be identified.

This report is, in part, based on the radiological surveys and sampling conducted by Teledyne Isotopes as a portion of this overall study. The focus is on decontamination and dismantling methods in general, and the decontamination or removal of the primary cooling water (PCW) and quadrant and canal (Q&C) systems in particular.

The PCW system is of special interest because it includes the largest contaminated piping in the PBRF, with approximately 270 feet of 24" piping embedded deep in concrete. A decision needs to be made to either decontaminate this piping or to remove it from the concrete.

The Q&C piping system is also of special interest because it includes approximately 1430 feet of 3" to 10" piping, generally embedded 2'6" deep in concrete. This represents most of the smaller embedded piping in the PBRF, and decontamination or removal costs developed for this piping will be applicable to other embedded piping.

1.3 General Approach

In Section 2.0, the applicable radioactivity release limits are defined, and the means of verification and the probability of successfully attaining and verifying the release limits are discussed in general for various pipe sizes and components. In Section 3.0, for non-embedded piping and components, internal decontamination to clean conditions and direct removal are evaluated.

In Section 4.0, decontamination and specific success probability as related to the embedded piping of the PCW and Q&C systems are evaluated. Direct removal of the PCW and Q&C systems embedded piping is also evaluated and, where appropriate, costs and benefits of decontamination are compared to direct removal. A cost sensitivity evaluation is also presented.

Results and conclusions are summarized in Section 5.0 and references are listed in Section 6.0.

2.0 DECONTAMINATION RELEASE LIMITS, VERIFICATION AND SUCCESS PROBABILITY

2.1 Decontamination Release Limits

The goal of decontamination for the systems considered in this report is to meet the requirements for unrestricted on-site release in accordance with NRC Regulatory Guide 1.86, June 1974, and with a direct radiation limit previously imposed on the PBRF decommissioning by the NRC. These limits may be summarized for the PBRF as follows:

Direct Radiation: <5μR/hr (<0.005 mR/hr) above natural background (≈5μR/hr) at one meter from all surfaces.

Removable Contamination:

Alpha	<20 dpm/100 cm^2
Beta-gamma	<1000 dpm/100 cm^2

Average (Total*) Contamination:

Alpha	<100 dpm/100 cm^2
Beta-gamma	<5000 dpm/100 cm^2

*For PBRF, this was defined as "fixed", but "total" appears to be the proper interpretation of RG 1.86.

Regulatory Guide 1.86 also limits maximum contamination levels for an area of 100 cm^2 or less as follows:

Maximum (Total) Contamination:

Alpha	<3000 dpm/100 cm^2
Beta-gamma	<15,000 dpm/100 cm^2

However, it is not clear at how many locations within a large system that credit could be taken for contamination up to the maximum limits. Therefore, for evaluation purposes, it is assumed that all surfaces must meet the removable and average contamination limits.

For embedded piping, the direct radiation limit is assumed to apply one meter above the floor level along the pipe run, including the locations where the pipe enters and leaves the concrete. The contamination limits are essentially contact readings which should be applied all along the inside of the piping, and are therefore more restrictive.

2.2 Decontamination Verification and Probability of Success

2.2.1 Decontamination Verification

Verification would be conducted in detail only if the decontamination brought the contamination levels at accessible locations within the release limits. Therefore, the dose rate to personnel conducting the verification would be very low. For example, the contact dose rate equivalent to 5000 dpm/100 cm^2 is only about 0.08 mR/hr based on Co-60, the dominant isotopic source for the systems being considered herein.

For the 24" Primary Cooling Water piping, contact readings and swipes could be taken by a man being lowered, pulled and lifted through the two 135 foot runs, starting at the reactor cavity end (see Figures 4.2-1 and 4.2-2). Although men did negotiate their way through this piping to check welds during construction, it would be much more difficult to do it with the radiological controls and protection that would be required now.

Some residual water is likely in the horizontal runs following decontamination. Double protective clothing, a cannister type respirator, a communications system and lighting would be required. Ventilation could be provided by exhausting air from the reactor end of the pipe run via a HEPA filter. A cable or rope system would be required to gradually lower the man head first down the reactor end of the pipe run, to assist in movement through the horizontal runs, and to lift the man up the vertical runs outside containment. The readings and swipes would be taken ahead of the man to assure transferable contamination is not overly disturbed prior to sampling. Contact readings could be read out via the communication system, but swipes would have to be bagged for subsequent counting. The cable or rope system could be used to establish the sampling locations along the pipe run. The cable or rope could be pulled through the pipes by first pneumatically forcing a light plastic ball attached to a light line through the pipe run. A supply reel with brake would be required at the reactor end and a takeup reel with a motor-gear drive and brake would be required at the pump house end.

Another approach would use a similar cable or rope system but would be unmanned. Since a device to obtain representative swipes would be difficult to design and costly, a count rate limit equivalent to removable contamination limits could be adopted. A device to hold four detectors, 90° apart and about one centimeter from the pipe wall, could be designed. However, the requirements of negotiating up to 6 elbows and 135 feet of pipe and for recording or transmitting the readings would also mean high hardware and development costs.

For 2" through 10" piping, it should be possible to design a probe capable of negotiating elbows. A probe with a surface detector and possibly swipe holders could be pushed and rotated through the pipes.

For the 2" PCW drain lines, access could be obtained in the valve box in the corridor to the subpile room. Two elbows would have to be negotiated to reach the 24" PCW lines, and one elbow would be negotiated to reach the subpile room.

For the 4" and 6" PCW supply and return lines from the 24" PCW pipes to the pipe rings, access would have to be via the 24" PCW pipes from the reactor end. For the 4" line, two elbows and a 45° elbow must be negotiated to reach the pipe ring. For the 6" line, three elbows must be negotiated to reach the downcomer which could also be reached via one elbow from the other end after removing valve 20V54. However, reaching the pipe ring would not be practical due to the tee branch connection, but only about one foot of 4" line between the 6" riser and the pipe ring would be inaccessible. Exposed sections of the pipe rings could be removed making easy access to the embedded portions, but there are embedded reducing tees in each pipe ring connecting to a significant amount of additional embedded piping, some of which would be difficult to reach and monitor.

For the quadrant and canal piping, a probe could be inserted from both ends of the embedded runs. Access to the pumpout piping from the drain fittings could be a problem due to the 6" piping with one or two elbows before teeing into the long 10" runs. Access to both ends of the recirculation lines could be easily made by removing the risers at the flanges a few inches above the quadrant and canal floors and flanged valves in the pump room.

All of these verification schemes would require development and would be time consuming and costly. Furthermore, sampling all along the embedded pipe run should not be necessary if it is likely that the contamination at accessible locations is representative of the contamination throughout the entire run. This is in accordance with the NRC's regulatory position given in Paragraph C.4.c of Regulatory Guide 1.86. As long as decontamination methods are designed to avoid crud deposition in piping low points and no special decontamination of the accessible ends of the embedded piping is made, these locations should be representative of the overall pipe run. Therefore, taking standard contact readings and swipes at accessible ends of embedded pipe runs, including weld surfaces where possible, is the recommended method for verification of decontamination.

This means of verification could also be applied to non-embedded piping by removing valves and other components and sampling at the locations thereby made accessible. For components with more complicated geometry including crud trap areas such as crevices, decontamination and verification would generally require disassembly of the component. For old valves, pumps and heat exchangers with no re-use potential, such disassembly with its high labor costs and exposure is not economical or ALARA.

2.2.2 Decontamination Success Probability

The probability of successful decontamination is dependent on several factors including material of construction, surface conditions, geometry, contamination level, and decontamination method and techniques. Success is much more likely for the stainless steel PCW piping than it is for the carbon steel quadrant and canal piping which has rust and scale on interior surfaces. Success on piping is more likely than it is for valves, pumps, heat exchangers and most other components due to the crud traps that tend to be present in such components.

Items with contamination levels within a factor of two of the release limits are more likely to be successfully decontaminated by chemical methods in one application since the probability of everywhere attaining a given decontamination factor (DF)* decreases rapidly with increasing required DF. Table 2.1-1 summarizes in a general manner the probability of achieving successful in-situ decontamination of various components as a function of material and condition.

Since items to be decontaminated during the decommissioning are generally not to be reused, aggressive decontamination methods

TABLE 2.1-1

Success Probability
In-Situ
Decontamination for Unrestricted Release

Item	Material	Surface Condition	Beta/Gamma Contamination Level, Total/Removable, dpm/100 cm2	Success Probability*
Pipe	Stainless Steel	Good	<10,000/2,000	Good
Pipe	Stainless Steel	Good	<50,000/10,000	Fair
Pipe	Stainless Steel	Good	>50,000/10,000	Poor
Pipe	Carbon Steel	Good	<10,000/2,000	Good
Pipe	Carbon Steel	Poor	<10,000/2,000	Fair
Pipe	Carbon Steel	Poor	>10,000/2,000	Poor
Valves	Any	Good to Poor	>5,000/1,000	Poor
Pumps	Any	Good to Poor	>5,000/1,000	Poor
Heat Ex-changers	Any	Good to Poor	>5,000/1,000	Poor

* Without disassembly for decontamination, must reduce all internal surfaces to less than 5,000 dpm/100 cm^2 total beta/gamma and less than 1,000 dpm/100 cm^2 removable beta/gamma.

could be employed, but there is a tradeoff with safety considerations, radwaste generation and processing requirements. Also, experience at BONUS indicates that the more aggressive methods (nitric acid and phosphoric acid) do not necessarily result in high decontamination factors (Ref. 3).

Success probability of decontamination is further discussed in Sections 3.1 and 4.1 for the specific systems and applicable decontamination methods.

$$* \ DF = \frac{\text{Radioactivity Present Before Decontamination}}{\text{Radioactivity Present After Decontamination}}$$

DF	= 2	50% reduction in radioactivity
DF	= 5	80% reduction in radioactivity
DF	= 10	90% reduction in radioactivity
DF	= 100	99% reduction in radioactivity

3.0 NON-EMBEDDED PIPING AND COMPONENTS

Although this study deals primarily with the Primary Cooling Water (PCW) and Quadrant and Canal (Q&C) Pumpout and Recirculation Systems, the following discussions regarding decontamination and removal are applicable to all of the non-embedded portions of radioactively contaminated systems.

3.1 Decontamination of Non-Embedded Piping and Components

3.1.1 Internal In-Situ Decontamination

Portions of systems that are not embedded in concrete typically include valves, pumps, heat exchangers, ion exchangers, filters, strainers, instrumentation and other components which generally must be removed from the piping system and disassembled to effect a thorough decontamination. This is especially true where the primary goal of decontamination is to meet the unrestrictive use limits of Regulatory Guide 1.86 as discussed in Section 2.1. Due to the complicated internal geometry of such components with crud traps such as crevices, plenums, etc., thorough in-situ decontamination to the unrestricted use limits is not likely, as discussed in Section 2.2 and in Reference 3 (5.1.1). The geometry of the piping is also generally complex, which increases the need to open the piping system in many places for those methods that employ an internal device that must traverse all of the piping. The effort to remove components and open piping to complete the decontamination and verification is likely to approach that of complete removal. Due to the characteristics and requirements of decontamination and verification methods, in-situ decontamination to unrestricted release conditions is not generally practical.

3.1.2 Decontamination After Removal

If piping and components are removed from the systems and sectioned or disassembled as required, several batch type decontamination methods (such as abrasive cleaning, vibratory finishing, ultrasonic cleaning, freon spray cleaning and electropolishing) could be used to reduce radioactive waste burial costs and provide a return on the scrap value of the materials. Decontamination utilizing electrolytic, chemical and vibratory abrasion methods have shown significant savings (up to

50%) relative to burial costs and decontamination costs at 35% to 40% of the value of released material (Ref. 23), but the costs of disassembly and exposure were not included in the evaluation. For components such as valves, pumps, and heat exchangers, the time, cost and exposure due to removal, disassembly, decontamination, verification and disposal of clean scrap and decontamination wastes will almost certainly exceed the cost resulting from removal, packaging and disposal at a radioactive waste burial ground. Decontamination of such components also has the risk of not attaining release limits or not being able to demonstrate compliance with the release limits, in which case the shipping and burial costs would be incurred in addition to the decontamination costs. In addition, there is a risk of releasing materials that do not meet the release limits. Therefore, contaminated components such as valves, pumps, and heat exchangers, which do not have re-use potential should be disposed of as contaminated waste without attempting internal decontamination. Larger components with relatively low radiation levels can be sealed and externally decontaminated to meet DOT shipping requirements, and shipped as their own container.

For items such as pipe, duct, liner plate and structural steel that have a relatively simple geometry after removal and segmenting, the cost savings of decontamination as described above (Ref. 23) should be attainable. Radiation exposure is likely to be somewhat higher for the decontamination approach, but this could be reduced or eliminated by decontaminating only relatively clean low radiation items, by using local shielding, and by using semi-remote handling wherever practical. An electropolishing facility similar to that shown in Figure 3.1-1 (Ref 23) would be capable of processing a significant portion of the contaminated metal piping, ducts, liners, etc., at a probable cost savings. Such a facility would also be capable of decontaminating tools.

The economics of an electropolishing facility would depend on the intensity and duration of use. Although an overall savings would be likely for prompt decommissioning, the electropolishing equipment costs over the long duration of extended prompt decommissioning would likely result in increased costs. For example, the rental cost for Bartlett Nuclear's mobile trailer mounted system is $350 per day plus about $60 per day for labor. This does not include electrolyte solidification and consumable costs. Because of the uncertainties in decommissioning work, Bartlett Nuclear does not bid fixed price work (Ref. 17).

A detailed study of the economics of an electropolishing facility would be required to firmly establish any potential cost savings. This study would have to be based on an accurate estimate of the quantity of various items that could be decontaminated together with a characterization of the materials, surface conditions and contamination levels. Surface conditions are important, since electropolishing requires relatively clean surfaces (Ref. 18), and the extent of pre-treatment equipment and effort would have a

MODULAR ELECTROLYTIC DECONTAMINATION SYSTEM

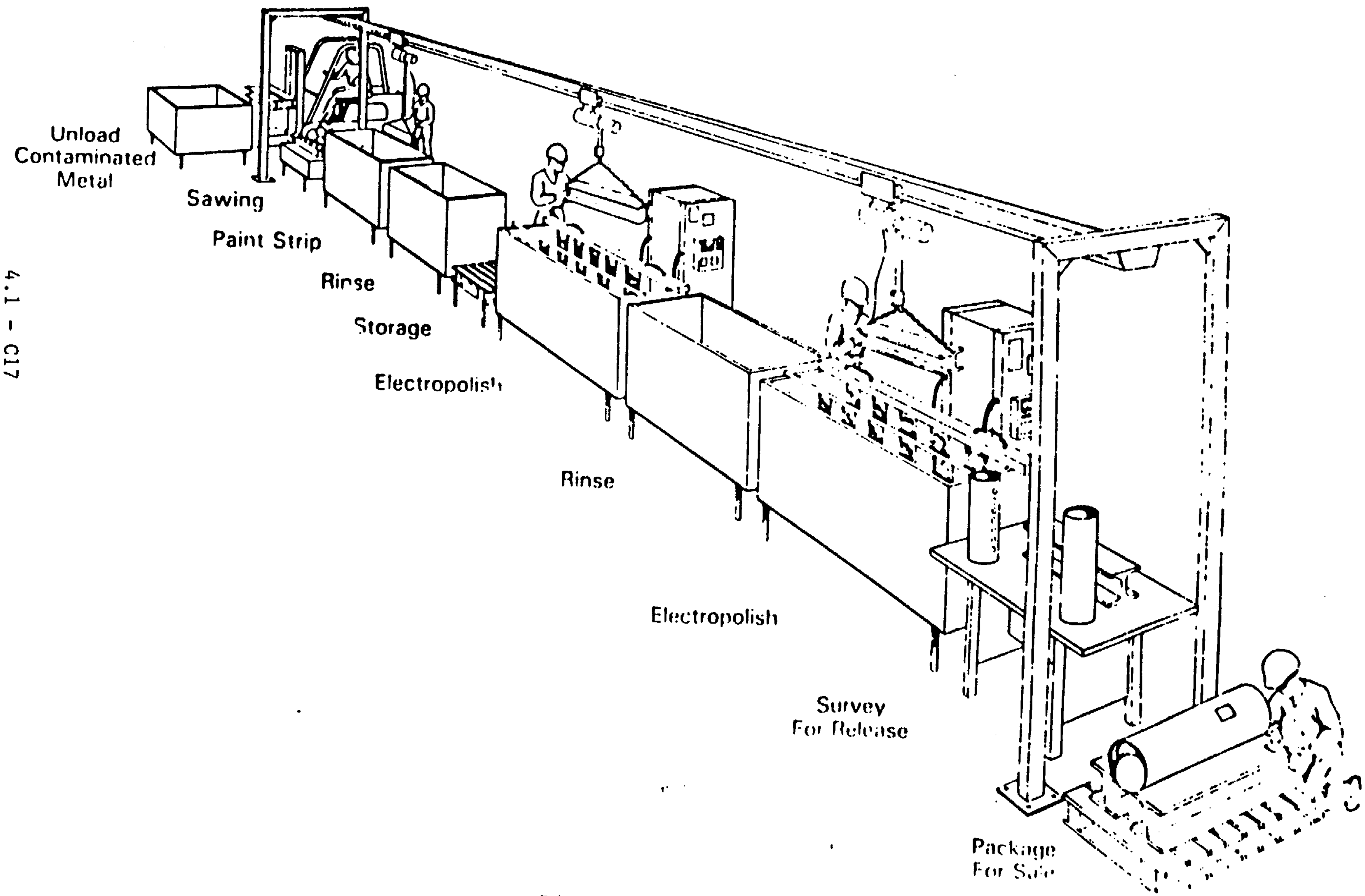


Figure 3.1-1

significant effect on the economics. Such information should be available when the present engineering study is complete. Also, the study should be based on the decommissioning mode selected by NASA, since costs are likely to be highly dependent on the intensity and duration of electropolishing facility use.

Since the economics of an electropolishing facility requires further detailed evaluation, the cost estimate for the present engineering study should be based on removing, packaging and shipping all radioactively contaminated materials to a radioactive waste burial ground. This approach should result in a conservative cost estimate.

3.1.3 Surface Decontamination

External surfaces of otherwise non-contaminated pipe, components, ductwork, electrical cabling and conduit, walls, floors, etc., may have to be decontaminated to meet the release limits. Generally, such contamination is loose or only semi-fixed and can be removed by hand application of various decontamination agents.

For the Shippingport Station Decommissioning Project, a study of decontamination methods was conducted which is applicable to similar applications at the PBRF (Ref. 13, ES 12.3). Various methods were evaluated, and decontamination agents for various applications were recommended as summarized on Table 3.1-1. Application concentration, waste generation and unit costs are also listed on Table 3.1-1.

TABLE 3.1-1

Summary of Recommended Decontamination Agents for External Decontamination*

Decontamination Target	Decontaminant	Application Concentration	Liquid Waste Generation*** gal/ft^2	Unit Cost \$/ft^2 (1982)**
Exposed Concrete:				
Loose Contamination	NUTEK 600 EL	12.5% Solution	0.1	1.02
	ALARA 1146 DECON	20-30 mil Strippable Coating	0.018 Compacted Solid	1.83
Semi-Fixed Contamination	NUTEX 69B	20% Solution	0.15	0.51
Coated Concrete:				
Loose Contamination	NUTEX 600 EL	12.5% Solution	0.1	1.02
	ALARA 1146 DECON	20-30 mil Strippable Coating	0.018 Compacted Solid	1.83
Semi-Fixed Contamination	NUTEX 69B	20% Solution	0.15	0.51
Fixed Contamination	Turco 6017	Full Strength Solution	0.1	0.60
Steel Surfaces:				
Loose Contamination	Industroclean	Full Strength Solution	0.08	0.45
Semi-Fixed Contamination	Feratone	17% Solution	0.15	0.92

* Ref. 13, ES 12.3
** Cost includes labor and chemicals, but not equipment costs
*** Rinse water included at 0.05 gal/ft^2

NUTEK-600EL is a low foam non-phosphate cleaner marketed by Nuclear Technology Corporation of Amston, Connecticut. It can be applied by power buffing a 6.25% solution or by manual scrubbing a 12.5% solution to emulsify, remove and suspend greases, oils and soils. NUTEX-69B is a strong surface cleaner applied in a 20% solution and allowed to soak on the concrete surfaces. It can also be used for wiping down steel surfaces.

ALARA 1146 DECON, marketed by Imperial Professional Coatings Co. of New Orleans, Louisiana, is a water base strippable coating that can be applied to concrete or steel surfaces to attract, absorb and bind contamination. After drying it may be pulled from the surface manually and compacted in 55 gallon drums.

Turco 6017, marketed by Turco Products of Carson, California, can be applied by squeegee to strip epoxy coatings from steel or concrete surfaces. When the epoxy coating crinkles, it is mopped off.

Industroclean, an AMWAY product, is an economical and effective cleaning compound that may be applied by brush or power cleaner to remove loose contamination. Feratone (Naval Jelly), by Penatone Inc., will dissolve several mils of rust and scale. It is generally applied by hand with sponges and removed after a short soak by rinsing or mopping with water.

3.2 Removal of Non-Embedded Piping and Components

As discussed in Section 3.1, all contaminated, non-embedded piping and components should be removed for decontamination and release for scrap value or for packaging, shipping and disposal at a radioactive waste burial ground. Removal should be accomplished by disconnecting flanges or other mechanical joints wherever possible.

When pipes must be cut, thermal or mechanical cutting methods may be used. The thermal methods include the plasma arc cutting process for all metals (Ref. 3, Section 8.3.1) and the oxygen burning (or oxyacetylene cutting) process (Ref. 3, Section 8.3.2) for carbon steel. These processes may be either by track controlled torch for remote operation or by hand held torch. Contaminated fumes are generated, which requires appropriate airborne contamination control in addition to fire controls. To minimize the need for these controls, power hacksaws (or guillotine saws) may be used (Ref. 3, Section 8.3.5). If the piping is to be electropolished after removal, power hacksaws should be used wherever practical since torch cut ends have entrained contamination that cannot be removed by electropolishing. Where access is very difficult, however, such as the embedded piping being considered in Section 4.0, hand held torch cutting should be used to minimize concrete removal requirements. For ductwork, power nibblers and shears may be used (Ref. 3, Section 8.3.9).

All piping should be cut into approximately 5 foot lengths to fit into shipping containers or into electropolishing tanks. To speed this process, stationary power hacksaws may be moved to segmenting and packaging locations within each successive general work area.

Hydraulic shears could also be used to segment smaller piping (about 2" and smaller) if it is not to be decontaminated.

4.0 EMBEDDED PIPING

This section compares decontamination and removal methods to determine the method that should be used for the embedded piping of the primary cooling water and quadrant and canal pumpout and recirculation systems.

The primary cooling water (PCW) system has two 24-inch diameter stainless steel lines embedded 9 feet below the floor of Canal "E" and Quadrant "B" in the containment and encased within a massive concrete pipe chase outside of containment. The quadrant and canal (Q&C) piping, generally embedded 2'6" below the canal and quadrant floors, ranges in size from 3" to 10" with a total of approximately 1430 feet of embedded pipe. These two piping systems account for most of the embedded piping at the PBRF and cover the full spectrum of embedded piping configurations.

Embedded piping decontamination to unrestricted use conditions is considered in 4.1, removal without decontamination is considered in 4.2, costs and benefits of the two methods are compared in 4.3, and a cost sensitivity evaluation is presented in 4.4.

4.1 Decontamination of Embedded Piping

Decontamination of embedded piping must expeditiously achieve the unrestricted use limits as described in 2.1. If not, decontamination duration and cost would rapidly increase, and if the release limits eventually prove unattainable, most of the decontamination cost would be wasted because the radiation fields for the removal scenarios presented in 4.2 are already low. Decontamination followed by removal could have a higher personnel exposure than removal without decontamination, since overall exposure durations for decontamination and removal would likely increase over the direct removal approach. Also, concentration of the radioactivity during decontamination would result in a more significant radiation source that must be properly processed, packaged and shipped. Therefore, the process to be used for the PCW or Q&C embedded piping must have a significant probability of attaining release limits in one application cycle.

The selected process for each application should have a reasonably high probability of achieving adequate decontamination factor (DF) to reach unrestricted release limits while resulting in wastes that can be economically processed. Since the PBRF radwaste processing system is not expected to be in operational condition due to years of layup without maintenance, it is assumed that temporary portable radwaste processing equipment would be required to support the selected decontamination process.

Decontamination processes may be categorized as chemical and non-chemical. Several of the non-chemical processes (Ref. 8, 9 and 19) may be eliminated from further consideration since they are not applicable or have not been developed and demonstrated for in-situ decontamination of pipe. These include vibratory finishing (Ref. 9, Section 6), ultrasonics (Ref. 9, Section 7), high-pressure freon (Ref. 9, Section 8), alternative electrolyte for electropolishing techniques (Ref. 9, Section 10), gels and pastes (Ref. 9, Section 12), strippable coatings (Ref. 9, Section 13), reflux decontamination (Ref. 9, Section 14), dry ice blasting (Ref. 9, Section 15), electrochemically-activated decontamination solutions (Ref. 9, Section 16), molten salt methods (Ref. 9, Section 17) and thermal erosion (Ref. 9, Section 18). Non-chemical processes that require further consideration include mechanical methods, high and ultrahigh pressure water, abrasive cleaning, electropolishing, steam/hot water cleaning and decontamination foams (Ref. 9, Sections 2, 3, 4, 5, 9, 11 and 12).

4.1.1 PCW Embedded Piping Decontamination

Contamination survey data taken by Teledyne Isotopes indicates that the PCW piping total beta-gamma contamination ranges from 25,000 to 100,000 dpm/100 cm^2. Removable beta-gamma contamination ranges from 344 to 940 dpm/100 cm^2. This is based on the assumption that the PCW piping contamination levels are similar to the valve housing contamination levels that were actually measured. It is likely that the PCW piping contamination levels are actually lower, and therefore 100,000 dpm/100 cm^2 total beta-gamma contamination should represent a conservatively high maximum.

Since site release would not occur for at least five years from the date of this survey, the contamination levels (which are mainly due to Co-60) can be expected to decrease by 50% or more (i.e., 50,000 dpm cm^2 or less) prior to the final site survey. Thus, a decontamination factor of 10 would be adequate to reduce the maximum activity to less than 5,000 dpm/100 cm^2. However, further contamination survey, such as at the reactor tank end of the lines, which is now inaccessible, could result in significantly higher readings. There is also the possibility that the release limits could be revised to lower values within the next five years. Therefore, a minimum DF of 20 or greater would be desirable to account for any change in survey data or release limits.

Teledyne Isotopes also conducted decontamination experiments using various chemicals. The results indicate that the contamination is in a thin, relatively adherent surface film.

Piping is mainly 24" diameter 304L stainless steel, but there is a considerable amount of smaller piping embedded in the reactor bio-shield. This smaller piping is 304 stainless ranging in size from 1" to 6", and its configuration is relatively complicated.

4.1.1.1 Process Selection

Most of the non-chemical processes (mechanical, high and ultrahigh pressure water, abrasive cleaning, electropolishing, and steam/hot water cleaning) require an application device to reach all points within the piping. This is considered impractical due to the length of the runs, both horizontal and vertical, in the case of the 24" lines and due to the complicated geometry of the smaller piping in the bio-shield. For the abrasive grit blasting process, it would also be impractical to remove all of the potentially contaminated grit from the long low point runs of 24" piping since there is only one 2" drain connection per line. A foam would likely be ineffective due to its mild cleaning action relative to the film's apparent integrity. Therefore, none of the non-chemical decontamination methods is considered to have an adequate success probability for the PCW embedded piping.

There are several chemical decontamination processes that could be considered (Ref. 10, 21). Since the film to be removed was formed at low temperature, it is probably not as tenacious as films encountered in BWR or PWR reactors. Therefore, processes that have been effective on BWR and PWR piping should be even more effective on the PCW piping. To minimize radwaste processing requirements, a process should be used that permits all removed radioactivity to be collected on filters and ion exchangers, without the need for evaporation and solidification processes.

Data on the various chemical decontamination processes are summarized in References 3 and 11. The CAN-DECON process, marketed by London Nuclear, circulates at high velocity a dilute mixture of acidic complexing agents (less than 0.5 weight percent) and generates a minimum amount of radwaste in the form of spent ion exchange resin. DFs between 5 and 10 have been achieved on several reactor systems (Ref. 22). Since the PCW piping deposits were formed at low temperature, the CAN-DECON process may result in somewhat higher DFs. Thus, the CAN-DECON process may be effective in decontaminating the PCW piping to releasable limits (Ref. 12), and it may be the most economical method to use for this application. However, it is a proprietary process which complicates cost estimating for this unique application. Although CAN-DECON is not selected as the process for cost estimating, it should be further evaluated if a decision is made to proceed with decontamination of the PCW piping as the baseline approach.

The APACE and AP, Citrox, EDTA processes were both evaluated for use on the Shippingport Decommissioning (Ref. 13), and the APACE process had a somewhat lower cost and exposure. Therefore, the APACE process, which can be expected to produce a DF of about 50 (Ref. 3) will be used as the decontamination process. To avoid deposition of crud in piping low points, a recirculation method (rather than a fill and soak method) is selected.

The basic APACE procedure is as follows (Ref. 3):

1. Recirculate a solution of alkaline permanganate (AP) at 250°F for 24 hours.
2. Discharge diluted AP solution through a cooler to holdup tank.
3. Process diluted AP solution through mixed bed ion exchangers.
4. Use effluent water to prepare ammonium citrate, EDTA (ACE) solution.

5. Recirculate ACE solution at 250°F for 24 hours.
6. Discharge diluted ACE solution through cooler to holdup tank.
7. Process diluted ACE solution through mixed bed ion exchangers.
8. Sample and discharge effluent water.
9. Dispose of ion exchange resin as radioactive waste.

4.1.1.2 Chemical Requirements

Solvent data for the APACE process is as follows (Ref. 3):

		Concentration
Alkaline Permaganate (AP):	Na OH	100 gm/l
	$KMnO_4$	13 gm/l
Ammonium Citrate (AC):	$(NH_4)_2\ HC_6H_5O_7$	13 g/l
EDTA (Ref. 11)		1 gm/l

The PCW piping internal volume is estimated to be about 930 ft^3. Assuming that the decontamination rig recirculation piping is about 25% of the PCW piping volume, solution volumes must be about 1163 ft^3. Therefore, 8720 gallons of demineralized water would be required to mix with the following reagent quantities:

		Grams	Pounds
AP:	Na OH	3.3×10^6	7277
	$KMnO_4$	4.3×10^5	946
AC		4.3×10^5	946
EDTA		3.3×10^4	73

4.1.1.3 Radwaste Generation, Shipping and Burial

Ion exchange resin volume is normally the same order of magnitude as the system volume to be decontaminated (Ref. 11). Since this is really a function of total solution volume, a resin volume of 1200 ft^3 is assumed. To avoid the need for a solidification system, high integrity containers (HICs) fitted with underdrains are used as filters and ion exchangers and serve as their own shipping container. HICs are assumed to have a useful capacity of 120 ft^3 and a burial volume of 170 ft^3. Thus, 10 ion exchanger HICs are required for chemical removal. Assuming one filter HIC, the total waste burial volume is 1870 ft^3.

The Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule (Ref. 26) includes weight and Curie surcharges. Each HIC weighs 900 pounds and holds approximately 9000 pounds of resin or filter media. For a total container weight of 9900 pounds, the weight surcharge is $550 per container. As further discussed in 4.2.2.7, the total activity in the embedded PCW piping is only about 8×10^{-4} Curies, and there is no Curie surcharge for less than one Curie/shipment.

Based on a truckload net capacity limit of 42,000 pounds and a container weight of 9900 pounds, 4 containers can be included in each shipment. For 11 containers, a total of 2.75 truckloads are required.

4.1.1.4 Decontamihation Rig Requirements

Any one of the Primary Cooling Water Pumps located in the pump-house could be used to produce a sufficiently high flow rate for the APACE process. Each pump has a 100 hp motor and is rated for 8650 gpm at 90 psi. The ceramic mechanical seals should tolerate the decontamination solutions, although a thorough evaluation of all materials that would be contacted by decontamination solutions would be required. Although the pumps have not been operated for 12 years, it may be possible to return one of them to operable conditions with minor repairs such as bearing replacement. The electric motors may also require servicing, but they are shielded from the pumps so that radiation levels are low. The overall system would have to be leak tested to assure system integrity after such a long shutdown period.

To maximize the probability of successfully decontaminating the embedded 24" piping so as to avoid the high cost of removal, it would be advantageous to remove the more highly contaminated components such as the heat exchanger, strainer and expansion joints from the system and replace them with spool pieces. However, this would involve a considerable expense and radiation exposure. Therefore, the overall system should be considered for use in the decontamination circuit. Other existing PBRF components could also be evaluated for decontamination solution mixing and radwaste holdup. Special ion exchangers would certainly be required, however, to process the spent decontamination solutions.

To firmly establish the optimum usage of existing plant systems and components for decontamination of the PCW system, a detailed study would be required to define a workable system based on existing component and piping arrangements, shielding, etc. The physical condition and materials of construction of components and piping would then have to be evaluated to assure compatibility with decontamination solutions.

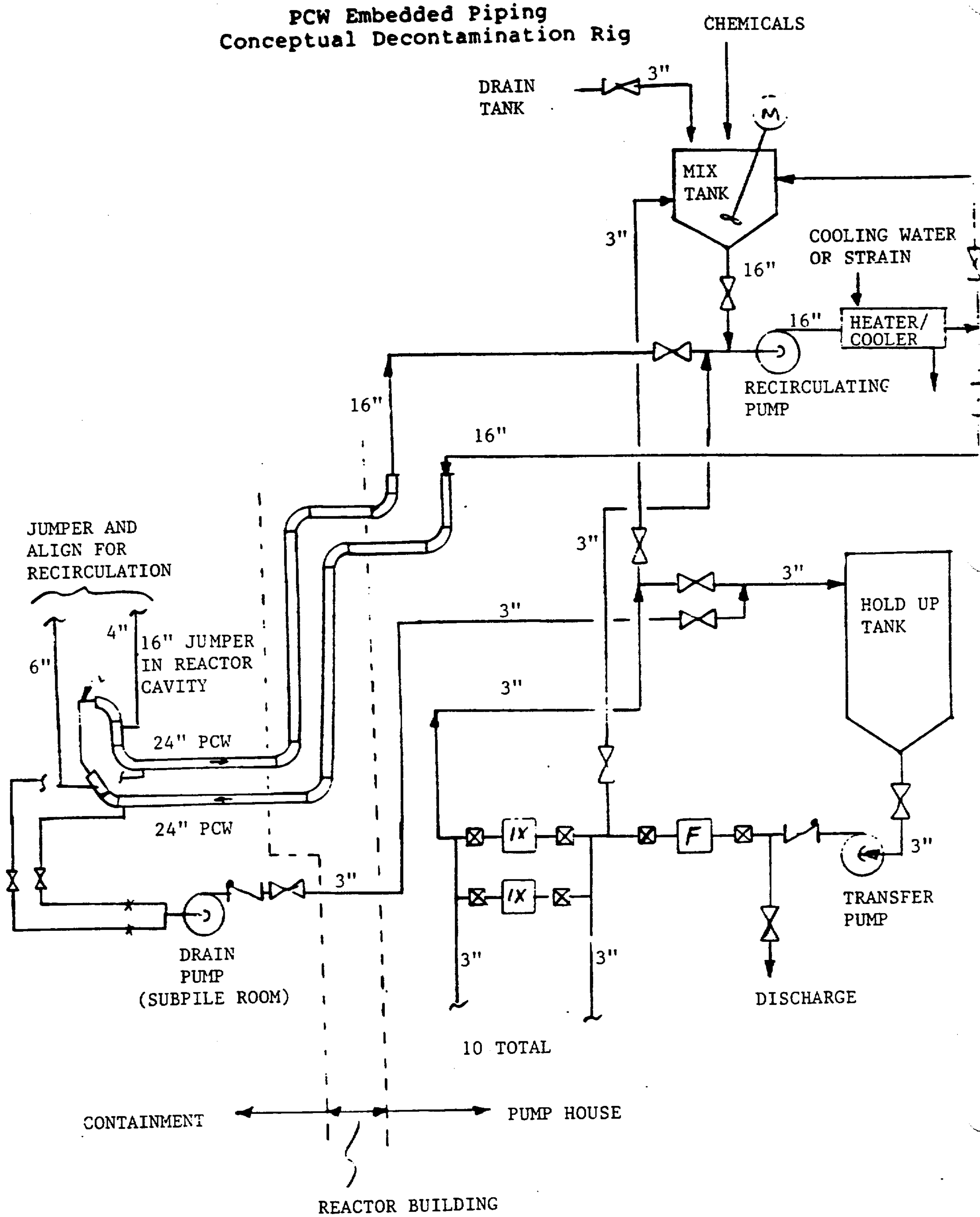
Therefore, to provide a conservative basis for estimating decontamination costs, duration and exposure, it is assumed that the existing plant components will not be used and that the decontamination contractor will provide a specially-designed decontamination rig. It is also assumed that this decontamination equipment will have future value to the contractor and therefore disposal costs do not apply. This approach results in a conservative estimate since existing components will be used only if it was demonstrated that a cost savings would result.

A conceptual decontamination rig is depicted in Figure 4.1-1. General component specifications are as follows:

Mix Tank	4500 gallons, stainless steel, electric mixer and controls
Recirculating Pump	7000 gpm at 10 ft TDH, stainless steel, electric motor and controls
Heater/Cooler	3.3×10^6 Btu/hr, stainless steel, 7000 gpm PCW tubeside flow, steam/water on shell

Figure 4.1-1

PCW Embedded Piping Conceptual Decontamination Rig



Hold Tank	9,000 gallons, stainless steel
Transfer Pump	150 gpm at 100 ft TDH, stainless steel, electric motor and controls
Filter	120 ft^3 HIC with charcoal (or other compatible filter media) and quick disconnects
Ion Exchanger	10-120 ft^3 HICs with mixed bed (H-OH) resin and quick disconnects
Drain Pump	150 gpm at 100 ft TDH, stainless steel, electric motor and controls
Piping	50'-16" stainless 200'-3" stainless
Valves	4-16" stainless, gate or butterfly 6-3" stainless, gate, ball or butterfly 2-3" stainless, check

Sizing is based on mixing the solutions in two batches, producing a velocity of about 5 ft/sec in the 24" piping, heating up in about four hours, holdup of one solution volume (8,720 gallons), draining the system in about one hour, and processing a solution volume (without filter or ion exchanger changeout) in about one hour. It is assumed that on-site systems may be used to provide cooling water and heating steam. The decontamination rig would be located in the pump house or outside in a temporary enclosure. A 3" line with drain pump would be run from the existing 2" drain lines in the subpile room to the holdup tank. The 24" PCW lines would be connected together in the reactor cavity to avoid the need to route large recirculation piping back to the decontamination rig. Both 24" lines would, therefore, be decontaminated at once. The drain pump could be used to continuously discharge through the drain lines, and the other piping embedded in the bio-shield would be interconnected and aligned to produce recirculation, using drain pump discharge if necessary. Continuous filtration could be accomplished by collecting drain pump discharge in the holdup tank and pumping it through the filter and back to the recirculation stream using the transfer pump.

4.1.1.5 PCW Piping Decontamination Procedure

4.1.1.5.1 Initial Conditions

Initial conditions are assumed to be as follows:

1. All radioactive piping and equipment either decontaminated or removed from the pump house with 24" pipes cut off just above the floor anchor.

2. Reactor tank and any activated concrete removed from the reactor bio-shield.

4.1.1.5.2 <u>Procurement</u>

1. Prepare specifications for decontamination rig and chemicals.

2. Evaluate bids and place order.

4.1.1.5.3 <u>Installation</u>

1. Install decontamination rig, including HICs, and hookup to electric power, demineralized water, processed waste discharge, cooling water, and steam/condensate systems.

2. Install 16" piping from decontamination rig to 24" PCW pipes in pump house and install 16" jumper between 24" pipes in reactor cavity.

3. Install drain pump in subpile room with 3" piping from 2" drain lines and to decontamination rig.

4. Install jumpers and align bio-shield piping to produce recirculation.

5. Fill system with demineralized water and pressure and leak test the system.

4.1.1.5.4 <u>Operations</u>

1. Operate drain pump to drain 24" PCW piping and transfer the demineralized water to the mix and holdup tanks.

2. Mix and heat AP solution in two batches and fill the recirculation loop.

3. Start recirculation pump and continue heatup to 250°F.

4. Recirculate at 250°F for eight hours (since the film was deposited at low temperature and a relatively low DF is required, this relatively short circulation time should be adequate).

5. Stop recirculation and align drain pump discharge to drain spent AP solution to the holdup tank via the heater/cooler for cooling.

6. Operate transfer pump to process spent AP solution through the filter and ion exchangers, discharging water to the mix tank.

7. Mix and heat ACE solution in two batches and fill the recirculation loop.

8. Recirculate at 250°F for eight hours (sampling would determine actual duration).

9. Stop recirculation and align drain pump discharge to drain spent ACE solution to holdup tank via the heater/cooler for cooling.

10. Survey PCW piping at accessible locations to assure release limits are met.

11. Operate transfer pump to recirculate spent ACE solution through filter and ion exchangers, discharging water back to holdup tank until sampling indicates that the water meets chemical and radioactivity (10CFR20) discharge limits.

12. Discharge water, monitoring as required.

13. Disconnect HICs and ship to radioactive burial ground (assume Hanford, WA).

14. Remove decontamination rig (assume contractor will take this away for future use).

4.1.1.6 PCW Piping Decontamination Productivity Factors

	Applicable Manhours	Work Time Increase Factors
Work at a Height	Non-Applicable	-
Work in Confined Space	Installation work in and around bio-shield	0.20
Use of Respirators	Installation work connecting decontamination rig to PCW piping	0.25

Radioactivity Protection Controls	Installation and operation work	0.10
Protective Clothing	Installation and operation work	0.20
Work Break and Transit	Installation and operation work	0.10

4.1.1.7 PCW Piping Decontamination Cost

The estimated cost for decontaminating the embedded PCW piping is summarized in Table 4.1-1. The total estimated cost is $1,074,000 in 1985 dollars (no escalation). A contingency of 20% is included.

The overall productivity factor developed for decontamination rig installation is equivalent to a factor of 1.62. For decontamination operations, it is 1.45.

The estimated cost for the assembled decontamination rig without the HICs is $91,789. The 11 HICs are estimated to cost $354,000, and chemicals are estimated at $5,931. Decontamination rig installation and test costs are estimated at $108,020 and operation and rig removal costs are estimated at $18,770. Shipping and burial cost totals $70,570 and the various markups total $424,920.

TABLE 4.1-1

Direct Cost Summary by Bid Item

3764-01

Burns and Roe Construction Group, Inc.

Project: PBRF

Client: TELEDYNE ISOTOPES

Estimate by: RHK

Checked by:

Page 1 of 2

Revision number:

Description of Bid Item or Specification	Schedule Data: Work Item	Hours	MP	ET	Fixed Date	Description
DECONTAMINATION						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST (FROM PAGE 2 OF 2)				3273	78,149	499,761	70,570	—	648,480
	CRAFT SUPPORT LABOR (7% OF D.L.)				229	5512				5512
	NON-CRAFT SUPPORT (6% OF D.L.)				196	4725				4725
	SUBTOTAL				3698	88,986	499,761	70,570		659,317
	PAYROLL TAXES & INSURANCE (48.8% OF LABOR)					43,425				43,425
	SUBTOTAL					132,411	499,761	70,570		702,742
	SMALL TOOLS (6% OF LABOR + P.R.T.& I.)					—	7945			7945
	EQUIP. F.O.M. (7% OF LABOR + P.R.T.& I.)					—	9269			9269
	SUBTOTAL					132,411	516,975	70,570		719,956
	SALES TAX (5% OF TAXABLE MAT'L)					—	25,849	—		25,849
	SUBTOTAL					132,411	542,824	70,570		745,805
	CONTINGENCY (20%)					26,482	108,564	14,114		149,160
	SUBTOTAL					158,893	651,388	84,684		894,965
	OH & PROFIT (≈20%)					31,807	130,312	16,916		177,035
	Total				3698	190,700	781,700	101,600		1,074,000

Bid Item: 4.1.1.5 | Project Area:

BR2230 (6/83) 1M

TABLE 4.1-1

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 2 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
DECONTAMINATION						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
					-	-	-	-	-	-
1.	INITIAL CONDITIONS				-	-	413,331	-	-	413,331
2.	PROCUREMENT/ASSEMBLY				1569	37,333	85,930	-	-	123,263
3.	INSTALLATION				504	12,600	500	-		13,100
4.	OPERATION & REMOVAL				-	-	-	20,570	-	20,570
	TRANSPORTATION AND DISPOSAL				2073	49,933	499,761	20,570	-	620,264
	SUBTOTAL									
	INSTALLATION PRODUCTIVITY +622				973	23,146				23,146
	OPERATION PRODUCTIVITY +452				227	5,620				5,620
Bid Item: 4.1.1	Project Area:			Total	3273	78,749	499,761	20,570		649,030

BR2230 (6... M

4.1 - C40

4.1.1.8 PCW Piping Decontamination Duration

The schedule for embedded PCW piping decontamination is shown in Figure 4.1-2. The overall duration is estimated to be approximately 10 weeks.

4.1.1.9 PCW Piping Decontamination Exposure

The estimated occupational radiation exposure for the PCW embedded piping decontamination is summarized on Table 4.1-2. The total exposure is estimated to be approximately 3.7 man-rem.

Exposure during radwaste transportation is not included but would be very low.

4.1.2 Q&C Embedded Piping Decontamination

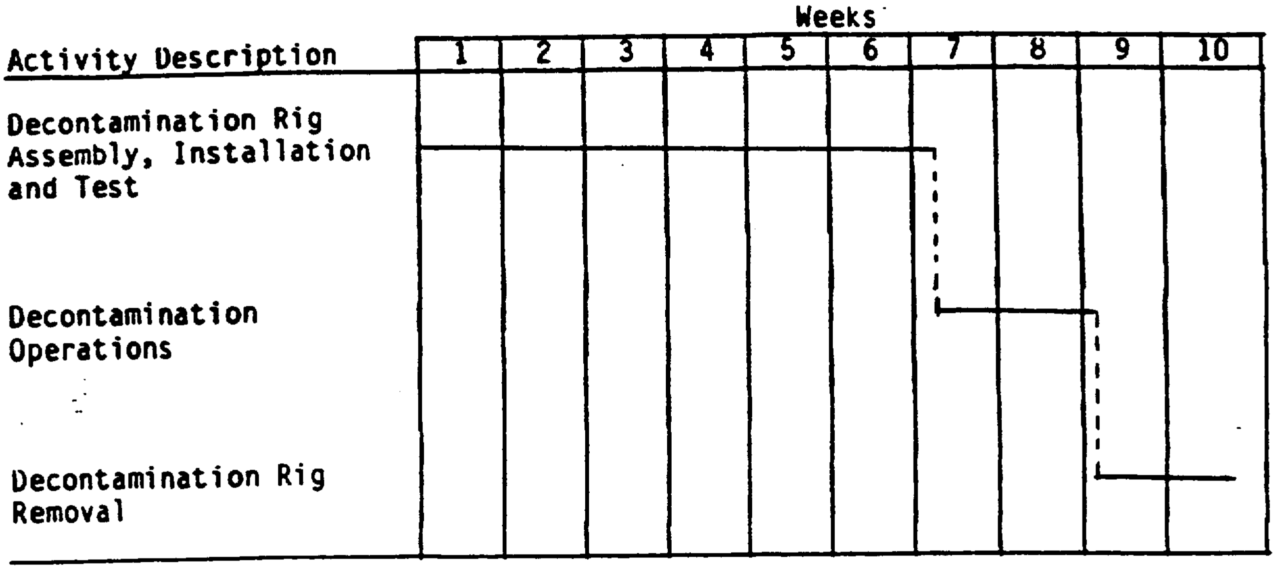
The Q&C embedded piping is Sch 80 carbon steel, ranging in size from 3" to 10". The internal surfaces of accessible pumpout piping are highly corroded with rust, scale and deposits. Data taken by Teledyne Isotopes indicate that the maximum required DFs for removable and total contamination are 4.5 and 1380, respectively. The internal condition of the recirculation piping is unknown, but survey data indicates that contamination is 10 to 100 times less than the pumpout piping.

4.1.2.1 Process Selection

There are several non-chemical processes that could be considered for Q&C piping (Ref. 8 and 9). The honing (surface grinding)

FIGURE 4.1-2

PCW Embedded Piping Decontamination Schedule



Note: Decontamination rig equipment procurement duration is not included.

TABLE 4.1-2

PCW Embedded Piping Decontamination Exposure Estimate

Activity Description	General Area Dose Rate (mR/hr)	Estimated General Area Work Time Manhours	Contact Dose Rate (mR/hr)	Estimated Contact Work Time Manhours	Estimated Occupational Exposure man-m Rem
Decontamination Rig Installation and Test (a)	0.05(b)	786	5(d)	525(c)	2831
Operations	0.05(b)	390	5(f)	167(e)	855
Decontamination Rig Removal	0.05(b)	120(g)	-	-	6
TOTAL					3692

(a) Decontamination Rig Assembly Manhours are not included since this should be done outside radiation areas.

(b) Since all radioactively contaminated piping and equipment are to be removed from the various work areas prior to embedded PCW piping decontamination, the general area dose rate should generally meet the 5μR/hr (0.005 mR/hr) dose rate limit for release so that a dose rate of 0.05 mR/hr is conservatively high.

(c) Approximately 40% of the total installation and test manhours are assumed to be spent close to the PCW piping.

(d) Based on direct radiation measurements taken by Teledyne Isotopes in June 1985, the PCW piping has a dose rate less than 5 mR/hr.

(e) Approximately 30% of the operations manhours are assumed to be spent close to the decontamination rig or HICs.

(f) Due to the large resin volume, the dose rate on the HICs will be less than the PCW pipe dose rate.

(g) It is assumed that the decontamination rig meets release limits after operations.

technique being developed at TMI (Ref. 14) has worked well in laboratory tests, but results during mockup testing have not been consistently good. The hone is capable of cleaning 4" to 8" pipe with insertion distances of 40 to 50 feet. Honing piping 3" and smaller and expansions or contractions have been problematic. Due to the configuration of the Q&C pumpout piping (6" piping teeing into 10" piping) and the 3" size of the recirculation piping, the honing system being developed at TMI would not be effective. The configuration of the pumpout piping would also be a problem for the mechanical methods described in Section 2 of Reference 9. Also, there is little or no experience in the use of such systems for radioactive pipe decontamination.

The use of flexible lance and high pressure water (1000 to 20,000 psi) may not achieve a releasable surface because fixed contamination is difficult to remove (Ref. 9, Section 3). Ultrahigh pressure water (20,000 to 60,000 psi) at pressures of 40,000 to 45,000 psi readily remove films, scale and contamination down to white metal, but hard spray water supply piping is required above 35,000 psi, making cleaning inside long lengths of small piping difficult (Ref. 9, Section 4). Water abrasive blasting (Ref. 9, Section 5) could be considered, but development of suitable spray nozzle would be required for 8" to 12" I.D. piping, and application to piping less than 8" I.D. is not considered practical (Ref. 15). Also, assuring grit removal from all portions of the piping may require a high velocity water flush.

In-situ electropolishing has been used to decontaminate small diameter piping, but insertion of an internal cathode device is limited to about 30 feet (Ref. 9, Section 9). Electropolishing experience in Germany reported by KWU (Ref. 16) indicates DFs somewhat greater than 150, but the device is designed for short lengths of large reactor coolant piping. Steam generator tubes about 0.7 inches in diameter have also been electropolished with DF values of 40 to 110 (Ref. 20). In-situ electropolishing has not used successfully to any extent in the U.S. (Ref. 17). Electropolishing requires a relatively clean surface to be effective (Ref. 18), which is not the case with the Q&C pumpout piping.

Wet steam (with the addition of acid) has been used to clean scale and corrosion products containing fixed contamination from the inside of pipes up to 1800 feet in length (Ref. 9, Section 11). A mixing nozzle must be inserted down the pipe, which could be a problem at the floor drain end of the pumpout piping due to the elbows in the 6" piping. Performance data is not readily available.

Foam, generated from phosphoric acid or acidic mixture and air or nitrogen in a foam generator, can be pumped through pipes and removed by water rinsing or spraying. The foam's cleaning action is rather mild, and the DFs of 5 to 50 that have been attained were on relatively clean surfaces (Ref. 9, Section 12).

For decontamination of carbon steel, phosphoric acid (H_3PO_4) and sulfamic acid (NH_2SO_3H) are effective chemical decontamination reagents (Ref. 3 and 11). Phosphoric acid has the advantage of being a faster process with a typical DF of 20, whereas the typical DF for sulfamic acid is only 3. However, if phosphoric acid remains in contact with steel surfaces longer than 20 minutes, a film forms on surfaces causing redeposition of the contamination.

Because of the high DF required for the embedded pumpout piping, its poor internal condition, and its relatively complicated geometry, none of the chemical or non-chemical methods are considered to have a significant success probability. Therefore, removal of the embedded pumpout piping is the only viable option. The embedded recirculation piping may be within release limits, and therefore decontamination would not be required. However, the embedded recirculation piping is, for the most part, adjacent to embedded pumpout piping that must be removed. Therefore, the recirculation piping should be removed with the pumpout piping unless further survey results confirm that it is within release limits. If it does meet release limits, it could be left in place or removed and set aside for unrestricted on-site use.

4.2 Removal of Embedded Piping

Removal of the PCW and Q&C embedded piping requires consideration of removal method, radwaste generation, cost, duration and radiation exposure. The removal of the piping first requires removal of non-radioactive reinforced concrete. For the PCW piping outside of containment, the steel sheathing around the pipes must be removed. Then the pipes must be cut and removed.

Most of the piping, however, must be removed directly from the concrete matrix. The following is a discussion of historical information on controlled blasting and metal cutting techniques applicable to embedded piping removal.

For the Elk River decommissioning, various methods to remove concrete structures were evaluated (Reference 1). Controlled blasting was selected as the method to use in removing large volumes of concrete and testing was done to verify the method. Controlled blasting was successfully accomplished on Elk River and on other decommissioning projects (Ref. 2), and it remains the method of choice for large volume concrete removal. Blast vibrations should not be a concern at the isolated PBRF site.

Similar data on the removal of reinforced concrete by controlled blasting is given in References 3 and 4, and the removal rate and cost data from Reference 4 is given in Table 4.2-1. The unit costs are in 1980 U.S. dollars and include crew cost, explosives, dust control measures, and subcontractor overhead and profit. Shipping and disposal costs are not included. The range of removal rates and costs shown reflect the difficulties associated with each type of concrete and the inefficiency of working in a radioactive environment. A typical blasting crew consists of the blasting expert, six laborers and one equipment operator (Ref. 4.).

An approach to developing unit costs for concrete removal is given in Reference 5 for various concrete configurations. Local labor

TABLE 4.2-1

Controlled Blasting
Concrete Removal Rates and Costs*

Concrete Type	Removal Rate yd^3/8 hr day	Removal Cost (1980) $/yd^3$
Massive Reinforced Standard Concrete: Non-Radioactive	10-400	100
Radioactive	4-6** 100***	400
Massive Nonreinforced Standard Concrete (Non-Radioactive)	250	13
Nonreinforced High Density Concrete (Radioactive)	6 to 8**	35
Lightly Reinforce Standard Concrete: Non-Radioactive	100****	35
Radioactive	6 to 8**	200

* From Ref 4.

** Actual removal rates including inefficiency due to personnel contamination and radiation work area control.

*** High removal rate possible if adequate space is available to use large capacity loading and hauling equipment.

**** Up to 1000 yd^3/day reported.

rates must be factored into the various unit rates to make them usable. The blasting parameters used in Reference 5 are generally consistent with blast design formulas given in Reference 6.

The effective use of blast mats and water fog spray to control dust and the spread of contamination is described in References 2 and 7. Standard steel cable blast mats are 10' x 12' and weigh 3,000 pounds (Ref. 6). A water mist (fog) can be produced using commercially available misting nozzles and standard tap water pressure (Ref. 7). For PBRF, a fog spray should be required only around the bio-shield where some activated concrete may exist.

Drilling has been done using both high-speed rotary percussion track (crawler) mounted drills (Ref. 2) which are capable of drilling a 6-foot deep hole in 3.5 minutes (Ref. 3) and slower hand held rotary percussion drills which can drill a 1" to 2" diameter hole 5' deep within 5 minutes (Ref. 7). Due to set-up time considerations, a hand held drill is about as fast as a track drill for holes 3' to 4' deep, but a hand held drill cannot penetrate rebar whereas a track drill can punch through rebar up to size #6 (Ref. 7).

Controlled blasting could probably be used successfully to directly loosen piping from the concrete without breaking the pipe (Ref. 7), but to be conservative, concrete removal by blasting to within about 6" of pipe followed by the use of paving breakers to expose the pipe will be assumed for estimating purposes.

Paving breakers (jack hammer or pneumatic drill) typically weighing 90 pounds would be used to remove small horizontal surfaces whereas chipping hammers, typically weighing 24 pounds, can be used to remove small vertical or overhead surfaces. They could be used in conjunction with controlled blasting to excavate around blast holes to improve access and to excavate embedded pipes out of the surrounding concrete. Removal rates and costs from Reference 3 are summarized in Table 4.2-2. For almost all embedded piping removal, jack hammers would be used rather than chipping hammers.

Rebar can be cut using hydraulic bolt cutters, but an oxyacetylene torch is normally used (Ref. 7). The steel sheathing around the PCW pipes outside containment could also be cut by oxyacetylene torch. Oxyacetylene torch may be used to cut carbon steel pipe, but plasma arc torch should be used for stainless steel pipe cutting (Ref. 3, Table 8.1). Hand held torches can be used since pipe walls are thin enough and the survey data indicates that radiation levels will be low. Hand held torch cutting minimizes the access that must be opened around the pipe cut locations. Torch operators must wear filter masks, and a high volume ventilation system should be provided to draw contaminated fumes through HEPA filters (Ref. 3). Data on plasma arc cutting is given in Reference 3, Sections 6.3.2 and 8.3.1 and Reference 4, Section 3.2. Data on oxyacetylene torch cutting (oxygen burner) is given in Reference 3, Section 6.3.3 and 8.3.2 and Reference 4, Section 3.3.

TABLE 4.2-2

Jack Hammer and Chipping Hammer

Concrete Removal Rates and Costs*

Concrete Type	Jack Hammer: Removal Rate yd^3/8hr day	Jack Hammer: Removal Cost (1980) \$/yd^3	Chipping Hammer: Removal Rate yd^3/8 hr day	Chipping Hammer: Removal Cost (1980) \$/yd^3
Non-Reinforced**	20	32	1	\$640/yd^3
Reinforced Concrete***	12	62	<1	>\$744/yd^3

* Reference 3.

** Crew consists of one light equipment operator and two laborers.

*** Crew consists of one light equipment operator, two laborers and one iron worker.

4.2.1 Quadrant and Canal (Q&C) Embedded Pipe Removal

4.2.1.1 Initial Conditions

1. All non-embedded radioactive piping and equipment either decontaminated or removed from quadrants and canals.

2. Gates between Quadrants "C" and "A" and Canal "F" and gate between Canal "F" and "G" removed.

3. Bulkhead between Canal "H" and "G" removed.

4. Quadrant and canal surfaces decontaminated such that concrete to be removed can be considered clean.

5. Risers removed from recirculation (purge) and overflow piping.

4.2.1.2 Q&C Pipe Data (Teledyne Isotopes Letter of 6/25/85)

Mainly 3", 6" and 10"

Carbon Steel

Sch 80

4.2.1.3 Reinforced Concrete Data

Slab at 0'0" North of Canal "G" (PF-00166)

8" thick with #4 x #4 on 6" x 6" Mesh Reinforcing

Compacted Fill Below

Containment Mats (PF-00171)

#11 bar at 12" OC X #11 bar at 12" OC at containment OD, 12" deep

Canal "F" and "G" Floor (PF-00155, 00162)

Top #11 at 4" OC X #8 at 12" OC

Bottom #8 at 4" OC X #8 at 12" OC

Reactor Bldg. El - 25' Floor (PF-00156 and 157)

#4 X #4, 6" x 6" Mesh

7" thick

Fill below

Quad Divider Walls (PF-00171, Section 5 and 00172)

Vertical, #11 at 8" OC, each face

Horizontal, #8 at 12" OC, each face

Diagonal/Vertical, #11 at 4" OC, each face, El -15' to -30'

Quad O.D. Wall (PF-00171, Section 1/221 and 00172)

Vertical, 4 curtains, #8 at 12" OC down to El -28'

Hoops, 4 curtains, 1.5" dia at 4-1/2" OC

4.2.1.4 Reference Drawings for Q&C Embedded Piping Removal

PF-00155	PF-00375
156	376
157	385
162	770

166	850
171	855
172	PF-04645

4.2.1.5 Productivity Factors for Q&C Embedded Piping Removal

Same as for PCW piping removal given in 4.2.2.5 below.

4.2.1.6 Concrete Removal Estimates for Q&C Embedded Piping Removal

Concrete removal is estimated in Table 4.2-3 based on concrete removal to within about 6" of the piping by controlled blasting with final exposure and loosening of pipes from the concrete by jack hammer.

Concrete Removal to Remove Q&C Embedded Piping

Area	Location	Blasting	Jack Hammer
Quad "D"	Floor	None	7'x3'x3' deep = 63 ft^3 = 2.3 yd^3
Quad "C"	Floor	None	8'x3'x3' deep = 72 ft^3 = 2.7 yd^3
Quad "B"	Floor	None	(4'x 1.5' + 1.5' x 1.5) x 3' deep = 25 ft^3 = 0.9 yd^3
Quad "A"	Floor	None	8'x3'x3' = 72 ft^3 = 2.7 yd^3
RB Annulus Basement	Floor	3.5'x41' x 1.5 deep = 2.15 ft^3 = 8 yd^3	2'x41'x1' deep = 82 ft^3 = 3 yd^3
	Tunnel Under Quad "D" Wall	4'tk x 3.5'w x 4'h = 56 ft^3 = 2 yd^3	2'x4'x1' deep = 8 ft^3 = 0.3 yd^3
Canal "E"	Floor Area 1	250 ft^2 x 1.5' deep = 375 ft^3 = 13.9 yd^3	155 ft^2 x 1' deep = 155 ft^3 = 5.7 yd^3
	Floor Are 2	56 ft^2 x 1.5' deep = 84 ft^3 = 3.1 yd^3	42 ft^2 x 1' deep = 42 ft^3 = 1.6 yd^3 12 ft^2 x 2.5' deep = 30 ft^3 = 1.1 yd^3 Total = 2.7 yd^3
	Floor Area 3	45 ft^2 x 1.5' deep = 68 ft^3 = 2.5 yd^3	22 ft^2 x 1' deep = 22 ft^3 = 0.8 yd^3
	Floor Area 4	39 ft^2 x 1.5' deep = 59 ft^3 = 2.2 yd^3	20 ft^2 x 1' deep = 20 ft^3 = 0.7 yd^3
	Tunnel Under Quad "C" Wall	3' tk x 4'w x 4'h = 48 ft^3 = 1.8 yd^3	3' th x 3'w x 1' deep = 0.3 yd^3

4.1 - C55

TABLE 4.2-3 (Cont'd)

Concrete Removal to Remove Q&C Embedded Piping

Area	Location	Blasting	Jack Hammer
Canal "E" (con't)	2 Tunnels Under Quad "B" Wall	2 (3'tk x 4'w x 4'h) = 96 ft^3 = 3.6 yd^3	3'tk x 1.5 w x 1' deep = 4.5ft^3 = 0.2 yd^3 3'tk x 3'w x 1' deep = 9 ft^3 = 0.3 yd^3 Total = 0.5 yd^3
	Tunnel Under Quad "A" Wall	3'tk x 3'w x 4'h = 36 ft^3 = 1.3 yd^3	3'tk x 1.5'w x 1' deep = 4.5 ft^3 = 0.2 yd^3
RB North of Canal "G"	Floor Slab Fill	.67' tk x 15' x 12' = 120 ft^3 = 4.5 yd^3 (Remove 180 ft^2 x 27' = 4860 ft^2 of compacted fill, shoring as required)	-
	Containment Wall	-	Cut steel liner with torch and remove. Then tunnel around pipes 1'tk x 8' x 1' = 8 ft^3 = 0.3 yd^3
	Canal "F" Wall	2.5'tk x 6'w x 3'h = 45 ft^3 = 1.7 yd^3	2.5tk x 5' x 1' = 13 ft^3 = 0.5 yd^3
Canal "F","G", & "H"	Floor Area 1 Canal "F" Wall	7' x 12' x 1.5' deep = 126 ft^3 = 4.7 yd^3 2.5'tk x 6'w x 3'h = 45 ft^3 = 1.7 yd^3	5' x 12' x 1' deep = 60 ft^3 = 2.2 yd^3 2.5'tk x 5' x 1' = 13 ft^3 = 0.5 ft^3
	Floor Area 2	422 ft^2 x 1.5' = 633 ft^3 23.4 yd^3	25 ft^2 x 2.6' = 65 ft^3 = 2.4 yd^3 350 ft^2 x 1' = 350 ft^3 = 13 yd^3 Total = 15.4 yd^3
	Canal "F" Wall	2.5'th x 14' x 3'h = 105 ft^3 = 3.9 yd^3	2.5'th x 13'x1'= 33 ft^3 = 1.2 yd^3
	Tunnel Under Canal "G" to "F" Wall	2'tk x 3'w x 4'h = 24 ft^3 = 0.9 yd^3	3'tk x 1.5w x 1'deep = 4.5 ft^3 = 0.2 yd^3

Concrete Removal to Remove Q&C Embedded Piping

Area	Location	Blasting	Jack Hammer
RB Southwest at El -25' and Pump Room	Floor Area 1 Including digging under pump room wall	(19' x 3' + 21' x 13' + 12' x 10') x 1.5' = 675 ft^3 =25 yd^3	(2' x 16' + 2' x 16' + 3.5' x 19' + 4' x 9' + 1/2 (7' x 6') + 15' x 5') x 1' = 263 ft^3 = 9.7 yd^3
	Floor Area 2 Including digging under pump room wall	15.5' x 14.5' x 1.5' = 337 ft^3 = 12.5 yd^3	15.5' x 13' x 1.2' = 242 ft^3 = 9 yd^3
	Trench and Sump Floor Area	3.5' x 10' x 3.5' = 123 ft^3 = 4.5 yd^3	2' x 15' x 1' = 30 ft^3 = 1.1 yd^3
	3 Cont. Wall Penetrations	-	Cut steel liner with torch and remove, then tunnel around pipes 1'tk x (1.5 + 1.5 + 4) x 1' = 7 ft^3 = 0.3 yd^3
Hot Lab Bldg. Dry Hot Storage	Floor	(15' + 11') x 3' x 2.5 = 195 ft^3 = 7.2 yd^3	39' x 2.5' x 1.5' = 146 ft^3 = 5.4 yd^3
	3 Tunnels Thru Wall	3 x (5'tk x 4'w x 4'h) = 240 ft^3 8.9 yd^3	3 (5'tk x 2'w x 1') = 30 ft^3 = 1.1 yd^3
Canal "J" & "K"	Floor	(41' x 3' + 9' x 3') x 3.5" deep = 525 ft^3 = 19.4 yd^3	(41' x 2' + 9' x 2') x 1' = 100 ft^3 = 3.7 yd^3 4' x 3' x 4.5' deep = 54 ft^3 = 2 yd^3 (2' x 9' + 2' x 8" + 35' x 3' + 5' x 2' + 45' x 2') x 1.5 = 306 ft^3 = 11.3 yd^3 Total = 17 yd^3

TABLE 4.2-3 (Cont'd)

Concrete Removal to Remove Q&C Embedded Piping

Area	Location	Blasting	Jack Hammer
Canal "J" & "K" (con't)	South Wall Tunnel	4'tk x 15'w x 4'h = 240 ft^3 = 8.9 yd^3	4'tk x 15'w x 1'd = 60 ft^3 = 2.2 yd^3
Valve Pit Area	Floor	9' x 5' x 1.5' = 54 ft^3 = 2 yd^3	3' x 8' x 1' = 24 ft^3 = 0.9 yd^3
	RB Wall	2'tk x 5'w x 4'h = 40 ft^3 = 1.5 yd^3	2'tk x 3'w x 1'd = 6 ft^3 = 0.2 yd^3
Totals		170 yd^3	90 yd^3

4.2.1.7 Q&C Contaminated, Embedded Piping Estimate for Shipping and Burial

Embedded Q&C piping to be removed is described in Table 4.2-4. The total lengths of the various pipe sizes are summarized in Table 4.2-5.

Since each size pipe can be nested in the next larger pipe, the 300' of 10" pipe can nest all of the 4", 6" and 8" pipe and 300' of the 3" pipe (only one length of 3" pipe will fit in a 6" pipe). Also, one 3" pipe can be placed between four 10" pipes. Thus, containers to hold 300' of nested 10" pipe and 270' of 3" pipe would be required. After cutting into 5' lengths, about 54 segments of non-nested 3" pipe must be placed in containers. Based on the B-25 container (see 4.2.2.7), 16 lengths of nested 10" pipe plus 9 lengths of 3" pipe (or 144 lengths of only 3" pipe) can be loaded in one container. Four (4) containers will hold the nested 10" pipe plus all of 3" pipe. To account for packaging inefficiencies, five (5) containers 80% filled are assumed for cost estimating. The burial volume based on 98 ft^3 per container is 490 ft^3.

The Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule (Ref. 28) includes surcharges for weight and Curie content. The total weight of the embedded Q&C piping is estimated to be 39,340 pounds. Each container would, therefore, contain about 7868 pounds of piping. Based on a container weight of 900 pounds, each container would weigh approximately 8,768 pounds.

Barnwell's April 15, 1985 Rate Schedule indicates a weight surcharge of $550 per container. The embedded Q&C piping is estimated to have an internal surface area of 1.82×10^6 cm^2. Based on the maximum measured beta-gamma dose rate of 345 mR/hr (which is equivalent to approximately 6.9×10^6 dpm/100 cm^2), the total activity in all the embedded Q&C piping is less than 0.06 Curies. There is no surcharge for shipments of less than 1 Curie.

The total weight of the embedded Q&C piping and containers is approximately 43,840 pounds. Although this could probably be shipped in one truckload, two truck loads were assumed for estimating purposes.

TAB[illegible] 2-4

EM[illegible]DDED D&[illegible] ING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	-25' Quad D	Pump Out	6/10	8/1	2'-6"	2 Floor Drains	375
RB	-25' Quad D	Recirc	3	1	2'-6"	Excludes 22' Flanged Riser	375/376
RB	-25' Quad C	Pump Out	6/10	8/1	2'-6"	2 Floor Drains	376
RB	-25' Quad C	Recirc	3	1	-	Excludes 22' Flanged Riser	376
RB	-25' Quad B	Pump Out	6/10	3/1	2'-6"	Piping Under Quad Wall 2 Pool Drains	376
RB	-25' Quad B	Recirc	3	8	2'-6"	4' Under Quad Wall Closed line so may be clean. Extent of riser uncertain.	376
RB	-25' Quad A	Pump Out	6/10	8/1	2'-6"	2 Floor Drains	376
RB	-25' Quad A	Pump Out	10	4	2'-6"	3' Under Quad Wall	376
RB	Annulus Basement	Quad D Pump Out	10	39	2'-6"		375/376
RB	Annulus Basement	Quad D Pump Out	10	4	-	Undewr Quad "D" Wall	375
RB	Annulus Basement	Quad D Recirc	3	41	2'-6"		375/376
RB	Annulus Basement	Quad D Recirc	3	4	-	Under Quad "D" Wall	375

TABLE 4.2-4 (Cont'd)
EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	Canal "E" EL-25'	Quad D Pump Out	10	40	2'-6"		376
	Canal "E" EL-25'	Quad D Recirc	3	40	2'-6"		376
	Canal "E" EL-25'	Quad C Pump Out	10	2.5	-	Under Quad C Wall	376
	Canal "E" EL-25'	Quad C Pump Out	10	24	2'-6"		376
	Canal "E" EL-25'	Quad C Recirc	3	3	-	Under Quad C Wall	376
	Canal "E" EL-25'	Quad C Recirc	3	25	2'-6"		376
	Canal "E" EL-25'	Quad B Recirc	3	18	2'-6"		376
	Canal "E" EL-25'	Canal "E" Pump Out	6	22	2'-6"	3 Floor Drains	376
	Canal "E" EL-25'	Canal "E" Pump Out	8	8	2'-6"		376
	Canal "E" EL-25'	Canal "E" Pump Out	10	5	2'-6"		376
	Canal "E" EL-25'	Canal "E" Recirc	3	1	2'-6"	Excludes Riser	376
	Canal "E" EL-25'	Quad B Pump Out	10	15	2'-6"		376
	Canal "E" EL-25'	Quad A Pump Out	10	13	2'-6"		376

TABLE 4.[illegible] Cont'd)

EMBEDDED O&C [illegible]ING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	0'0" Slab and Compacted Fill North of Canal "G"	Quad D Pump Out	10	1.5	-	Under Cont. Wall	376
		Quad D Pump Out	10	15	27'-6"	In Fill	376
		Quad D Pump Out	10	2.5	-	Under Canal "F" Wall	378
		Quad D Recirc	3	1.5	-	Under Cont. Wall	376
		Quad D Recirc	3	19	27'-6"	In Fill	376
		Quad D Recirc	3	2.5	-	Under Canal "F" Wall	376
		Quad C Pump Out	10	1.5	-	Under Cont. Wall	376
		Quad C Pump Out	10	11	27'-6"	In Fill	376
		Quad C Pump Out	10	2.5	-	Under Canal "F" Wall	376
		Quad C Recirc	3	1.5	-	Under Cont. Wall	376
		Quad C Recirc	3	14	27'-6"	In Fill	376
		Quad C Recirc	3	2.5	-	Under Canal "F" Wall	376
		Quad B Recirc	3	1.5	-	Under Cont. Wall	376

TABLE 4.2-4 (Cont'd)

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
		Quad B Recirc	3	9	27'-6"	In Fill	376
		Quad B Recirc	3	2.5	-	Under Canal "F" Wall	376
RB	Canal "F", "G", & "H" EL- 25'	Quad "D" Pump Out	10	12	2'-6"		376
		Quad "D" Recirc	3	12	2'-6"		376
		Quad "C" Pump Out	10	12	2'-6"		376
		Quad "C" Recirc	3	12	2'-6"		376
		Quad "B" Recirc	3	12	2'-6"		376
		Canal "H" Pump Out	6	62	2'-6"	One Floor Drain	376
		Canal "H" Recirc	3	72	2'-6"	Excludes Riser	376
		Canal "H" Overflow	4	38	4'-3"	Excludes Riser	376
		Canal "H" Overflow	8	19	4'-3"	Excludes Risers	376
		Canal "G" Pump Out	6	23	2'-6"	One Floor Drain	376
		Canal "G" Recirc	3	21	2'-6"	Excludes Riser	

EMBEDDED O&C PI BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
		Canal "F" Pump Out	6	1	2'-6"	One Floor Drain	
		Canal "F" Recirc	3	1	2'-6"	Excludes Riser	
		Dry Hot Storage Drain	4	21	3'-2"	Includes 2' Under Canal "G" to "F" Wall	
RB	-25' El SW & Pump Room	Quad D Pump Out	10	2.5	-	Under Canal "F" Wall	376
		Quad D Pump Out	10	21	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad D Recirc	3	2.5	-	Under Canal F Wall	376
		Quad D Recirc	3	20	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad C Pump Out	10	2.5	-	Under Canal "F" Wall	376
		Quad C Pump Out	10	24	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad C Recirc	3	2.5	-	Under Canal "F" Wall	376
		Quad C Recirc	3	23	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad B Recirc	3	2.5	-	Under Canal "F" Wall	376
		Quad B Recirc	3	26	2'-6"	Includes 9" Under Pump Room Wall	376

TABLE 4.2-4 (Cont'd)

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	-25' El SW & Pump Room (Cont'd)	Canal "E" Pump Out	10	2	-	Under Cont. Wall	376
		Canal "E" Pump Out	10	21	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal "E" Recirc	3	2	-	Under Cont. Wall	376
		Canal "E" Recirc	3	20	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad B Pump Out	10	1	-	Under Cont. Wall	376
		Quad B Pump Out	10	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Quad A Pump Out	10	1	-	Under Cont. Wall	376
		Quad A Pump Out	10	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal F Recirc	3	2.5	-	Under Canal "F" Wall	376
		Canal F Recirc	3	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal F Pump Out	6	2.5	-	Under Canal "F" Wall	376
		Canal F Pump Out	6	16	2'- "	Includes 9" Under Pump Room Wall	376
		Canal G Recirc	3	2.5	-	Under Canal "F" Wall	376

TABLE 4.2- Cont'd

EMBEDDED O&C P BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
RB	-25' El SW & Pump Room (Cont'd)	Canal G Recirc	3	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal G Pump Out	6	2.5	-	Under Canal "F" Wall	376
		Canal G Pump Out	6	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal "H" Recirc	3	2.5	-	Under Canal "F" Wall	376
		Canal "H" Recirc	3	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal "H" Pump Out	6	2.5	-	Under Canal "F" Wall	376
		Canal "H" Pump Out	6	16	2'-6"	Includes 9" Under Pump Room Wall	376
		Canal F,G H Overflow	8	2.5	-	Under Canal "F" Wall	376
		Canal F,G H Overflow	8	30	4'-3"	Includes 9" Under Pump Room Wall and 5' under trench	376
		Dry Hot Storage Drain	4	2.5	-	Under Canal "F" Wall	376
		Drain	4	16	3'-2"	Includes 9" Under Pump Room Wall	376
		HLB Pump Out	6	11	2	Includes 9" Under Pump Room Wall	376
		HLB Pump Out	6	2	-	Under RB Wall	376

TABLE 4.2-4 (Cont'd)

EMBEDDED O&C PIPING BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
		HLB Recirc	3	13	2	Includes 9" Under Pump Room Wall	376
		HLB Recirc	3	2	-	Under RB Wall	376
HLB	Dry Hot Storage Cell, -25'	DHS Pump Out	4	38	3'-2"	2 Floor Drains	4645
		DHS Pump Out	4	5		Under DHS Wall	4645
		DHS Pump Out	6	6	1.5'	Sealed Floor Drain, Line Should Be Clean	4645
		DHS Pump Out	6	8	-	Under DHS Wall	4645
		DHS Recirc	3	2	1.5	Excluding Riser	4645
		DHS Recirc	3	5	-	Under DHS Wall	4645
		DHS Overflow	4	2	4'-3"	Excluding Riser	4645
		DHS Overflow	4	5	-	Under DHS Wall	4645
HLB	Canal "J" & "K" El- 25	DHS Pump Out	6	12	1.5	Should Be Clean	4645
		DHS Pump Out	6	4	-	Under Canal "J" Wall	4645
		Canal J Pump Out	6	8	1.5	One Floor Drain	4645

EMBEDDED O&C [illegible]NG BY LOCATION

BLDG.	AREA	PIPE NAME	SIZE, IN	HORIZ. LENGTH, FT.	CENTERLINE DEPTH	REMARKS	REF DWG. PF-00XXX
		Canal J Pump Out	6	4	-	Under Canal "J" Wall	4645
		Canal K Pump Out	6	44	1.5	One Floor Drain	4645
		Canal K Pump Out	6	6	-	Under Canal "J" Wall	4645
		Canal K Recirc	3	32	1	Excluding Riser	4645
		Canal K Recirc	3	4	-	Under Canal "J" Wall	4645
		Canal J Recirc	3	2	1	Excluding Riser	4645
		Canal J Recirc	3	4	-	Under Canal "J" Wall	4645
		DHS Recirc	3	12	1		
		DHS Recirc	3	4	-	Under Canal "J" Wall	4645
		Overflow	4	62	4'-3"	Excluding Risers	4645
		Overflow	4	4	-	Under Canal "J" Wall	4645
HLB	Valve Pit Area, -25'	Pump Out	6	6	2	From Valve Pit to RB Wall	4645
	Valve Pit Area, -25'	Recirc	3	7	2	From Valve Pit to RB Wall	4645

Table 4.2-5

Q&C Embedded Piping Summary

Q&C Pipe Size, in.	Total Horizontal* Length, ft	Sch 80 ID in	Sch 80 OD in.
3	570	2.9	3.5
4	200	3.826	4.5
6	300	5.761	6.625
8	60	7.625	8.625
10	300	9.564	10.75
Total	1430		

* Vertical runs are negligible.

4.2.1.8 Q&C Embedded Pipe Removal Procedures

Four general procedures cover removal of all of the Q&C embedded piping: Concrete Removal from Floors, Concrete Removal Under Walls, Slab and Compacted Fill Removal and Piping Removal. All concrete to be removed is assumed to be non-radioactive.

4.2.1.8.1 Concrete Removal from Floors

Concrete is first removed to within about 6" of the pipe by controlled blasting and the remaining concrete cover is removed by jack hammers.

Operations

1. Move drilling equipment (track drill where possible) into position.
2. Drill vertical holes to within 3" of top of embedded pipe.
3. Place charges and stemming (material placed in hole to prevent gases from escaping upon detonation).
4. Place blast mats.
5. Evacuate area and detonate charges.
6. Verify all charges have detonated.
7. Remove mats.
8. Check for contamination (none expected since drill holes are at least one charge diameter from pipe (Ref. 7).

9. Cut rebar with torch and pile on floor nearby.

10. Remove rubble with small backhoe if space permits or by hand (shovel) and pile on floor nearby.

11. Remove concrete with jack hammer above and on sides of pipe until it is loose, and at predetermined locations excavate under pipe to provide access for cutting torch (at all elbows and about every 20' along runs).

4.2.1.8.2 Concrete Removal Under Walls

After trenching up to walls from both sides, a hole about 4' high is to be blasted through the wall with the bottom of the hole located about 1' above the pipe(s), thereby permitting access to remove the remaining concrete cover using jack hammers. The width of the blasted hole should be 3 feet or more, depending on the number of adjacent pipes embedded under the wall.

1. Move drilling equipment (track drill where possible) into position.
2. Drill horizontal holes through wall.
3. Place charges and stemming.
4. Place blast mats.
5. Evacuate area and detonate charges.
6. Verify all charges have detonated.
7. Remove mats.
8. Check for contamination (none expected).
9. Cut rebar with torch and pile locally.
10. Remove rubble using backhoe or shovel and pile locally.

11. Remove concrete with jack hammer above and on sides of pipe until loose.

4.2.1.8.3 Slab and Compacted Fill Removal

Concrete floor slab about 8" thick on Elevation 0'-0" in the Reactor Building is to be removed by controlled blasting, the fill down to the pipes is to be removed, shoring as required.

1. Move hand drilling equipment into position.
2. Use hand drills to drill holes in slab.
3. Place charges and stemming.
4. Place blast mats.
5. Evacuate area and detonate charges.
6. Verify all charges have detonated.
7. Remove mats.
8. Cut mesh reinforcing with torch or hydraulic cutter.
9. Remove rubble and mesh to local pile.
10. Remove fill, shoring as required (about 27' of fill must be removed to reach pipes), and pile locally.

4.2.1.8.4 Piping Removal

1. Install contamination controls (plastic sheet under cutting locations and elephant trunk to exhaust fan with the HEPA filter) at cut locations and at a segmenting area nearby.
2. Cut pipe using hand held oxyacetylene torch at pre-determined locations, normally every 20' and at all

elbows.

3. Pry pipe from concrete and cover ends with plastic sheet and tape.
4. Rig if necessary and move pipe to segmenting area.
5. Segment pipe into about 5' lengths using power hacksaw or oxy-torch.
6. Nest 3", 4", 6", 8" and 10" pipe and load into shipping containers (remove end coverings as required).
7. Remove contamination controls and bag plastic sheeting.
8. Survey area.
9. Erect safety barriers as required.

4.2.1.9 Q&C Pipe Removal Cost

The estimated cost for removal of the embedded Q&C piping is summarized in Table 4-2.6. The total estimated cost is $372,500 in 1985 dollars (no escalation). A contingency of 20% is included.

For clean concrete removal, the penalty evaluated for reduced productivity (due to work inside a nuclear facility) increased the manhours and costs by a factor of 1.74. For contaminated pipe removal, manhours and costs were increased by a factor of 1.85. These factors are consistent with the factors used for similar work in other decommissioning estimates (Ref. 5 and 13).

The unit rates developed and used in this estimate are summarized on Table 4.2-7.

TABLE 4.2

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc. 3764-01

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 1 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q.&C. PIPE REMOVAL (EMBEDED)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST (FROM PAGE 2 of 2)				4691	112,132	15,905	27,677		155,714
	CRAFT SUPPORT LABOR (7% OF D.L.)				328	7849	–	–		7849
	NON-CRAFT SUPPORT (6% OF D.L.)				281	6,728	–	–		6,728
	SUBTOTAL				5,300	126,709	15,905	27,677		170,291
	PAYROLL TAXES & INSURANCE (48.8% OF LABOR)					61,834				61,834
	SUBTOTAL					188,543	15,905	27,677		232,125
	SMALL TOOLS (6% OF LABOR + PART I)					–	11,313	–		11,313
	EQUIP. E.O.M (7% OF LABOR + PART I)					–	13,198	–		13,198
	SUBTOTAL					188,543	40,416	27,677		256,636
	SALES TAX (5% OF TAXABLE MAT'L)					–	2021	–		2021
	SUBTOTAL					188,543	42,437	27,677		258,657
	CONTINGENCY (20%)					37,709	8487	5535		51,731
	SUBTOTAL					226,252	50,924	33,212		310,388
	O/H & PROFIT (≈20%)					45,248	10,176	6658		62,112
	Total				5300	271,500	61,100	39,900		372,500

Bid Item	Project Area
2.2.2.	13.1

4.1 - C75

BR2230 (6/83) 1M

TABLE 4.2-6

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF | Estimate by: AHK | Page 2 of 2
Client: TELEDYNE ISOTOPES | Checked by: | Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
Q&C PIPE REMOVAL (EMBEDDED)						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Conc. Manhours	Pipe Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	QUAD "D"				14	11	577	106			703
	QUAD "C"				16	11	645	111			756
	QUAD "B"				6	12	428	94			522
	QUAD "A"				16	14	715	135			850
	RB ANNULUS				37	72	3078	865			3943
	"CANAL "E"				135	212	8314	2457			10,771
	RB BASEMENT				7	-0-	173	89			262
	NORTH OF CANAL "G"				296	85	8940	974			9914
	CANALS "F", "G", & "H"				216	275	12,225	3406			15,631
	SOUTHWEST RB @ ELEV -25' & PUMP ROOM				222	378	14,342	4103			18,445
	HOT LAB BUILDING				48	-0-	1167	291			1458
	HOT DRY STORAGE				27	67	2248	705			2953
	CANAL "J" & "K"				177	184	8693	2373			11,066
	VALVE PIT AREA				12	15	611	196			807
	CONTAINERS, TRANSPORTATION & DISPOSAL								27,677		27,677
					1233	1376	62,176	15,905	27,677		105,758
	SUBTOTAL										
	CONCRETE PRODUCTIVITY + 7121		21.50		912		22,344				22,344
	PIPING PRODUCTIVITY + 852		23.60			1170	27,612				27,612
					2145	2546					
	Total					4691	112,132	15,905	27,677		155,714

Bid Item: 2.2.2 | Project Area: 1

4.1 - C76

TABLE 4.2-7

Unit Rates Summary*

Activity Description	Manhours/Unit	Aver. Crew Labor Cost $/MH	Material Cost $/Unit	Total Rate $/Unit
Non-Radioactive Concrete Removal by Controlled Blasting - Rubble Piled Adjacent to Removal Location	2.3 /CY	25	27 /CY	84.50/CY
Non-Radioactive Concrete Removal by Jackhammer - Rubble Piled Adjacent to Removal Location	5.8 /CY	24	18 /CY	157.20/CY
Excavate Clean Compacted Fill	1.5 /CY	23.28	11 /CY	35.92/CY
Contaminated Pipe Removal - 2.5" to 8" Diameter, Including Cutting to 5' Lengths and Packaging	0.9 /LFP	23.60	6.25/LFP	27.49/LFP
Contaminated Pipe Removal - 8" Diameter and Larger, Including Cutting to 5' Lengths and Packaging	1.05/LFP	23.60	7.30/LFP	32.08/LFP
Sectioning 24" Diameter Pipe	0.2 /LFC	23.60	0.10/LFC	4.82/LFC

CY = Cubic Yard   LFP = Linear Feet of Pipe   LFC = Linear Feet of Cut

* These unit rates are used to estimate major work activities. Other unit rates for minor activities were selected by the estimator, based in part on References 26 and 27.

4.2.1.10 Q&C Pipe Removal Duration

The schedule for embedded Q&C piping removal is shown in Figure 4.2-1. The overall duration for this work is estimated to be approximately 10 weeks, based on a peak of 3 crews for concrete removal and 3 crews for pipe removal.

4.2.1.11 Q&C Pipe Radiation Exposure

The estimated occupational radiation exposure for the removal of the Q&C embedded piping is summarized on Table 4.2-8. The total exposure is estimated to be approximately 22.6 man-rem, based on current dose rate measurements. The decay of dose rate prior to the embedded Q&C piping removal work would reduce this estimated exposure by 50% or more if Co-60 is currently the dominant radionuclide, as expected. Exposure during radwaste transportation is not included but would be very low.

4.2.2 Primary Cooling Water (PCW) Embedded Pipe Removal

After the Q&C embedded piping is removed, the PCW embedded piping (which runs under the Q&C piping in several locations) may be removed. The configuration of the PCW pipes is shown in Figures 4.2-2 and 4.2-3. Pipe cut locations for removal are shown by heavy lines and cuts at local segmenting areas are shown by dashed lines.

FIGURE 4.2-1

Q&C Embedded Piping Removal Schedule

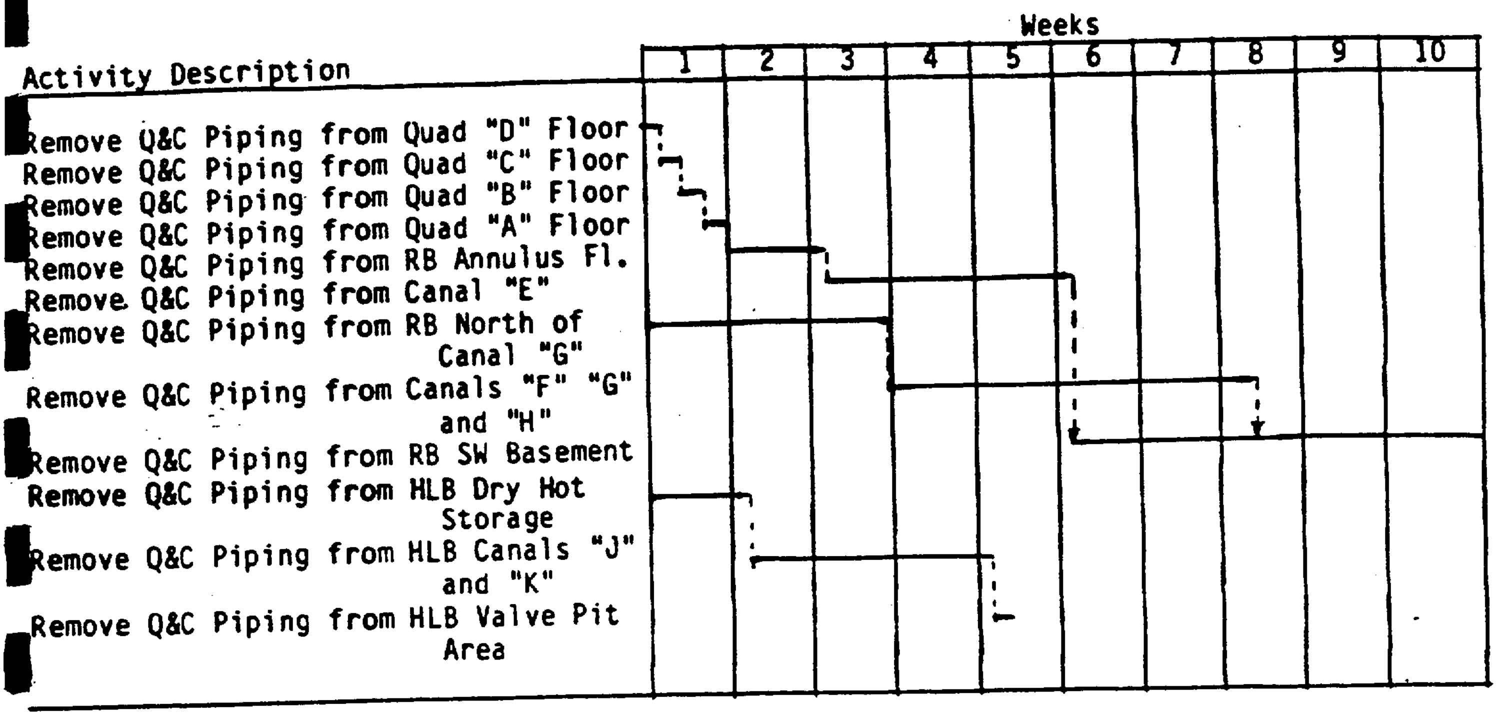


TABLE 4.2-8

Q&C Embedded Piping Removal Exposure Estimate

Activity Description	General Area Dose Rate (mR/hr)	Estimated General Area Work Time Manhours	Contact Dose Rate (mR/hr)	Estimated Contact Work Time Manhours	Estimated Occupational Exposure man-m Rem
Clean Concrete Removal	0.05[(a)]	1445	5[(c)]	700[(b)]	3,572
Piping Removal	0.05[(a)]	646	10[(e)]	1,900[(d)]	19,032
TOTAL					22,604

(a) Since all radioactively contaminated piping and equipment are to be removed from the various work areas prior to embedded Q&C piping removal, the general area dose rate should generally meet the 5μR/hr (0.005 mR/hr) dose rate limit for release so that a general area dose rate of 0.05 mR/hr is conservatively high.

(b) Approximately 33% of the total concrete removal manhours are assumed to be spent close to the Q&C piping, including all of the jackhammer removal manhours and about 80 manhours due to fill removal operations.

(c) Since some concrete (shielding) will exist around the Q&C piping during most of the concrete removal operations, an average of 5mR/hr is considered conservative relative to the maximum pipe dose rate discussed in (e) below.

(d) Approximately 75% of the pipe removal manhours are assumed to be spent near the Q&C piping due to the use of hand held torch for cutting operations.

(e) Based on direct radiation measurements taken by Teledyne Isotopes in June 1985, the Q&C pipe dose rate ranges from 0.23 to 20 mR/hr (≈ 5 mR/hr ave.) for pumpout piping and from 0 to 2.5 mR/hr for recirculation piping. Therefore, an average contact dose rate of 10 mR/hr is considered conservatively high.

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W.O. No. ______ Date ______ Book No. ______ Page No. ______
Drawing No. ______ Calc. No. ______ Sheet ______ of ______
By ______ Checked ______ Approved ______
Title ______

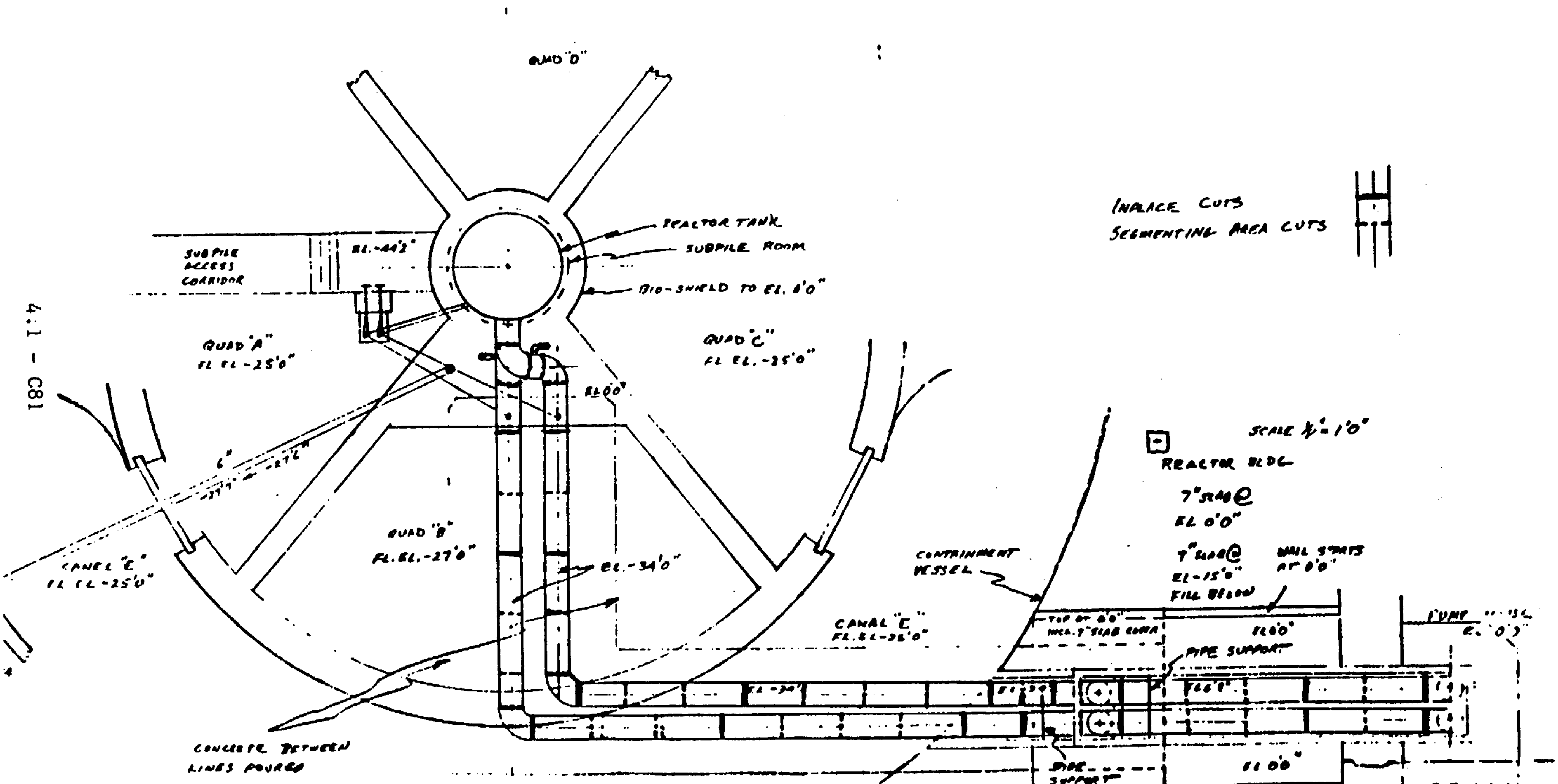

FIGURE 4.2-2

Form BR R002 7A

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W.O. No. ______ Date ______ Book No. ______ Page No. ______
Drawing No. ______ Calc. No. ______ Sheet ______ of ______
By ______ Checked ______ Approved ______
Title ______

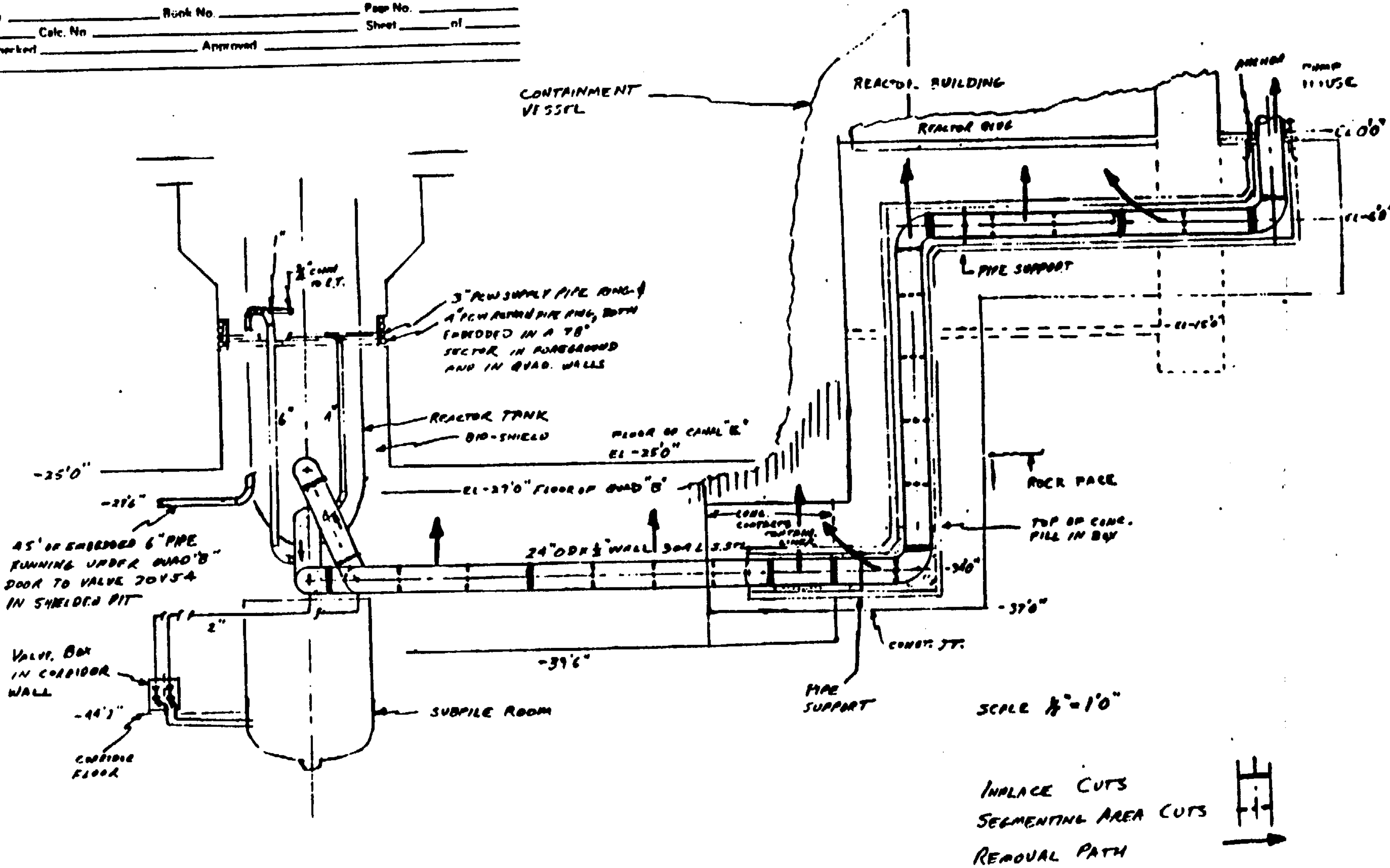


FIGURE 4.2-2

Form BR R002 7A

4.2.2.1 Initial Conditions

1. All non-embedded radioactive piping and equipment either decontaminated or removed from pump house with 24" pipes cut off just above floor anchor and closed with plastic and tape.

2. Reactor tank and any activated concrete removed from the reactor bio-shield.

3. Quad "A" to Canal "E" gate removed.

4. Canal "E" and Quads "A", "B" and "C" cleared of equipment and surfaces decontaminated.

5. Embedded quadrant and canal piping removed.

4.2.2.2 PCW Pipe Data (PF-00382)

24" O.D. x 1/2" wall
304L Stainless Steel
Approx. 270 linear ft. pipe
10 LR 90° elbows
Steel Sheathing Outside Containment (PF-00126)
Two Pipe Supports Outside Containment (PF-00382 and 00424)

4.2.2.3 Reinforced Concrete Data

Chase Outside Containment (PF-00159 and 00152, Note 7)

3000# Concrete

Rebar, #6 at 18" O.C., each way, all around

Slab Above Chase at 0'0" Outside Containment (PF-00166)

8" slab on Chase and Compacted Fill, #4 x #4 on 6" x 6" mesh reinforcement

Slab at 15'0" Outside Containment (PF-00159)

6" slab, #4 x #4 on 6" x 6" mesh

Containment Mats (PF-00171)

#11 bar at 12" O.C. x #11 bar at 12" O.C. at containment O.D., 12" deep.

Reactor Pedestal (PF-00176)

High density concrete poured inside steel plate liners to El.-2'-0"

Quad "B" Surface - #8,6" O.C., Horizontal and Vertical with 1/2" CS plate liner.

Upper Protrusion Outerlayer - #8, Hoops 4" O.C., Verticals 6" O.C., 1/4" CS plate liner.

Shell Outer/Upper Protrusion Inner Layer - #8, Hoops 4" O.C., Vertical 6" O.C., 1/4" CS plate liner.

Central Platform (PF-00177 and 00178)

Standard Concrete El - 2'0" to 0'0"

Outside Surface - #8 hoops 4" O.C.

Top and Bottom Surface - #9 partial hoop, 4" O.C.,
#8 radial on 4" O.C. at reactor tank

Quadrant Divider Walls (PF-00171, Section 5 and 00172)

Vertical - #11 at 8" O.C., each face

Horizontal - #8 at 12" O.C., each face

Diagonal/Vertical - #11 at 4" O.C., each face (El.-15' to -30')

Quadrant O.D. Wall (PF-00171, Section 1/221 and 00172)

Vertical - 4 curtains #8 at 12" O.C. down to El.-28'

Hoops - 4 curtains 1-1/2" diameter at 4-1/2" O.C.

4.2.2.4 Reference Drawings for PCW Embedded Pipe Removal

PF-00126	PF-00178
PF-00152	PF-00249
PF-00155	PF-00250
PF-00159	PF-00375
PF-00160	PF-00376
PF-00161	PF-00382
PF-00165	PF-00387
PF-00166	PF-00392

PF-00170	PF-00423
PF-00171	PF-00424
PF-00172	PF-00452
PF-00176	PF-00454
PF-00177	

4.2.2.5 Productivity Factors for PCW Embedded Pipe Removal

	Applicable Manhours	Work Time Increase Factors
Work at a height	None	-
Work in confined space	All	0.20
Use of respirators	Pipe Cutting	0.25
Radioactivity protection controls	Pipe Cutting	0.10
Protective clothing	All	0.20
Work break and transit	All	0.10

See "Cost Estimating Scope and Guidelines" for method of application (Ref. 24).

4.2.2.6 Concrete Removal Estimates for PCW Embedded Pipe Removal

Numbers correspond to removal procedures numbers in 4.2.2.8 (i.e., 1. corresponds to 4.2.2.8.1)

1. Concrete Volume = 10 ft. x 2 ft. x 5 ft. deep = 100 ft.^{3} = 3.7 yd.^{3}

2. Concrete Volume = (11' x 4.5' deep + 3' x 4.5' deep) x 23' long = 1449 ft.^{3} = 53.7 yd.^{3}

3. Slab Volume (8" thick) = 0.67tk x 1/2 (13'x15') = 65 ft.^{3} = 2.4 yd.^{3}

   Fill Volume = 1/2 (13'x15') x 28' deep = 2730 ft.^{3} = 101 yd.^{3}

   Concrete Volume = 6'x8'x4' deep + 1/2 (7'x8'x4' deep) = 304 ft.^{3} = 11.3 yd.^{3}

   Concrete Fill Inside Steel Sheathing Around 24" pipes (Horizontal & Vertical) = 1.5 deep x 6' wide x 14' long = 126 ft.^{3} = 4.7 yd.^{3}

4. Blasting Concrete Volume = 6' deep x [1/2 x 10.5' x 11' + 10.5' x 13' + 1/2 x 25' x (4' + 10.5') + 4'x20'] = 2733 ft.^{3} = 101 yd.^{3}

   Jack Hammer Concrete Volume = (4' deep x 8' wide - 2 ! x2^2/4)x40' long = 1008 ft.^{3} = 37 yd.^{3}

5. Blasting Concrete Volume = 4' deep x 14' x 20' long = 1120 ft.^{3} = 41.5 yd.^{3}

   Jack Hammer Concrete Volume = (4' deep x 10' wide - 2 ! x 2^2/4)x20' long = 674 ft.^{3} = 25 yd.^{3}

6. Blasting Concrete Volume (Above El.-25') = 25' high x 1/2 x 9'x(10' + 25') = 3938 ft.^{3} = 146 yd.^{3}

Blasting Concrete (El.-25' to El.-35') = 10' deep x [1/2x9'x(10'+25') - 10' x 7'] = 875 ft.^{3} = 32.4 yd.^{3}

Jack/Chipping Hammer Concrete Volume N 10' deep x 10' x 7' = 700 ft.^{3} = 26 yd.^{3}

7. Blasting Concrete Volume = 38' long x 4' wide x 1.5' deep = 228 ft.^{3} = 8.5 yd.^{3}

   Jack/Chipping Hammer Concrete Volume = 38' long x 2' wide x 1' deep = 76 ft.^{3} = 2.8 yd.^{3}

4.2.2.7 PCW Contaminated Embedded Piping Estimate for Shipping and Burial

Use of a B-25 container by Container Products Corporation with a capacity of 90 ft^3 is assumed (Ref. 25). The interior is about 45" wide, 45" high and 71" long. The exterior is 46" x 51" x 72", giving a burial volume of 98 ft.^{3}. In 10 gauge construction, the capacity is 10,000 pounds, and its weight is 900 pounds.

The 24" PCW piping will be cut into 54 pipe segments, each of which will fit into the container lengthwise. The 54 segments and the 10 elbows will be sectioned lengthwise into semi-circular pieces to improve packaging efficiency. Thus, 108 semi-circular pipe sections and 20 semi-circular elbow sections must be placed in containers. Each container will hold 12 pipe sections or 8 elbow sections, requiring 9 containers for pipe and 3 containers for elbows. Thus, 12 containers will be required for a total burial volume of 1176 ft.^{3}.

These containers could also be loaded with small components and pipes to fill the voids.

The Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule (Ref. 26) includes a weight surcharge of $275 per container for container weights between 1001 and 5000 pounds. Each container of embedded PCW piping is estimated to weigh approximately 4700 pounds. Therefore, a surcharge of $275 per container is applicable. The embedded PCW piping is estimated to have an internal surface area of 1.8×10^6 cm^2. Based on an activity of 100,000 dpm/100 cm^2, the total activity in all of the embedded PCW piping is less than 8×10^{-4} Curies. There is no surcharge for shipments less than 1 Curie.

Based on a truckload net capacity limit of 42,000 pounds and a container weight of 4700 pounds, 1.5 truckloads are required to ship the 12 containers of embedded PCW piping.

4.2.2.8 PCW Pipe Removal Procedures

PCW pipe removal is covered by the following seven procedures. Blasting parameters given herein are for estimated purposes only, and each blast design must be done by an expert blaster.

4.2.2.8.1 Remove Vertical PCW Lines from Pump House Floor

Two vertical segments of 24" PCW pipe, each approximately 5 feet long, each with a long radius elbow, are to be removed. The concrete floor slab between the pipes and the adjacent pump house/

reactor building wall is to be removed by controlled blasting by drilling vertical holes with a hand held drill, loading the holes with explosives, placing blast mats and detonating. Jackhammers will be used to clear the access if necessary, and oxyacetylene torch will be used to cut rebar and the steel sheathing box. Concrete rubble and steel will be left in separate piles on the pumphouse floor. The PCW pipes will be cut at the bottom of the elbows using plasma-arc torch and rigged from the pit to a segmenting/sectioning area. The elbows will be cut from the pipe, and the pipe segments and elbows will be sectioned and loaded into shipping containers.

Operations

1. Check equipment and move into pumphouse on El. 0'0" via blocked up openings (PF-00452) or roof hatch No. 7 (PF-00454).
2. Remove 10 nuts from anchor (PF-00424).
3. Rig to anchor.
4. Move drilling equipment into position.
5. Drill vertical holes (2" diam., spaced 1' x 2', 4.5' deep, covering 2' x 10' area) and remove equipment.
6. Place charges in holes.
7. Place blast mats.
8. Evacuate area and detonate charges.
9. Verify all charges have detonated.
10. Remove blast mats.

11. Check for radioactive contamination (none expected due to steel sheathing around pipes).
12. Cut rebar with torch and pile on pumphouse floor.
13. Remove rubble and pile on pumphouse floor.
14. Clear access with jackhammers.
15. Cut steel sheathing with torch and remove to pile.
16. Adjust rigging.
17. Install contamination controls at cut locations and at segmenting/ sectioning area - plastic sheet under cover and elephant trunk to exhaust fan with HEPA filter.
18. Cut 24" pipes at bottom of elbows with hand held plasma-arc torch (2 cross cuts).
19. Separate and cover ends (4) with plastic sheet and tape.
20. Lift pipe and elbows from pit and move to segmenting/ sectioning area.
21. Cut elbows from pipe segments (2 cross cuts) and section by cutting pipes and elbows in half lengthwise (4 cuts x 5.5' + 2 cuts x 6' + 2 cuts x 3' = 40' total longitudinal cut).
22. Load 4 pipe sections and 4 elbow sections into shipping containers.
23. Remove contamination controls and bag plastic sheet for disposal.
24. Conduct final area contamination survey.
25. Install safety fence or cover excavation (do not backfill).

4.2.2.8.2 Remove Horizontal PCW Lines at El.-6'8" From Pumphouse and Reactor Building

Two horizontal runs of 24" PCW pipe, each approximately 26' long, are to be removed. The floor slab and the top and one side of the massive concrete pipe chase are to be removed by controlled blasting.

Operations

1. Check equipment and move into reactor building on El. 0'0" north of Canal "H" (PF-00152).
2. Move drilling equipment into position.
3. Drill vertical holes (2" diam., spaced 2' x 3' x 4' deep covering a 7' x 23' area and 9' deep covering a 4' x 23' area) and remove equipment.
4. Place charges.
5. Place blast mats.
6. Evacuate area and detonate charges.
7. Verify all charges have detonated.
8. Remove blast mats.
9. Check for contamination (none expected).
10. Cut rebar with torch and pile locally.
11. Remove rubble and pile locally.
12. Clear access with jackhammers.
13. Cut steel sheathing top and sides by torch and pile locally.
14. Rig to piping.

15. Install contamination controls at 4 cut locations and at segmenting/sectioning area.
16. Cut 24' pipes using hand held torch at top of elbow and 16' from elbow (4 cross cuts).
17. Cut pipe support.
18. Lift two pipe sections, covering open ends (8) and move to segmenting area.
19. Pull two 10' sections from chase under wall, lift and move to segmenting area.
20. Cut 24" PCW pipes into N 5' sections (6 cross cuts total) and section each segment (20 cuts x 5' = 100' total longitudinal cut).
21. Load 20 sections of 24" pipe, about 5' long each, into shipping containers.
22. Remove contamination controls and bag plastic sheeting.

4.2.2.8.3 <u>Remove Horizontal PCW Lines at El.-34'0" and Vertical Run from El.-6'8" down to -34'0"</u>

Two horizontal runs of 24" PCW pipe, one 10' long and one 8' long, each with an elbow, and two vertical runs, each 24' long, each with an elbow, are to be removed. The concrete floor slab in the reactor building adjacent to the containment above the pipe chase is to be removed by controlled blasting, the fill down to the pipe chase is to be removed, shoring as required, and the top of concrete pipe chase is to be removed by controlled blasting. The sheathing is to be cut by torch, and the concrete fill around the 24' pipes is to be removed by jackhammers.

Operations

1. Remove the 8" thick floor slab (98 ft.^{2}).
2. Remove fill and shore as required (down 28', but should be rock side walls below El.-25'), piling on El. 0'0".
3. Move drilling equipment into position.
4. Drill vertical holes (1-1/2" diam., spaced 2' x 3' x 3' deep covering 44 ft.^{2}) and remove equipment.
5. Place charges.
6. Place blast mats.
7. Evacuate area and detonate charges.
8. Verify all charges have detonated.
9. Remove mats.
10. Check for contamination (none expected).
11. Cut rebar with torch.
12. Load rubble in lift buckets and pile locally on El. 0'0".
13. Clear access with jackhammers.
14. Move drilling equipment into position on El.-35'.
15. Drill horizontal holes (1-1/2" diam., spaced 2' x 2' x 3.5' deep covering a 4' x 8' area) and remove.
16. Repeat steps 5 through 13.
17. Cut steel sheathing by torch and remove to local pile.
18. Remove concrete fill around pipes with chipping and jackhammers.
19. Rig to horizontal pipes.
20. Rig to vertical pipes at elbows at El.-6'8".
21. Install contamination controls at cut locations (6).

22. Cut 24" pipes using hand torch at containment and 5' from containment (4 cross cuts).
23. Cut pipe support from north pipe.
24. Lift pipe segments (2), covering open ends (8) and move to segmenting area.
25. Cut 24" pipes at top of elbows (2 cross cuts at El.-32').
26. Lift vertical pipes (2), covering ends (4) and move to segmenting area.
27. Cut pipe support from south pipe.
28. Pull 2 sections from under concrete chase, lift and move to segmenting area.
29. Cut each vertical pipe into 5 segments and elbow (5 cross cuts) and section each piece (20 cuts x 5' + 2 cuts x 6' + 2 cuts x 3' = 118' total longitudinal cut).
30. Cut elbow from two horizontal segments (2 cross cuts) and section 4 segments and 2 elbows (6 cuts x 5' + 2 cuts x 3' + 2 cuts x 6' + 2 cuts x 3' = 54' total longitudinal cut).
31. Load 28 sections of pipe and 8 sections of elbow into shipping containers.
32. Remove contamination controls and bag plastic sheeting.
33. Conduct final survey of area.
34. Install fence or cover excavation at El. 0'0" (do not backfill).

4.2.2.8.4 Remove PCW Lines from Containment under Canal "E" Floor

Two horizontal runs of 24" PCW piping, each about 35 feet long, are to be removed by a combination of controlled blasting and jackhammers.

Operations

1. Move equipment inside containment and into Canal "E" on El.-25'.
2. Move drilling equipment into position.
3. Drill vertical holes (2" diam., spaced 2' x 3', 6' deep covering an area 10.5' wide by 32' long (avg.)) and remove equipment.
4. Place charges.
5. Place blast mats.
6. Evacuate area and detonate charges.
7. Verify all charges have detonated.
8. Remove blast mats.
9. Check for contamination (none expected since blasting down only 6 feet, leaving 2 feet of concrete around pipes).
10. Cut rebar with torch and pile in canal.
11. Remove rubble and pile in canal.
12. Drill horizontal holes (2" diam., spaced 2' x 3' x 4' deep, 20' x 6' area) to excavate a hole under the Quad B wall extending from El.-32'to El.-26', 20' wide and 4' deep, and remove equipment.

13. Repeat steps 4 to 11.

14. Remove remaining concrete cover (about 1') and concrete around 24" pipes using jackhammers.

15. Rig pipes (4).

16. Install contamination controls for pipe cuts (4) and segmenting area.

17. Cut 3/8" thick containment steel shell around the two 24" pipes.

18. Cut 24" pipes approximately 20' from containment shell (2 cross cuts).

19. Lift 2 pipe sections, cover ends (4) and move to segmenting area.

20. Cut 24" pipes from elbows (2 cross cuts).

21. Pull pipes from under wall, covering ends (4).

22. Lift 2 pipe sections to segmenting area.

23. Cut pipes into approximately 5 foot lengths (10 cross cuts total) and section each segment (2 x 14 x 5' = 140' total longitudinal cut).

24. Load 28 sections into shipping containers.

25. Remove contamination controls and bag plastic sheeting.

4.2.2.8.5 <u>Remove PCW Lines from Under Quad "B" Floor</u>

Two horizontal runs of 24" PCW piping, each about 20 feet long and each with an elbow, are to be removed by a combination of controlled blasting and jackhammers.

Operations

1. Move equipment into Quad "B" on El.-27'.
2. Move drilling equipment into position.
3. Drill vertical holes (2" diam., spaced 2' x 3' x 4' deep, 14'x 20' area) and remove equipment.
4. Place charges.
5. Place blast mats.
6. Evacuate area and detonate charges.
7. Verify all charges have detonated.
8. Remove blast mats.
9. Check for contamination (none expected).
10. Cut rebar with torch and pile on Quad "B" floor.
11. Remove rubble and pile on Quad "B" floor.
12. Remove remaining concrete cover (N 2') and concrete around 24" pipes using jackhammers, opening through to excavation in Canal "E".
13. Rig pipes (4).
14. Install contamination controls for pipe cuts (4) and segmenting area.
15. Cut 24" pipes about 1 foot and 11" from Quad "B" north wall (4 cross cuts).
16. Lift 2 pipes from north end, covering ends (8), and move to segmenting area.
17. Lift and pull 2 pipes from under Quad "B" wall, lift and remove to segmenting area.

18. Cut piping into approximately 5 foot lengths (7 cross cuts total) and section 9 segments and 2 elbows (8 x 2 x 5' + 2 x 3' + 4 x 6' + 4' x 3' = 122' total longitudinal cut).
19. Load 18 pipe sections and 4 elbow sections into shipping containers.
20. Remove contamination controls and bag plastic sheeting.
21. Conduct survey of Canal "E" and Quad "B" areas.
22. Fence or cover Canal "E" on El.-25' and Quad "B" on El.-27' for safety and to prevent bio-shield rubble from falling into excavation.

4.2.2.8.6 Remove PCW Lines from Quad "B" Bio-Shield

Two 24" PCW lines, two 2" drain lines and 4" and 6" PCW supply and return lines are to be removed by controlled blasting and jackhammers. Other potentially contaminated pipes embedded in the Quad "B" bio-shield will also be removed.

Operations

1. Move drilling equipment to El. 0'0" on central platform.
2. Drill vertical holes avoiding embedded pipes (1-1/2" diam., spaced 2' x 3' x 3' deep, covering 158 $ft.^2$) and remove equipment.
3. Place charges.
4. Place blast mats and start fog spray.
5. Evacuate area and detonate charges.

6. Verify all charges have detonated.
7. Remove fog spray and blast mats.
8. Check for contamination and load any contaminated rubble into a shipping container.
9. Cut rebar with torch and pile on a clean Quad floor.
10. Cut liner steel and remove and dump rubble to a clean Quad A, B or C floor.
11. Remove pipes from bio-shield as uncovered (see Table 4.2-9), and section and load into shipping container if activated or contaminated.
12. Repeat steps 1 to 11 to demolish Quad "B" bio-shield down to El.-25'. Based on about 3 feet per shot, about 8 cycles are required.
13. Repeat steps 1 to 11 to excavate down to El.-35', leaving about 2 feet of concrete around the PCW pipes.
14. Remove concrete around PCW lines using jack hammers, rigging to 24" lines as concrete support is removed.
15. Excavate down to El.-37' to expose 2" drain lines from under 24" PCW lines to valve box and to reactor cavity using jack and chipping hammers.
16. Install containment controls.
17. Cut 2" drain lines from under 24" PCW lines to valve box and to reactor cavity, covering ends and moving to segmenting area.
18. Cut remaining 4" and 6" supply and return risers from 24" lines, cover ends and move to segmenting area.

Table 4.2-9

EMBEDDMENTS IN QUAD "B" CONCRETE BIO-SHIELD

Item	Drawing	Size
Thermal Column	PF-00249 and 00250	4 feet
Reactor Tank Vent (CA)	PF-00382 and 00376	2 inches
Hot Drain (SRP)	PF-00382 and 00376	2-1/2 inches
Hot Drain Pipe Ring	PF-00387	4 inches
Hot Drain	PF-000376	6 inches
Waste Air-Process	PF-00387	4 inches
Pipe Ring		
Process Waste	PF-00376	6 inches
Cooling Air		
Quadrant Sleeve	PF-00382 and 00375	3 inches
PCW Return Pipe Ring	PF-00387	4 inches
Inst. Service & Hot Drain	PF-00382	6 inches
Conn. to RT	PF-00382	1 inch
PCW Supply Pipe Ring	PF-00387	3 inches
Inst. Service	PF-00382	4 inches
PCW Supply - Inst.	PF-00392	2-1/2 inches
WA-Process	PF-00392	2-1/2 inches
HD-Inst.	PF-00392	2-1/2 inches
PCW Return - Inst.	PF-00392	3 inches
Two Valve Boxes with Shield Plugs	PF-00392	-
Pressure Transducer Sensing Lines in Sleeve	PF-00392	-
Valve 29V 38 Extension Operator	PF-00392	-

19. Lift 24" lines to segmenting area.

20. Cut 24' PCW lines near mitered joint and at end of each elbow (5 cross cuts) and section 5 pipe segments and 2 elbows (4 x 2 x 5' + 2 x 2' + 2 x 6'+ 2 x 3' = 62' total longitudinal cut).

21. Load 10 pipe sections and 4 elbow sections into shipping containers.

22. Remove contamination controls and bag plastic sheeting.

23. Conduct final survey of excavation.

24. Fence or cover excavation for safety at El.-25/-27'.

4.2.2.8.7 Remove 6" PCW Return Pipe from Under Quad "A" and Canal "E" Floors

A 6" run of pipe embedded 2'6" below the El.-25' floor is to be removed. Removal is similar to that required for the embedded quadrant and canal water lines. Controlled blasting is used to excavate within 0.5 to 1 foot of the pipe and the remaining concrete cover is removed by jack hammers.

Operations

1. Move drilling equipment to El.-25' in Quad "A".
2. Drill vertical holes (3/4" diam., spaced 1' x 1', 1.5' deep, covering 3' x 29') and remove equipment.
3. Place charges.
4. Place blast mats.
5. Evacuate area and detonate charges.

6. Verify all charges have detonated.

7. Remove mats.

8. Check for contamination (not expected).

9. Cut rebar with torch and pile on floor.

10. Remove rubble and pile on floor.

11. Remove concrete around 6" line using jack hammers, tunneling under containment wall.

12. Rig to pipe.

13. Install contamination controls.

14. Cut 6" pipe at valve box and about 20 feet from valve box (2 cross cuts).

15. Lift two segments of 6" pipe to segmenting area.

16. Cut 6" pipe into 8 segments (6 cross cuts).

17. Load 8 segments into shipping container.

18. Remove contamination controls and bag plastic.

19. Conduct final survey.

20. Cover trench at El.-25' for safety.

4.2.2.9 PCW Pipe Removal Cost

The estimated cost for removal of the embedded PCW piping is summarized in Table 4.2-10. The total estimated cost is $360,300 in 1985 dollars (no escalation). A contingency of 20% is included.

The overall productivity factor for the clean concrete removal work is equivalent to a factor of 1.74 , whereas it is 1.89 for embedded contaminated pipe removal. These factors are consistent with those used for similar work in other decommissioning estimates (Ref. 5 and 13).

TABLE 4.2-10

4.1 - C104

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PARF
Client: TELEDYNE ISOTOPES
Estimate by: RHK
Checked by:
Page 1 of 2
Revision number:

Description of Bid Item or Specification	Work Item	Hours	MP	ET	Fixed Date	Description
PCW EMBEDDED PIPE REMOVAL						

Account	Detail Item Description	Quantity	Unit	MH/Unit	Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
	DIRECT COST (FROM PAGE 2 OF 2)				3871	93,974	15,492	54,348		163,814
	CRAFT SUPPORT LABOR (7% OF D.L.)				271	6,578	–	–		6,578
	NON-CRAFT SUPPORT " (6% OF D.L.)				232	5638	–	–		5638
	SUBTOTAL				4374	106,190	15,492	54,348		176,030
	PAYROLL TAXES & INSURANCE (48.8% OF LABOR)					51,821	–	–		51,821
	SUBTOTAL					158,011	15,492	54,348		227,851
	SMALL TOOLS (6% OF LABOR + PART 2 I)					–	9481	–		9,481
	EQUIP. E.O.M. (7% OF LABOR + PART 2 I)					–	11,061	–		11,061
	SUBTOTAL					158,011	36,034	54,348		248,393
	SALES TAX (5% OF TAXABLE MAT'L)					–	1802	–		1802
	SUBTOTAL					158,011	37,836	54,348		250,195
	CONTINGENCY (20%)					31,602	7567	10,870		50,039
	SUBTOTAL					189,613	45,403	65,218		300,339
	O/H & PROFIT = 20%					37,857	9,077	13,082		60,066
Bid Item / Pro… / Area	Total				[illegible]274	227,5[illegible]	51,5[illegible]	78,39[illegible]		360,3[illegible]

TABLE 4.2-1c

Direct Cost Summary by Bid Item

Burns and Roe Construction Group, Inc.

Project: PBRF
Client: TELEDYNE ISOTOPES
Estimate by: BIIK
Checked by:
Page 2 of 2
Revision number:

Work Item	Hours	MP	ET	Fixed Date	Description

Schedule Date

Description of Bid Item or Specification: PCW EMBEDDED PIPE REMOVAL

Account	Detail Item Description	Quantity	Unit	MH/Unit	CONC Manhours	NPC Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
1	PUMPHOUSE FLOOR				9	29	910	250			1160
2	HORIZ. LINES @ EL 6'-8" IN PH & RB				124	73	4823	1825			6648
3	HORIZ. PCW LINES @ EL -34' & VERT -6'-8" TO -34'				285	124	9710	1617			11,327
4	PCW LINES FROM CONT. UNDER CANAL "C" FLOOR				448	92	13165	3900			17,055
5	REMOVE PCW LINES FROM UNDER QUAD "B" FLOOR				241	88	7756	2016			9772
6	REMOVE PCW LINES FROM QUAD "A" BIO SHIELD				545	45	14,536	5304			19,840
7	REMOVE 6" PCW RETURN UNDER QUAD "A" & CANAL "C"				36	43	1899	580			2479
	CONTINGENCY, TRANSPORTATION & DISPOSAL								54,348		54,348
	SUBTOTAL				1688	494	52,989	15,492	54,348		122,829
	CONCRETE PRODUCTIVITY +243		29.50		1249		30,601				30,601
	PIPING PRODUCTIVITY +893		23.50			440	10,354				10,354
					2937	934					

Bid Item	Project Area					Manhours	Labor	Taxable Materials	Non-taxable Materials	Subcontracts	Total
		Total				3871	93,974	15,492	54,348		163,814

4.1 - C105

BR2230 (6/83) 1M

The unit rates developed and used in this estimate are summarized on Table 4.2-7.

4.2.2.10 PCW Pipe Removal Duration

The schedule for embedded PCW piping removal is shown in Figure 4.2-4. The overall duration is estimated to be 6.5 weeks, based on a peak of 3 crews for concrete removal and 3 crews for pipe removal.

4.2.2.11 PCW Pipe Removal Radiation Exposure

The estimated occupational radiation exposure for the PCW embedded piping removal is summarized on Table 4.2-11. The total exposure is estimated to be approximately 6 man-rem, based on current dose rate measurements. The decay of dose rate prior to the embedded PCW pipe removal work would reduce this estimated exposure by 50% or more if Co-60 is currently the dominant radionuclide as expected.

Exposure during radwaste transportation is not included but would be very low.

4.3 Cost/Benefit Comparisons

The cost, duration and exposure estimates for decontamination and removal of the PCW embedded piping is summarized in Table 4.3-1. Removal is clearly the best approach in terms of direct cost and duration. The estimated exposure for removal is somewhat higher than for decontamination, but on the basis of $2000 per man-rem

FIGURE 4.2-4

PCW Embedded Piping Removal Schedule

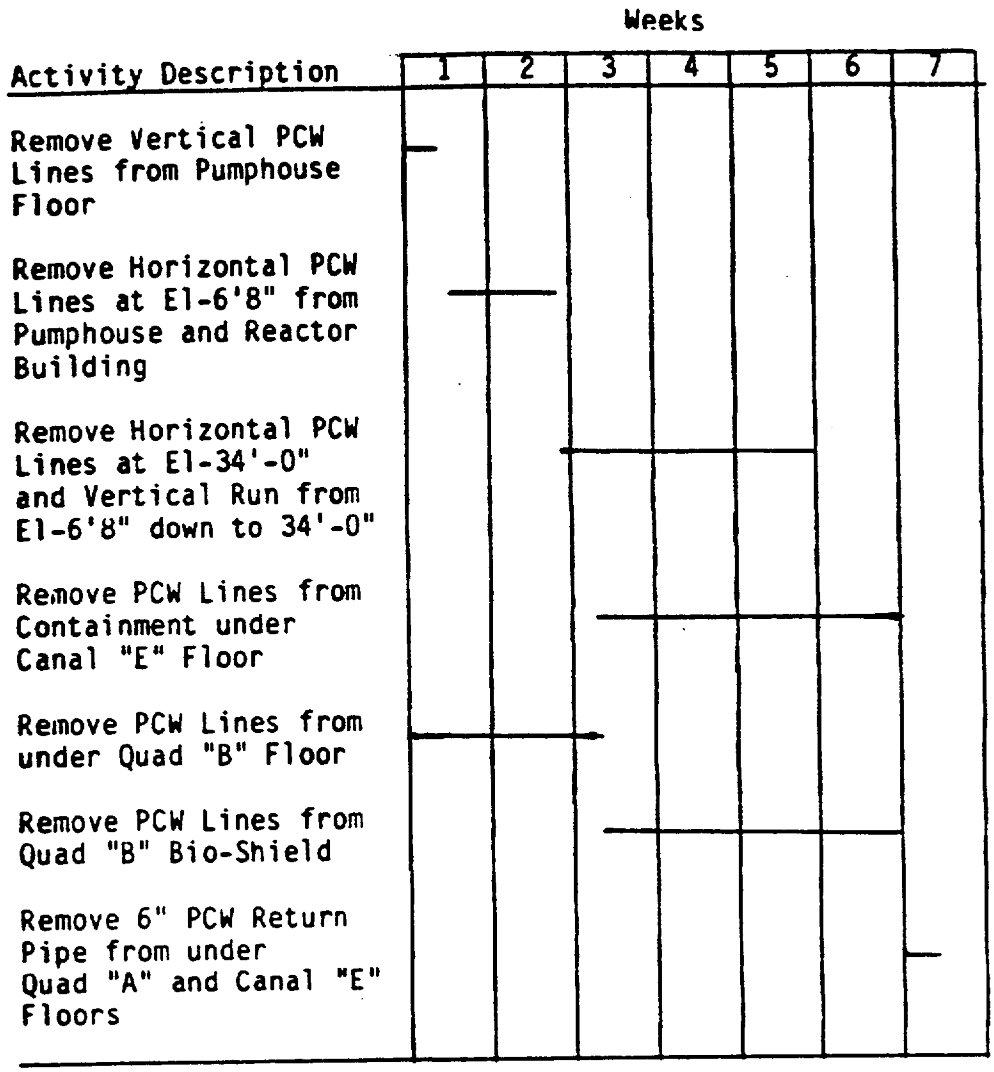


TABLE 4.2-11

PCW Embedded Piping Removal Exposure Estimate

Activity Description	General Area Dose Rate (mR/hr)	Estimated General Area Work Time Manhours	Contact Dose Rate (mR/hr)	Estimated Contact Work Time Manhours	Estimated Occupational Exposure man-m Rem
Clean Concrete Removal	0.05[(a)]	1762	2[(c)]	1175[(b)]	2438
Piping Removal	0.05[(a)]	234	5[(e)]	700[(d)]	3512
TOTAL					5950

(a) Since all radioactively contaminated piping and equipment are to be removed from the various work areas prior to embedded PCW piping removal, the general area dose rate should generally meet the 5μR/hr (0.005 mR/hr) dose rate limit for release so that a general area dose rate of 0.05 mR/hr is conservatively high.

(b) Approximately 40% of the total concrete removal manhours are assumed to be spent close to the PCW piping, including all of the jackhammer removal manhours and about 120 manhours due to blasting and fill removal operations.

(c) Since some concrete (shielding) will exist around the PCW piping during most of the concrete removal operations, an average of 2mR/hr is considered conservative relative to the maximum pipe dose rate discussed in (e) below.

(d) Approximately 75% of the pipe removal manhours are assumed to be spent near the PCW piping due to the use of hand held torch for cutting operations.

(e) Based on direct radiation measurements taken by Teledyne Isotopes in June 1985, the PCW pipe south of the strainer has a dose rate of < 5mR/hr. The maximum contamination level of 100,000 dpm/100 cm^2 would equate to only about 2 mR/hr of Co-60 inside the piping.

TABLE 4.3-1

PCW Embedded Piping Decontamination vs. Removal

	Direct Cost	Duration	Exposure
Decontamination	$ 1,074,000	10 weeks	3.7 man-Rem
Removal	360,300	6.5 weeks	6 man-Rem
Difference	$ 713,700	3.5 weeks	-2.3 man-Rem

(Ref. 13, App. J), the equivalent cost penalty would be only $4600, which is negligible in comparison to the large cost and duration savings offered by removal.

4.4 Cost Sensitivity

The purpose of this cost sensitivity evaluation is to determine if plausible changes in the various cost elements of the decontamination and removal estimates for the PCW embedded piping could be large enough to offset the cost advantage estimated for the removal approach, which (before markup) is $485,266. The cost element breakdown for the decontamination and removal estimates are summarized in Table 4.4-1, along with a qualitative indication of potential cost variation.

For the removal approach, variation could exist in the takeoff quantities or in the unit rates. Since takeoff quantities (including concrete removal volumes, pipe cutting requirements and radwaste volumes) were estimated in considerable detail directly from the PBRF drawings, only small variation would be expected.

Unit rates of $84.50/CY and $157.20/CY used for concrete removal by controlled blasting and jackhammer, as given in Table 4.2-7, include costs for waste packaging but do not include the decrease in productivity due to work in a radiation area. For controlled blasting, the corresponding rate of $35/CY (from Table 4.2-1) escalated at 5% per year would be about $45/CY in 1985 dollars,

TABLE 4.4-1

PCW Embedded Piping Cost Sensitivity
(Costs in 1985 Dollars)

Cost Element	Decontamination	Potential Cost Variation	Removal	Potential Cost Variation
Decontamination Rig	$ 91,789	Modest Increase to Large Decrease		
Waste Containers	$ 354,000	Large Decrease	$ 11,088	Small
Chemicals	$ 5,931	Small		
Installation	$ 108,020	Modest Decrease		
Operations	$ 18,770	Modest Decrease		
Shipping	$ 4,302	Small Decrease	$ 2,091	Small
Disposal	$ 66,268	Modest Decrease*	$ 41,169	Small*
Concrete Removal by Controlled Blasting			$ 50,883	Modest Decrease
Concrete Removal by Jackhammer			$ 27,458	Modest Decrease
Fill Removal			$ 6,400	Small
Pipe Removal			$ 24,725	Small
	$ 649,080	Modest Decrease	$ 163,814	Modest Decrease

* Based on current rates remaining stable

including lower radiation area productivity but excluding packaging. Since the costs of lower productivity are comparable to the costs of packaging, the unit rate used for controlled blasting appears to be conservatively high.

Likewise, for concrete removal by jackhammer, the rates of $32/CY and $62/CY from Table 4.2-2 escalated to 1985 would be about $41/CY and $79/CY, excluding lower radiation area productivity and packaging. The rate of $157.20/CY used is about twice as high as the $79/CY rate for reinforced concrete, which is more than enough to account for packaging. Furthermore, since most of the jackhammer work will not involve reinforced concrete, the rate used should be conservatively high.

For cutting pipe, Table 11.3 of Reference 3 gives a rate of $16/ft of pipe length for piping greater than 8" in diameter. This would escalate to about $20/ft in 1985 dollars. This unit rate and the unit rate of $32.08/ft used for estimating (which includes packaging) appear consistent.

For pipe sectioning, a rate of $4.82/ft of cut was used. Since sectioning should be a relatively efficient operation, that rate appears consistent with the rate of $0.35/in of cut given in Table 11.1 of Reference 3, which equates to $5.38/ft cut escalated to 1985.

Overall, the cost for the removal approach is likely to be somewhat less, rather than greater, than the estimated cost.

Radioactive waste disposal cost could escalate drastically over the next few years, but this would tend to have a greater effect on the decontamination approach due to its larger estimated waste volume. Also, it may be practical to expose and loosen pipes directly by controlled blasting without breaking the pipes. This would tend to reduce the cost of the removal approach.

For the decontamination approach, the most significant potential for cost variation would be in decontamination rig equipment and installation costs and in waste container and associated disposal costs. Table 11.6 of Reference 3 gives $73,000 in 1980 dollars for a 1000 gallon decontamination rig. Escalated at 5% per year to 1985, this would be $93,168. Therefore, the $91,789 estimated for a 9000 gallon rig could be low. On the other hand, if the contractor already has a suitable rig, only a usage charge of about $10,000 would be required, for a savings of about $82,000.

There is some potential for reducing ion exchange resin volume requirements and ion exchange resin unit cost. As indicated in Reference 3 (pages 5-7 and 5-18), the Shippingport Station decontamination program required a resin volume of only 80% of the system volume, whereas 100% was used in the cost estimate. Although ion exchange resin cost can be volital, commercial grade resin at $165/CF could be used rather than the $250/CY for nuclear grade resin used in the estimate. Potential estimated cost reductions would be $150,400 for waste containers (includes ion exchange resin), $783 for shipping and $11,501 for disposal.

Since the minimum disposal cost for the decontamination approach would still exceed the disposal cost for the removal approach, an increase in disposal rates would still have a greater affect on decontamination costs.

There appears to be potential for reduced installation and operations costs. If installation time could be reduced to about 3 weeks, labor costs would be reduced by about 50% or by $15,500. If operations could be completed in one week, a savings of $9700 would result.

The maximum potential reduction in decontamination cost for the APACE process is about $270,000, assuming the best of circumstances. This is only about 55% of the total differential of the estimated costs and, therefore, there is essentially no possibility that decontamination would be more cost effective than removal.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Internal decontamination of piping and components to meet the unrestricted release limits is generally not practical and/or economical. The cost estimate for the PBRF decommissioning should therefore be based on the removal, packaging and shipping of all activated or internally contaminated items, with disposal at a low level radioactive waste disposal facility. This includes the embedded PCW and Q&C piping. Only costs for external decontamination of otherwise non-radioactive items to unrestricted release limits or of shipping containers to DOT limits of 10CFR173 should be included.

The following should be considered for further study in FY 1986:

1. Survey the inside surface of the PCW pipes to determine if the pipe has a significantly lower contamination level than the available valve body measurements. It may be possible to demonstrate that the activity on the PCW pipes will decay below the applicable release limits within the time frame of the extended prompt decommissioning mode.

2. Detailed cost evaluation of an electropolishing facility.

3. Obtain a decontamination contractor's cost estimate and success probability for the PCW piping, using the CAN-DECON or other dilute decontamination process.

10. Nuclear News, Vol. 28, No. 8, June 1985, "Chemical Decontamination: An Overview", R. A. Shaw and C. J. Wood, pp. 107-111.

11. Decontamination Methods as Related to Decommissioning of Nuclear Facilities, NEA Experts Report, March 1981.

12. Personal Communication, R. Oakes, BRI to T. Beaman, London Nuclear, June 25, 1985.

13. Decommissioning Plan, Shippingport Station Decommissioning Project, Document No. RL/SFM 83-4, Volume No. XI, "ES 12.2, Cost/Benefit Analysis for The Decontamination of the Shippingport Atomic Power Station Primary Systems" and "ES 12.3, Decontamination Methods".

14. Personal Communication, R. Oakes, BRI to V. Gilbert, GPU at TMI, June 27, 1985.

15. Evaluation of Abrasive Grit-High-Pressure Water Decontamination, EPRI NP-2691, October 1982.

16. Executive Conference on Decontamination, ANS, "Decontamination of Power Reactors: The Cost, Benefits and Consequences", September 16-19, 1984.

17. Personal Communication, R. Oakes, BRI to B. Bartlett, Bartlett Nuclear Inc., June 25, 1985.

18. Electropolishing as a Decontamination Technique - Progress and Applications, PNL-SA-6858, April 1978.

19. Plant Decontamination Methods Review, EPRI NP-1168, May 1981.

20. Personal Communication, R. Oakes, BRI to K. Faroehlick, Utility Power Corporation (KWU), June 25, 1985.

21. Decontamination Methods, PNL-SA-7770 Rev. 1, L. D. Perrigo and J. R. Divine, May 1980.

22. Cost Effectiveness of Dilute Chemical Decontamination, LNL-18, J. E. LeSurf, London Nuclear, and G. D. Weyman, Vermont Yankee Nuclear Power Corporation, 1981.

23. Impact of Advanced Decontamination Technology on Nuclear Waste Management Economics, H. W. Arrowsmith and H. R. Gardner, Quadrex Corp., December 1981.

24. C. S. Ehrman, Burns and Roe Inc. letter to J. E. Ross, Teledyne Isotopes, "Cost Estimating Scope and Guidelines", BT-3, June 21, 1985.

25. Waste Containers for Decommissioning, DOE/RLO-SFM-82-6, Sept. 1982, pp. 43, 44.

26. Building and Construction Cost Data, 1984, R. S. Means.

27. 1984 Labor Rates for the Construction Industry, R. S. Means

28. Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule, Effective April 15, 1985 with Southeast Regional Compact Fee corrected to $0.462 per ft^3.

TELEDYNE ISOTOPES

APPENDIX D

TO

APPENDIX 4.1

PROMPT DECOMMISSIONING COST ESTIMATING SCOPE AND GUIDELINES

PLUM BROOK REACTOR FACILITY

PROMPT DECOMMISSIONING COST ESTIMATING SCOPE AND GUIDELINES

The purpose of this scope and guidelines is to summarize the cost elements that will be included in each WBS element. It should help assure that all appropriate cost elements are recognized and appropriately incorporated into the cost estimate.

WBS No.	Description	Cost Elements
0.0	Plum Brook Reactor Decommissioning	WBS 1.0 + WBS 2.0
1.0	Decommissioning Planning	WBS 1.1 + WBS 1.2
1.1	Planning Direction & Support	WBS 1.1.1 + WBS 1.1.2
1.1.1	Planning Direction	Direct Labor - NASA staff level of effort based on planning duration. Project Manager 2 Assistants $45,000 avg. per person for above Secretary Labor overhead (OH), payroll taxes insurance (PT&I), holiday adjustment and vacation (HA&V) Travel transportation (T) and subsistence (S) Other Direct Costs (ODC) - Reproduction (R), Communications (C), Postage (P), Supplies (S) Spread base dollars by quarters, summarize by fiscal year, apply escalation and contingency by fiscal year and total.
1.1.2	Planning Site Support	Teledyne Isotopes should provide cost estimate for level of effort in excess of that needed for caretaker function based on planning duration including the following: Direct Labor OH, PT&I, HA&V ODC - R, C, P, S Equipment, Tools, Materials

WBS No.	Description	Cost Elements
		Subcontract Consultant Spread base dollars by quarters, summarize by fiscal year, apply escalation and contingency by fiscal year and total. Fee
1.2	Engineering and Planning	WBS 1.2.1 + WBS 1.2.2 + WBS 1.2.3 Fee
1.2.1	Engineering and Planning Management	WBS 1.2.1.1 + WBS 1.2.1.2 + WBS 1.2.1.3 Spread base dollars, add escalation and contingency, and total.
1.2.1.1	Management and Administration	Direct Labor - Level of effort based on planning duration: Project Director (Part Time ~ 2.5%) Project Manager Project Engineer Project Control Engineer Secretary Word Processing OH, PT&I, HA&V Travel T & S ODC - R, C, P, S, Computer Usage (CU)
1.2.1.2	Quality Assurance	Direct Labor - Level of effort based on planning duration: QA Engineer (Part time ~ 25%) OH, PT&I, HA&V ODC - R, S
1.2.1.3	Technical and Safety Review Committee	Direct Labor - 5 people x 5 meetings 4 hr/meeting = 100 MH OH, PT&I, HA&V Travel - None, meetings assumed to be at home office. ODC - R

Note: Client representative covered in WBS 1.1.1.

WBS No.	Description	Cost Elements
	Project representatives covered in WBS 1.2.1.1, 1.2.2 and 1.2.3	
1.2.2	Engineering	Sum of WBS 1.2.2.1 through WBS 1.2.2.20. Spread base dollars, add escalation and contingency, and total.
1.2.2.1	Decommissioning Operations Contractor (DOC) Activities	AS1 to be prepared by staff included in WBS 1.2.1.1
1.2.2.2	Site Security	AS2 to be prepared by staff included in WBS 1.2.1.1 with support from staff included in WBS 1.1.2.
1.2.2.3	Health Physics	Prepare AS3 Direct Labor - Nuclear Engineer,/Health Physicist, Word Processing OH, PT&I, HA&V ODC - R, C, P, S
1.2.2.4	Systems Operation, Maintenance & Deactivation	Prepare AS4 Direct Labor - PT&O Engineer Electrical Engineer Nuclear Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.5	Contaminated Soil Removal	Prepare AS5 Direct Labor - Nuclear Engineer Civil Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S

WBS No.	Description	Cost Elements
1.2.2.6	Site Preparation	Prepare AS6 Direct Labor - Nuclear Engineer Mechanical Engineer Electrical Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.7	Asbestos Removal	Prepare AS7 Direct Labor - Nuclear Engineer Mechanical Engineer Environmental Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.8	Loose Equipment Removal	Prepare AS8 Direct Labor - Nuclear Engineer Mechanical Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC-R, C, P, S
1.2.2.9	Activated Material in Hot Dry Storage Removal	Prepare AS9 Direct Labor - Nuclear Engineer Mechanical Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.10	Decontamination and Liquid Waste Mgmt.	Prepare AS10 Direct Labor - Nuclear Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S

WBS No.	Description	Cost Elements
1.2.2.11	Reactor Internals and Vessel Removal	Prepare Internals and Reactor Removal Study and AS11 Direct Labor - Nuclear Engineer Mechanical Engineer Structural Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.12	Contaminated Piping and Equipment Removal	Prepare AS12 Direct Labor - Nuclear Engineer Mechanical Engineer Structural Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.13	Contaminated Concrete and Embedded Pipe Removal	Prepare AS13 Direct Labor - Nuclear Engineer Civil Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.14	Final Site Survey Note: Initial Site Survey was conducted by Teledyne Isotopes in 1984/1985.	Prepare AS14 Direct Labor - Nuclear Engineer- Health Physicist Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.15	Regulatory Requirements and Permitting Plan	Prepare Plan Direct Labor - Nuclear Engineer Environmental Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S

WBS No.	Description	Cost Elements
1.2.2.16	Radiological Limits and Pathway Analysis	Prepare Analysis and Writeup Direct Labor - Nuclear Engineer Environmental Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.17	Safety Assessment and Radiation Exposure Estimate	Prepare Exposure Estimate, Calculation and Safety Assessment Writeup Direct Labor - Nuclear Engineers (3) Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.18	Decommissioning Plan	Staff included in WBS 1.2.1.1 to prepare writeup similar to Volume I of SSDP. Incorporate AS's, plans, assessments, etc. as appendices.
1.2.2.19	Environmental Report	Update and expand as required the Environmental Report, Amendment 1, Feb. 18, 1981. Direct Labor - Nuclear Engineer Environmental Engineer Word Processing OH, PT&I, HA&V Travel T&S ODC - R, C, P, S
1.2.2.20	General Engineering Support	Provide a budget at 2% of the sum of WBS elements 1.2.2.1 through 1.2.2.19.
1.2.3	Scheduling and Cost Estimating	Sum of WBS 1.2.3.1 through WBS 1.2.3.4. Spread base dollars, add escalation and contingency, and total.
1.2.3.1	WBS Update	Update WBS as required by staff included in WBS 1.2.1.1.

WBS No.	Description	Cost Elements

1.2.3.2	Scheduling	Prepare Computerized Schedules
		Direct Labor
		  Schedulers
		  Computer Services
		  Computerized Drafting
		OH, PT&I, HA&V
		Travel T&S
		ODC - R, C, P, S, CU

1.2.3.3	Cost Estimating	Update cost estimate Direct Labor Cost estimators OH, PT&I, HA&V Travel T&S ODC - R, C, P, S, CU
1.2.3.4	General Scheduling Cost Estimating Support	Provide a budget at 2% of the sum of WBS elements 1.2.3.1 to 1.2.3.3.
2.0	Decommissioning Operations Note: For extended prompt decommissioning, staffs under WBS elements 2.1 and 2.2 should be reduced.	WBS 2.1 + WBS 2.2 + WBS 2.3
2.1	Operations Direction and Support	WBS 2.1.1 + WBS 2.1.2

2.1.1	Operations Direction	NASA staff level of effort based on operations duration:
		Direct Labor - Project Manager
		  7 Assistants
		  $45,000/yr. avg. per person
		OH, PT&I, HA&V
		Travel T&S
		Relocation - See WBS 2.2.1.1 for breakdown
		ODC - R, C, P, S
		
		Spread base dollars, add escalation and contingency, and total.

WBS No.	Description	Cost Elements
2.1.2	Operations Site Support	Level of effort to provide personnel with significant knowledge of facility and history. Teledyne to provide estimate including: Direct Labor OH, PT&I, HA&V ODC - R, C, P, S Equipment, Tools, Materials Subcontract Consultant Spread base dollars, add escalation and contingency, and total. Fee Ohio Franchise Tax Use 5% of Fee
2.2	Operations Management and Decommissioning Activities	WBS 2.2.1 + WBS.2.2.2 Fee at about 8%. (DOC fee base includes subcontractor's costs) Ohio Franchise Tax Use 5% of Fee
2.2.1	Operations Management and Support	Sum of WBS 2.2.1.1 through 2.2.1.5
2.2.1.1	DOC Site Management and Administration Note: Office space refurbishment as required to be provided under WBS 2.2.2.6 including installation of reproduction, telephone, telecopy, computer and other equipment procured under WBS 2.2.1.4.	Direct Labor - See DOC Organization Chart (Fig. 1). Prepare Manning Duration Chart based on operations duration to obtain duration of each position, denoting home office relocation or field hire. Manning shall cover site closeout and final report. Use appropriate labor rates by position. OH, PT&I, HA&V-Use appropriate markups for relocated home office and field hire personnel.

WBS No.	Description	Cost Elements
		Travel T&S - To home office, clients office, etc. Relocation - All home office personnel Home Hunting Trip Transportation and Expenses to Site 30 to 60 day Settling-in Movement of Household Goods Auto Rental Incidental Expenses Home Management or Real Estate and Mortgage Differential Assistance Return Relocation Expenses ODC - See WBS 2.2.1.4 and 2.2.1.5. Spread base dollars, add escalation and contingency, total.
2.2.1.2	DOC Site Staff Note: Same note as for WBS 2.2.1.1.	Direct Labor - See DOC Organization Chart (Fig. 1). Prepare Manning Requirements Chart based on operations duration for each position denoting home office relocation or field hire. Manning, in support of WBS 2.2.1.1, shall cover site closeout and the final report. Use appropriate labor rates by position. OH, PT&I, HA&V-Use appropriate markups for relocation home office and field hire personnel. Travel - T&S - To home office, contractors, etc. Relocation - All home office personnel. Same items identified for WBS 2.2.1.1. ODC - See WBS 2.2.1.4 and 2.2.1.5 Spread base dollars, add escalation and contingency, total.

WBS No.	Description	Cost Elements
2.2.1.3	DOC Home Office Management and Engineering Support	Direct Labor - H.O. Manager at 10% of time over operations duration. Misc. H.O. support based on 10% of one man over operations duration. H.O. engineering based on man hour estimate and appropriate labor rates for preparing any specific bid packages and/or evaluation, material specs, or detailed procedure review. OH, PT&I, HA&V Travel T&S - To site. ODC - R, C, P, S, CU Spread base dollars, add escalation and contingency, total.
2.2.1.4	DOC Procurement	Direct Labor - None OH, PT&I, HA&V - None Travel - None ODC - None Materials & Services: 55 Gal Drums for Compressible Waste, Telephone & Telecopy Equipment and Usage, Reproduction (Photocopy and Drawing) Equip. and Supplies, Computer Equipment & Usage, Display writers and Typewriters, Postage Equipment & Usage, Video Equipment, Vehicles, Weigh Scale, Office Furniture, Office and Support Supplies, Office Trailers (if needed), Safety Equipment & Supplies, HP Equipment & Supplies, Personnel Decon. Equipment & Supplies, TLD Processing, Reference Materials, Special Site Security Equipment,

WBS No.	Description	Cost Elements
		Road and Yard Maintenance, Snow Removal, Trash Removal, Miscellaneous Radwaste Transportation, Protective Clothing Cleaning, Hospital Support, Medical Exams, Suggestion Awards. Spread base dollars, add escalation and contingency, total.
2.2.1.5	Utilities	Direct Labor - None OH, PT&I, HA&V - None Travel - None ODC - Fuel Oil, Electric Power, Water, Kerosene Spread base dollars, add escalation and contingency, total.
2.2.2	Decommissioning Activities Note: Some of these subcontracts may have high payroll taxes and insurance rates due to demolition category.	Sum of WBS 2.2.2.2 through WBS 2.2.2.14.
2.2.2.1	Not Used	
2.2.2.2	Site Security Note: DOC to procure special site security equipment such as portal metal detectors under WBS 2.2.1.4.	Obtain a subcontract total cost quote (document basis) or estimate based on the following cost factors: Direct Labor Captain Guards (6) Refine staffing and prepare manning duration chart based on operations duration.

WBS No.	Description	Cost Elements
		OH, PT&I, HA&V Travel and Relocation - In OH ODC - In OH Profit Ohio Franchise Tax Use 5% of Profit Spread base dollars, add escalation and contingency and total.
2.2.2.3	Health Physics Note: DOC to procure major HP and personnel decon equipment, supplies and services under WBS 2.2.1.4.	Obtain a subcontract total cost quote (document basis) or estimate based on the following cost factors: Direct Labor H.P. Manager Sr. H. P. Technicians (2) H. P. Technicians (6) Clerks (2) Refine staffing and prepare manning duration chart based on operations duration. OH, PT&I, HA&V Travel and Relocation - In OH ODC - In OH Profit Ohio Franchise Tax Use 5% of Profit Spread base dollars, add escalation and contingency, and total.
2.2.2.4	System Operation, Maintenance and Deactivation	Direct Labor O&M Manager Secretary Clerk Operators (2) Electricians (2) Mechanic (1) Laborers (2) Refine staffing and prepare manning chart based on project duration. OH, PT&I, HA&V Travel & Relocation - In OH

WBS No.	Description	Cost Elements
		Material and Equipment Estimate for specific tasks. One major task will be to provide deionized water to fill the reactor tank and domestic water to partially fill the quadrants in support of WBS 2.2.2.11 and to drain this water and deliver it for processing under WBS 2.2.2.10 as required. ODC - In OH including small tools Profit Ohio Franchise Tax Use 5% of Profit Spread base dollars, add escalation and contingency, sum to present worth.
2.2.2.5	Contaminated Soil Removal	Obtain a subcontract total cost quote (document basis) or estimate based on the following cost factors: Direct Labor and Material: Based on Teledyne Isotopes' survey data defining contaminated soil locations, areas, depths and radioactivity levels, list activities per Tables 1 and 2 and expand to work items. Estimate manhours and costs as summarized for WBS element 2.2.2.10. Evaluate with Teledyne Isotopes the need for dewatering. Consider sodding and use of sod rolling equipment for removal of shallow surface contamination layer.

WBS No.	Description	Cost Elements
		Craft Support Labor: Use ~ 7% of direct labor and appropriate labor rate.
		Support Labor (non-craft): Use ~ 6% of direct labor and appropriate labor rate.
		Payroll Taxes & Insurance: Use appropriate % of total labor.
		Small Tools & Consumables: Use ~ 6% of total labor with PT&I.
		Equipment Maintenance: Use ~ 7% of total labor with PT&I.
		Overhead and Profit: Use appropriate % of accumulated costs.
		Performance Bonds Use appropriate % of accumulated costs.
		Ohio Franchise Tax Use 5% of Profit
		Spread base dollars, add escalation and contingency, and total.
2.2.2.6	Site Preparation	Direct Labor & Material: Teledyne Isotopes and BRI to develop a scope of work based on needs vs. existing facilities. List activities by building/area per Table 1 and 2 and expand to work items as required to estimate material quantities, construction equipment, and normal labor manhours (total crew manhours).

WBS No.	Description	Cost Elements
		Use material and construction equipment unit costs and crew rates ($/MH) to calculate material, equipment and normal direct labor costs. Total material and equipment costs and normal direct labor manhours and costs for each activity. Adjust labor manhours and costs for work at a height or in confined spaces and for work breaks and transit time as indicated in Table 3. Craft support labor including fringe benefits: Use ~ 7% of direct labor manhours and appropriate labor rate. Support labor (non-craft): Use ~ 6% of direct labor manhours and appropriate labor rate. Payroll Taxes & Insurance: Use appropriate % of total labor cost. Small tools, consumables, scaffolding, etc.: Use ~ 6% of total labor cost with PT&I. Equipment Maintenance: Use ~ 9% of labor cost with PT&I. Overhead and Profit: Use appropriate % of accumulated costs.

WBS No.	Description	Cost Elements
		Performance Bond: Use appropriate % of accumulated costs. Ohio Franchise Tax Use 5% of Profit. Spread base dollars, add escalation and contingency, and total.
2.2.2.7	Asbestos Removal	Obtain a subcontract total cost quote (document basis) or estimate based on the following cost factors: Direct Labor and Material: Based on the criteria for asbestos insulation removal, on survey data defining locations and thicknesses of contaminated asbestos, and on definition of the locations and thicknesses of all other asbestos to be removed, list activities per Tables 1 and 2 and expand to work items. Estimate manhours and costs as summarized for WBS element 2.2.2.10. Craft Support Labor: Use ~ 7% of direct labor and appropriate labor rate. Support Labor (non-craft): Use ~ 6% of direct labor and appropriate labor rate. Payroll Taxes & Insurance: Use appropriate % of total labor. Small Tools & Consumables: Use ~ 6% of total labor with PT&I. Equipment Maintenance: Use ~ 7% of total labor with PT&I.

WBS No.	Description	Cost Elements
		Overhead and Profit: Use appropriate % of accumulated costs.
		Performance Bond: Use appropriate % of accumulated costs. Ohio Franchise Tax Use 5% of Profit
		Spread base dollars, add escalation and contingency, and total.
		Overhead and Profit: Use appropriate % of accumulated costs.
		Performance Bond: Use appropriate % of accumulated costs. Ohio Franchise Tax Use 5% of Profit
		Spread base dollars, add escalation and contingency, and total.
2.2.2.8	Loose Equipment Removal	Direct Labor and Materials:
		Based on survey data sheets on radioactivity contaminated experimental piping systems and other loose equipment, tools and materials to be provided by Teledyne Isotopes, list activities per Tables 1 and 2 and expand to work items. Estimate manhours and costs as summarized for WBS element 2.2.2.10.
		Craft Support Labor:
		Use ~ 7% of direct labor and appropriate labor rate. Support Labor (non-craft): Use ~ 6% of direct labor and appropriate labor rate.

WBS No.	Description	Cost Elements
		Payroll Taxes & Insurance: Use appropriate % of total labor. Small Tools and Consumables: Use ~ 6% of total labor with PT&I. Equipment Maintenance: Use ~ 7% of total labor with PT&I. Overhead and Profit: Use appropriate % of accumulated costs. Performance Bond: Use appropriate % of accumulated cost. Ohio Franchise Tax Use 5% of Profit. Spread base dollars, add escalation and contingency, and total.
2.2.2.9	Activated Material in Hot Dry Storage Removal	Direct Labor and Materials: Based on activity inventory and component size data provided by Teledyne Isotopes, list activities per Table 1 and 2 and expand to work items. Estimate manhours and costs as summarized for WBS element 2.2.2.10. Craft Support Labor: Use ~ 7% of direct labor and appropriate labor rate. Support Labor (non-craft): Use ~ 6% of direct labor and appropriate labor rate. Payroll Taxes & Insurance: Use appropriate % of total labor. Small Tools and Consumables: Use ~ 6% of total labor with PT&I.

WBS No.	Description	Cost Elements
		Equipment Maintenance: Use 7% of total labor with PT&I. Overhead and Profit: Use appropriate % of accumulated costs. Performance Bond: Use appropriate % of accumulated cost. Ohio Franchise Tax Use 5% of Profit. Spread base dollars, add escalation and contingency, and total.
2.2.2.10	Decontamination and Liquid Waste Management	Direct Labor and Material: Based on Teledyne Isotopes' contamination survey data and on BRI decontamination studies, list activities per Table 1 and expand to work items. Estimate material quantities and normal labor manhours (total crew manhours). Use unit material and construction equipment costs and average crew rates ($/MH) to calculate material, equipment and normal direct labor costs. Total the material and equipment costs and normal direct labor manhours and costs for each activity. Adjust labor manhours and labor costs for reduced productivity due to working at heights or in confined areas, for use of respirators, for radiation protection controls, for use of protective clothing and for work breaks and transit times as indicated on Table 3.

WBS No.	Description	Cost Elements
		Costs for any centralized decontamination facility for tools, piping or components should be included. Craft Support Labor: Use ~ 7% of direct labor and appropriate labor rate. Support Labor (non-craft): Use ~ 6% of direct labor and appropriate labor rate. Payroll Taxes & Insurance: Use appropriate % of total labor. Small Tools & Consumables: Use ~ 6% of total labor with PT&I. Equipment Maintenance: Use ~ 7% of total labor with PT&I. Overhead and Profit: Use appropriate % of accumulated costs. Performance Bond: Use appropriate % of accumulated costs. Ohio Franchise Tax Use 5% of Profit. Spread base dollars, add escalation and contingency, total.
2.2.2.11	Reactor Internals and Vessel Removal	Direct Labor and Materials: Based on radioactivity and radiation dose rate calculations to be provided by Teledyne Isotopes for the approximate removal dates and on Dismantling Plan, Plum Brook Reactor Dismantling, Amendment 1, 2/18/81, Appendix E, Sequence for

WBS No.	Description	Cost Elements

Removing Reactor Tank Internals, list activities per Tables 1 and 2 and expand to work items. Estimate manhours and costs as summarized for WBS element 2.2.2.10.

Consider the latest DOT regulations for shipping requirements and the latest NRC regulations and burial site limitations for burial requirements.

Consider need for exposure limit cost accruals.

Craft Support Labor:
Use ~ 7% of direct labor and appropriate labor rate.

Support Labor (non-craft):
Use ~ 6% of direct labor and appropriate labor rate.

Payroll Taxes & Insurance:
Use appropriate % of total labor.

Small Tools & Consumables:
Use ~ 6% of total labor with PT&I.

Equipment Maintenance:
Use ~ 7% of total labor with PT&I.

Overhead and Profit:
Use appropriate % of accumulated costs.

Performance Bond:
Use appropriate % of accumulated costs.

Ohio Franchise Tax
Use 5% of Profit.

Spread base dollars, add escalation and contingency, and total.

WBS No.	Description	Cost Elements
2.2.2.12	Contaminated Piping & Equipment Removal	Direct Labor and Materials: Based on survey data sheets on all radioactivity contaminated piping and equipment to be provided by Teledyne Isotopes, list activities per Tables 1 and 2 and expand to work items. Estimate manhours and costs as summarized for WBS element 2.2.2.10. The approach to asbestos removal per WBS 2.2.2.7 must be factored into this WBS. Piping hangers and supports and other non-radioactive items are to be removed only to the extent that would expedite removal of contaminated piping. Craft Support Labor: Use ~ 7% of direct labor and appropriate labor rate. Support Labor (non-craft): Use ~ 6% of direct labor and appropriate labor rate. Payroll Taxes & Insurance: Use appropriate % of total labor. Small Tools & Consumables: Use ~ 6% of total labor with PT&I. Equipment Maintenance: Use ~ 7% of total labor with PT&I. Overhead and Profit: Use appropriate % of accumulated costs.

WBS No.	Description	Cost Elements
		Performance Bond: Use appropriate % of accumulated costs. Ohio Franchise Tax Use 5% of Profit. Spread base dollars, add escalation and contingency, and total.
2.2.2.13	Contaminated Concrete and Embedded Pipe Removal	Direct Labor and Material: Based on Teledyne Isotopes' survey data defining location, areas, depths and radioactivity levels of concrete activation or contamination and on BRI's embedded piping decontamination/removal studies, list activities per Tables 1 and 2 and expand to work items. Estimate manhours and costs as summarized for WBS element 2.2.2.10. Consider the use of explosives for removal of activated concrete around the reactor vessel. Craft Support Labor: Use ~ 7% of direct labor and appropriate labor rate. Support Labor (non-craft): Use ~ 6% of direct labor and appropriate labor rate. Payroll Taxes & Insurance: Use appropriate % of total labor. Small Tools & Consumables: Use ~ 6% of total labor with PT&I. Equipment Maintenance: Use ~ 7% of total labor with PT&I.

WBS No.	Description	Cost Elements
		Overhead and Profit: Use appropriate % of accumulated costs. Performance Bond: Use appropriate % of accumulated costs. Ohio Franchise Tax Use 5% of Profit. Spread base dollars, add escalation and contingency, and total.
2.2.2.14	Final Site Survey	Obtain a subcontract total cost quote (document basis) or estimated based on the following cost factors: Based on final site survey criteria provided by Teledyne Isotopes, list activities per Table 1 and 2 and expand to work items. Use data on initial site survey provided by Teledyne Isotopes to estimate manhours and costs as summarized for WBS element 2.2.2.10. Craft Support Labor: Use ~ 7% of direct labor and appropriate labor rate. Support Labor (non-craft): Use ~ 6% of direct labor and appropriate labor rate. Payroll Taxes & Insurance: Use appropriate % of total labor. Small Tools & Consumables: Use ~ 6% of total labor with PT&I. Equipment Maintenance: Use ~ 7% of total labor with PT&I.

WBS No.	Description	Cost Elements
		Overhead and Profit: Use appropriate % of accumulated material and labor costs. Ohio Franchise Tax Use 5% of Profit. Spread base dollars, add escalation and contingency, and total.
2.3	Radioactive Waste Burial	Based on radioactive waste volumes, weights, curie contents, and cask requirements for the radwastes generated under WBS elements 2.2.2.5 and 2.2.2.7 to 13, estimate radwaste burial costs relative to the Barnwell Low-Level Radioactive Waste Disposal Facility Rate Schedule, Effective April 15, 1985.

TABLE 1

Work Breakdown Structure By Buildings/Areas

Decommissioning Activities WBS No.	Building/Area Identification No.	Description	Remarks
2.2.2.X.1	1111	Reactor Building & Containment	
2.2.2.X.2	1112	Reactor Hot Laboratory & Tunnels to 1132 & 1141	
2.2.2.X.3	1134	Reactor Primary Pump House & Tunnel	
2.2.2.X.4	1141	Reactor Office & Laboratory	Hoods, drains and sump only
2.2.2.X.5	1192	Reactor Effluent Metering Station	
2.2.2.X.6	1132	Reactor Fan House and Stack	
2.2.2.X.7	1133	Reactor Waste Handling Building	
2.2.2.X.8	1154	Reactor Cold Retention Basins	Concrete with plastic liners.
2.2.2.X.9	1155	Reactor Hot Retention Basins	Eight (8) steel tanks in concrete vault
2.2.2.X.10	-	Yard Contaminated Buried Pipes and Catch Basins	
2.2.2.X.11	-	Emergency Retention Basin and Ditches	

X = Activity Specification Designation per WBS Level 4.

TABLE 2

Work Breakdown Structure By System

Decommissioning Activities WBS No.	System No.	System Description	Remarks
2.2.2.X.Y.1	-	Concrete Surfaces	
2.2.2.X.Y.2	-	Structural Steel Surfaces	Includes all items requiring light surface decon.
2.2.2.X.Y.3	-	Loose Equipment, Tools, & Materials	
2.2.2.X.Y.4	-	Experimental Rigs	
2.2.2.X.Y.5	-	Temporary Decommissioning Systems	
2.2.2.X.Y.6 to 9	-	Not Assigned	
2.2.2.X.Y.10	1000	Primary Cooling Water (PCW)	Y = .1 & .3
2.2.2.X.Y.11	1100	Primary Cooling Water Shutdown (PCWS)	Y = .1
2.2.2.X.Y.12	1800	Quadrant & Canal Recirculating Water (Q&C RW)	Y = .1, .2, .6 & .9
2.2.2.X.Y.13	1900	Quadrant & Canal Pump Out Water (Q&C PO)	Y = .1, .2, .6, & .9
2.2.2.X.Y.14	2000	Hot Drain Water (HD)	Includes sumps Y = .1, .2, .3, .4, .6, .7
2.2.2.X.Y.15	2300	Waste Cleanup, Hot & Cold Retention Area (HRA, CRA)	Y = .8 & .9

TABLE 2 (Cont'd)

Decommissioning Activities WBS No.	System No.	System Description	Remarks
2.2.2.X.Y.16	3300	Contaminated Air (CA)	Ventilation Y = .1, .2, .3, .4, .6, .7, .8, .9.
2.2.2.X.Y.17	3500	Offgas Cleanup (OC)	Y = .1, .2
2.2.2.X.Y.18	-	Chem. Lab Hoods and HEPA Filter Housings	Y = .4
2.2.2.X.Y.19	-	Yard Drain Systems	Y = .10

X = Activity Specification Designation
Y = Building/Area Designator per Table 1

TABLE 3

Productivity Factor Application

Productivity Factor	Applicable Estimated Normal Manhours		Work Time Increase Factor **		Work Time Manhours		Applicable Rate $/MH		Direct Labor Cost
Subtotal-Estimated Normal Manhours/ Cost	-		-		ENM		-		ENC
Work at Height	A	x	(0.1 to 0.2)	=	a	x	r_1	=	C_1
Work in Confined Space	B	x	(0.2 to 0.6)	=	b	x	r_2	=	C_2
Use of Respirators *	C	x	(0.25)	=	c	x	r_3	=	C_3
Radioactivity or Asbestos Protection Controls*	D	x	(0.1 to 0.2)	=	d	x	r_4	=	C_4
Protective Clothing*	E	x	(0.20)	=	e	x	r_5	=	C_5
Work Break & Transit	F	x	(0.1)	=	f	x	r_6	=	C_6
Total Direct Labor					ENM + a to f				ENC + C_1 to C_6

Notes:

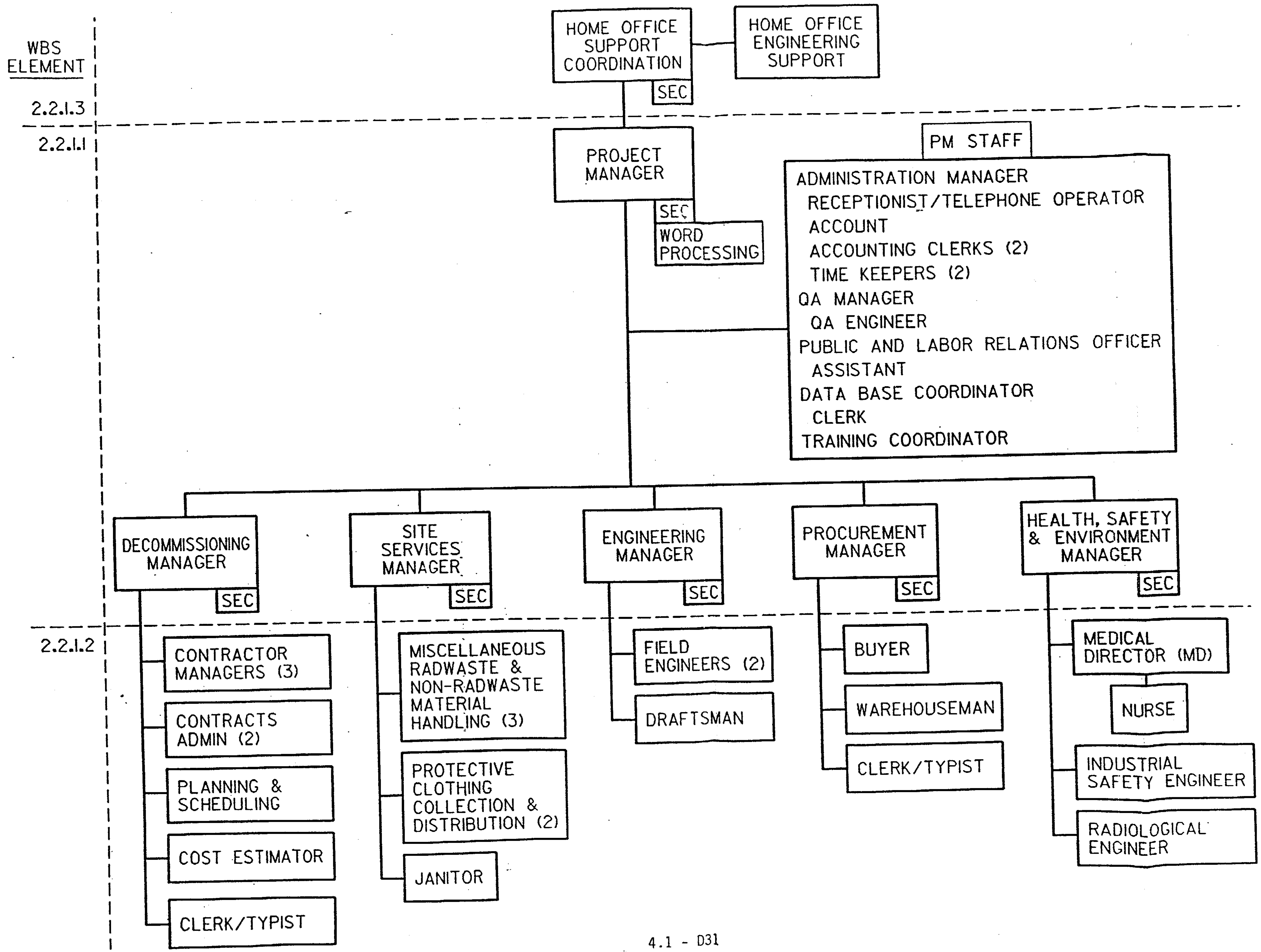
1. A, B and C are applicable portions of Estimated Normal Manhours (ENM).
2. Normally, D = ENM + a + b + c.
3. Normally, E = ENM + a + b + c + d = D + d.
4. Normally, F = ENM + a + b + c + d + e = E + e.
5. r_1, r_2 and r_3 are rates for applicable personnel (average crew rate is normally an adequate approximation).
6. Normally, $r_4 = r_5 = r_6$ = average crew rate.

* 7. For work in asbestos or radioactivity areas only.

** 8. Use factors at higher end of ranges for work at higher levels, in more confined spaces, and in higher radiation levels.

FIGURE 1

DOC ORGANIZATION CHART



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TELEDYNE ISOTOPES

APPENDIX E

TO

APPENDIX 4.1

PROMPT DECOMMISSIONING COST
ESTIMATING BASIS AND
ASSUMPTIONS

WBS*

0.0 Plum Brook Reactor Decommissioning Project

Contingency - The overall contingency included in the cost estimate is 16.5% or $4,553,664. Table E-1 provides a summary of contingencies included in the various WBS elements.

1.0 Decommissioning Planning

Durations - Select DOC, 4 months
Decommissioning Planning, 8 months
NRC Review and Approval, 6 months

Relocation - For the decommissioning planning phase, no personnel relocation costs are included.

*Basis and assumptions are summarized at the highest applicable WBS level.

TABLE E-1

PBRF Prompt Decommissioning Cost Estimate Contingencies

WBS	Description	Contingency (%)	Dollars (1985)	Remarks
0.0	Plumbrook Decommissioning Project	16.5	4,553,664	Overall Project Contingency
1.0	Decommissioning Planning	15	158,838	Overall Planning Contingency
1.1	Planning Direction & Support	15	57,469	
1.1.1*	Planning Direction	15	33,469	
1.1.2*	Planning Site Support	15	24,000	
1.2	Engineering & Planning	15	101,369	
1.2.1*	Engineering & Planning Management	15	53,951	
1.2.2*	Engineering	15	35,530	
1.2.3*	Schedule & Cost Estimating	15	11,888	
2.0	Decommissioning Operations	16.57	4,394,826	Overall Operations Contingency
2.1	Operations Direction & Support	18.91	293,934	
2.1.1*	Operations Direction	20	226,934	
2.1.2*	Operations Site Support	20	67,000	
2.2	Operations Management & Decommissioning Activities	16.1	3,687,159	
2.2.1	Operations Management & Support	18.46	1,510,100	
2.2.1.1*	DOC Site Management & Administration	20	741,600	
2.2.1.2*	DOC Site Staff	20	605,620	
2.2.1.3*	DOC Home Office Management & Engineering Support	20	19,200	
2.2.1.4*	DOC Procurement	20	118,680	
2.2.1.5*	Utilities	11.1	25,000	

TABLE E-1 (Cont'd)

PBRF Prompt Decommissioning Cost Estimate Contingencies

WBS	Description	Contingency (%)	Dollars (1985)	Remarks
2.2.2	Decommissioning Activities	17.78	2,177,059	
2.2.2.1	Not Used	-	-	
2.2.2.2*	Site Security	20	108,029	
2.2.2.3*	Health Physics	20	345,847	
2.2.2.4*	Systems Operation, Maintenance & Deactivation	20	214,573	
2.2.2.5*	Contaminated Soil Removal	10	10,347	Based on 1985 detailed survey data.
2.2.2.6*	Site Preparation	20	15,671	
2.2.2.7*	Asbestos Removal	10	4,791	Based on contractor's 1985 estimate.
2.2.2.8*	Loose Equipment Removal Removal	20	61,158	
2.2.2.9*	Activated Mat'l. in HDS Removal	20	50,499	Limited, well defined scope, but material handling and cutting could be problems.
2.2.2.10*	Decontamination & Liquid Waste Mgmt.	20	137,617	
2.2.2.11*	Reactor Internals & Vessel Removal	20	245,539	Well defined scope but high activity disassembly work is subject to problems.
2.2.2.12*	Contaminated Piping & Equip. Removal	27	830,461	Large scope subject to increases and problems.
2.2.2.13*	Contaminated Concrete & Embedded Pipe Removal	10	140,527	Methods and assumptions considered conservative.
2.2.2.14*	Final Site Survey	10	12,000	Based on 1985 survey cost.
2.3*	Radioactive Waste Burial	20	413,733	Costs based on currently effective rate schedule.

* Contingencies applied at these WBS elements.

WBS

1.1.1 Planning Direction

NASA Staff - An average rate equivalent to $45,000 per year per person was used.

Travel - 20 one day trips from Cleveland to the PBRF are included.

1.1.2 Planning Site Support

Site Support Staff - An average rate of $20 per hour (loaded) was used.

1.2 Engineering & Planning

Travel - 14 trips of 5 days each from 500 miles away are included.

Markup - A markup of 1.7 of direct labor cost was applied to cover payroll taxes and insurance, overhead and profit.

1.2.2 Engineering

Engineering - Engineering estimates were based on the use of engineers experienced in preparing activity specifications, plans and analyses as required by a decommissioning project.

1.2.2.19 Environmental Report

It was assumed that the Environmental Report, Amendment 1, Feb. 18, 1981 would be updated and expanded as required.

1.2.3 Scheduling and Cost Estimating

It was assumed that the schedules would be computerized and this cost estimate would be updated but not increased in detail.

2.0 Decommissioning Operations

Duration - Level of effort staff costs were based on buildup and gradual reduction of staffs over a total duration of 34 months.

Work Week - It was assumed that all decommissioning activities would be performed on a 5 day per week, 8 hours per day basis.

WBS

2.1.1 Operations Direction

NASA Staff - An average rate equivalent to $45,000 per year per person was used.

Relocation - Costs were included for 8 NASA personnel to relocate at $25,000 per relocation.

Travel - For NASA personnel, 30 trips for 2 days each, 500 miles away on average are included.

2.1.2 Operations Site Support

Operations Site Support Staff - An average loaded rate of $20 per hour was used.

Ohio Franchise Tax was applied at 5% of fee.

2.2 Operations Management & Decommissioning Activities

DOC Contract & Fee - The DOC would be responsible for the performance of all decommissioning operations under a cost plus fixed fee (CPFF) contract with a fee of 8% on the total estimated cost.

Special Nuclear Insurance - It was assumed that the DOC would obtain Special Nuclear Insurance for $175,000 to cover the entire project and indemnify all subcontractors for general liability above $300,000.

Ohio Franchise Tax - Included at 5% of DOC fee.

Performance Bond - Included at 1% of estimated cost of DOC's contract.

2.2.1 Operations Management & Support

DOC Overhead, Payroll Taxes and Insurance, Other Direct Costs, etc. - Included at 125% of direct costs for site staff.

DOC Relocation - Costs were included for 21 key personnel to relocate at $25,000 per relocation.

DOC Travel - For DOC personnel, 70 trips for 2 days each, 500 miles away on average are included.

DOC Other Direct Costs - Included an allowance of $5,000 for home office.

DOC Sales Tax - Included at 5% of taxable materials.

WBS

2.2.1.4 **Procurement**

Procurement was based on a large formal project with on-site radiological analysis capability. The existing office facilities, furniture, vehicles, equipment, etc. are assumed to be available for use.

2.2.1.5 **Utilities**

It was assumed that the DOC will provide all utilities. Dry nitrogen gas for reactor tank purging is not included.

2.2.2 **Decommissioning Activities**

It was assumed that all activities under 2.2.2 are subcontracted.

Subcontractor Craft Support Labor - Included at 7% of direct labor.
Subcontractor Non-Craft Support Labor - Included at 6% of direct labor.
Subcontractor Payroll Taxes & Insurance - Included at 48.8% of total labor.
Subcontractor Small Tools, Consumables, Scaffolding, etc. - Included at 6% of total labor plus PT&I.
Subcontractor Equipment, Fuel Oil & Maintenance - Included at 7% of total labor plus PT&I.
Subcontractor Sales Tax - Included at 5% of taxable material.
Subcontractor Overhead - Included at 7.5% of subtotal cost with contingency.
Subcontractor Profit - Included at 7.5% of subtotal cost with contingency.
Subcontractor Ohio Franchise Tax - Included at 5% of profit.
Subcontractor Performance Bond - Included at 1% of estimated subcontract cost.

Scrap - Scrap value was not considered. All non-radioactive materials are assumed to remain on-site.

Radwaste Containers - It was assumed that most of the LSA waste would be shipped in 90 cubic foot 10,000 pound capacity steel containers costing $824 each including delivery to the PBRF.

Shipping - A trailer delivery charge of $273 was included based on $1.98 per mile and 138 miles.

A trailer demurage charge or $70 was included based on 4 days.

State fees for shipping to Barnwell, SC, were included at $50 per shipment.

Transportation cost was included based on $1.76 per mile and 684 miles to Barnwell, SC.

WBS

2.2.2.2 Site Security

It was assumed that a 7 man guard force will control access and egress from the PBRF on a 5 day per week, 8 hours per day basis. At other times, access would be controlled by the existing Plum Brook Station security force.

2.2.2.3 Health Physics

It was assumed that an 11 man health physics staff will be adequate to effectively perform their functions without undue restriction of ongoing decommissioning operations. Since no materials are to leave the site for uncontrolled use, the extra effort that that can require is not applicable.

2.2.2.4 Systems Operation, Maintenance and Deactivation

It is assumed that this staff will deenergize and tag out all electrical equipment prior to dismantling activities in an area.

2.2.2.5 Contaminated Soil Removal

Scope - It was assumed that all contaminated soil (except possibly under the CRA's as discussed under WBS 2.2.2.13) has been identified by the thorough survey conducted in 1985.

Productivity - A productivity factor of 1.452 was applied to account for radioactive work area controls, use of protective clothing and their impact on work breaks times.

2.2.2.6 Site Preparation

Scope - Site modifications and refurbishings are based on accommodating a large formal project, using the ROLB for NASA, DOC, and subcontractor offices.

2.2.2.7 Asbestos Removal

Scope - Insulation removal only from radioactive systems and components is included. Insulation on the radwaste evaporator is assumed to be contaminated, requiring disposal as radwaste. All other insulation is assumed to be clean, with disposal at a local hazardous waste disposal facility.

Estimate - The estimated manhours and costs are based on an estimate performed by Affiliated Environmental Services, Inc.

WBS

2.2.2.8 Loose Equipment Removal

Scope - All loose equipment was assumed to be contaminated above release limits although further survey and minimal decontamination may be adequate to release many items for unrestricted use. Only a few objects with very simple geometry were assumed to be decontaminated to release limits. Items with potential decommissioning usage were included, although if used, they would likely be disposed of under WBS elements 2.2.2.11 or 2.2.2.12. Although some items have potential to serve as shipping containers for other smaller items, this was not considered in the estimate.

Productivity - A productivity factor of 1.633 was applied to account for work in confined areas, use of respirators during some cutting operations, radioactive work area controls, use of protective clothing, and their impact on work break times.

2.2.2.9 Activated Material in Hot Dry Storage Removal

Scope - An outline procedure was developed to define the work scope.

Shipping Containers - Shipping cask/liners and containers were selected to minimize the extent of cutting required. It was assumed that the shielded shipping casks will be available when required. This may require commitment to use the casks at least six months in advance.

Productivity - A productivity factor of 1.584 was applied to account for radioactive work area controls, use of protective clothing, and their impact on work break times.

2.2.2.10 Decontamination & Liquid Waste Management

Scope - Areas to be decontaminated were conservatively selected by the personnel who were involved in the 1985 radiological surveys. It was assumed that portable systems would be leased for liquid waste processing and solidification and that these systems would be used on other jobs so that disposal is not required. The CV decontamination tank (400 gal.) connections would be modified to make it serve as the decontamination waste collection tank.

Decontamination Costs - Decontamination costs were based on the selected surface areas and unit decontamination costs developed for the Shippingport Station Decommissioning Project (Reference 2), escalated from 1982 to 1985 (3 years) at 5% per year.

Productivity - Productivity was included in the unit rates used.

WBS

2.2.2.11 Reactor Internals & Vessel Removal

Scope - The relatively low radioactivity mock-up reactor core box, although not identical to the main reactor core box, is to be removed first to check out procedures and tools and to train the work force. The procedure developed for the 1978 study was updated to cover removal of all components and to delete the requirements to flood the quadrants. Cask/liner and container handling procedures were outlined to aid in cost estimating.

Shipping Containers - Shipping cask/liners and containers were selected to minimize the extent of cutting or breaking required. It was assumed that the shield shipping casks will be available when required. This may require commitment to use the casks at least six months in advance.

Productivity - The work was estimated on a crew day basis which included consideration of reduced productivity in radiation/ contamination areas.

2.2.2.12 Contaminated Piping & Equipment Removal

Scope - It was assumed that the canal gates, the neutron diffraction experiment shielding in Quad B, the underwater beam room and the vent stack would be removed for decontamination to release limits under WBS 2.2.2.10. Valves and fittings are to be cut from pipe to facilitate pipe nesting, and relatively efficient pipe nesting was assumed, with pipe cut to approximately 5' lengths. Fittings were assumed to fit in the pipe containers at the ends or on top. Large pipe (24" and 30") was assumed to be sectioned in half lengthwise while 54" pipe was assumed quartered lengthwise to facilitate packaging. However, these large pipes could be used to make LSA containers.

Components were assumed to be cut up only if necessary to fit into the shipping container, except large volume to weight items such as vent hoods and duct were assumed to be cut up to improve packaging. Selected large components were assumed to be sealed, decontaminated externally to DOT limits, and shipped. This includes the Off Gas Cleanup Vessel with internal components. Sumps not encased in concrete were assumed to be removed under this WBS element.

Electrical items (pumps, etc.) were assumed to be deenergized and tagged out under WBS element 2.2.2.4 and cables cut by demolition laborers under this WBS element.

A special container was assumed for shipping the hot sample storage cave in one piece.

WBS

Productivity - A productivity factor of 2.075 was applied to account for work at heights and in confined spaces, use of respirators during some cutting operations, radioactive work area controls, use of protective clothing, and their impact on work break times.

2.2.2.13 Contaminated Concrete & Embedded Pipe Removal

Scope - It was assumed that canal gate frames and other embedments in the Quadrants and Canals will have to be removed to check for contamination, but this may generally not be necessary.

The extent of contaminated concrete surface removal work was estimated very conservatively. For example, it was assumed that sump holes would require concrete surface removal even though sump tanks probably prevented the contaminants from contacting the concrete surfaces.

It was assumed that it would be necessary to remove both Cold Retention Areas (CRA's) to expose any contaminated soil below the structures, but that only CRA Unit 2 would require removal of contaminated soil. A core sampling and analysis program is recommended to better define the scope of work that will be required.

It was assumed that all embedded piping would be removed and that it would be removed from the concrete using jackhammers after controlled blasting to within 1 to 2 feet. However, it may be practical to remove the pipe directly by controlled blasting, with significant cost savings.

Productivity - For contaminated concrete surface removal work, a factor of 2.05 was used to account for working at heights and in confined areas, use of respirators, radioactive work area controls, use of protective clothing, and their impact on work-break times. For Quadrant and Canal embedded pipe, factors of 1.74 and 1.85 were used for concrete and pipe removal work, respectively. For Primary Coolant embedded pipe, factors 1.74 and 1.89 were used for concrete and pipe removal work, respectively. For hot drain and other miscellaneous embedded pipe, a factor of 1.85 was used for both concrete and pipe removal work.

2.2.2.14 Final Site Survey

Scope - It was assumed that soil sampling can be limited to those areas in which decommissioning work is required because the 1985 survey has demonstrated that other areas around the PBRF site are clean. It was assumed that the 1985 survey plan could be easily modified and used for the final site survey.

WBS

2.2.2.14 (Cont'd) Cost Estimate - The final survey cost estimate is based on the 1985 survey costs, adjusted for such factors as reduced planning effort, reduced congestion in the various areas after decommissioning and reduced system and soil sampling requirements.

2.3 Radioactive Waste Burial

Costs are based on the Barnwell Rate Schedule effective April 5, 1985, with a base disposal charge of $24.94/ft^3. Surcharges based on container weight and shipment Curie content, cask handling fees, and Barnwell County Business License Tax were included in the disposal cost estimates as applicable.