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In-Plant Source Term Measurements at Rancho Seco Station

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Prepared for
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Commission

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ABSTRACT

This report presents data obtained at Rancho Seco as a part of the In-Plant Source Term Measurement Program in operating pressurized water reactors (PWR's). The work was conducted for the Office of Nuclear Regulatory Research in support of the Effluent Treatment Systems Branch of the Office of Nuclear Reactor Regulation. The primary objective of this program is to provide the Nuclear Regulatory Commission (NRC) with operational data that can be used in evaluation of plant designs for liquid and gaseous waste treatment systems.

Data presented were obtained at the Rancho Seco Nuclear Generating Station, operated by the Sacramento Municipal Utility District (SMUD), located near Clay Station, California, 35 miles southeast of Sacramento, California. In-plant measurements were conducted during the time period from September, 1978 to March, 1979. This plant is the fourth in a planned series of six operating PWR's to be studied, two from each of the major PWR vendors. Data from all plants will be combined and interpreted to provide a data base for radioisotope inventory in plant systems, radioactive waste treatment system performance, and source terms for both liquid and gaseous systems.

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1. INTRODUCTION

1.1 Objectives of the In-Plant Measurement Program

The primary objective of the in-plant source term measurement study at operating pressurized water reactors (PWR's) is to provide the Nuclear Regulatory Commission (NRC) with operational data that can be used in evaluation of plant designs for liquid and gaseous waste treatment systems. This evaluation requires a knowledge of the sources and quantities of radioactive waste materials generated at a nuclear power reactor during normal operation including anticipated operational occurrences, how these sources vary with plant design, the radioisotope inventory in plant systems, how radioactive materials move through plant systems, and radioactive waste treatment system performance.

Specific objectives of the in-plant measurement study are:

1. Obtain data on the inventory of radioisotopes present (i.e., locations, concentrations, etc.) in operating reactor plant systems during normal operation and anticipated operational occurrences.

2. Study radioactive waste treatment system performance and determine decontamination factors (DF's) for demineralizers. evaporators, filters, and gaseous cleanup systems.

3. Obtain data on radioisotope concentrations in fuel pool waters and perform a tritium balance during refueling.

4. Determine the releases of radioactive materials in the gaseous and liquid effluents.

5. Estimate annual release of airborne activity from the auxiliary building ventilation system, process gas system, and containment buildings.

6. Provide additional source term information so that the parameters used in calculational models (1) can be updated as necessary.

Measurements are to be made during the three stages of plant operation (i.e., power generation prior to refueling, during refueling operations, and power generation following refueling) so that the data can be used to estimate equipment performance and radioactivity releases over the lifetime of a nuclear power plant.

The In-Plant Source Term Measurement Program is being carried out by the Idaho National Engineering Laboratory (INEL) and is a joint effort involving EG&G Idaho, Inc., and Exxon Nuclear Idaho Company, Inc. In order to provide a data base for currently operating PWR's, a total of 6 PWR's were to be studied, 2 from each of the major vendors (Westinghouse, Combustion Engineering (CE), and Babcock & Wilcox (B&W)). In-plant measurements were initiated during the summer of 1976. During 1976 and 1977 measurements were made at the Fort Calhoun Station, Blair, Nebraska (operated by Omaha Public Power District) and at the Zion Station, Zion, Illinois (operated by Commonwealth Edison Co.). Results of these measurements are reported in references 2 and 3. From 11/77 through 6/78 measurements were made at the Turkey Point Power Station (operated by Florida Power and Light). These measurements were reported in reference 4. Measurements were made at the Rancho Seco Nuclear Power Station from 9/78 through 3/79. This report provides the results of these measurements.

1.2 Rancho Seco Nuclear Generating Station

1.2.1 In-Plant Measurements at Rancho Seco

The measurement program at Rancho Seco was initiated in August, 1978. First, sample points and locations in the liquid and gaseous process streams were selected. This was accomplished by examining the piping and instrument diagrams (P&ID's) to determine where samples should be taken, discussing the proposed sample points with plant personnel, and inspecting the actual systems to verify the efficacy of the sample points and locations. Results were used to generate a preliminary measurement plan for the specific studies to be made at Rancho Seco. The NRC Mobile Laboratory was then moved to Rancho Seco on 8/15/78. Actual in-plant measurements began on 9/7/78.

During the first 6 weeks of measurements, all of the systems were sampled and the sample points validated. This included a study of each sample point to determine purge times adequate to give a consistent sample. Following this, the preliminary measurement plan was modified to provide the plan for which all subsequent sampling would follow (reference 5).

In-plant measurements at Rancho Seco spanned the period 9/7/78 to 3/6/79. Samples from both liquid and gaseous process streams were collected and analyzed using the procedures described in reference 6. During this 6-month period, the plant was down for refueling from 11/14/78 to 12/19/78.

1.2.2 Description of the Rancho Seco Nuclear Generating Station

The Rancho Seco Nuclear Generating Station, operated by the Sacramento Municipal Utility District (SMUD), is located on a dry knoll of ground near Clay Station, California, 35 miles southeast of Sacramento, California. The reactor is a 935 MWe pressurized light water reactor

supplied by Babcock & Wilcox. The unit has a thermal rating of 2770 MW and commenced operation in 1974. The plant had a number of turbine troubles during the first years of operation and did not achieve reliable operation until the second core operation.

The nuclear unit consists of a pressurized water reactor, reactor coolant system, secondary system, spent fuel storage pool, and associated auxiliary fluid systems. The reactor coolant system has two coolant loops, each with a vertical once through steam generator. The auxiliary systems are used to charge the reactor coolant system, add makeup water, purify reactor coolant water, provide chemicals for corrosion inhibition and reactor control, cool system components and the spent fuel storage pool, remove residual heat when the reactor is shut down, and provide for emergency coolant injection.

Figures 1.1 and 1.2 show simplified schematic diagrams of the liquid and solid systems and the gaseous waste disposal system, respectively, at Rancho Seco. Piping and Instrument Diagrams (P&ID's), which contain more details for each system, can be found in Appendix C.

For purposes of measurement, Rancho Seco was divided into two major systems - liquid and gaseous. The liquid system was subdivided into five basic subsystems - reactor coolant and letdown system, coolant radwaste cleanup system, boric acid recovery system, liquid radwaste system, and spent fuel pit cleanup system. The gaseous system was subdivided into three basic subsystems - auxiliary building ventilation, process gas, and containment. Each of these subsystems and the data obtained are discussed in detail in the following sections of this report. Sample and data handling procedures are discussed in Appendix A. Appendix B contains the experimental data.

1.2.3 Plant Data

Wherever possible, plant data were collected to supplement the measurement data and to help interpret the measurements. Plant operational data used to characterize samples included the control room logs, hot lab logs, daily tank level reports, airborne discharge reports, radwaste operation logs, and discussions with plant personnel.

Information obtained from the control room log included power level, reactor coolant flow, reactor coolant temperatures and pressures. The control room tank level log provided tank levels recorded on a once-per-day basis. The radwaste operator log provided information on the operation of the evaporators and demineralizers. The hot lab log provided the daily radiochemistry results from the Rancho Seco radiochemical measurements.

The results of radiochemical analyses of reactor coolant samples performed by plant personnel have been included in a few instances in this report to provide a more complete understanding of the phenomena that are being studied.

Plant information pertinent to the in-plant measurements can be found in Appendix C.

FIGURE 1.1

SCHEMATIC DIAGRAM OF LIQUID AND SOLID RADWASTE SYSTEM

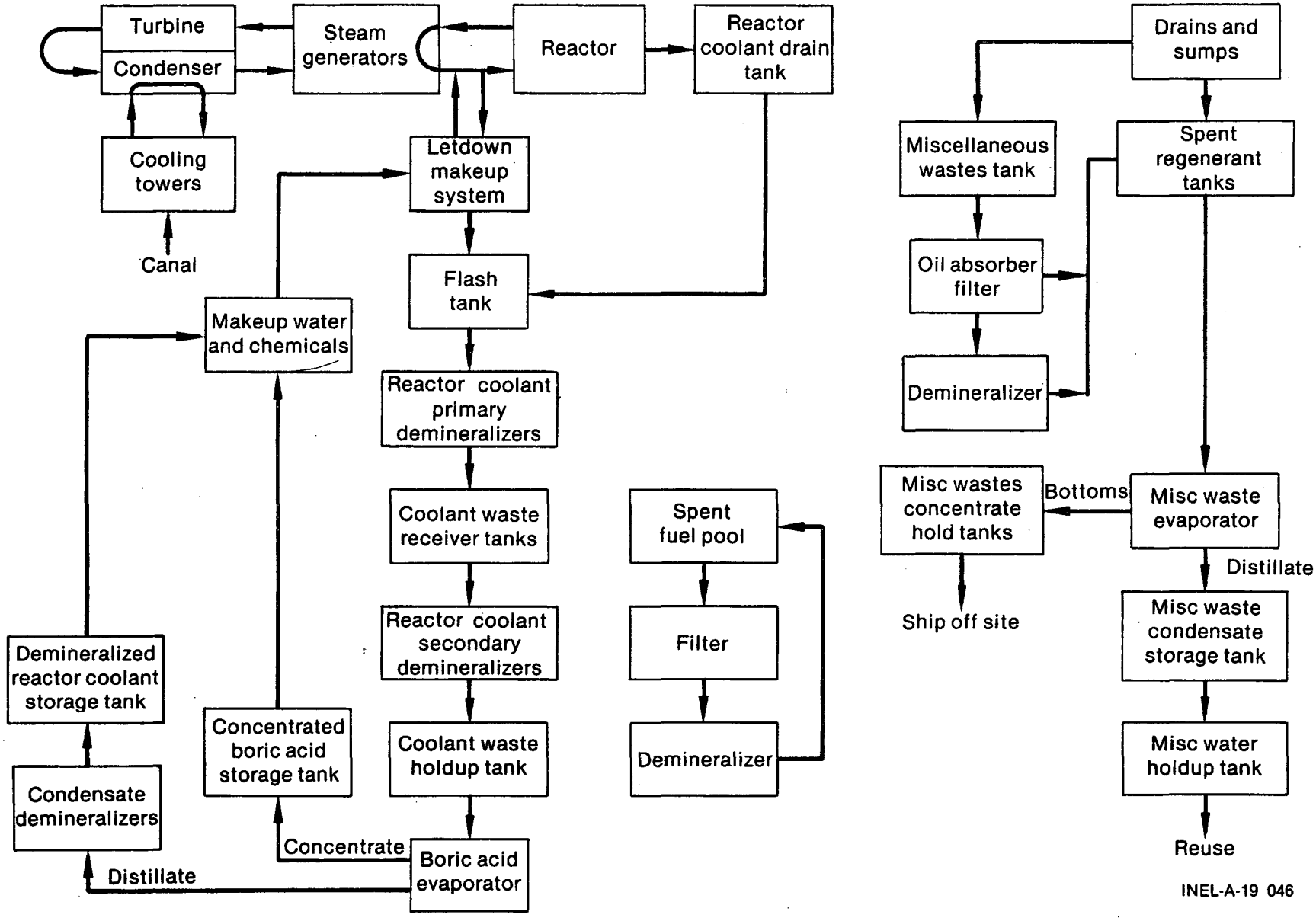
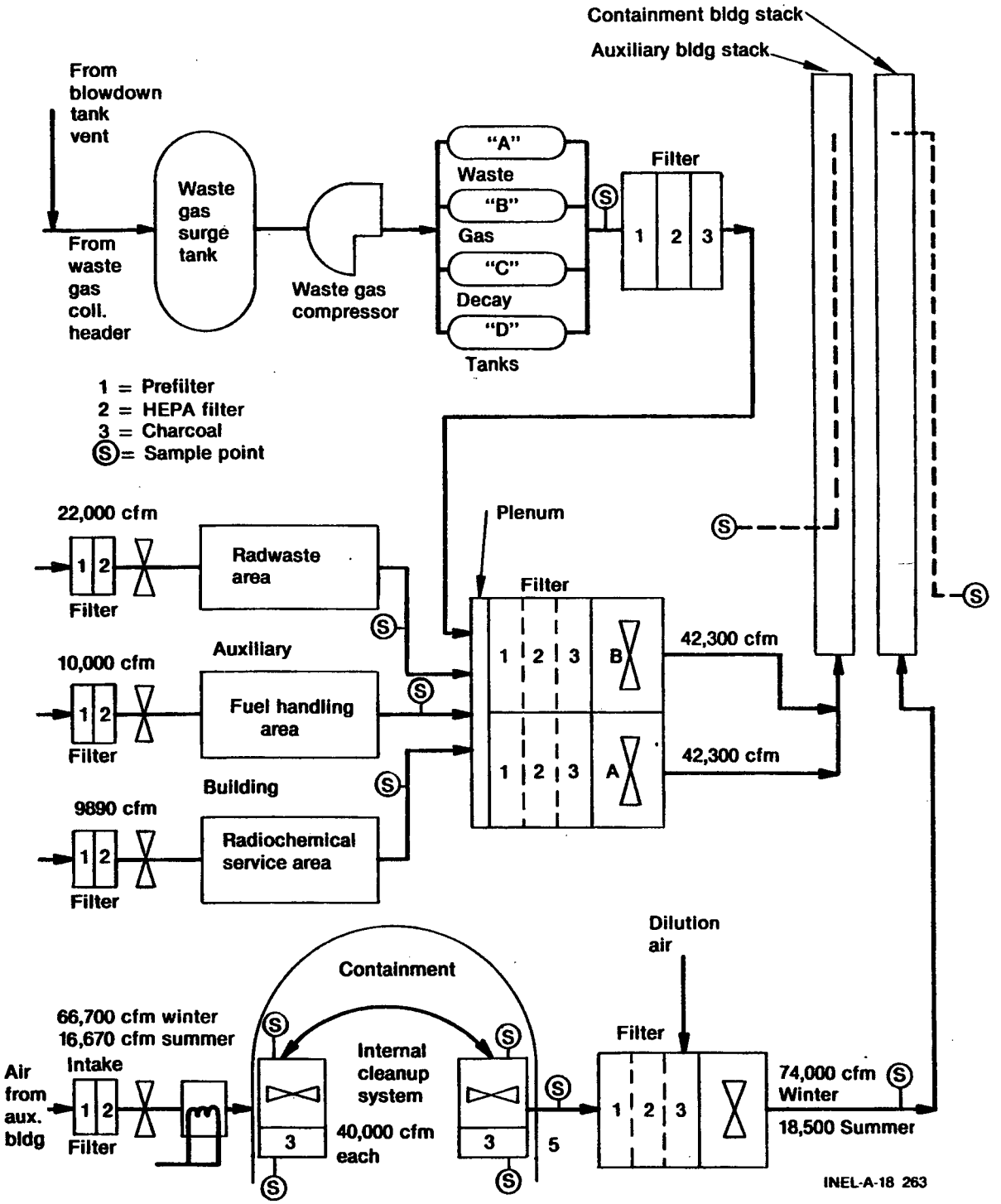


FIGURE 1.2

SCHEMATIC DIAGRAM OF GASEOUS RADWASTE SYSTEM



2. SUMMARY AND CONCLUSIONS

2.1 General Plant Operation During In-Plant Measurement Study

Measurements were conducted at Rancho Seco Nuclear Power Station from 9/7/78 to 3/6/79. The shutdown for refueling was from 11/15/78 to 12/19/78. Shorter unplanned outages occurred on 9/10/78, 9/15/78, 10/15/78, 10/24/78, 11/8/78, 1/2/79, 1/5/79, 1/20/79, and 2/25-28/79. Figure 2.1 shows the power level for the measurement period.

The plant was divided into the following basic liquid and gaseous subsystems for measurements:

1. Reactor Coolant and Makeup and Purification System
2. Coolant Radwaste System
3. Boric Acid Evaporator System
4. Miscellaneous Radwaste Evaporator System
5. Spent Fuel Pit
6. Auxiliary Building Ventilation System
7. Gaseous Waste Disposal System
8. Containment Building Atmosphere and Internal Cleanup System

Each subsystem will be discussed with the important conclusions highlighted below.

2.2 Reactor Coolant and Makeup and Purification System

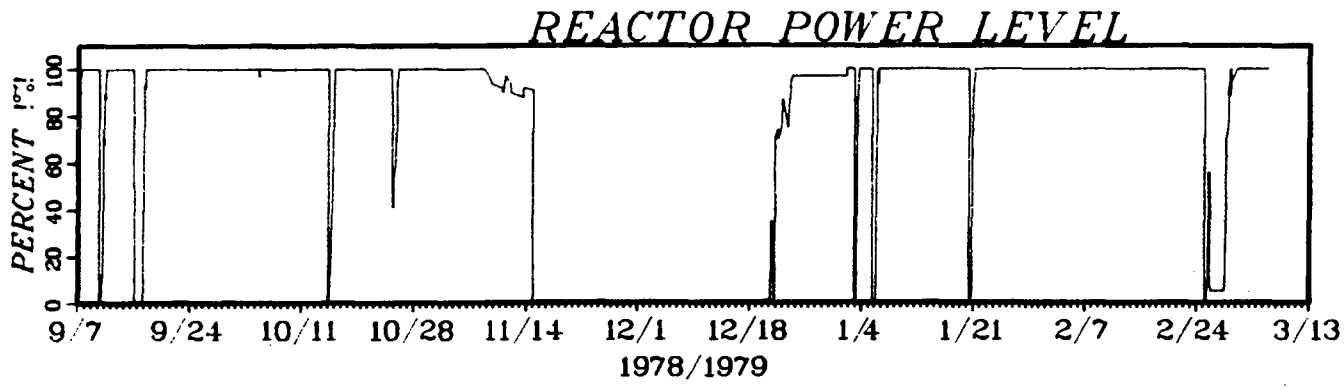
The reactor coolant and makeup and purification system consists of the circulating primary system, the letdown filter and demineralizer, the makeup filter and makeup tank.

2.2.1 Reactor Coolant

Measurements of the radionuclide concentrations in the reactor coolant during steady-state conditions have been compared to the predicted values based on the ANSI N237-1976 (7) model. In general, the predictions agree well with the measured concentrations, with the predicted fission product concentrations tending toward the high side and the crud-associated radionuclides tending to be midway between the results before and after refueling. Radionuclide spiking was studied for three different shutdowns; two were hot shutdowns and one the cold shutdown before refueling. In all three cases the maximum radionuclide concentrations occurred at 7 to 10 hours after shutdown, with the shorter-lived radionuclides spiking earlier. Figures 3.7-3.14 show the behavior of ^{131}I, ^{137}Cs and ^{58}Co for the 9/10/78, 11/15-16/78, and 1/20/79 spikes, respectively.

FIGURE 2.1

REACTOR POWER LEVEL DURING IN-PLANT MEASUREMENT PERIOD



2.2.2 Letdown Filter

Samples were taken periodically from the outlet stream of the letdown filter. These samples were used to provide the DF across this filter for all of the radionuclides normally detected in the reactor coolant stream. The DF's found for this filter are not particularly large, on the order of 1.0 to 2.0, but this does represent a considerable amount of filtered crud when one considers the total volume filtered over the course of the measurement period. Table 2.1 lists "best value" DF's* for selected radionuclides observed in letdown filter inlet and outlet samples. Table 3.9 provides more detailed results for the steady-state DF's for this filter system.

2.2.3 Purification Demineralizer

The behavior of the letdown demineralizer (which is a mixed-bed demineralizer) was studied for both steady-state and spiking conditions. Table 2.2 lists "best value" DF's for selected radionuclides observed in purification demineralizer inlet and outlet samples. More detailed DF's that were determined for this demineralizer were for steady-state conditions and are presented in Table 3.11. In almost all of the radionuclides studied, the DF increased during spiking in the coolant. This same phenomenon was reported in the evaluation of the Turkey Point data (4). It is interesting to note that before the spiking occurs, the three Cs isotopes nearly always have a DF of 1. During the spike Cs DF's always increase. The reasoning and the theory to explain this phenomena are described in section 2.6.4.

2.2.4 Makeup Filter

The makeup filter provided little, if any, removal of crud-associated radionuclides; however, its primary purpose is for the removal of resin fines that are released from the demineralizer. Table 2.1 contains "best value" makeup filter DF's for selected radionuclides. Table 3.13 presents more detailed data for the measured DF's.

---

* "Best value" DF, defined as the ratio of the average inlet concentration to the average outlet concentration, is used rather than the average of the individual DF's in order to include less-than values (i.e., lower limits of detection). In determining average concentrations, less thans are treated as one-half the less-than value (with a 100% uncertainty). Since less-than values usually occur in measuring outlet concentrations, the corresponding DF's are greater-than values. These greater-than values cannot be included in an average. Since it is desirable to include as much measured data as possible in the average DF's, it was decided to use the "best value" DF rather than the average DF.

TABLE 2.1

"BEST VALUE" DF's FOR FILTERS

Nuclide	Letdown Filter	Makeup Filter	Spent Fuel Pit Filter
^{131}I	1.0	1.0	1.0
^{134}Cs	1.0	1.0	1.2
^{137}Cs	1.0	1.0	0.9
^{54}Mn	1.5	2.1	2.0
^{58}Co	1.6	2.3	1.6
^{60}Co	1.5	2.2	2.4
^{99}Mo	1.1	*	1.0
^{124}Sb	1.5	1.3	0.9

* Data insufficient to determine DF.

2.3 Coolant Radwaste System

The coolant radwaste system consists of four large mixed-bed demineralizers in series. Water from the outlet of the letdown demineralizer is processed through the primary demineralizers A and B in series to the waste receiver tanks. From there it is pumped through two more demineralizers, the secondary demineralizers A and B, into the waste holdup tanks.

Table 2.2 presents "best value" DF's for selected radionuclides observed in inlet and outlet samples from the four demineralizers in the coolant radwaste system. Table 4.7 presents more detailed DF's for these demineralizers. The iodine isotopes are all essentially removed by the first demineralizer, and the crud-associated radionuclides have very little removal. The cesium isotopes, however, are found throughout the system with each demineralizer showing a different DF. The explanation of this phenomenon is given in sections 4.3 and 2.6.4.

2.4 Evaporators

2.4.1 Boric Acid Evaporator

The boric acid evaporator receives water that has been processed through the coolant radwaste system. The feed to the boric acid evaporator contains very little iodine or cesium isotopes, but has a high concentration of crud-associated radionuclides. "Best value" DF's for selected radionuclides are listed in Table 2.3 for the combined feed filter-evaporator system. More detailed results are presented in Table 5.5. Individual DF's could not be measured since it was not possible to take a sample between the filter and the evaporator proper.

2.4.2 Miscellaneous Radwaste Evaporator

The miscellaneous radwaste evaporator processes feed from the spent regenerant tanks directly without ion-exchange pretreatment. This evaporator therefore has a significant iodine and cesium isotopic content. "Best value" DF's for selected radionuclides are listed in Table 2.3 for the combined feed filter-evaporator system. More detailed results can be found in Table 5.12.

It should be noted that the DF's measured for the miscellaneous radwaste evaporator are much higher than the DF's measured for the boric acid evaporator. This is probably due to the higher (several orders of magnitude) inlet concentrations to the miscellaneous radwaste evaporator compared to the inlet concentrations to the boric acid evaporator. It has been found (see Section 2.4.4) that evaporator DF's are a strong function of the inlet (feed) concentration.

2.4.3 Evaporator Condensate Demineralizer

Both the boric acid evaporator and the miscellaneous radwaste evaporator have a demineralizer that is used to process the condensate in order to provide clean water for reuse in the reactor system. The

TABLE 2.2

"BEST VALUE" DF's FOR DEMINERALIZERS

	Coolant Radwaste System Demineralizers					
Nuclide	Purification Demin.	Primary Demin. A	Primary Demin. B	Secondary Demin. A	Secondary Demin. B	Spent Fuel Pit Demin.
^{131}I	100	420	1.5	1.5	1.1	22
^{134}Cs	1.0	7.3	13	33	11	66
^{137}Cs	1.0	3.8	10	29	18	61
^{54}Mn	40	2.2	0.6	0.8	6	7.1
^{58}Co	40	1.2	1.2	2.2	1.4	4.8
^{60}Co	40	1.3	0.6	1.9	1.3	3.6
^{99}Mo	50	4.9	>1.5	*	*	>33
^{124}Sb	2.3	1.6	4.6	0.8	5.2	>41

* Data insufficient to determine DF.

TABLE 2.3

"BEST VALUE" EVAPORATOR DF's

Nuclide	Boric Acid Evaporator*	Misc. Waste Evaporator*
^{131}I	3.3(1)	4.0(2)
^{134}Cs	1.4(1)	9.8(2)
^{137}Cs	3.2(1)	1.0(3)
^{54}Mn	4.1(1)	6.3(3)
^{58}Co	3(3)	1.2(4)
^{60}Co	8.2(2)	4.2(3)
^{99}Mo	1.7(1)	1.2(3)
^{124}Sb	1.8(1)	2.8(3)
^{140}Ba	2.9(1)	3.0(2)

* In this report, the number in parentheses following a number represents the power of ten multiplier, e.g., 3.97(-4) = 3.97×10^{-4}.

miscellaneous radwaste system has two demineralizers in series. Tables 5.16 and 5.19 present the "best value" DF's for all three demineralizers. Due to the high purity of the water from the evaporator most of these numbers are near one. There are two exceptions, the high DF, approximately 40, for ^{131}I on the miscellaneous radwaste evaporator condensate demineralizer and the cesium DF's that are significantly lower than 1 for all three demineralizers. The iodine DF across an evaporator is usually much less than that of the cesium or crud-associated radionuclides. This fact along with the high DF on the condensate resin indicates that there is a small volatile ^{131}I component that is carried over into the distillate, condensed with the water and is in the ionic form. The actual chemical state is unknown.

The reason that cesium DF's are much less than 1 for the boric acid evaporator condensate demineralizer is probably related to the fact that the evaporator is frequently bypassed and the condensate resin used to deborate the solution directly, putting a high load on the resin. When the evaporator is put back into the flow path, the inlet concentration to the demineralizer would then be much lower than before and activity would be removed from the resin bed (thereby raising the activity level in the liquid) until equilibrium is again attained. We believe that the low cesium DF for the miscellaneous radwaste condensate demineralizer is related to higher cesium concentrations in the inlet during past operation.

2.4.4 General Considerations for Both Evaporators

The DF's of the evaporators are a strong function of the feed concentrations with the crud-associated radionuclides having the strongest dependence, the cesiums the next and ^{131}I the least. This phenomena was also reported for the Turkey Point data (4). Also the distillate concentration is a function of the feed concentration with ^{131}I having the strongest dependence and the crud-associated radionuclides the least.

A mass balance was made on the evaporator system to calculate the efficiency of the feed filter for the removal of activity. Basically the balance consisted of measuring the feed activity and the bottoms and distillate activities several times during the run. Using the boron as a control which assumes a DF across the filter of 1.0, the net difference in activity for the bottoms and distillate was calculated. A net loss could be from filtering or from volatilization into the vacuum system. Two runs were made with the boric acid evaporator and four for the miscellaneous radwaste evaporator when a mass balance could be calculated. Tables 5.3 and 5.4 present the results of these data. Note that as much as 50% of the iodine fed to the evaporator was unaccounted for. Since most of the filters in the reactor system have a DF for iodine of 1.0, the unaccounted for iodine was most likely lost from the system through the vacuum system on the evaporator and gas stripper. However, the fraction lost was not consistent from run to run.

2.5 Spent Fuel Pool

The spent fuel pool subsystem consists of a recirculating line with a filter and mixed-bed demineralizer. "Best value" DF's for selected radionuclides for the filter and demineralizer are presented in Tables 2.1 and 2.2, respectively. More detailed results are listed in Tables 6.2 and 6.4. It should be noted that during refueling concentrations of the major radionuclides in the pool increased. The DF's for the spent fuel pool filter and demineralizer both increased, reflecting the increased concentrations. Normal steady-state DF's were all much lower than those listed. Section 2.6 provides a detailed explanation of the behavior of demineralizers, especially for the soluble radionuclides, iodines, and cesiums.

2.6 Demineralizers and Radiocesium

Rancho Seco has several demineralizers (ion-exchange columns in the mixed bed H-OH form) in use for the removal of radionuclides. They are located in almost every system in the plant. Each of the demineralizers operates in a unique manner and appears to remove radionuclides somewhat differently.

2.6.1 Letdown Demineralizer

This ion-exchange resin system operates continuously at 70 to 100 gpm, with the entire reactor coolant system being processed once every 14 to 20 hours. During steady-state operation the DF across this ion-exchanger is observed to be approximately 1.0 for ^{134}Cs, ^{136}Cs and ^{137}Cs. If there exists a constant input rate from the core, then the activity levels in the reactor coolant would increase unless there were also some removal mechanism other than the letdown demineralizer. Reactor coolant is removed for boron reduction. We believe that this is the removal mechanism for cesium.

During spiking phenomena it was observed that the DF of some of the nuclides increased. The most notable of these are the DF's for the three Cs isotopes. The DF increases, and as a result of this increase the purification system removes the cesium isotopes and slowly drops the reactor coolant levels nearly back to the levels in the coolant before the spike. After a few days, however, the cesium DF has dropped back to near 1.0 and the cesiums have come into equilibrium again. There has been a small increase in reactor coolant ^{134}Cs and ^{137}Cs concentration. The net result of this process is to transfer most of the cesium isotopes released during the spike to the letdown ion-exchange resin, with a small amount being left in the coolant, raising the coolant activity levels a small amount.

The DF for iodine isotopes was greater than that of the cesium. It was always greater than 100. The iodine thus appears to be tightly held by the ion exchange resin, while cesium is more easily dislodged and tends to pass through the resin. However, there was definitely an increase in the DF for the iodine isotopes during spikes in the coolant

concentration. In both cases the effluent from the demineralizer tended to be constant for all inlet concentrations. For ^{131}I then, there exists a constant coolant concentration during steady-state operations between spikes that does not build up with time.

The behavior of the crud-associated radionuclides on the demineralizer resins is very sporadic and reflects the difficulties in sampling and measuring these radionuclides. The resin itself acts more like a filter than an ion-exchanger for these radionuclides. The source of crud-associated radionuclides in the plant is the transport and activation of corrosion and wear products in the reactor coolant system. The behavior of these products in a PWR is not well understood.

2.6.2 Fuel Pool Demineralizer

This ion-exchange resin system also operates continuously with a design flow of 160 gpm. At this flow rate the entire fuel pool is processed through the demineralizer every 63 hours. This demineralizer acted very much like the letdown demineralizer towards the iodine and cesium radionuclides. The one difference is that the time scale is stretched out due to the longer processing period for the fuel pool system. The increase in the Cs DF at the beginning of the shutdown was found to be more pronounced for the fuel pool demineralizer compared to the letdown demineralizer. We believe this was due to the larger magnitude of increase in the Cs inlet concentration as compared to the letdown demineralizer. But basically the two resin systems behaved identically.

2.6.3 Coolant Radwaste System Demineralizer

The coolant radwaste system has four large ion-exchange resin columns in series. They are operated in sets of two with large holding tanks in between. The water processed through this system includes all of the water collected from the drain collection header in the reactor system. This water is basically all reactor coolant that has been processed through the letdown filter and demineralizer. The amount of water processed through these resins is several orders of magnitude less than that processed by the letdown demineralizer or the fuel pool demineralizer. These resins effectively reduce the iodine and cesium radionuclide concentration to very low levels before the water is processed by the evaporators. The behavior of these resins is different from those previously discussed, but the differences are due to the mode of operation of the systems and not to differences in the resin or other parameters. Most of the iodine is stopped by the first resin. The iodine DF for this resin is about the same as for the letdown demineralizer and the fuel pool demineralizer. The last three of the four resins in series show small iodine DF's, but this is expected due to the very low inlet concentrations. The DF's for the cesium isotopes, however, show marked deviation from expectations (i.e., DF's of about 1.0). The cesium DF's progress as follows as the coolant passes through the letdown demineralizer and four coolant radwaste demineralizers. It is believed that these demineralizers are acting as the letdown or fuel pool demineralizers do during a concentration spike. They have not processed enough activity

to become "saturated" as the fuel pool and letdown demineralizers have. But as indicated by the lower cesium DF for the primary demineralizer A, this first demineralizer in the line is further along toward saturation than primary demineralizer B or the secondary demineralizer A. The same explanation is applicable for the difference between cesium DF's for the primary demineralizer B and the secondary demineralizer A. We do not know why the cesium DF for secondary demineralizer B is so low. It may be that the inlet concentration is just not high enough for a very high DF.

	DF	
	^{134}Cs	^{137}Cs
Letdown Demineralizer	1.0	1.0
Primary Demineralizer A	7.3	3.8
Primary Demineralizer B	13	10
Secondary Demineralizer A	33	29
Secondary Demineralizer B	11	18

2.6.4 Development of Theory

In an ion exchange system the ratio of the concentration of an ion in solution to the concentration of the ion on the resin is a constant, i.e.,

$$C_S/C_R = K$$

where the usual units are

C_S = milliequivalents/ml solution

C_R = milliequivalents/gram resin

K = distribution ratio

or for radioactive species

C_S = millicuries/ml solution

C_R = millicuries/gram resin

when the specific activity of the radionuclide in the solution is the same as that in the resin when the total isotopic composition is considered.

These distribution ratios are normally measured for a static system, by contacting a known amount of activity (or nuclide) with a measured amount of resin. However, in practice the ion-exchange column is a

dynamic system in which the bed acts like a series of batch contactors and the initial concentration for each successive increment is the output from the previous one.

The distribution through the bed for the retention of a radionuclide such as cesium will be exponential and would look something like Figure 2.2A for the beginning of the removal from a stream of constant concentration. As the column loads, the resin at the top of the bed comes into equilibrium with the inlet concentration and the distribution with time changes as is shown in Figure 2.2B. The shape of the curve is a function of K for each nuclide. As the resin comes into equilibrium, the profile on the resin becomes flat. Ultimately the resin will become saturated and the DF across it will be 1. This does not mean, however, that the activity passes straight through the demineralizer. What is actually happening is that the activity is being absorbed at the top with a slow migration down the column and an equal amount coming off the bottom. Once saturation has occurred, the cesium DF will be 1.0. However, a perturbation at this point will cause one of two effects. (1) If the inlet concentration is increased, a new, and higher, equilibrium level will be established and an initial instantaneous DF greater than 1 will be observed with a column distribution as shown in Figure 2.2C. The DF will remain greater than 1.0 until a new equilibrium level has been established with this constant feed. (2) If the inlet concentration is decreased, a lower equilibrium level will be established and the initial instantaneous DF will be less than 1.0 as shown in Figure 2.2C. Both of these situations have been observed with the letdown demineralizer, during spiking conditions.

2.7 Secondary System

The secondary system at Rancho Seco was sampled to determine whether a primary-to-secondary leak existed. The results of the samples taken indicate that a primary-to-secondary leak did not exist during the in-plant measurement period.

2.8 Analysis of Spent Resin

A sample of spent resin was obtained from the spent resin tank. Since the spent resin tank contains the spent ion exchange resins from several demineralizers, it was impossible to determine which demineralizer was the source of the resin sampled.

The resin sample was analyzed for transuranic radionuclides and the following concentrations were measured.

Radionuclide	Concentration (μCi/g resin)
^{238}Pu	6.1 ± 0.1(-6)
$^{239,240}Pu$	1.12 ± 0.02(-5)

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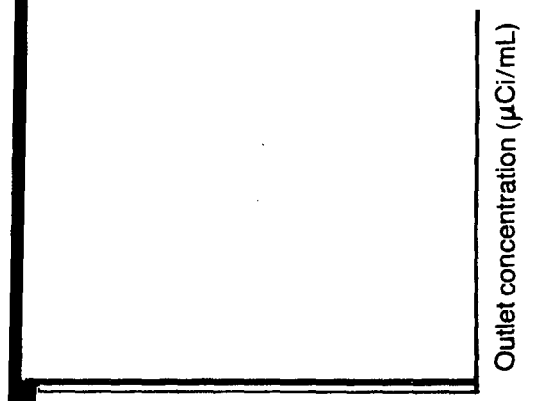
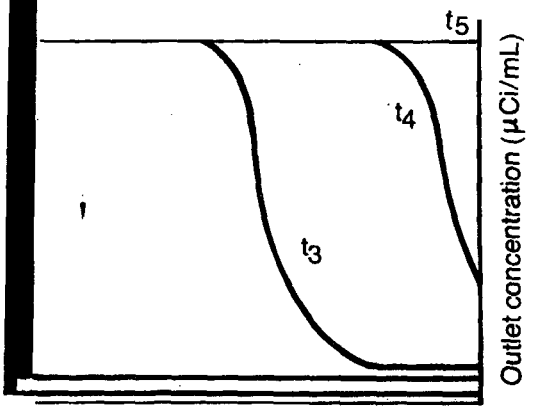


mn length

entration gradient



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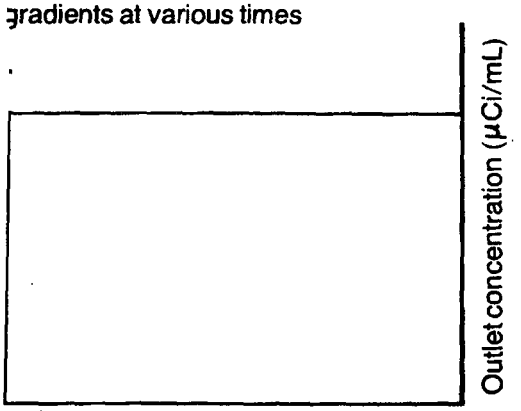
gradients at various times



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Radionuclide	Concentration (μCi/g resin)
^{241}Am	2.5 ± 0.2(-6)
^{242}Cm	3.2 ± 0.2(-6)
^{244}Cm	3.8 ± 0.2(-6)

2.9 Gaseous Systems

At Rancho Seco the gaseous waste disposal system (Figure 1.2) was separated into the following major systems for study: auxiliary building ventilation system, containment (reactor) building ventilation system, and waste gas processing system. Within the auxiliary building the ventilation system was divided into three subsystems (see Figure 2.3) during the early phases of the in-plant measurement study. Subsequently, each subsystem was subdivided to pinpoint specific sources of radionuclides. The areas monitored by each individual sampler are listed in Table 8.2. The auxiliary building ventilation system was monitored continuously during the period 9/11/78-3/13/79 and individual samplers were changed out on a nominal two-week schedule. During the in-plant measurement period at Rancho Seco, four waste gas decay tanks (WGDT's) were sampled prior to release. In addition, the containment atmosphere was sampled over a period of 14 purges and when an internal charcoal filter was put in service.

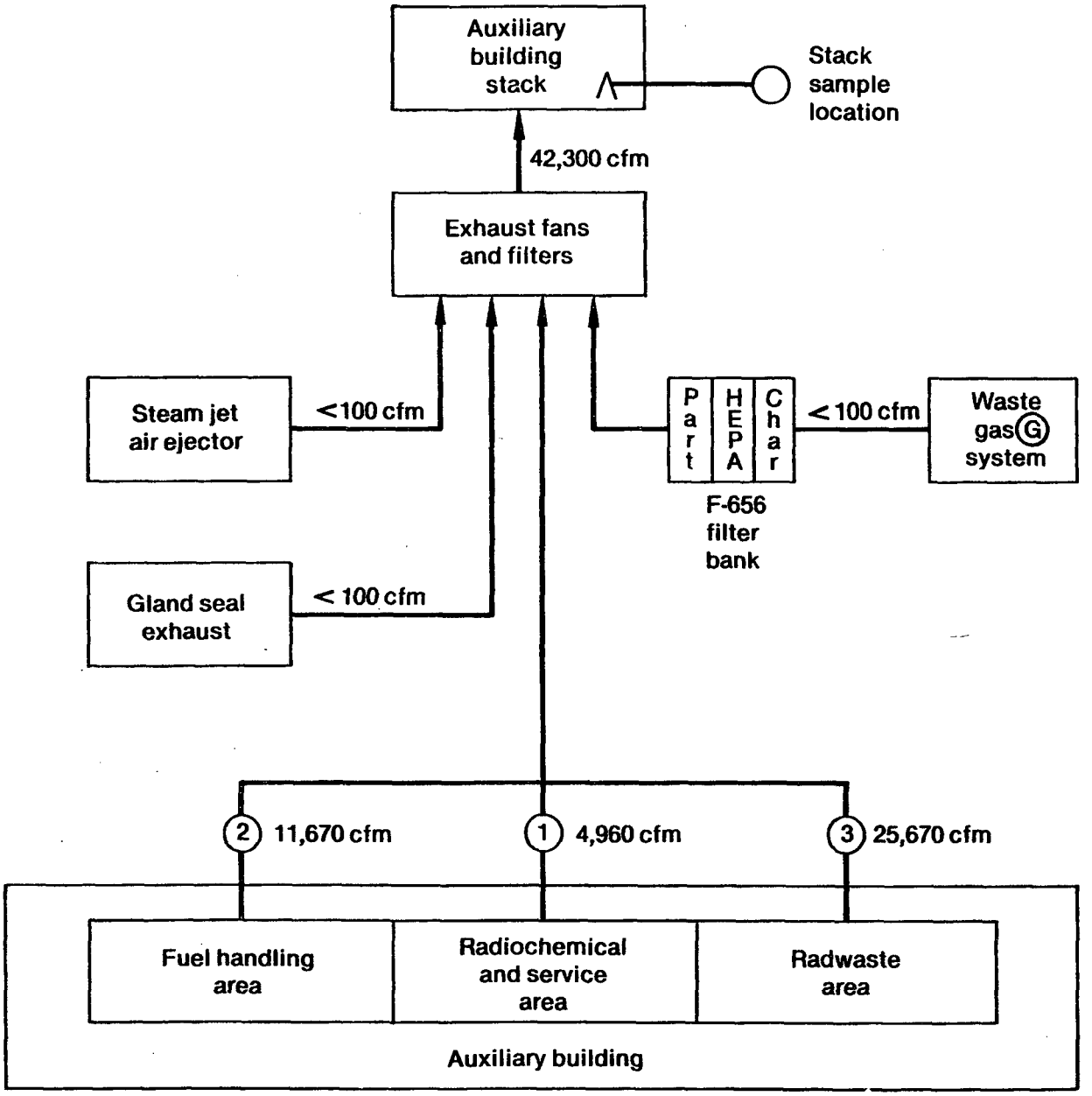
Table 2.4 shows estimated annual releases from the three major systems for selected radionuclides. The releases are upstream of plant filtration systems.

Releases from waste gas decay tanks (WGDT) are based on average concentrations in the tanks measured on four occasions (Table 7.2) multiplied by an assumed annual frequency of 11 tanks/year. All values are measured upstream of a HEPA charcoal filter system for releases from waste gas decay tanks. Note that even without filtration, releases from the WGDT's are very small. Only the release of ^{14}C is a significant fraction of the total plant release (19%).

Releases of nuclides in containment purges were determined for the refueling outage and for intermittent purging during power operation (see Tables 7.33-7.35). The values in Table 2.4 are the sums of releases during the two operations. During refueling, concentrations were measured downstream of HEPA and charcoal filters and the releases in Table 2.4 were determined by multiplying by the filter decontamination factor (88 for ^{131}I and 50 for particulates). During operation, releases were calculated using measured containment air concentrations. Containment was a significant source for a few nuclides. It provided 47% of the ^{131m}Xe, 20% of the ^{14}C, 63% of the ^{58}Co and 55% of the ^{131}I in the estimated annual release.

FIGURE 2.3

AUXILIARY BUILDING STACK VENTILATION SYSTEM



Notes:
1. F-656 consists of prefilters, HEPA filters and charcoal filters (section 7.17)
2. Circled numbers (1) indicate long-term sampling locations
3. Circled letters (G) indicate short-term sampling locations
4. Main stack sample location was located on the plant sample line
5. The flow rates listed are design specifications

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TABLE 2.4

ESTIMATED ANNUAL RELEASES**

(Ci/yr)

	^{131}I	^{134}Cs	^{137}Cs	^{58}Co	^{60}Co	^{3}H	^{14}C	^{85}Kr	^{131m}Xe	^{133}Xe
Aux. Building	3.0(-2) [45.] †	2.4(-2)*** [94.0]	3.3(-2)*** [86.8]	1.5(-3)*** [37.2]	7.5(-3)*** [95.8]	6.9(1) [92.0]	2.7(0) [61.0]	8.4(1) [88.]	1.7(2) [53.1]	3.3(4) [84.2]
Containment	3.7(-2) [55.]	1.5(-3) [6.0]	5.0(-3) [13.2]	2.5(-3) [62.8]	3.3(-4) [4.2]	6.0(0) [8.0]	9.0(-1) [20.0]	5.4(0) [6.0]	1.5(2) [46.9]	6.3(3) [15.8]
WGDT (1)*	4.2(-6)	1.1(-8)	2.6(-8)	5.0(-8)	5.9(-8)	4.3(-3)	8.5(-1) [19.]	5.9(0) [6.2]	1.6(-1)	3.7(-1)
Total	6.7(-2)	2.6(-2)	3.8(-2)	4.0(-3)	7.8(-3)	7.5(1)	3.6(0)	8.9(1)	3.2(2)	3.9(4)

* Included in auxiliary building releases since the WGDT discharges are monitored at the main stack.

** Releases are upstream of plant filtration systems. Actual plant releases were lower due to filtration of each effluent path.

***Releases are calculated by multiplying the releases measured downstream of the filter by 50 (see Section 8.3.3).

† Number in brackets indicates percent contribution to total plant release.

Table 2.4 also shows the estimated annual releases from the auxiliary building. The release of ^{131}I was measured upstream of the charcoal adsorber in the effluent duct (see Table 8.6). Particulate radionuclides were measured downstream of the HEPA filter and a decontamination factor of 50 was applied to estimate the release ahead of the HEPA. The reason for doing this rather than using the measurements upstream of the HEPA is that upstream samplers may not have sampled all of the particulate releases during the refueling shutdown (see Section 8.3.5). Note that the auxiliary building was a substantial source for most radionuclides.

It can be seen from Table 2.4 that on an annual basis the auxiliary building is the principal source of radioactivity for all airborne radionuclides except for ^{58}Co and ^{131}I. However, the auxiliary building is not the principal source of radioactivity during all stages of plant operation. Table 2.5 presents average release rates for the three systems during refueling and non-refueling operations. Examination of Table 2.5 indicates that the containment was the principal source of ^{131}I during non-refueling operations, while during refueling the auxiliary building was the major source. For particulates, the principal source was the auxiliary building during non-refueling periods. During refueling, the contribution from the containment increases and, in fact, surpasses that of the auxiliary building for ^{58}Co. During both the refueling and non-refueling intervals, ^{3}H and ^{14}C principally came from the auxiliary building, but the containment's contribution increased during refueling. The principal source of ^{131m}Xe was the containment, but the containment was the primary source of ^{133}Xe only during the non-refueling period.

Table 2.6 presents the relative contribution of each of the systems sampled to the total release of ^{131}I from the auxiliary building. During non-refueling operations, the two significant sources of ^{131}I were systems #1 (radiochemical and service area) and #3 (radwaste area). As expected, during refueling, system #2 (refueling area) was a significant source of ^{131}I. The predominant source of ^{131}I in system #1 was traced to the reactor coolant sampling hood. The major source in system #3 was found to be the tank rooms. The tank rooms house the reactor coolant waste receiver and holdup tanks, the concentrated boric acid storage tank, and the spent regenerant tanks. The cover gases from these tanks feed directly into the auxiliary building ventilation system. Results indicate that the spent regenerant tanks were the major source of ^{131}I in system #3.

The major source of particulates in the auxiliary building was also within system #3. The fuel handling area was the major source of ^{3}H. Specific sources of these radionuclides could not be identified due to very low levels of the radionuclides or physical inaccessibility of the individual components feeding the systems. Sources of noble gases were not obtained because noble gases were monitored at the auxiliary building stack only.

To compare releases of ^{131}I from Rancho Seco to those from other plants, the absolute release rates were divided by the coolant

TABLE 2.5

AVERAGE RELEASE RATES DURING REFUELING AND NON-REFUELING OPERATIONS ***

(μCi/s)

	^{131}I	^{134}Cs	^{137}Cs	^{58}Co	^{60}Co	^{3}H	^{14}C	^{85}Kr	^{131m}Xe	^{133}Xe
Aux. Building (non-refueling)	1.7(-5) [7.8]**	4.2(-6) [56]	3.0(-6) [40.5]	6.6(-7) [82.5]	4.0(-6) [98.0]	2.1(0) [81.4]	6.0(-2) [83.3]	6.4(0)	1.1(1) [12.1]	6.3(2) [22.3]
Containment (non-refueling)	2.0(-4) [92.2]	3.3(-6) [44]	4.4(-6) [59.5]	1.4(-7) [17.5]	7.0(-8) [1.7]	4.8(-1) [18.6]	1.2(-2) [16.7]	††	8.0(1) [87.9]	2.2(3) [77.7]
Aux. Building (refueling)	4.6(-5) [69.7]	1.8(-5) [38.3]	5.7(-5) [64.0]	1.2(-6) [5.4]	5.0(-6) [60.2]	2.3(0) [65.7]	3.5(-1) [62.5]	2.8(0) [68.3]	1.4(1) [2.0]	3.9(1) [86.5]
Containment (refueling)	2.0(-5) [30.3]	2.9(-5) [61.7]	3.2(-5) [36.0]	2.1(-5) [94.6]	3.3(-6) [39.8]	1.2(0) [34.3]	2.1(-1) [37.5]	1.3(0) [31.7]	6.1(0) [98.0]	6.7(2) [13.5]
WGDT*	7.5(-6)	2.0(-8)	3.7(-8)	9.1(-8)	1.1(-7)	7.9(-3)	1.5(0)	1.1(1)	2.8(-1)	6.6(-1)
Total† (non-refueling)	2.2(-4)	7.5(-6)	7.4(-6)	8.0(-7)	4.1(-6)	2.6(-1)	7.2(-2)	6.4(0)	9.1(1)	2.8(3)
Total† (refueling)	6.6(-5)	4.7(-5)	8.9(-5)	2.2(-5)	8.3(-6)	3.5(0)	5.6(-1)	4.1(0)	6.8(2)	4.5(1)

* Included in auxiliary building releases since WGDT discharges are monitored at the main stack.

** Number in brackets indicates percent contribution to total plant release during the respective time interval, i.e., refueling or non-refueling.

*** Except for WGDT release rates the release rates are measured downstream of HEPA and charcoal filters.

† Total plant release rate during containment purge.

†† Radionuclide not detected due to interference from 0.51 MeV annihilation radiation in gamma-ray spectrum.

TABLE 2.6

PERCENT CONTRIBUTION OF EACH SYSTEM TO AUXILIARY BUILDING ^{131}I RELEASE

Sample Period	Systems (%) #1	#2	#3	Tank Room	#5	#6	#7	#8	#9	Total #1-#3 Release µCi/s	Main Stack µCi/s
9/13-9/27	17	*	83	†	†	†	†	†	†	5.9(-4)	3.7(-6)
9/27-10/12	19	1	80	†	†	†	†	†	†	8.9(-5)	2.4(-6)
10/12-10/26	24	<1	76	†	†	†	†	†	†	2.8(-4)	4.8(-6)
10/26-11/9	32	*	68	†	†	†	†	†	†	7.5(-5)	8.7(-7)
11/9-11/20 (4)	1	3	96	†	†	†	†	†	†	1.7(-2)	7.7(-5)
11/20-12/7 (4)	1	47	52	†	†	†	†	†	†	1.5(-3)	1.7(-5)
12/7-12/21 (4)	1	13	86	†	†	†	†	†	†	3.8(-4)	3.5(-5)
12/21-1/4 (4)	5	1	94	†	†	†	†	†	†	9.3(-4)	5.5(-5)
1/4-1/18	24	1	75	†	†	†	†	†	†	9.9(-4)	1.0(-4)
1/18-2/1	49	<1	51(1)	47.4(1)	0.5(1)	1.9(1)	0.3(1)	0.9(1)	†	4.7(-4)	4.9(-6)
2/1-2/15	32	1	67(1)	51.7(1)	<0.1(1)	7.7(1)	5.8(1)	1.8(1)	32.0(2)	7.6(-5)	3.2(-7)
2/15-3/1	44	<1	56(1)	26.4(1)	3.7(1)	14.4(1)	9.7(1)	1.8(1)	28.7(2)	1.4(-4)	*
3/1-3/13	24	*	76(1)	59.9(1)	*	1.8(1)	9.5(1)	4.8(1)	14.2(2)	1.5(-4)	*
										Avg.	2.7(-5)(3)

(1) Percentage breakdown of sampling station upstream of sampling station #3. Stations #3-#8, for this period are averages of two one-week samples.

(2) Percentage contribution of station #9 to station #1.

(3) Only positive values were used in averaging, i.e., lower limits of detection were not used.

(4) During refueling interval. The average auxiliary building main stack release rates before, during, and after refueling were respectively 2.9(-6), 4.6(-5), and 3.5(-5) µCi/sec. No lower limits of detection were used in the average.

* ^{131}I not detected in sample.

† Sampler not installed.

concentrations to obtain what is called the normalized release rate (see Section 8.3.1). The estimated annual average normalized release rate at Rancho Seco was 0.15 μCi/sec/μCi/g (see Table 8.6). This release rate is for upstream of the charcoal filters. The actual release rate (i.e., downstream of the charcoal filters) should be approximately 1/90 that upstream. The comparable value for Fort Calhoun is 0.3 μCi/sec/μCi/g and for 3 other PWR's the average was 0.07 μCi/sec/μCi/g. It appears that for the same coolant concentration of ^{131}I, average release rates at Rancho Seco were not appreciably different than those of other PWR's.

3. REACTOR COOLANT AND MAKEUP AND PURIFICATION SYSTEM

3.1 System Description and Sample Points

3.1.1 Reactor Coolant System

The reactor coolant system (RCS) is used to circulate the heated, high-pressure reactor coolant from the reactor to the steam generators. Rancho Seco utilizes two once-through steam generators (OTSG), thus the reactor coolant system consists of two loops - designated A & B - one for each steam generator. Coolant is let down from the cold leg of loop A through letdown coolers to the makeup and purification system for chemical and volume control. A diagram of the RCS is shown in Figure 3.1.

Reactor coolant samples were taken from the normal plant sample point which leaves the letdown line just after the letdown coolers. This sample point terminates in the hot lab sample sink. The reactor coolant sample line is on recirculation at all times, thus samples can be taken after a short (15 min) purge of the connecting line and valve to the sample sink.

Samples were taken by two methods. Most samples were collected in 50 ml bottles as described in the Source Term Procedures (6). Since an indeterminate amount of the noble gases may be lost from these samples, a more specialized sampling technique was employed when noble gas concentrations were desired. This technique consisted of plumbing a 35 ml liquid bomb sampler in series with the sample line, purging the sampler for a minimum of 2 minutes, then closing the stopcocks to collect a sample that had retained its dissolved noble gases. Noble gas concentrations are reported only for reactor coolant samples obtained using the 35 ml liquid bomb sampler. Since proper flow adjustments for liquid bomb sampling may require adjustment of the flow rate during sampling, which may perturb corrosion product concentrations, only noble gases are reported for liquid bomb samples.

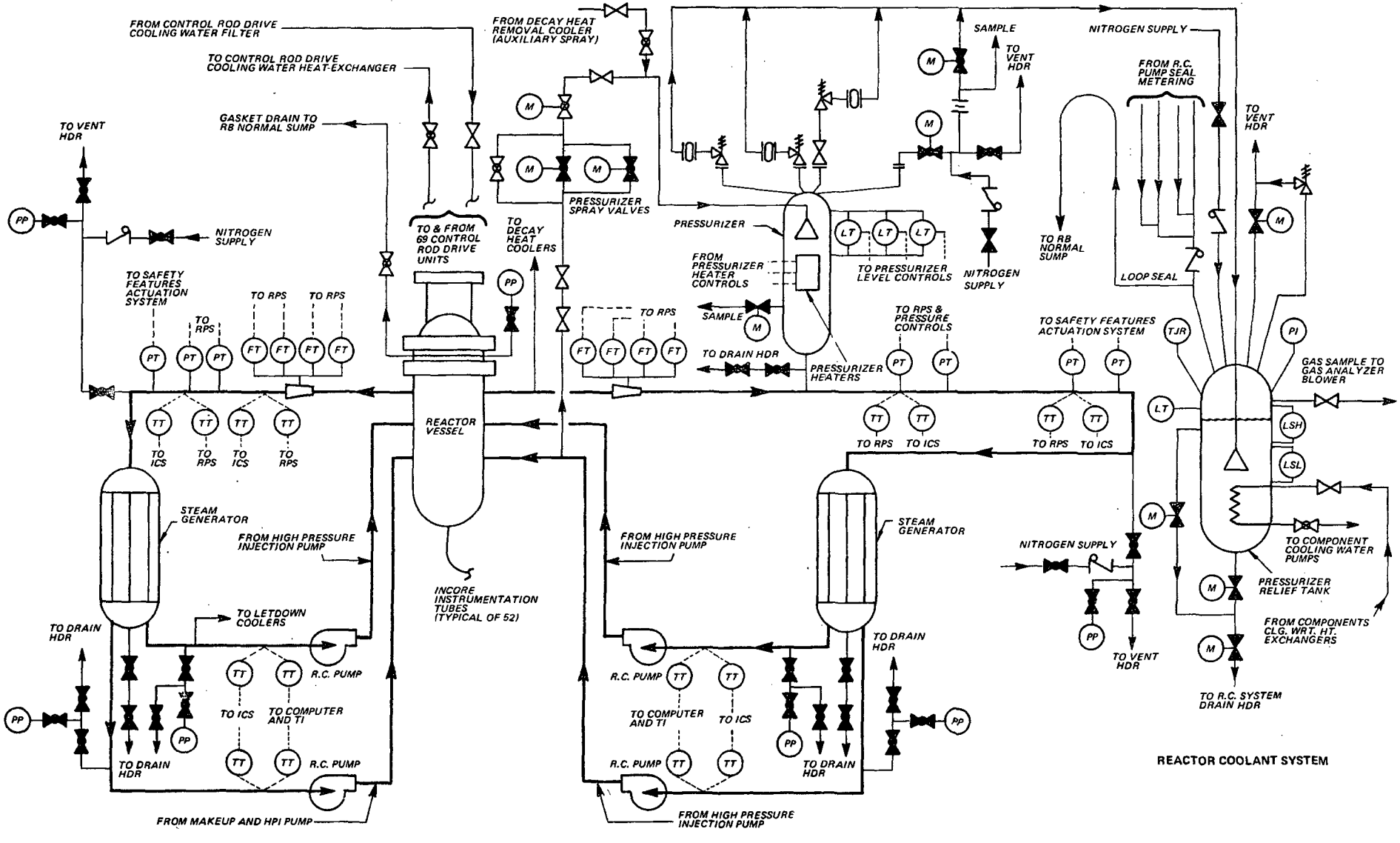
Reactor coolant samples were obtained approximately weekly between 9/7/78 and 3/7/79. When the makeup and purification system was being studied and spiking due to shutdown was being investigated, more frequent sampling was utilized. Samples for analysis of beta-only-emitting radionuclides were obtained on a less frequent basis.

3.1.2 Makeup and Purification System

The makeup and purification system (MUAPS) allows for chemical and volume control of the reactor coolant while providing purification of the reactor coolant liquid. Figure 3.2 is a diagram of the MUAPS showing local sample points. Table 3.1 is a summary of the principal component information.

FIGURE 3.1

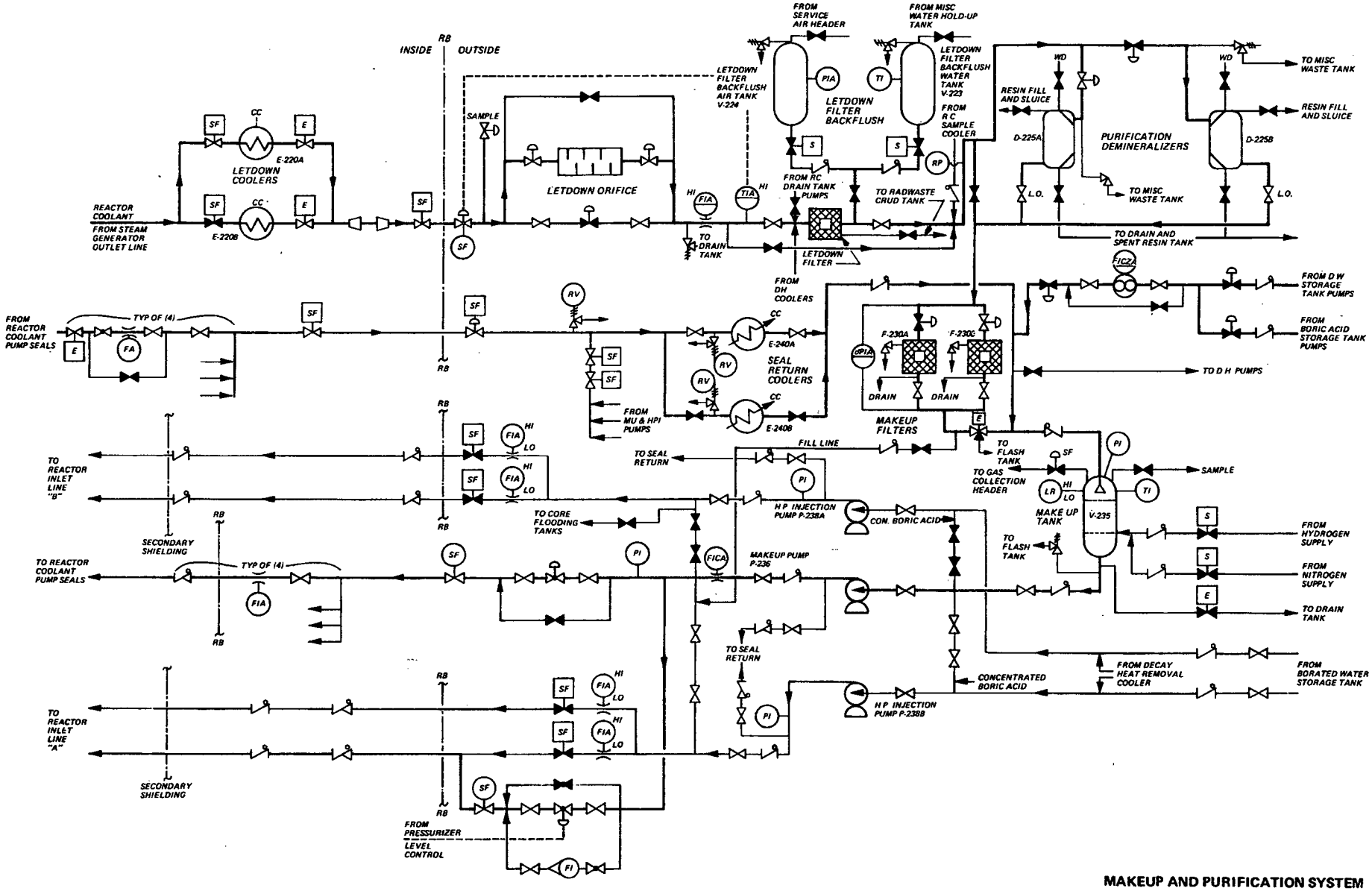
DIAGRAM OF REACTOR COOLANT SYSTEM†



† Source FSAR

FIGURE 3.2

DIAGRAM OF MAKEUP AND PURIFICATION SYSTEM†



MAKEUP AND PURIFICATION SYSTEM

† Source - FSAR

TABLE 3.1

MAKEUP AND PURIFICATION SYSTEM PERFORMANCE AND COMPONENT DATA†

Normal letdown flow	45 gpm
Maximum letdown flow	140 gpm
Total seal flow to each reactor coolant pump	8 gpm
Seal inleakage to reactor coolant system per reactor coolant pump	7 gpm
Temperature to seals, normal/maximum	125/150°F
Purification letdown fluid temperature, normal/maximum	125/135°F
Makeup tank normal operating pressure range	15-35 psig
Makeup tank water volume, nominal	400 ft^3
Makeup Pump	
Type	Horizontal, multistage, centrifugal, mechanical seal
Rated capacity	300 gpm (also see figure 6.2-3)
Rated head	5,545 ft H_2O (also see figure 6.1-3)
Motor horsepower	700 nameplate hp
Pump material	SS wetted parts
Design pressure	3,000 psig
Design temperature	200°F
Letdown Cooler	
Type	Shell and spiral tube
Heat transferred	16.1×10^6 Btu/h
Letdown flow	3.5×10^4 lb/h

TABLE 3.1 (cont'd)

MAKEUP AND PURIFICATION SYSTEM PERFORMANCE AND COMPONENT DATA†

Letdown cooler inlet/outlet temperature	55/120°F
Material, shell/tube	CS/SS
Design pressure (shell/tube)	200/2,500 psig
Design temperature (shell/tube)	350/600°F
Cooling water flow (each)	2×10^5 lb/h
Code (tube/shell)	ASME III-C/VIII
Reactor Coolant Pump Seal Return Cooler	
Type	Shell and tube
Heat transferred	1.38×10^6 Btu/h
Seal return flow	9.2×10^4 lb/h
Seal return temperature change	140 to 125 F
Material (shell/tube)	CS/SS
Design pressure (shell/tube)	150/150 psig
Design temperature (shell/tube)	250/200°F
Cooling water flow (each)	9.2×10^4 lb/h
Code (tube/shell)	ASME III-C/VIII
Makeup Tank	
Volume	600 ft^3
Design pressure	100 psig
Design temperature	200°F
Material	SS
Code	ASME III-C

TABLE 3.1 (cont'd)

MAKEUP AND PURIFICATION SYSTEM PERFORMANCE AND COMPONENT DATA†

Letdown Filter	
Flow rate	140 gpm
Material	304 SS
Design pressure	900 psig
Design temperature	150°F
Code	ASME III-C
Purification Demineralizer	
Type	Mixed bed, boric acid saturated
Material	SS
Resin volume	50 ft^3
Flow	140 gpm
Vessel design pressure	150 psig
Vessel design temperature	200°F
Code	ASME III-C
Makeup Filter	
Flow rate	80 gpm
Material	SS
Design pressure	300 psig
Design temperature	250°F
Code	ASME III-C

† Source FSAR Rancho Seco (9)

During normal operation, reactor coolant is let down from the cold leg of loop A through the letdown coolers and the letdown orifice and then through the letdown filter which removes particulate material. The letdown filter effluent provides inlet water to one of two mixed-bed purification demineralizers. The purification demineralizers contain boric acid saturated mixed-bed resin. Throughout the measurement program at Rancho Seco, purification demineralizer A was used exclusively. Demineralizer A is loaded with Amberlite IRN-150 LC resin, and was placed in service on 10/16/77. The demineralized effluent passes through one of two makeup filters (nominal pore size 1 micron) to remove any fine particulate washed from the purification demineralizer then to the makeup tank. This tank serves as a receiver for letdown water, chemical addition and system makeup. Makeup tank water is normally routed back to the reactor coolant system via a makeup inlet line and the reactor coolant pump seals. Either the makeup tank inlet or outlet streams can be directed to the reactor coolant radwaste system when boron removal is required.

Samples were obtained from the letdown filter effluent and the purification demineralizer effluent approximately weekly between 9/7/78 and 2/21/79. Samples of makeup filter effluent and makeup tank effluent were obtained on a less frequent basis. Sample lines for these sample points terminate in the hot lab sample sink. Samples were collected in 50 ml bottles as described in the Source Term Procedures (6) after a minimum of 30 minutes purge time.

The letdown filter is provided with a backflush system, and the filter is backflushed at intervals dependent on the ΔP registered across the filter. Flushing frequency is highly irregular. Prior to the refueling outage the letdown filter was backflushed at an average frequency of once per shift. At times daily flushes were used while at other times as many as five backflushes occurred in a single shift. After the refueling outage, filter backflushes were performed at a mean frequency of about once per week. The irregular backflushing schedule precluded establishing a sampling regime to directly test the effect of a flushing operation on the efficiency of the letdown filter. An attempt was made to correlate changes in the measured decontamination factor (DF) across the letdown filter with backflushing operations as recorded in the operator's log. While samples were obtained just prior to, just after, and perhaps even during backflush operations (at which time the filter is actually bypassed), no obvious correlation of filter DF with filter backflush was apparent. The backflushed waste is routed to the miscellaneous radwaste crud tank via the letdown filter backflush waste tank. Very high radiation levels at the sample locations for these tanks precluded their sampling during the in-plant measurement program.

3.2 Discussion of Measurement Data - Reactor Coolant

3.2.1 Radionuclide Concentrations

Reactor coolant samples were obtained approximately weekly between 9/7/78 and 3/7/79. This period covers the three stages of reactor

operation - power generation prior to refueling, refueling outage, and power generation following refueling. Results of analyses of these samples are contained in Appendix B, Tables B.1 and B.2.

Table 3.2 lists the average radionuclide concentrations in the reactor coolant measured during steady-state power operations. Averages are presented for the measurement periods prior to and following the refueling outage. Averages were not computed for the reactor coolant activities measured during refueling due to perturbations induced by radioactive decay and the mixing of reactor coolant water with that of the fuel transfer cavity.

Examination of Table 3.2 indicates that as a result of refueling the average ^{131}I concentration decreased by about a factor of two. Both the ^{134}Cs and ^{137}Cs concentrations increased by about 70%. It is not known why this increase occurred. All crud-associated radionuclides exhibited marked reductions in concentration after refueling. Typical reduction factors range from approximately 14 for ^{54}Mn to approximately 76 for ^{58}Co.

The measured concentration of radioiodines in the reactor coolant were used to evaluate the fission product release mode, and thus the overall fuel cladding integrity, for the periods of power operation both before and after refueling. The method used was that of Skarpelos and Gilbert (8). Appendix A presents a discussion of the technique and the calculational results for Rancho Seco. The analysis shows the release mechanism both before and after refueling to be a mixture of direct recoil from tramp uranium and diffusion releases from small ("pin-hole") cladding defects. The proportion of release attributed to diffusion decreased after refueling. This is expected since the overall cladding integrity was presumably improved as a result of the refueling operation. The spiking of reactor coolant radionuclide concentrations during power level changes is normally attributed to a diffusion release from the fuel rods.

Figure 3.3 shows plots of the power level and ^{131}I concentration in the reactor coolant. Hot lab analyses performed by SMUD are included. The connecting line does not indicate ^{131}I concentrations between measurement points but simply directs the eye from data point to data point. As Figure 3.3 indicates, the ^{131}I concentration in the reactor coolant spikes strongly upon reactor shutdown. Even the power dip to 54% power on 10/25/78 resulted in a small iodine spike. The only obvious spike on startup is that noted on 12/24/78 when power operations were resumed after the refueling outage. The 12/24/78 startup spike is about one-third the magnitude of the shutdown spikes noted. Nearly all commonly observed fission product radionuclides and crud-associated radionuclides exhibited varying degrees of spiking during shutdown. Figures 3.4 and 3.5 show the reactor coolant concentrations versus time for ^{137}Cs and ^{58}Co. Shutdown spikes are clearly visible.

TABLE 3.2

AVERAGE RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT DURING REACTOR POWER OPERATIONS †

Nuclide	Measured During Period†† 9/7/78 to 11/14/78 (μCi/ml)	Measured During Period * 1/3/79 to 3/6/79 (μCi/ml)
^{85m}Kr	4.5 ± 1.4(-2)	5.3 ± 2.5(-2)
^{85}Kr	<6.2(-2)	<6.5(-1)
^{87}Kr	5.5 ± 2.1(-2)	4.9 ± 1.1(-2)
^{88}Kr	9.5 ± 3.1(-2)	8.0 ± 1.8(-2)
^{131m}Xe	3.7(-3)	3.4(-3)
^{133m}Xe	2.2 ± 0.6(-2)	6.0 ± 4.5(-2)
^{133}Xe	7.9 ± 2.5(-1)	2.1 ± 1.3(0)
^{135m}Xe	6.4(-1)	4.3(-1)
^{135}Xe	3.0 ± 0.8(-1)	5.2 ± 5.3(-1)
^{137}Xe	<8.7(0)	<3.6(-1)
^{138}Xe	6.7 ± 2.5(-2)	2.4(-1)
^{84}Br	9.0(-2)	8.9(-3)
^{131}I	1.6 ± 0.4(-2)	8.8 ± 1.3(-3)
^{132}I	5.2 ± 1.5(-2)	4.2 ± 0.4(-2)
^{133}I	4.5 ± 0.5(-2)	3.6 ± 0.3(-2)
^{134}I	7.4 ± 2.3(-2)	7.1 ± 0.7(-2)
^{135}I	5.8 ± 0.9(-2)	4.8 ± 0.4(-2)
^{88}Rb	1.4 ± 0.8(-1)	1.1 ± 0.2(-1)
^{89}Rb	<3.8(-2)	<5.1(-2)
^{134}Cs	5.4 ± 1.8(-3)	9.3 ± 1.0(-3)
^{136}Cs	2.2 ± 0.8(-4)	1.4 ± 0.6(-4)
^{137}Cs	6.5 ± 2.1(-3)	1.1 ± 0.1(-2)
^{138}Cs	9.9 ± 5.4(-2)	9.2 ± 1.2(-2)
^{139}Cs	1.2(0)	5.6(-1)
^{41}Ar	6.5 ± 3.1(-3)	1.4 ± 0.7(-2)
^{3}H	2.23 ± 0.04(-1)	2.51 ± 0.04(-1)
^{14}C	2.1 ± 0.2(-5)	**
^{24}Na	1.2 ± 0.1(-2)	1.1 ± 0.2(-2)
^{32}P	2.1 ± 0.1(-4)	**
^{51}Cr	1.1 ± 1.1(-2)	<2.7(-4)
^{54}Mn	1.1 ± 1.2(-3)	7.7 ± 1.5(-5)
^{55}Fe	7.83 ± 0.04(-3)	**
^{59}Fe	8.8 ± 9.2(-4)	1.1(-5)
^{57}Co	7.9 ± 8.2(-5)	<7.3(-6)
^{58}Co	4.2 ± 4.1(-2)	5.5 ± 0.7(-4)
^{60}Co	1.5 ± 1.6(-3)	7.0 ± 1.1(-5)
^{63}Ni	2.43 ± 0.02(-4)	**
^{65}Zn	<2.3(-5)	<1.2(-5)

TABLE 3.2 (cont'd)

AVERAGE RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT DURING REACTOR POWER OPERATIONS †

Nuclide	Measured During Period †† 9/7/78 to 11/14/78 (μCi/ml)	Measured During Period * 1/3/79 to 3/6/79 (μCi/ml)
^{89}Sr	3.95 ± 0.07(-5)	**
^{90}Sr	2.71 ± 0.09(-6)	**
^{91}Sr	<5.0(-4)	<7.5(-4)
^{91}Y	1.61 ± 0.06(-5)	**
^{91m}Y	<5.0(-4)	<1.4(-3)
^{93}Y	<2.2(-3)	<2.3(-3)
^{95}Zr	4.6 ± 5.7(-4)	<1.1(-5)
^{95}Nb	8.0 ± 9.5(-4)	<9.3(-6)
^{99}Mo	1.9 ± 0.8(-3)	1.1 ± 0.6(-3)
^{103}Ru	1.1 ± 1.2(-4)	<1.2(-5)
^{106}Rh	<1.6(-4)	<1.8(-4)
^{110m}Ag	1.5(-4)	<1.8(-5)
^{124}Sb	5.7 ± 8.2(-5)	<5.6(-6)
^{125}Sb	<4.7(-5)	<4.1(-5)
^{129m}Te	<3.2(-4)	<2.2(-4)
^{129}Te	<6.0(-2)	<6.9(-2)
^{131m}Te	<4.0(-4)	<3.4(-4)
^{131}Te	5.9(-3)	<7.0(-3)
^{132}Te	3.4(-5)	<1.7(-5)
^{139}Ba	1.4(-2)	1.4(-2)
^{140}Ba	1.6(-4)	2.8 ± 1.1(-4)
^{140}La	1.0(-4)	<8.4(-5)
^{141}Ce	4.1(-5)	<3.9(-5)
^{143}Ce	<1.4(-4)	<1.9(-4)
^{144}Ce	3.8(-4)	<4.2(-4)
^{152}Eu	<9.6(-5)	<5.8(-5)
^{154}Eu	<1.3(-5)	<1.3(-5)
^{155}Eu	<2.2(-4)	<3.5(-4)
^{187}W	2.9 ± 1.4(-3)	1.8 ± 1.0(-3)
^{239}Np	1.2(-3)	<1.1(-4)
^{238}Pu	2.60 ± 0.09(-8)	9 ± 10(-9)
$^{239/240}Pu$	4.9 ± 0.2(-8)	1.7 ± 1.5(-8)
^{241}Am	1.7 ± 0.1(-8)	2 ± 3(-9)
^{244}Cm	1.97 ± 0.06(-8)	1 ± 2(-8)
^{242}Cm	4.5 ± 0.2(-7)	2 ± 4(-9)

† Averages were computed as described in Appendix A

†† Data obtained from the following samples (see Appendix B)

1012, 9/14/78	1128, 10/4/78	0940, 11/1/78
1401, 9/20/78	1140, 10/12/78	0920, 11/8/78
1438, 9/22/78	1149, 10/18/78	1145, 11/13/78
1130, 9/27/78	1431, 10/24/78	

* Data obtained from the following samples (see Appendix B)

0922, 1/11/79	1338, 2/2/79	0903, 2/14/79
1408, 1/17/79	1116, 2/8/79	0953, 2/21/79
		1510, 3/6/79

** Analysis not performed for radionuclide.

FIGURE 3.3

POWER LEVEL AND ^{131}I CONCENTRATION IN REACTOR COOLANT

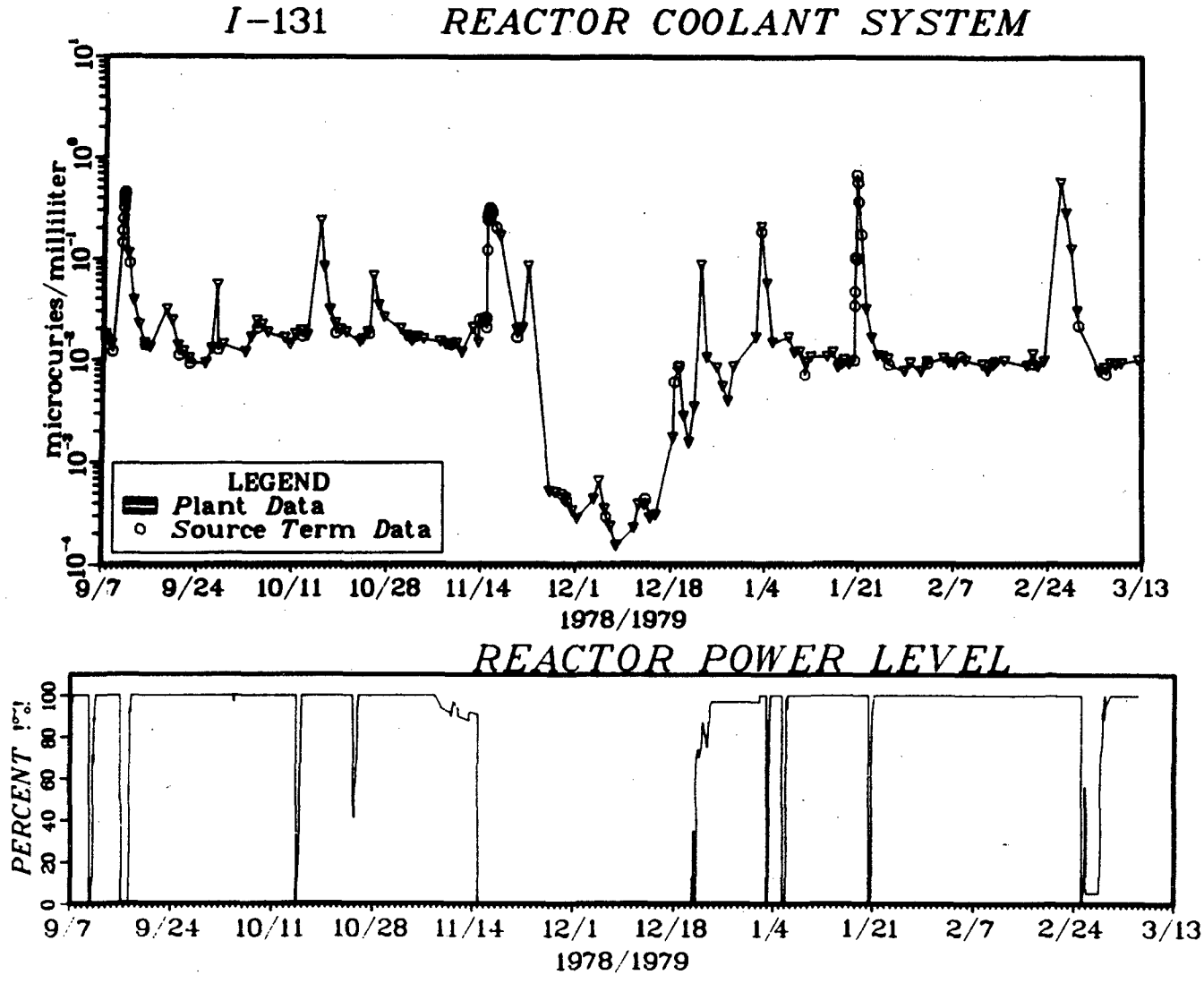


FIGURE 3.4

^{137}Cs CONCENTRATION IN REACTOR COOLANT

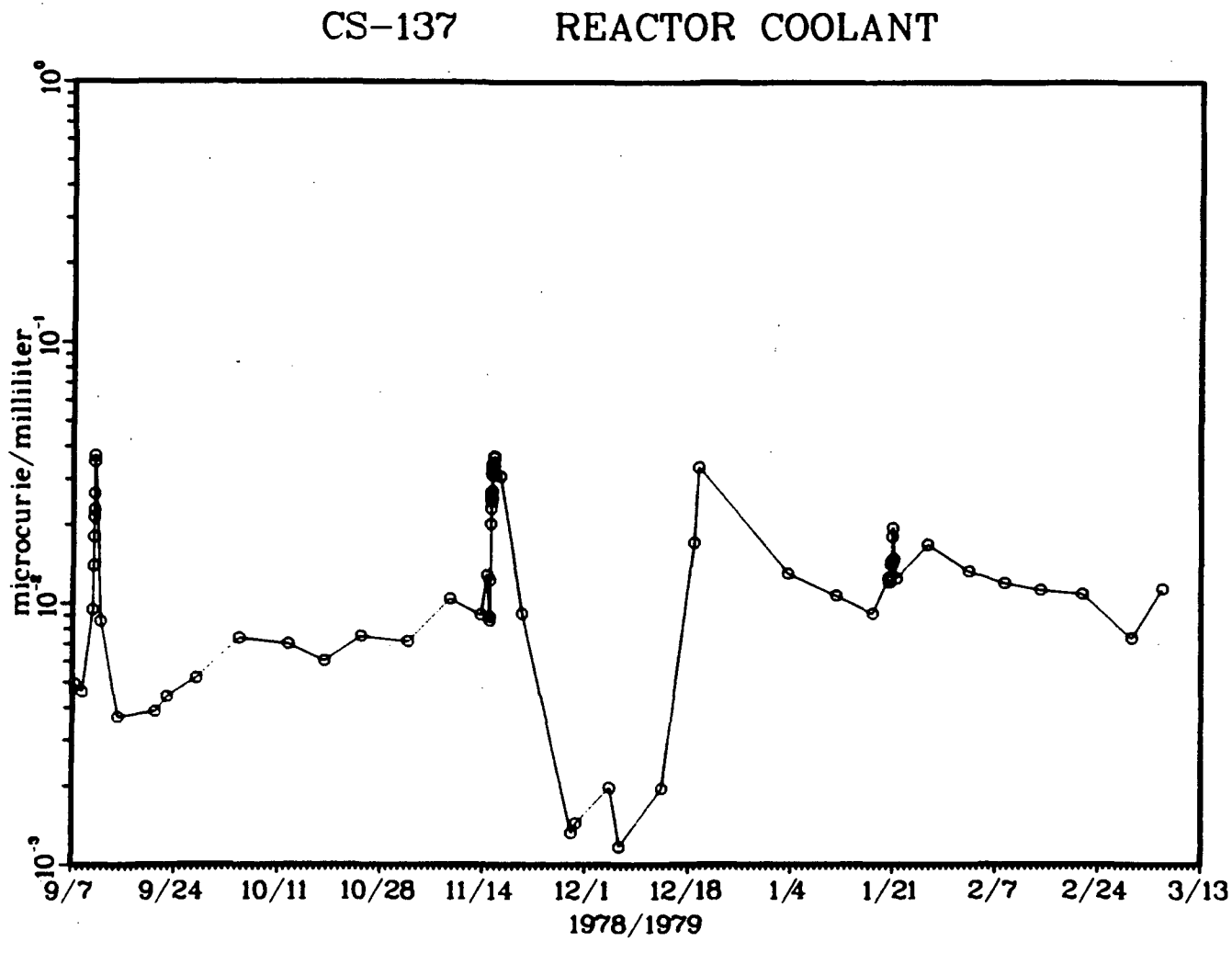
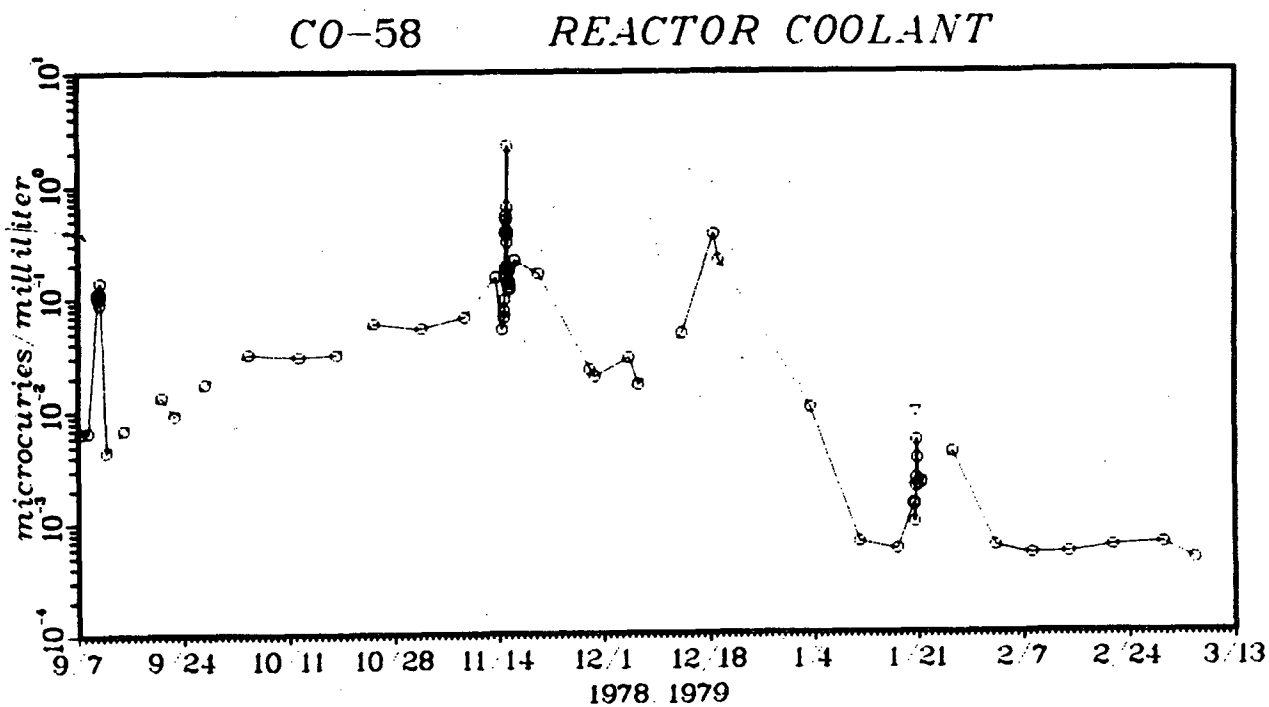


FIGURE 3.5

^{58}Co CONCENTRATION IN REACTOR COOLANT



3.2.2 Predicted Radionuclide Concentrations in Coolant Waters

The American Nuclear Society, Standards Committee Working Group ANS-18.1 has prepared a set of typical radionuclide concentrations for use in estimating the radioactivity in the principal fluid streams of a light water reactor over its lifetime (7). Expected radionuclide concentrations in the primary and secondary coolants for Rancho Seco can be derived from the ANSI N237-1976 values by adjusting the parameters of the reference PWR to those of Rancho Seco. Table 3.3 presents these expected activity levels and Table 3.4 lists the parameters used for adjustment of the reference PWR to Rancho Seco. These parameters are for once through steam generators and assume all volatile treatment (AVT) of the secondary coolant.

Although the techniques used to collect the data in the in-plant measurement study are capable of detecting all gamma-emitting radionuclides present in any sample, some radionuclides treated in ANSI N237-1976 were not observed at Rancho Seco (cf the radionuclides denoted with an asterisk in Table 3.3). These radionuclides were not observed because they were either not present in detectable quantities, they have very short half lives, or they emit only very low energy gamma rays. For example, ^{86}Rb and ^{130}I are present only in very small amounts because of their very low fission yields (about 2(-3)% for each isotope). In addition, their gamma rays are masked by gamma rays of about the same energy emitted by more abundant radionuclides. The radionuclides ^{16}N, ^{85}Br, and ^{89}Kr have very short half-lives which precluded their detection by the measurement techniques utilized in the in-plant studies. The radionuclides ^{83}Br and ^{83m}Kr could not be detected due to their very low gamma-ray energies. Other radionuclides such as ^{90}Y, ^{91m}Y, ^{99m}Tc, ^{103m}Rh, ^{106}Ru, ^{137m}Ba, ^{143}Pr, and ^{144}Pr could not be detected due to very low gamma-ray intensities or interferences from other radionuclides, but they are parents or daughters of radionuclides that were measured. The concentrations of these radionuclides can be estimated by assuming that they are in equilibrium with their parent or daughter. The tellurium isotopes were not detected with any consistency since they are held on the reactor internals (4).

In Table 3.5 the radionuclide concentrations predicted for Rancho Seco reactor coolant are compared with the average concentrations actually measured during steady-state power operations. In general, the predictions agree well with measured values. For the fission gas nuclides, the predictions agree well with measurements for the kryptons and some xenons, but tend to be high for the majority of the xenon isotopes. Predictions for the radiohalogens, rubidiums and radiocesiums are somewhat high. The predicted tritium concentration is a factor of 4 to 5 higher than that measured. Predicted concentrations for the normal crud-associated radionuclides and other fission product radionuclides compare well with the measured concentrations, tending to be midway between the results measured before and after refueling for nearly all isotopes.

TABLE 3.3

PREDICTED RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT AND SECONDARY COOLANT†

Nuclide	Reactor Coolant (μCi/g)	Secondary** Coolant (μCi/g)
* ^{83m}Kr	1.9(-2)	6.3(-9)
^{85m}Kr	9.8(-2)	3.4(-8)
^{85}Kr	2.4(-1)	8.2(-8)
^{87}Kr	5.3(-2)	1.8(-8)
^{88}Kr	1.8(-1)	6.0(-8)
* ^{89}Kr	4.4(-3)	1.5(-9)
^{131m}Xe	1.1(-1)	3.8(-8)
^{133m}Xe	2.0(-1)	7.0(-8)
^{133}Xe	1.7(+1)	5.8(-6)
^{135m}Xe	1.2(-2)	3.9(-9)
^{135}Xe	3.1(-1)	1.1(-7)
^{137}Xe	8.0(-3)	2.7(-9)
^{138}Xe	3.9(-2)	1.3(-8)
* ^{83}Br	4.2(-3)	3.4(-10)
^{84}Br	2.3(-3)	1.8(-10)
* ^{85}Br	2.7(-4)	2.1(-11)
*^{130}I	1.8(-3)	1.4(-10)
^{131}I	2.3(-1)	1.9(-8)
^{132}I	8.8(-2)	6.9(-9)
^{133}I	3.3(-1)	2.6(-8)
^{134}I	4.2(-2)	3.2(-9)
^{135}I	1.7(-1)	1.3(-8)
* ^{86}Rb	8.0(-5)	1.0(-11)
^{88}Rb	1.8(-1)	2.8(-8)
^{134}Cs	2.4(-2)	3.0(-9)
^{136}Cs	1.2(-2)	1.5(-9)
^{137}Cs	1.7(-2)	2.3(-9)
* ^{16}N	4.0(+1)	1.0(-6)
^{3}H	1.0(0)	1.0(-3)
^{51}Cr	1.6(-3)	1.3(-10)
^{54}Mn	2.6(-4)	2.8(-11)
^{55}Fe	1.4(-3)	1.1(-10)
^{59}Fe	8.6(-4)	7.1(-11)
^{58}Co	1.4(-2)	1.1(-9)
^{60}Co	1.7(-3)	1.3(-10)
^{89}Sr	3.0(-4)	2.8(-11)
^{90}Sr	8.6(-6)	7.1(-13)
^{91}Sr	5.7(-4)	4.3(-11)
* ^{90}Y	1.0(-6)	8.6(-14)
^{91m}Y	3.2(-4)	2.9(-11)
* ^{91}Y	5.5(-5)	4.3(-12)
^{93}Y	3.0(-5)	2.9(-12)

TABLE 3.3 (cont'd)

PREDICTED RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT AND SECONDARY COOLANT†

Nuclide	Reactor Coolant (μCi/g)	Secondary** Coolant (μCi/g)
^{95}Zr	5.1(-5)	4.3(-12)
^{95}Nb	4.3(-5)	2.8(-12)
^{99}Mo	7.2(-2)	5.7(-8)
* ^{99m}Tc	4.2(-2)	2.9(-8)
^{103}Ru	3.8(-5)	2.8(-12)
*^{106}Ru	8.6(-6)	7.1(-13)
^{103m}Rh	4.0(-5)	2.9(-12)
^{106}Rh	8.9(-6)	7.3(-13)
^{125m}Te	2.5(-5)	1.4(-12)
^{127m}Te	2.4(-4)	1.4(-11)
^{127}Te	7.4(-4)	5.8(-11)
^{129m}Te	1.2(-3)	9.9(-11)
^{129}Te	1.4(-3)	1.2(-10)
^{131m}Te	2.2(-3)	1.4(-10)
^{131}Te	9.7(-4)	7.3(-11)
^{132}Te	2.3(-2)	1.4(-9)
*^{137m}Ba	1.4(-2)	1.2(-9)
^{140}Ba	1.9(-4)	1.4(-11)
^{140}La	1.3(-4)	1.0(-11)
^{141}Ce	6.0(-5)	4.3(-12)
^{143}Ce	3.5(-5)	2.9(-12)
^{144}Ce	2.8(-5)	2.8(-12)
*^{143}Pr	4.3(-5)	2.8(-12)
*^{144}Pr	2.9(-5)	2.9(-12)
^{239}Np	1.0(-3)	8.6(-11)

† - Prediction based on ANSI N237-1976 Standard (7)

* - Radionuclide treated in ANSI N237-1976 but not directly measured at Rancho Seco.

** - Calculation assumes all volatile treatment chemistry for secondary water.

TABLE 3.4

PARAMETERS USED TO ADJUST N237 REFERENCE
PWR PREDICTED REACTOR COOLANT CONCENTRATIONS TO RANCHO SECO STATION

Parameter	Symbol	Unit	Rancho Seco Value
Thermal power	P	MWt	2772*
Steam flow rate (all generators)	FS	lbs/hr	1.22(7)*
Weight of water in reactor coolant system	WP	lbs	5.07(5)**
Weight of water in all steam generators	WS	lbs	1.01(5)**
Reactor coolant letdown flow (purification)	FD	lbs/hr	3.50(4)**
Reactor coolant letdown flow (yearly average for boron control)	FB	lbs/hr	2.53(2)†
Flow through the purification system cation demineralizer	FA	lbs/hr	0.0††
Ratio of condensate demineralizer flow rate to the total steam flow rate	NC	---	0.77**
Ratio of the total amount of noble gases routed to the gaseous radwaste from the purification system to the total amount routed from the purification system (not including the boron recovery system)	Y	---	0.0**

* Information from FSAR (9).

** Based on information obtained during measurement program.

† Estimated using plant personnel's suggestion of integrating over a yearly cycle boron decrease from 800 ppm to 10 ppm.

†† A cation demineralizer is installed but was not in service during the measurement program.

TABLE 3.5

COMPARISON OF PREDICTED AND MEASURED
RADIONUCLIDE CONCENTRATION IN REACTOR COOLANT

Nuclide	Predicted † Concentration (μCi/ml)	Measured Concentration Before Refueling (μCi/ml)	Measured Concentration After Refueling (μCi/ml)
^{85m}Kr	9.8(-2)	4.5(-2)	5.3(-2)
^{85}Kr	2.4(-1)	<6.2(-2)	<6.5(-1)
^{87}Kr	5.3(-2)	5.5(-2)	4.9(-2)
^{88}Kr	1.8(-1)	9.5(-2)	8.0(-2)
^{131m}Xe	1.1(-1)	3.7(-3)	3.4(-3)
^{133m}Xe	2.0(-1)	2.2(-2)	6.0(-2)
^{133}Xe	1.7(+1)	7.9(-1)	2.1(0)
^{135m}Xe	1.2(-2)	6.4(-1)	4.3(-1)
^{135}Xe	3.1(-1)	3.0(-1)	5.2(-1)
^{137}Xe	8.0(-3)	<8.7(0)	<3.6(-1)
^{138}Xe	3.9(-2)	6.7(-2)	2.4(-1)
^{84}Br	2.3(-3)	9.0(-2)	8.9(-3)
^{131}I	2.3(-1)	1.6(-2)	8.8(-3)
^{132}I	8.8(-2)	5.2(-2)	4.2(-2)
^{133}I	3.3(-1)	4.5(-2)	3.6(-2)
^{134}I	4.2(-2)	7.4(-2)	7.1(-2)
^{135}I	1.7(-1)	5.8(-2)	4.8(-2)
^{88}Rb	1.8(-1)	1.4(-1)	1.1(-1)
^{89}Rb	*	<3.8(-2)	<5.1(-2)
^{134}Cs	2.4(-2)	5.4(-3)	9.3(-3)
^{136}Cs	1.2(-2)	2.2(-4)	1.4(-4)
^{137}Cs	1.7(-2)	6.5(-3)	1.1(-2)
^{138}Cs	*	9.9(-2)	9.2(-2)
^{139}Cs	*	1.16(0)	5.6(-1)
^{41}Ar	*	6.5(-3)	1.4(-2)
^{3}H	1.0(0)	2.2(-1)	2.5(-1)
^{14}C	*	2.1(-5)	**
^{24}Na	*	1.2(-2)	1.1(-2)
^{32}P	*	2.1(-4)	**
^{51}Cr	1.6(-3)	1.1(-2)	<2.7(-4)
^{54}Mn	2.6(-4)	1.1(-3)	7.7(-5)
^{55}Fe	1.4(-3)	7.8(-3)	**
^{59}Fe	8.6(-4)	8.8(-4)	1.1(-5)
^{57}Co	*	7.9(-5)	<7.3(-6)
^{58}Co	1.4(-2)	4.2(-2)	5.5(-4)
^{60}Co	1.7(-3)	1.5(-3)	7.0(-5)
^{63}Ni	*	2.4(-4)	**
^{65}Zn	*	<2.3(-5)	<1.2(-5)
^{89}Sr	3.0(-4)	4.0(-5)	**
^{90}Sr	8.6(-6)	2.7(-6)	**
^{91}Sr	5.7(-4)	<5.0(-4)	<7.5(-4)

TABLE 3.5 (cont'd)

COMPARISON OF PREDICTED AND MEASURED
RADIONUCLIDE CONCENTRATION IN REACTOR COOLANT

Nuclide	Predicted † Concentration (μCi/ml)	Measured Concentration Before Refueling (μCi/ml)	Measured Concentration After Refueling (μCi/ml)
^{91m}Y	3.2(-4)	<5.0(-4)	<1.4(-3)
^{91}Y	5.5(-5)	1.6(-5)	**
^{93}Y	3.0(-5)	<2.2(-3)	<2.3(-3)
^{95}Zr	5.1(-5)	4.6(-4)	<1.1(-5)
^{95}Nb	4.3(-5)	8.0(-4)	<9.3(-6)
^{99}Mo	7.2(-2)	1.9(-3)	1.1(-3)
^{103}Ru	3.8(-5)	1.1(-4)	<1.2(-5)
^{106}Rh	8.9(-6)	<1.6(-4)	<1.8(-4)
^{110m}Ag	*	1.5(-4)	<1.8(-5)
^{124}Sb	*	5.7(-5)	<5.6(-6)
^{125}Sb	*	<4.7(-5)	<4.1(-5)
^{129m}Te	1.2(-3)	<3.2(-4)	<2.2(-4)
^{129}Te	1.4(-3)	<6.0(-2)	<6.9(-2)
^{131m}Te	2.2(-3)	<4.0(-4)	<3.4(-4)
^{131}Te	9.7(-4)	5.9(-3)	<7.0(-3)
^{132}Te	2.3(-2)	3.4(-5)	<1.7(-5)
^{139}Ba	*	1.4(-2)	1.4(-2)
^{140}Ba	1.9(-4)	1.6(-4)	2.8(-4)
^{140}La	1.3(-4)	1.0(-4)	<8.4(-5)
^{141}Ce	6.0(-5)	4.1(-5)	<3.9(-5)
^{143}Ce	3.5(-5)	<1.4(-4)	<1.9(-4)
^{144}Ce	2.8(-5)	3.8(-4)	<4.2(-4)
^{152}Eu	*	<9.6(-5)	<5.8(-5)
^{154}Eu	*	<1.3(-5)	<1.3(-5)
^{155}Eu	*	<2.2(-4)	<3.5(-4)
^{187}W	*	2.9(-3)	1.8(-3)
^{239}Np	1.0(-3)	1.2(-3)	<1.1(-4)

* Radionuclide not treated in ANSI N237-1976.

** Analysis not performed for radionuclide.

† Prediction based on ANSI N237-1976 model (7).

3.2.3 Spiking Studies

As noted in section 3.2.1, reactor coolant concentrations of the radioiodines, cesiums, and most crud-associated radionuclides spike strongly during abrupt reactor power changes. Three such spikes resulting from reactor shutdowns were followed in detail. Reactor coolant samples were obtained on approximately an hourly basis during the spiking studies.

On 9/10/78 Rancho Seco underwent a hot shutdown. Reactor power started declining between 0400 and 0500 and reached zero power between 0600 and 0700. Complete shutdown lasted about six hours. The power increase was quite gradual starting at about 1300 hours and not reaching 100% power until about 0600 hours on 9/11/78. The reactor coolant concentrations during the shutdown period were studied in detail. Samples of the reactor coolant were obtained approximately hourly from about 0700 to 1400 on 9/10/78. Results of the analysis of these samples are presented in Appendix Table B.2, and results for ^{131}I, ^{134}Cs and ^{58}Co for the spike period are displayed in Figures 3.6, 3.7, and 3.8.

As indicated in Figures 3.6-3.8 and Appendix Table B.2, spiking for most longer-lived nuclides appears to have reached a maximum at about 1400 hours on 9/10/78. The actual point of maximum spiking is difficult to determine since the reactor power started to raise at 1300 and spike sampling stopped at the SMUD shift change. During the early stages of the measurement program, SMUD personnel were required to draw samples. For other special situations (e.g., spikes) later on in the measurement program, arrangements were made to continue sampling after shift change. The apparent maximum spike occurred 9 to 10 hours after the start of power decline and 7 to 8 hours after 0% power was reached. The shorter-lived nuclides spiked earlier. The measured concentrations of ^{131}I, ^{134}Cs and ^{58}Co spiked at values of about 38, 9.2, and 21 times the prespike levels, respectively.

On 11/15/78 the reactor went to cold shutdown for refueling. Prior to power reduction the power level had been steady at 91%. Power reduction started at about 2200 hours on 11/14/78 and 0% was reached at about 0200 on 11/15/78. In addition to collecting reactor coolant samples on an hourly basis, certain reactor conditions were recorded from the control room instrumentation. Reactor conditions corresponding to samples obtained during the spiking study are presented in Table 3.6. Reactor coolant temperatures and pressures were kept up until about 0800 on 11/15/78 when a gradual cooldown commenced. Cooldown was completed by 1700 hours on 11/15/78. The results of analyses of the samples obtained are given in Appendix Table B.2. Figures 3.9, 3.10, and 3.11 display the ^{131}I, ^{137}Cs, and ^{58}Co behavior, respectively. The ^{131}I concentration reached a maximum concentration at about 0900 hours and remained essentially constant until 1200 hours. The cobalt activities (^{60}Co and ^{58}Co) exhibited a minor spike at about 0600 hours, and then spiked strongly at about 1000. The longer-lived radiocesiums reached maximum concentration at about 1200. Thus, depending on the nuclide, maximum spiking occurred from 7 hours to 10 hours after 0% power was

FIGURE 3.6

^{131}I CONCENTRATION IN REACTOR COOLANT DURING 9/10-11/78 SPIKING STUDY

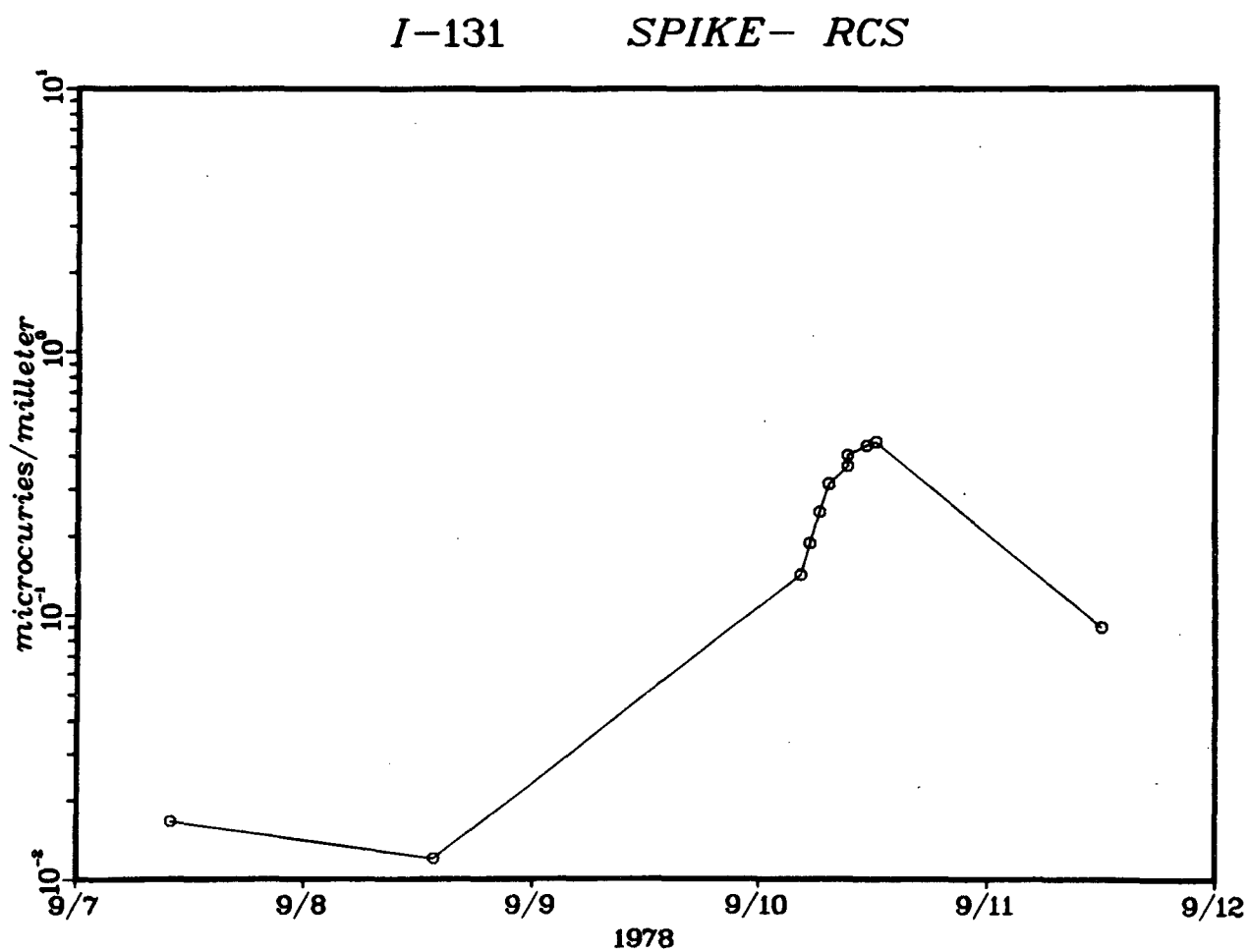


FIGURE 3.7

^{137}Cs CONCENTRATION IN REACTOR COOLANT DURING 9/10-11/78 SPIKING STUDY

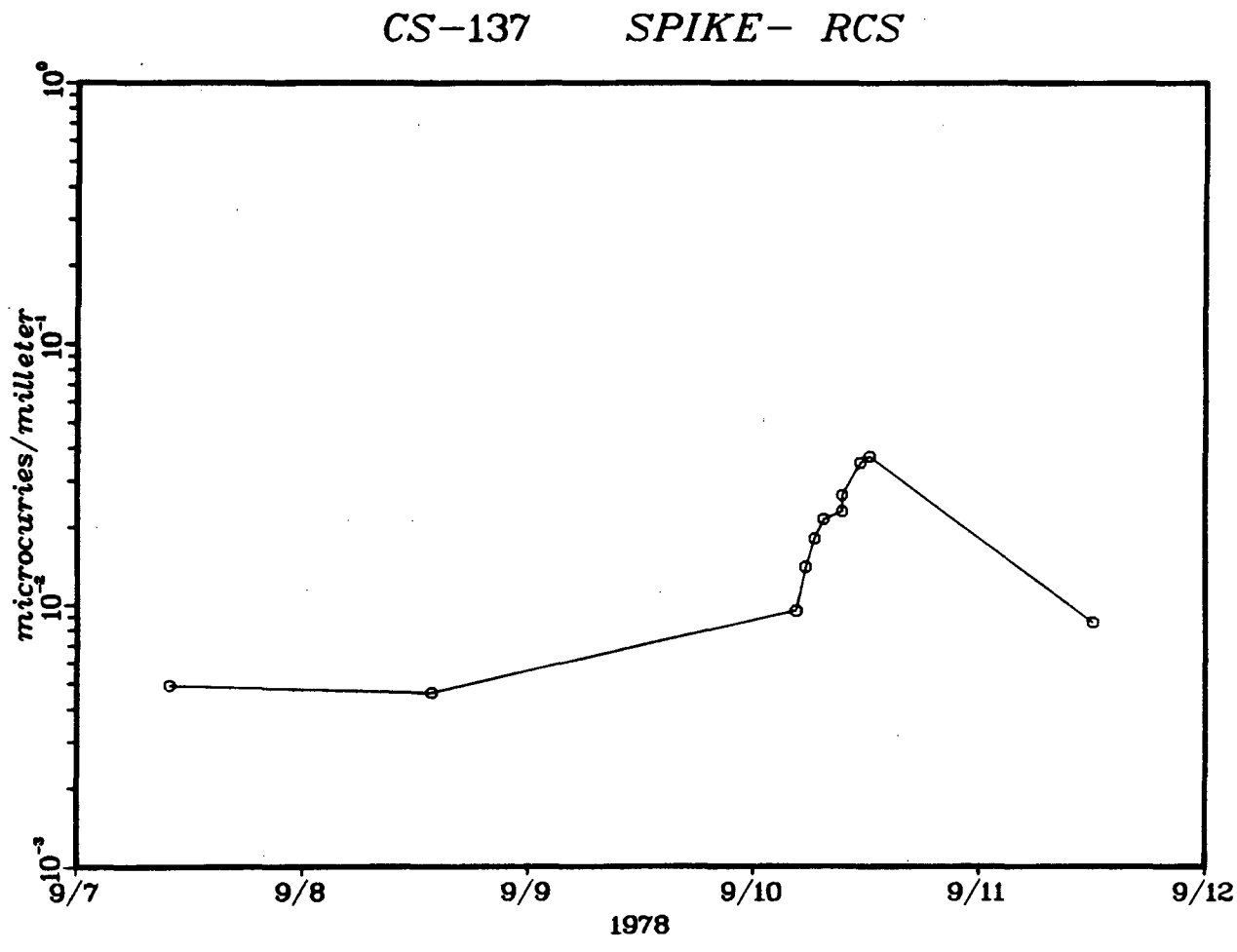


FIGURE 3.8

^{58}Co CONCENTRATION IN REACTOR COOLANT DURING 9/10-11/78 SPIKING STUDY

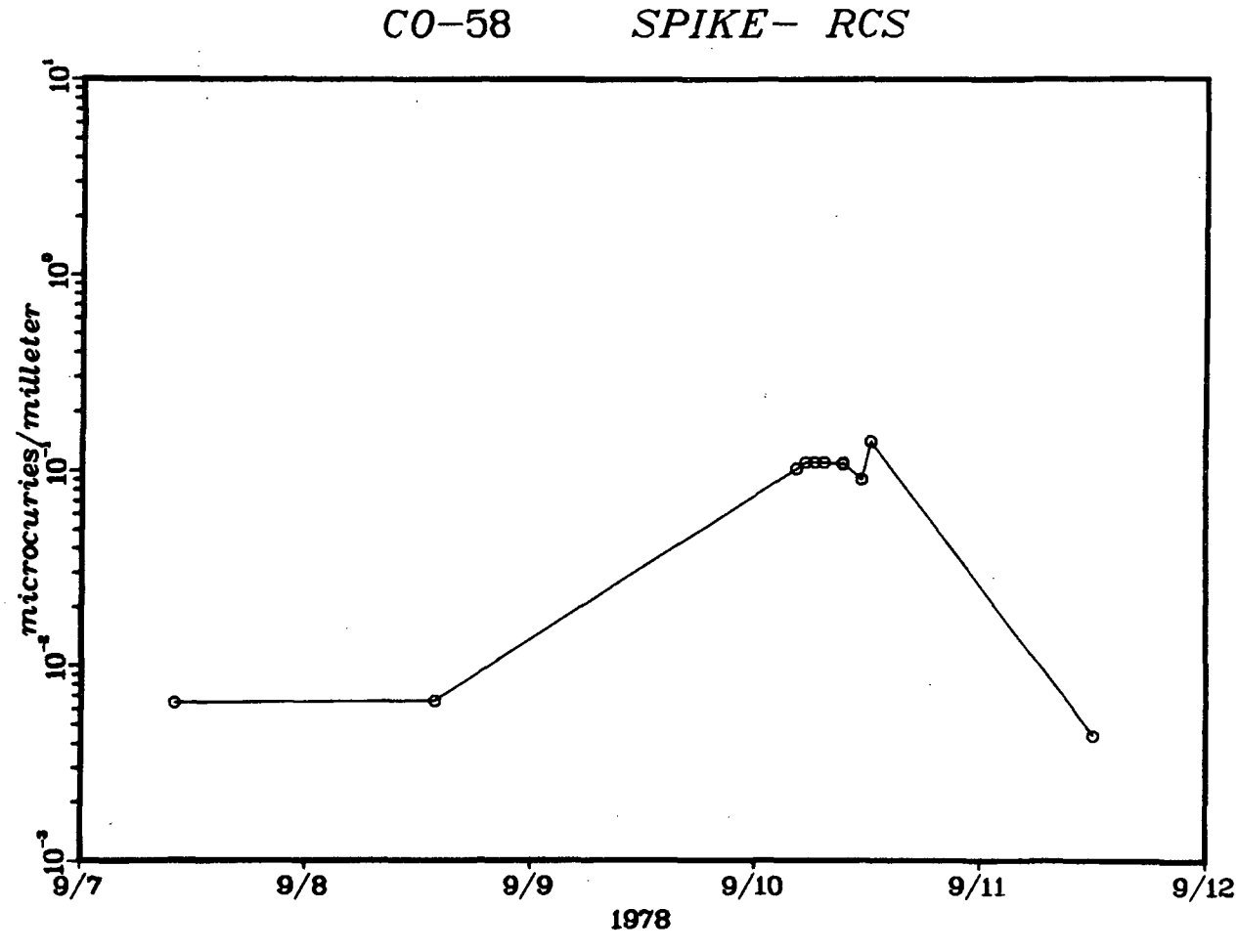


TABLE 3.6

REACTOR CONDITIONS DURING THE 11/14-15/78 SPIKING STUDY

Sample Number	Date	Time	% Power	Letdown Flow (GPM)	Coolant * Temp (°F)	Coolant ** Pressure (psi)
82	11/14/78	2155	91	75	558	2140
83	11/14/78	2257	28	75	567	2130
84	11/14/78	2357	3	75	574	2140
85	11/15/78	0100	3	75	565	2130
86 †	11/15/78	0100	3	75	565	2130
87	11/15/78	0200	0	75	551	2140
88 ††	11/15/78	0303	0	75	537	2145
89	11/15/78	0403	0	75	529	2150
90	11/15/78	0503	0	75	531	2135
91	11/15/78	0601	0	75	527	2145
92	11/15/78	0703	0	75	529	2140
93 †	11/15/78	0706	0	75	529	2140
94 ††	11/15/78	0800	0	75	530	2170
95	11/15/78	0905	0	75	510	2110
96	11/15/78	0958	0	75	485	1940
97	11/15/78	1100	0	75	485	1715
98	11/15/78	1200	0	60	460	1400
99	11/15/78	1300	0	50	420	900
100	11/15/78	1400	0	60	375	525
101 †	11/15/78	1403	0	60	375	525
102	11/15/78	1506	0	50	340	325
103	11/15/78	1600	0	50	320	200

* Recorded temperatures are average figures for T_c ≡ steam generator out.

** Average of registered pressure of loops A & B.

† Liquid bomb samples obtained for noble gas determinations.

†† Letdown filter and purification demineralizer effluent sampled along with the reactor coolant.

FIGURE 3.9

^{131}I CONCENTRATION IN REACTOR COOLANT DURING 11/14-15/78 SPIKING STUDY

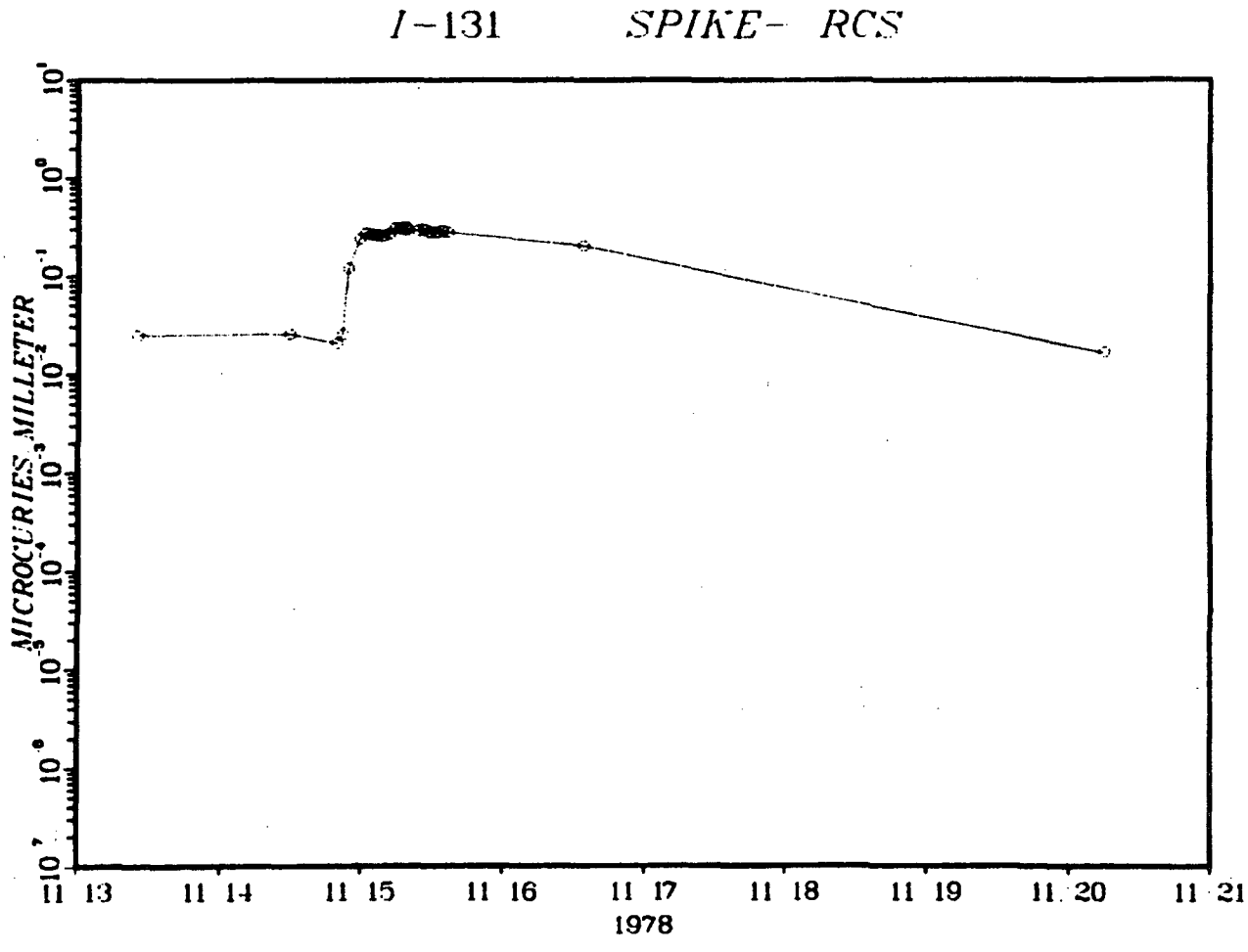


FIGURE 3.10

^{137}Cs CONCENTRATION IN REACTOR COOLANT DURING 11/14-15/78 SPIKING STUDY

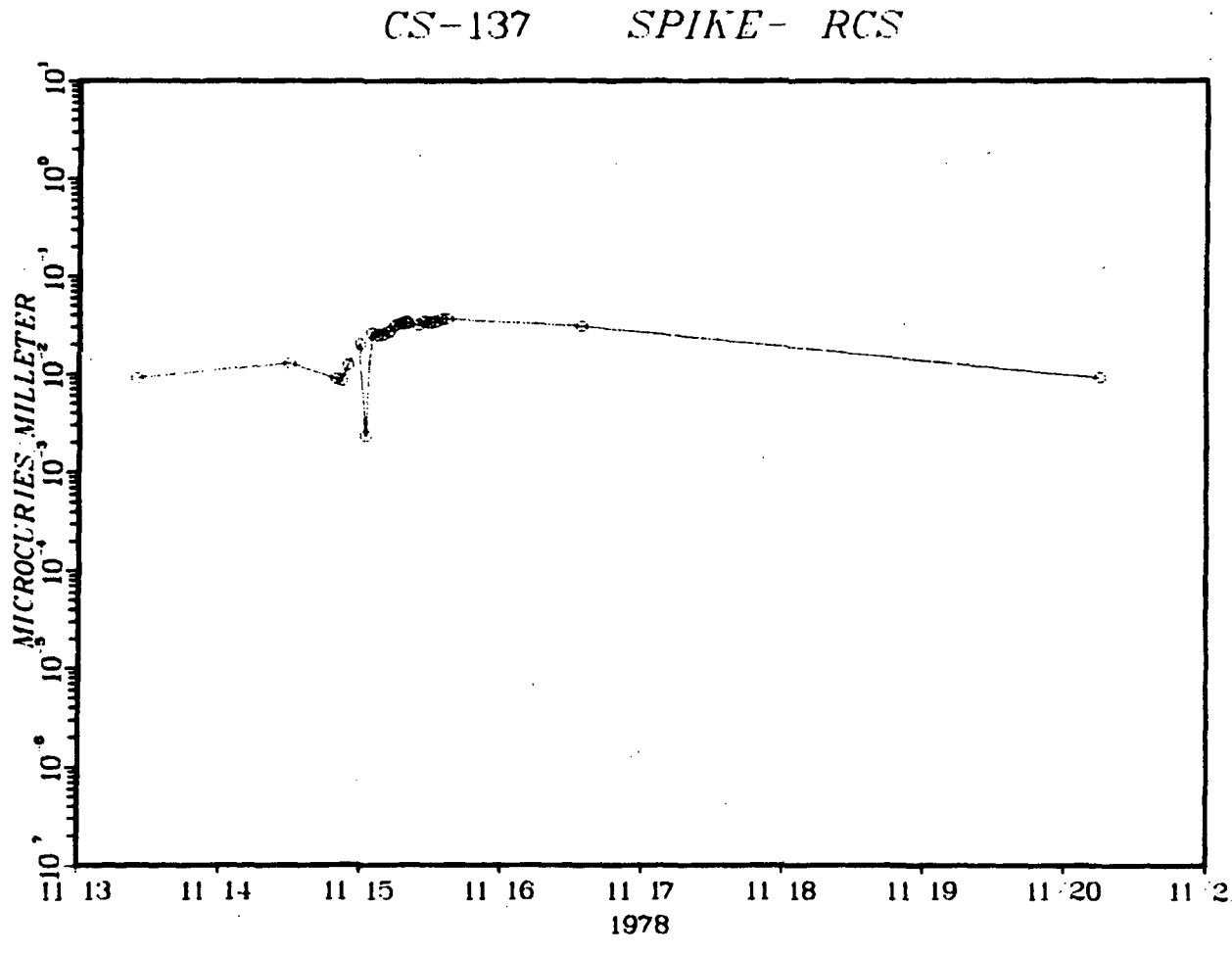
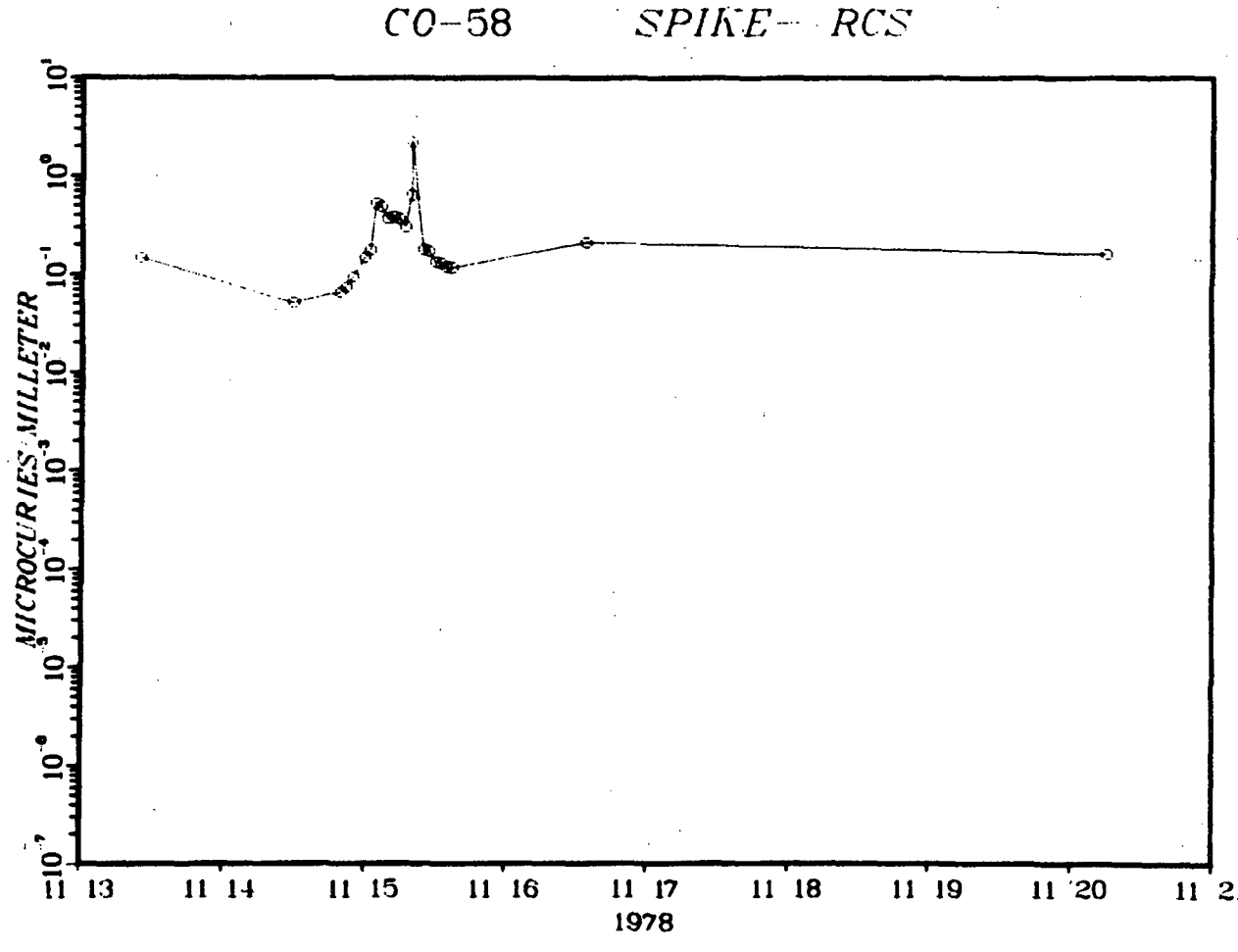


FIGURE 3.11

^{58}Co CONCENTRATION IN REACTOR COOLANT DURING 11/14-15/78 SPIKING STUDY



reached. As observed during the 9/10/78 spike, the shorter-lived radionuclides tended to spike much earlier. At their maxima, the ^{131}I, ^{134}Cs and ^{58}Co activities reached levels of about 13, 4, and 37 times their pre-spike levels, respectively.

Results for three samples that contained noble gases are presented in Appendix Table B.1. All of the noble gases registered their maximum concentrations in the sample obtained at 0100 hours. This rapid spiking is consistent both with the generally shorter half-lives of the fission gases and with their high mobility during a diffusion-type release. The paucity of gas data precludes a complete analysis of noble gas spiking.

Analysis of purification demineralizer effluent data accumulated during the 11/15/78 spike (see section 3.3.3) generated an interest in following the behavior of the letdown demineralizer during reactor coolant spiking. Thus, when a hastily scheduled hot shutdown occurred on 1/20/79, a modified system of spiking study was employed. Power reduction commenced at about 0600 on 1/20/79 and 0% power was reached at about 0900. The complete shutdown lasted for about seven hours and the power reached 91% at 2100 hours where it was held until about 0600 hours on 1/21/79 when the final increase to 100% was registered. During this spiking study, samples of the purification demineralizer effluent were taken hourly, along with samples of either the letdown filter effluent or the reactor coolant. The letdown filter and the reactor coolant were alternately sampled so that each was sampled every two hours. The discussion of the results for the letdown components is reported in section 3.3.3. This method of spike studying provided a reactor coolant sample at approximately two-hour intervals rather than the normal one-hour spacing; however, for the soluble species such as iodine and cesium whose concentrations are not appreciably affected by filtering, the letdown filter effluent provides data indicative of the reactor coolant concentrations between actual primary samples. Samples were obtained in this manner from 0605 to 1900 hours on 1/20/79 and then with somewhat less than a two-hour frequency until 1214 on 1/21/79. Analytical results are given in Appendix Tables B.2 and B.3, and the combined RCS and letdown filter effluent concentrations for ^{131}I and ^{134}Cs are displayed in Figures 3.12 and 3.13. The maximum concentrations for ^{131}I, ^{134}Cs, and ^{58}Co were all registered at 1638, some 7.5 hours after complete shutdown. The ^{137}Cs concentration spiked somewhat later at 1904. The maximum concentrations reached during spiking for ^{131}I, ^{134}Cs, ^{137}Cs, and ^{58}Co were factors of about 74, 1.5, 1.8, and 9, respectively, greater than pre-spike levels.

3.3 Discussion of Measurement Data - Makeup and Purification System

3.3.1 Sample Characteristics

Sample points available from the makeup and purification system include (1) the effluent of the letdown filter, (2) the effluent of purification demineralizer A, (3) the effluent of the makeup filter, and (4) the makeup tank effluent as shown in Figure 3.2. Samples of these

FIGURE 3.12

^{131}I CONCENTRATION IN REACTOR COOLANT DURING 1/20-21/79 SPIKING STUDY

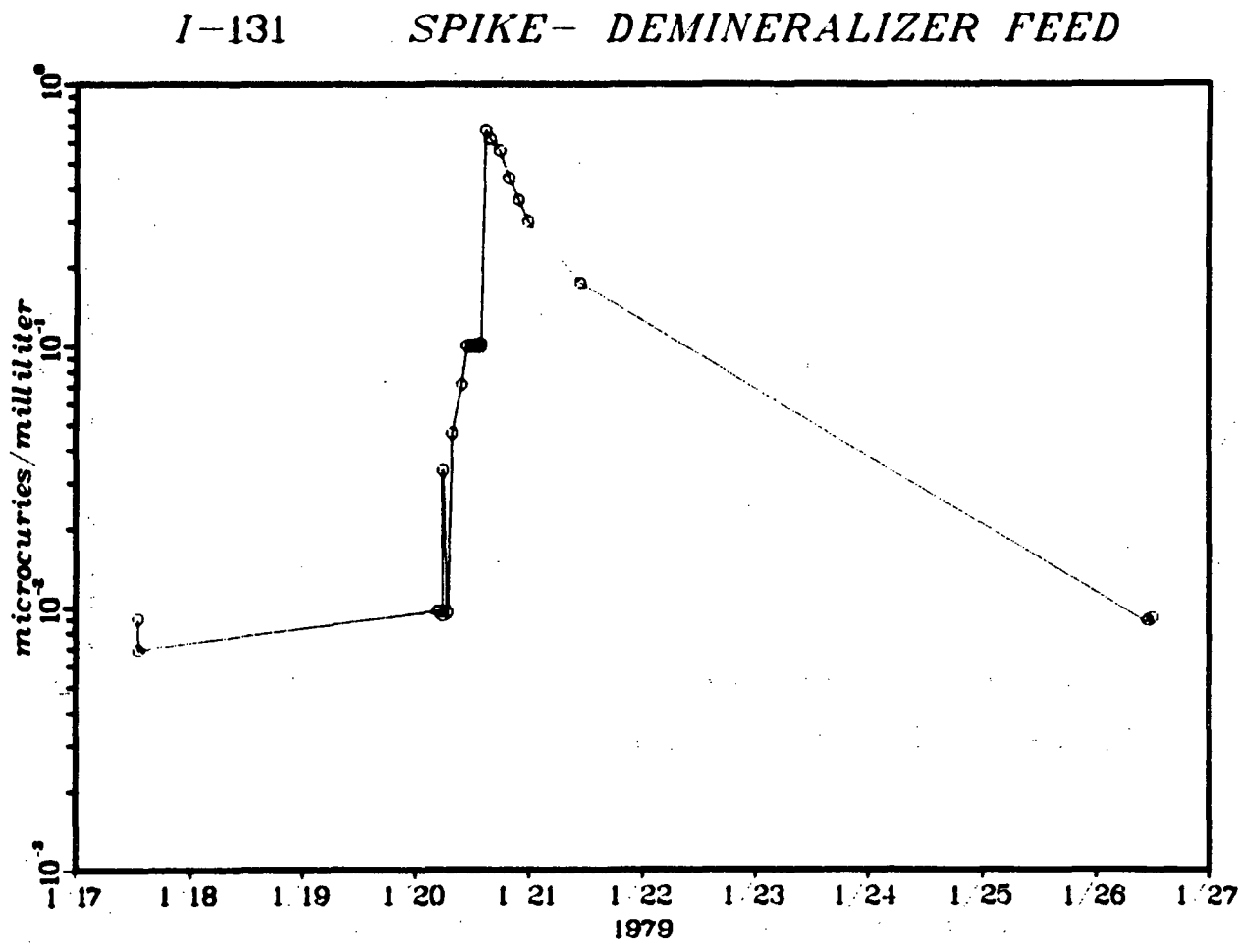
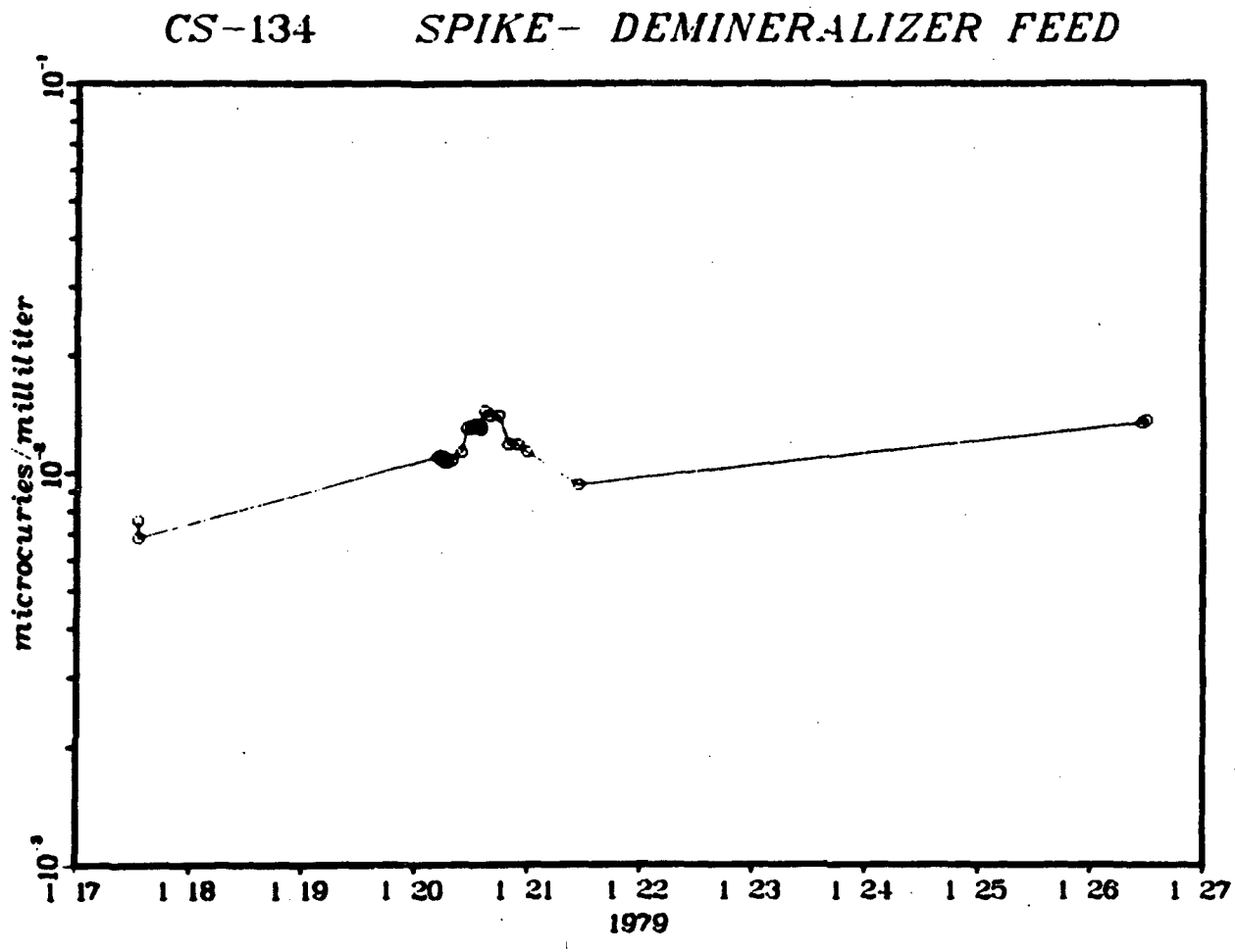


FIGURE 3.13

^{134}Cs CONCENTRATION IN REACTOR COOLANT DURING 1/20-21-79 SPIKING STUDY



streams were taken approximately weekly from 9/7/78 to 2/21/78. Not all sample points were sampled on a weekly basis as the emphasis was on evaluation of the purification demineralizer. The makeup filter effluent and the makeup tank effluent were sampled much less frequently than the other sample points.

Table 3.7 lists dates and times of sampling of the makeup and purification system, identifies the components sampled, and presents the letdown flow rate and reactor coolant chemistry information applicable to these samples.

3.3.2 Letdown Filter

Analytical results obtained from samples of the letdown filter effluent are presented in Appendix Table B.3. Decontamination factors (DF's) for the letdown filter were calculated by dividing the measured reactor coolant inlet concentrations (Appendix Table B.2) by the corresponding effluent (Appendix Table B.3). The calculated DF's are tabulated in Table 3.8. Figures 3.14-3.17 graphically display the results for ^{24}Na, ^{54}Mn, ^{59}Fe, and ^{58}Co.

Cleaning of the letdown filter is accomplished by backflushing the filter and sluicing the trapped material to the radwaste crud tank. These backflushes are performed at intervals dependent on the pressure differential registered across the letdown filter. The irregular timing of the filter backflushes precluded establishing a sampling regime to test their effect on the filter efficiency. Prior to refueling some shifts recorded as many as 5 backflushes/shift while after refueling the backflushing frequency was about one per week. From the reactor operator's log, the times and dates of filter backflushes performed during the measurement period were established. Using this information, DF's across the letdown filter were classified as either "clean filter" or "dirty filter" DF's according to the relative time since the last filter backwash (relative to the recorded duration between backflushing operations). Some measured DF's could not be clearly categorized. The DF measurements at 1431 on 10/24/78, 0800 on 11/15/78, and 1116 on 2/8/79 were classified as dirty filter measurements while those at 1438 on 9/22/78, 0942 on 11/1/78, and 0953 on 2/21/79 were classified as clean. The average clean filter DF's for ^{60}Co and ^{54}Mn were 1.7 ± 0.2 (0) and 1.36 ± 0.07(0), respectively. The average dirty filter ^{60}Co and ^{54}Mn DF's were slightly lower at 1.5 ± 0.3(0) and 1.3 ± 0.2(0), respectively, but no statistical significance can be attributed to this difference.

While reviewing the times and dates of the backflushing operations, an interesting observation was made concerning the letdown filter effluent sampled at 1145 on 11/13/78. The reactor operator's log records a filter backwash at 1141 on 11/13/78. Depending on the duration of the backflushing, it is possible that the letdown filter was actually bypassed for backwashing when the 1145 sample was taken. An examination of the DF's calculated for this sample shows all DF's for crud-associated

TABLE 3.7

MAKEUP AND PURIFICATION SYSTEM SAMPLE INFORMATION

Time[1]	Date	Components Sampled: Filter Out	Demin Out	MU Filter Out*	MU Tank Out	Letdown Flow Rate (GPM)	Power Level (% P)	Boron (ppm)	pH	Conductivity (μmhos)
1140	9/7/78	X	X			70	100	176	7.35	[5]
1456	9/11/78	X	X		X	100	100	248	7.05	13.0
1400[2]	9/20/78	X	X			65	100	148	7.45	18.0
1440	9/22/78	X	X			65	100	145	7.45	[5]
1145	10/4/78	X	X			70	97	111	7.6	18.0
1429	10/24/78	X	X			72	70	47	7.95	16.0
0942	11/1/78	X	X			74	100	25	8.2	14.0
1156	11/13/78	X	X		X	70	91	14.2	8.65	15.0
0310[3]	11/15/78	X	X			75	0	106	7.7	[5]
0802[3]	11/15/78	X	X			79	0	513	6.9	[5]
0945[4]	11/29/78		X			45[4]	0	1876	5.45	[5]
1306	1/3/79	X	X	X	X	100	100	881	6.15	9.2
0956	11/11/79	X	X	X		70	100	869	[5]	[5]
1412	1/17/79	X	X	X	X	70	100	848	6.4	[5]
0614[3]	1/20/78		X			75	100			
0705[3]	1/20/78	X	X			75	50			
0758[3]	1/20/79		X			75	17			
0858[3]	1/20/79	X	X			75	0			
0935[3]	1/20/79		X			75	0			
1117[3]	1/20/79	X	X			75	0			
1215[3]	1/20/79		X			75	0	[5]	[5]	[5]
1321[3]	1/20/79	X	X			75	0			
1406[3]	1/20/79		X			75	0			
1509[3]	1/20/79	X	X			75	0			
1740[3]	1/20/79	X	X			75	20			
1404[3]	1/20/79		X			75	56			
2111[3]	1/20/79	X	X			75	91			
2320[3]	1/20/79		X			75	91			
0100[3]	1/21/79	X	X			75	91	840	6.5	[5]
1214[3]	1/21/79		X			75	91	840	6.5	[5]
1337	2/2/79	X	X			70	100	800	6.6	[5]
1112	2/8/79	X	X			70	100	776	6.6	[5]
0907	2/14/79	X	X			70	100	760	6.5	17.5
0946	2/21/79	X	X	X	X	72	100	734	6.4	17.0

TABLE 3.7 (cont'd)

MAKEUP AND PURIFICATION SYSTEM SAMPLE INFORMATION

* No record was kept of whether makeup filter 230A or 230B was in service. The units are indentical and data are a composite of both filters.

[1] Time recorded is the sample time for the letdown filter effluent if it was sampled, if not it is the earliest time in the sample series.

[2] Sampled in triplicate for sample validation (see section

[3] Samples obtained during reactor coolant spikes.

[4] Sampled during the refueling outage at a local sample point at the demineralizer. Residual heat removal system was in use. Inlet water was the same as the refueling cavity (see section

[5] Not recorded.

TABLE 3.8

DECONTAMINATION FACTORS FOR LETDOWN FILTER

REACTOR COOLANT LETDOWN FILTER - DF

DATE	9/ 7	9/11	9/22	10/ 4	10/24
TIME	1140	1454	1438	1136	1429
NUCLIDE	DECONTAMINATION FACTOR				
BR-84	8.33±2.0(-1)	<2.8(-1)	<1.6(-1)	>1.4(0)	>7.4(-1)
I-131	9.82±.42(-1)	1.38±.01(0)	1.04±.01(0)	9.22±.10(-1)	1.03±.01(0)
I-132	1.02±.01(0)	3.78±.07(-1)	2.61±.05(-1)	9.52±.12(-1)	1.05±.01(0)
I-133	9.35±.07(-1)	1.08±.01(0)	9.27±.10(-1)	9.42±.05(-1)	1.04±.01(0)
I-134	9.77±.11(-1)	7.44±.27(-2)	8.28±.20(-2)	1.04±.02(0)	1.12±.03(0)
I-135	9.70±.13(-3)	6.63±.23(-1)	6.04±.09(-1)	9.75±.13(-1)	1.02±.02(0)
RB-88	8.25±.57(-1)	5.31±.74(-1)	2.40±.26(-1)	5.77±.77(-1)	1.07±.54(0)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	9.45±.07(-1)	1.31±.01(0)	1.09±.01(0)	8.82±.08(-1)	9.29±.11(-1)
CS-136	6.10±.48(-1)	1.41±.02(0)	9.84±.28(-1)	7.41±.39(-1)	1.14±1.9(0)
CS-137	9.94±.10(-1)	1.26±.01(0)	1.04±.01(0)	9.09±.09(-1)	9.68±.11(-1)
CS-138	9.52±.34(-1)	3.27±.21(-2)	7.62±.29(-2)	9.69±.74(-1)	1.16±.18(0)
CS-139	>4.6(-1)	NOTE 1	NOTE 1	>1.1(-1)	NOTE 1
NA-24	9.47±.08(-1)	9.53±.41(-1)	8.25±.15(-1)	8.82±.19(-1)	1.08±.03(0)
CR-51	8.91±2.4(0)	5.00±10.(0)	3.03±.04(0)	3.50±.13(0)	2.34±.08(0)
MN-54	3.00±.17(0)	1.27±.11(0)	1.36±.01(0)	2.32±.21(0)	>3.8(0)
MN-56	NOTE 1	NOTE 1	>3.3(-1)	>4.6(0)	2.64±.26(0)
FE-59	6.62±1.6(0)	2.13±.58(0)	1.50±.06(0)	2.73±.25(0)	1.50±.16(0)
CO-57	>2.0(0)	NOTE 1	1.53±.14(0)	3.67±1.3(0)	7.50±2.4(-1)
CO-58	4.59±.07(0)	2.22±.03(0)	2.14±.02(0)	3.23±.04(0)	2.10±.02(0)
CO-60	2.51±.14(0)	2.06±.11(0)	1.82±.03(0)	3.00±.11(0)	2.04±.06(0)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	>1.0(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	>1.4(0)	NOTE 1	NOTE 1
ZR-95	>4.5(0)	>3.2(0)	1.95±.15(0)	3.13±.48(0)	2.15±.20(0)
NB-95	>4.1(0)	>1.6(0)	1.96±.05(0)	4.48±.48(0)	1.98±.22(0)
MO-99	9.61±.08(-1)	3.84±.09(-1)	1.05±.01(0)	1.04±.01(0)	1.02±.02(0)
RU-103	>1.6(0)	NOTE 1	3.19±.53(0)	2.00±.63(0)	2.34±1.1(0)
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	<1.4(0)	>2.9(0)	NOTE 1	>7.1(-1)
SB-124	>1.1(0)	NOTE 1	1.66±.25(0)	1.32±.56(0)	>1.2(0)
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	<1.6(0)	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	<7.9(-1)	NOTE 1	>2.4(-1)	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	<8.3(-2)	NOTE 1	NOTE 1
BA-139	>2.6(-1)	NOTE 1	NOTE 1	>4.8(-1)	NOTE 1
BA-140	8.13±1.6(-1)	1.80±.32(0)	1.08±.11(0)	2.22±1.1(0)	>1.8(0)
LA-140	>6.5(-1)	NOTE 1	NOTE 1	>2.4(0)	NOTE 1
CE-141	NOTE 1	<1.7(0)	>3.0(0)	1.42±.73(0)	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	>3.7(0)	<4.6(-2)	>4.3(0)
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	1.12±.05(0)	NOTE 1	1.08±.34(0)	2.08±.21(0)	1.50±.13(0)
NP-239	>1.5(0)	NOTE 1	>3.5(0)	6.57±3.1(0)	2.84±.35(0)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 3.8 (cont'd)

DECONTAMINATION FACTORS FOR LETDOWN FILTER

REACTOR COOLANT LETDOWN FILTER - DF

DATE	11/ 1	11/13	11/15	11/15	1/ 3
TIME	540	1150	306	800	1059
NUCLIDE	DECONTAMINATION FACTOR				
BR-84	NOTE 1	NOTE 1	NOTE 1	>1.1(0)	>5.8(-1)
I-131	1.04±.01(0)	1.00±.01(0)	1.12±.02(0)	1.19±.02(0)	1.40±.02(0)
I-132	1.34±.02(0)	1.06±.02(0)	1.12±.08(0)	2.83±.04(0)	1.38±.06(0)
I-133	1.22±.01(0)	1.05±.01(0)	1.13±.02(0)	1.11±.01(0)	1.52±.03(0)
I-134	1.61±.21(0)	1.05±.02(0)	1.19±.06(0)	>1.3(0)	5.76±.17(-1)
I-135	1.27±.02(0)	1.04±.02(0)	1.16±.01(0)	1.12±.02(0)	1.35±.02(0)
RB-88	NOTE 1	NOTE 1	>1.5(0)	1.00±.28(0)	5.71±.95(-1)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.01±.02(0)	9.56±.09(-1)	1.12±.01(0)	1.41±.01(0)	1.18±.02(0)
CS-136	1.12±.17(0)	9.09±1.2(-1)	1.18±.02(0)	1.33±.03(0)	1.46±.04(0)
CS-137	9.92±.09(-1)	1.00±.01(0)	1.14±.01(0)	1.26±.01(0)	1.17±.01(0)
CS-138	NOTE 1	<1.2(0)	NOTE 1	NOTE 1	>9.1(-1)
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	1.28±.03(0)	9.83±.19(-1)	1.16±.04(0)	6.77±.23(-1)	7.20±.25(-1)
CR-51	1.98±.06(0)	1.05±.01(0)	1.80±.02(0)	1.27±.01(0)	>3.8(0)
MN-54	1.49±.15(0)	1.04±.01(0)	1.78±.02(0)	1.47±.02(0)	2.50±.10(0)
MN-56	2.17±.28(0)	1.06±.04(0)	1.69±.08(0)	1.69±.30(0)	NOTE 1
FE-59	1.57±.13(0)	1.05±.02(0)	1.78±.04(0)	1.59±.03(0)	6.67±1.8(0)
CO-57	6.25±1.3(-1)	8.66±.56(-1)	1.12±.05(0)	1.52±.11(0)	NOTE 1
CO-58	1.94±.03(0)	9.80±.14(-1)	1.81±.03(0)	1.25±.02(0)	4.84±.15(0)
CO-60	2.01±.04(0)	1.03±.01(0)	1.76±.02(0)	1.33±.01(0)	3.95±.16(0)
ZN-65	NOTE 1	<1.1(0)	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	>1.0(0)	2.67±1.4(0)	6.83±2.3(-1)
Y-91M	NOTE 1	NOTE 1	NOTE 1	>9.3(-1)	>6.8(-1)
Y-93	NOTE 1	NOTE 1	<2.9(-1)	2.75±1.2(0)	<2.0(0)
ZR-95	2.50±.96(0)	1.19±.03(0)	2.08±.05(0)	2.00±.05(0)	>8.0(0)
NB-95	>1.3(1)	1.11±.02(0)	1.87±.03(0)	1.63±.04(0)	>9.7(0)
MO-99	1.29±.04(0)	9.55±.42(-1)	1.31±.02(0)	1.81±.02(0)	1.54±.04(0)
RU-103	>1.3(0)	9.39±.70(-1)	1.66±.08(1)	1.24±.07(0)	>1.4(0)
RU-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	1.00±.19(0)	1.64±.34(0)	1.13±.34(0)	>1.7(0)
SB-124	8.36±3.8(-1)	1.04±.05(0)	1.92±.10(0)	1.34±.09(0)	1.88±1.1(0)
SB-125	NOTE 1	<1.1(0)	>2.3(0)	<6.3(-1)	NOTE 1
TE-129M	NOTE 1	NOTE 1	>1.4(0)	NOTE 1	NOTE 1
TE-129	<1.8(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	>1.8(0)	<2.0(0)	1.63±.77(0)	3.97±.92(0)	<1.1(-1)
LA-140	NOTE 1	NOTE 1	<1.0(0)	3.30±1.7(0)	>1.8(0)
CE-141	NOTE 1	1.31±.30(0)	>7.6(-1)	>1.4(0)	NOTE 1
CE-143	NOTE 1	<1.5(-1)	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	3.13±1.2(0)	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	<5.4(-1)	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	2.64±.24(0)	1.09±.09(0)	1.62±.25(0)	1.29±.20(0)	1.46±.80(0)
NP-239	5.53±.90(0)	1.28±.07(0)	1.98±.25(0)	1.50±.09(0)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE 3.8 (cont'd)

DECONTAMINATION FACTORS FOR LETDOWN FILTER

REACTOR COOLANT LETDOWN FILTER - DF

DATE	1/11	1/17	1/20	1/26	2/ 2
TIME	938	1409	1506	1355	1337
NUCLIDE	DECONTAMINATION FACTOR				
BR-84	NOTE 1	<5.9(-1)	NOTE 1	1.10±.53(0)	>1.1(0)
I-131	9.23±.16(-1)	1.32±.02(0)	9.71±.14(-1)	9.78±.13(-1)	1.03±.01(0)
I-132	1.17±.04(0)	1.05±.03(0)	9.95±.10(-1)	1.05±.02(0)	1.06±.03(0)
I-133	1.07±.02(0)	1.42±.02(0)	9.77±.11(-1)	9.56±.18(-1)	9.72±.26(-1)
I-134	1.33±.03(0)	1.31±.22(0)	NOTE 1	1.08±.02(0)	1.25±.04(0)
I-135	1.12±.02(0)	1.06±.03(0)	9.71±.25(-1)	1.09±.03(0)	1.09±.02(0)
RB-86	1.20±.31(0)	8.82±6.0(-1)	1.35±.35(0)	1.07±.11(0)	1.02±.19(0)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.10±.03(0)	1.11±.01(0)	9.77±.21(-1)	9.85±.23(-1)	1.00±.01(0)
CS-136	1.33±.12(0)	9.45±.54(-1)	1.05±.07(0)	5.50±1.1(-1)	1.05±.07(0)
CS-137	1.03±.01(0)	1.22±.02(0)	9.72±.34(-1)	1.07±.02(0)	1.00±.01(0)
CS-138	>1.1(0)	NOTE 1	NOTE 1	9.89±.96(-1)	>1.1(0)
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	1.13±.03(0)	1.26±.03(0)	NOTE 1	1.05±.03(0)	1.05±.03(0)
CR-51	NOTE 1	<5.9(-1)	NOTE 1	NOTE 1	NOTE 1
MN-54	1.17±.08(0)	4.05±.16(-1)	NOTE 1	NOTE 1	1.11±.09(0)
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	1.86±.59(-1)	NOTE 1	NOTE 1	>1.6(0)
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	1.32±.03(0)	3.40±.07(-1)	6.64±.31(-2)	>9.0(-1)	1.25±.03(0)
CO-60	1.53±.06(0)	3.30±.16(-1)	NOTE 1	NOTE 1	1.58±.16(0)
ZN-65	NOTE 1	<5.9(-1)	NOTE 1	NOTE 1	NOTE 1
SR-91	4.56±2.6(-1)	>1.5(0)	NOTE 1	<1.9(0)	<1.1(0)
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<5.1(-1)
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	>3.9(-1)	<1.1(-1)	NOTE 1	>2.7(-1)	<8.2(-1)
NB-95	>1.1(0)	<4.0(-2)	NOTE 1	NOTE 1	NOTE 1
MO-99	9.62±.30(-1)	2.28±.10(0)	NOTE 1	NOTE 1	9.26±1.6(-1)
RU-103	NOTE 1	<3.4(-1)	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	<1.0(0)	NOTE 1	NOTE 1	>1.2(0)
SB-124	NOTE 1	<3.2(-1)	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	>3.0(-1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	>4.0(-1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	>8.3(-1)	1.17±.09(0)	NOTE 1	NOTE 1	9.06±1.9(-1)
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	1.09±.07(0)	2.20±.29(0)	NOTE 1	8.85±2.0(-1)	1.38±.31(0)
NP-239	NOTE 1	NOTE 1	NOTE 1	>2.3(0)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 3.8 (cont'd)
DECONTAMINATION FACTORS FOR LETDOWN FILTER

REACTOR COOLANT LETDOWN FILTER - DF

DATE	2/ 8	2/14	2/21
TIME	1113	904	949
NUCLIDE	DECONTAMINATION FACTOR		
BR-84	8.00±3.5(-1)	>1.1(0)	1.08±.39(0)
I-131	9.73±.13(-1)	9.76±.07(-1)	1.08±.01(0)
I-132	1.01±.02(0)	9.93±.21(-1)	1.14±.02(0)
I-133	1.01±.01(0)	9.89±.10(-1)	1.05±.02(0)
I-134	1.01±.02(0)	1.01±.02(0)	1.19±.03(0)
I-135	1.05±.03(0)	9.90±.24(-1)	1.09±.02(0)
RB-88	9.27±2.0(-1)	6.70±1.1(-1)	7.43±.73(-1)
RB-89	NOTE 1	NOTE 1	NOTE 1
CS-134	1.00±.01(0)	9.92±.14(-1)	1.03±.01(0)
CS-136	1.12±.04(0)	1.00±.09(0)	1.03±.06(0)
CS-137	9.60±.11(-1)	9.66±.19(-1)	1.06±.01(0)
CS-138	9.30±.93(-1)	9.40±.41(-1)	1.20±.11(0)
CS-139	NOTE 1	>2.9(-1)	>1.8(-1)
NA-24	9.92±.35(-1)	9.64±.25(-1)	1.07±.02(0)
CR-51	NOTE 1	NOTE 1	NOTE 1
MN-54	1.09±.05(0)	7.75±3.9(-1)	1.24±.06(0)
MN-56	NOTE 1	NOTE 1	NOTE 1
FE-59	1.69±.55(-1)	<1.2(0)	1.73±.68(0)
CO-57	NOTE 1	NOTE 1	NOTE 1
CO-58	1.13±.02(0)	1.02±.04(0)	1.29±.02(0)
CO-60	1.06±.08(0)	1.21±.18(0)	1.24±.09(0)
ZN-65	<9.1(-2)	NOTE 1	NOTE 1
SR-91	>1.6(0)	>4.7(-1)	1.72±.64(0)
Y-91M	NOTE 1	NOTE 1	NOTE 1
Y-93	<7.3(-1)	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1
MO-99	1.06±.08(0)	9.20±.18(-1)	1.07±.10(0)
RU-103	NOTE 1	NOTE 1	NOTE 1
RU-106	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	>6.5(-1)	>6.8(-1)
BA-140	9.29±.79(-1)	7.38±1.2(-1)	1.21±.10(0)
LA-140	<7.5(0)	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	>1.9(0)	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1
W-187	6.84±1.9(-1)	9.63±3.2(-1)	1.68±.24(0)
NP-239	NOTE 1	NOTE 1	NOTE 1

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FIGURE 3.14

^{24}Na DECONTAMINATION FACTOR FOR LETDOWN FILTER

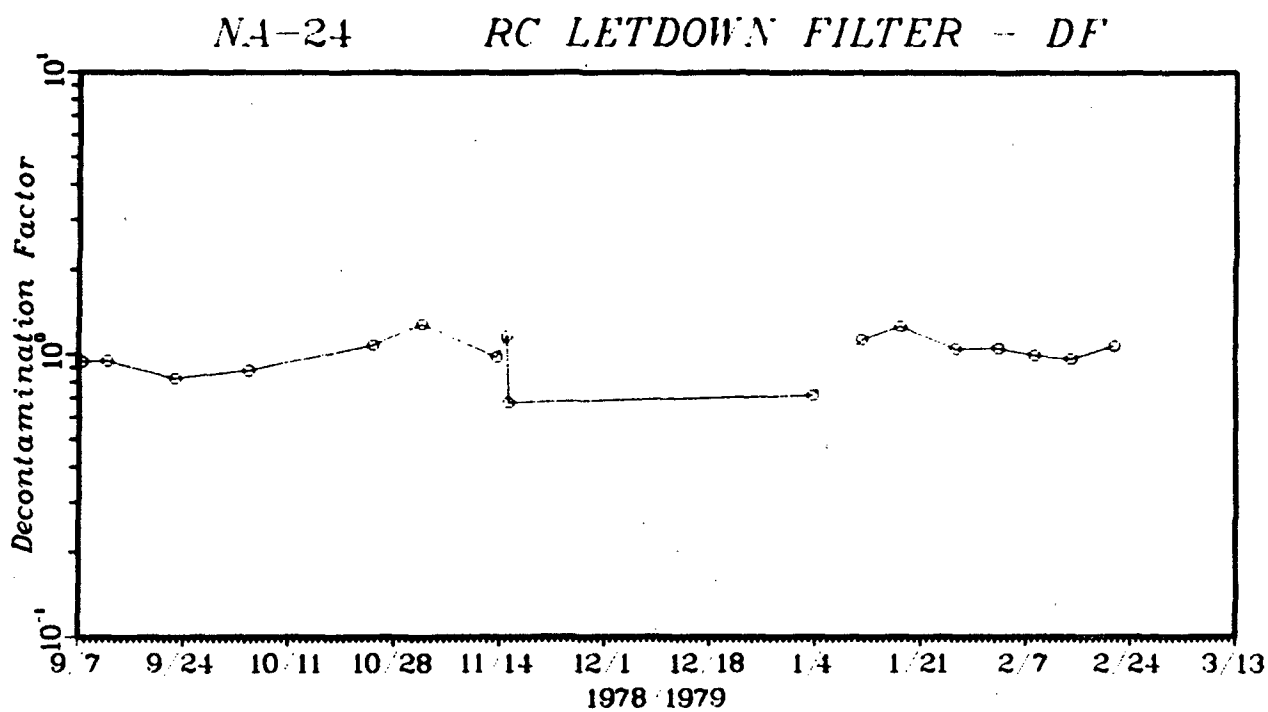


FIGURE 3.15

^{54}Mn DECONTAMINATION FACTOR FOR LETDOWN FILTER

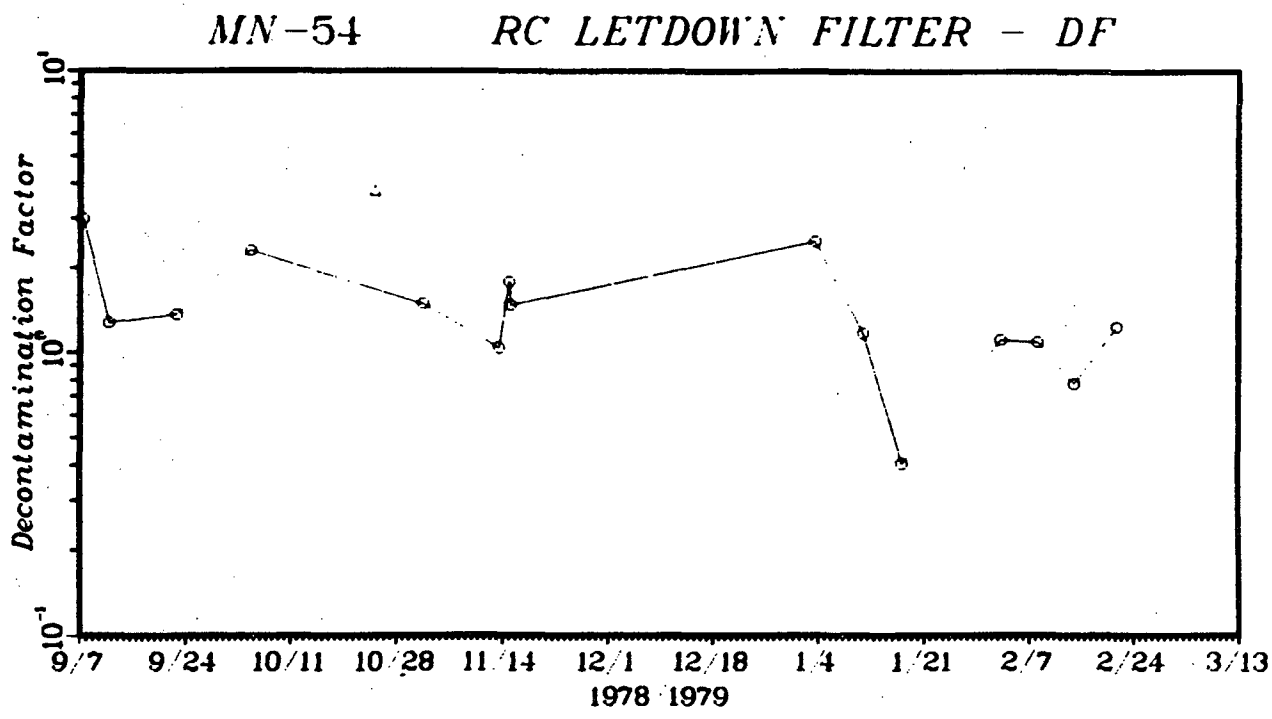


FIGURE 3.16

^{59}Fe DECONTAMINATION FACTOR FOR LETDOWN FILTER

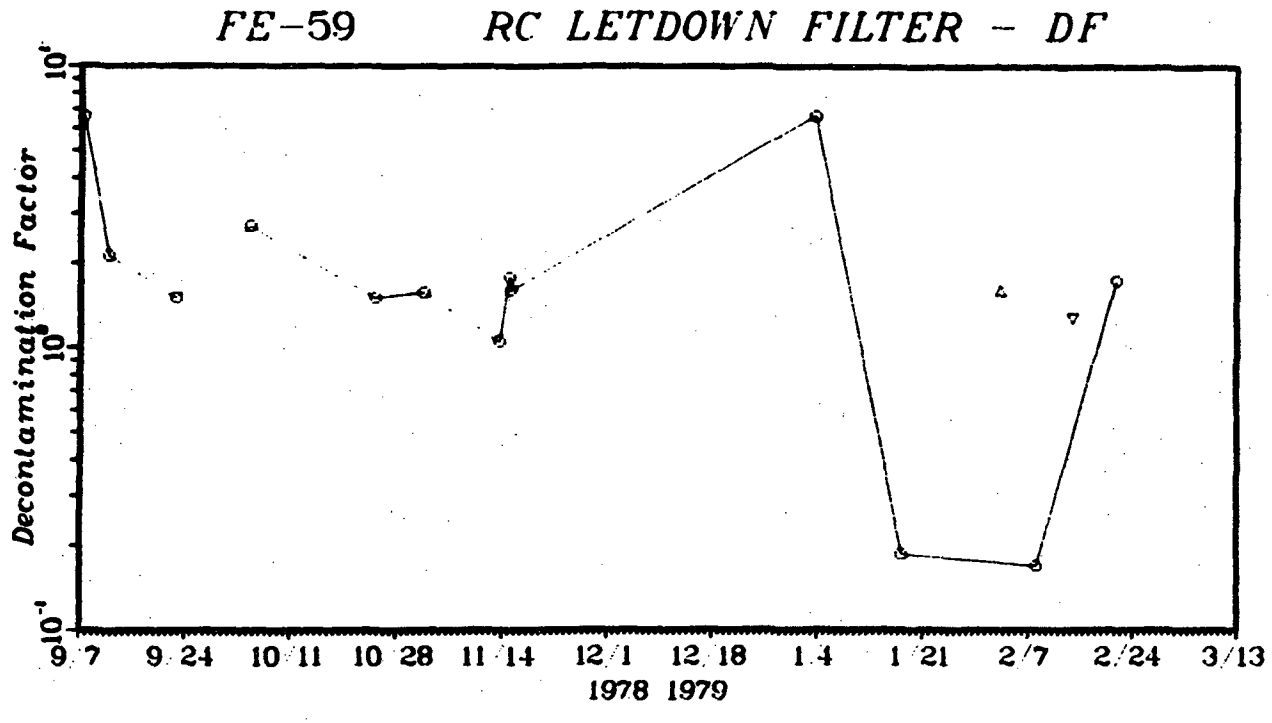
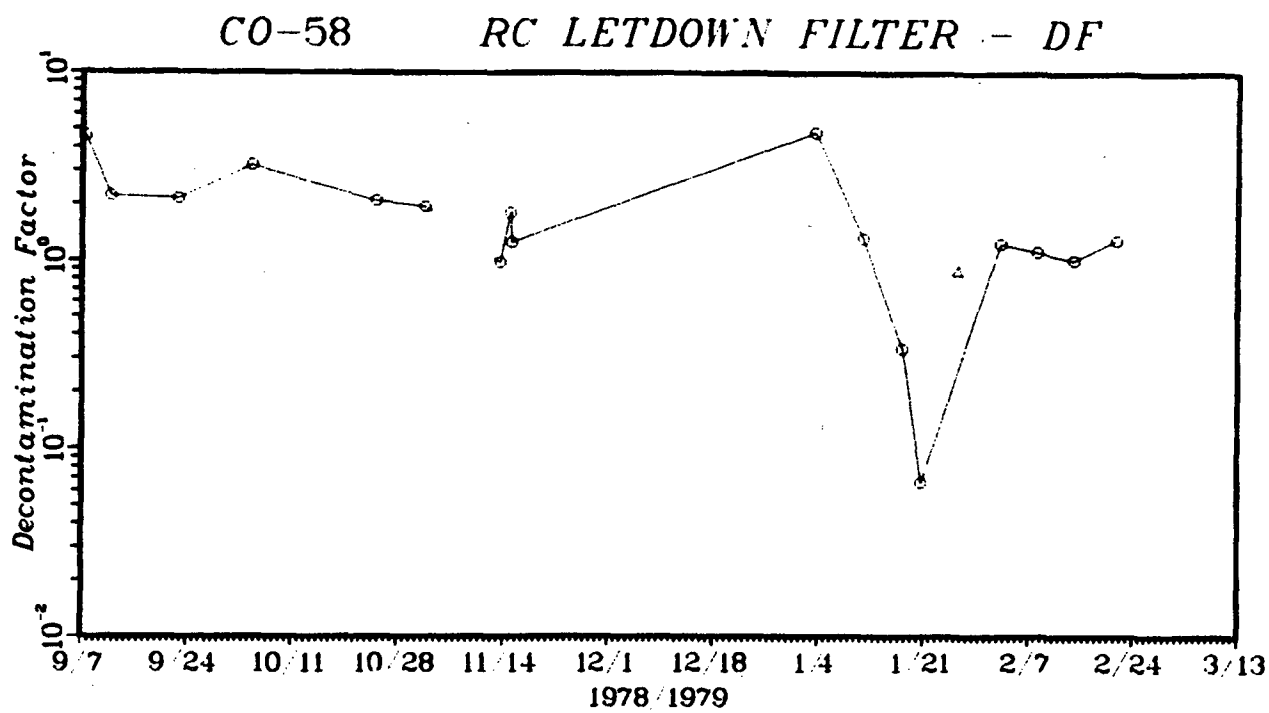


FIGURE 3.17

^{58}Co DECONTAMINATION FACTOR FOR LETDOWN FILTER



radionuclides to be statistically equal to 1.0. We, therefore, conclude that the filter was bypassed during the collection of this sample, and the resultant data were not used in computing the average filter DF's.

The dependence of the DF's registered across the letdown filter upon the inlet crud-associated radionuclide concentration was studied. Plots of the filter DF versus inlet concentration for the usual crud-associated radionuclides were inspected both visually and using least-squares linear regression techniques. No strong correlation between inlet concentration and DF could be established.

Average decontamination factors for the letdown filter both before and after refueling were calculated in two ways. The instantaneous DF's were tested for flyers using the Dixon outlier test (10), flyers were removed, and an error-weighted average was performed to calculate an average DF. In addition, "best value" DF's were calculated by dividing the average inlet (reactor coolant) concentration of each nuclide by the average concentration of the same nuclide in the letdown filter effluent. While the first technique is algebraically correct and yields results with generally lower relative errors, the second technique allows the estimation of decontamination factors for those isotopes which are not detected with any regularity in either the inlet or outlet streams. Since the filter DF did not appear to be sensitive to the inlet concentration, averages of the instantaneous DF's were not limited to steady-state power operations and include results measured during reactor coolant spiking. Averages obtained by average inlet over average outlet use only the steady-state averages. Table 3.9 presents the average letdown filter DF's computed by both methods for the measurement periods before and after refueling.

3.3.3 Purification Demineralizer (D-225A)

Sampling frequency, reactor power, and reactor coolant chemistry information concerning measurements across the purification demineralizer (D-225A on Figure 3.2) are presented in Table 3.7. The purification demineralizer has a resin volume of 50 ft^3 (1.42 m^3), a surface area of 12.5 ft^2 (1.16 m^2), and a design flow rate of 140 gpm (5.05 lps). The exchanging medium is Amberlite IRN-150LC, a mixed-bed resin.

The results of analyses of samples obtained from the purification (letdown) demineralizer outlet are presented in Appendix Table B.4. Decontamination factors (DF's) were calculated by dividing the nuclide concentrations measured in the effluent of the letdown filter (Appendix Table B.3), which provides inlet water to the letdown demineralizer, by those measured in the demineralizer effluent. The calculated DF's are presented in Table 3.10 and are displayed graphically for ^{131}I, ^{136}Cs, ^{137}Cs, ^{58}Co, and ^{24}Na in Figures 3.18-3.22. The most prominent features

TABLE 3.9

DECONTAMINATION FACTORS MEASURED ACROSS THE LETDOWN FILTER

Nuclide	Before Refueling		After Refueling	
	$\overline{DF}$ †	$\overline{IN/OUT}$ ††	$\overline{DF}$ †	$\overline{IN/OUT}$ ††
^{84}Br	8.3 ± 2.0(-1)*	5.0(-1)	9.6 ± 2.3(-1)	6.9(-1)
^{131}I	1.07 ± 0.01(0)	8.8 ± 3.5(-1)	1.03 ± 0.01(0)	1.00 ± 0.22(0)
^{132}I	1.04 ± 0.01(0)	1.11 ± 0.52(0)	1.03 ± 0.01(0)	1.08 ± 0.17(0)
^{133}I	1.10 ± 0.01(0)	1.11 ± 0.39(0)	1.00 ± 0.01(0)	1.11 ± 0.17(0)
^{134}I	1.02 ± 0.01(0)	1.22 ± 0.54(0)	1.05 ± 0.01(0)	1.20 ± 0.22(0)
^{135}I	1.05 ± 0.01(0)	1.15 ± 0.40(0)	1.06 ± 0.01(0)	1.08 ± 0.14(0)
^{88}Rb	6.06 ± 0.35(-1)	7.2 ± 4.6(-1)	9.02 ± 0.41(-1)	9.2 ± 2.9(-1)
^{89}Rb	**	**	**	**
^{134}Cs	1.03 ± 0.01(0)	9.2 ± 4.0(-1)	1.03 ± 0.01(0)	1.02 ± 0.19(0)
^{136}Cs	1.17 ± 0.01(0)	7.0 ± 5.4(-1)	1.05 ± 0.02(0)	1.01 ± 0.61(0)
^{137}Cs	1.01 ± 0.01(0)	9.3 ± 3.8(-1)	1.03 ± 0.01(0)	1.00 ± 0.21(0)
^{138}Cs	9.61 ± 0.30(-1)	1.03 ± 0.78(0)	9.69 ± 0.33(-1)	1.11 ± 0.15(0)
^{139}Cs	**	**	**	**
^{24}Na	9.44 ± 0.06(-1)	1.18 ± 0.50(0)	1.06 ± 0.01(0)	1.06 ± 0.31(0)
^{51}Cr	1.75 ± 0.01(0)	1.2 ± 2.1(0)	**	**
^{54}Mn	1.45 ± 0.01(0)	7.8 ± 1.2(0)	1.28 ± 0.04(0)	8.1 ± 6.0(-1)
^{56}Mn	1.96 ± 0.07(0)	1.38(0)	**	**
^{59}Fe	1.64 ± 0.02(0)	0.96 ± 1.6(0)	1.80 ± 0.33(0)	3.6(-1)
^{57}Co	1.20 ± 0.04(0)	6.4 ± 9.6(-1)	**	**
^{58}Co	2.00 ± 0.01(0)	1.0 ± 1.7(0)	1.24 ± 0.01(0)	8.3 ± 6.0(-1)
^{60}Co	1.50 ± 0.01(0)	0.94 ± 1.6(0)	1.75 ± 0.04(0)	8.9 ± 6.8(-1)
^{91}Sr	2.7 ± 1.4(0)*	**	1.72 ± 0.64(0)*	**
^{93}Y	2.8 ± 1.2(0)*	**	**	**
^{95}Zr	2.05 ± 0.03(0)	1.2 ± 2.3(0)	**	**
^{95}Nb	1.84 ± 0.02(0)	1.0 ± 1.9(0)	**	**
^{99}Mo	1.13 ± 0.01(0)	1.41 ± 0.86(0)	1.05 ± 0.02(0)	1.14 ± 0.96(0)

TABLE 3.9 (cont'd)

DECONTAMINATION FACTORS MEASURED ACROSS THE LETDOWN FILTER

Nuclide	Before Refueling		After Refueling	
	$\overline{DF}$ †	$\overline{IN/OUT}$ ††	$\overline{DF}$ †	$\overline{IN/OUT}$ ††
^{103}Ru	1.45 ± 0.05(0)	0.92 ± 1.9(0)	**	**
^{106}RuD	**	**	**	**
^{110m}Ag	1.39 ± 0.24(0)	2.6(0)	**	**
^{124}Sb	1.57 ± 0.06(0)	0.71 ± 1.40(0)	**	**
^{131}Te	**	**	**	**
^{132}Te	**	1.3(0)	**	**
^{139}Ba	**	**	**	**
^{140}Ba	1.11 ± 0.08(0)	1.2(0)	1.03 ± 0.05(0)	8.2 ± 3.4(-1)
^{140}La	3.3 ± 1.7(0)*	1.9(0)	**	**
^{141}Ce	1.42 ± 0.17(0)*	8.7(-1)	**	**
^{143}Ce	**	**	**	**
^{144}Ce	**	2.1(0)	**	**
^{187}W	1.27 ± 0.04(0)	1.5 ± 1.2(0)	1.16 ± 0.06(0)	1.2 ± 1.0(0)
^{239}Np	1.66 ± 0.08(0)	1.4(0)	**	**

† Computed as the error-weighted average of the instantaneous DF's with flyers eliminated. Flyers were detected using the Dixon outlier test operating at a 5% significance level.

†† Computed as the ratio of the average steady-state inlet concentration to the average steady-state outlet concentration.

* Value based on only one real value.

** No meaningful result can be computed.

TABLE 3.10

DECONTAMINATION FACTORS FOR PURIFICATION DEMINERALIZER

REACTOR COOLANT LETDOWN DEMINERALIZER - DF

DATE	9/ 7	9/11	9/22	10/ 4	10/24
TIME	1143	1457	1436	1146	1427
NUCLIDE	DECONTAMINATION FACTOR				
BR-84	>1.2(0)	>2.7(0)	>2.1(1)	NOTE 1	NOTE 1
I-131	1.26±.02(2)	1.25±.05(2)	1.09±.03(2)	1.31±.02(2)	1.04±.04(2)
I-132	8.00±.94(1)	1.01±.20(2)	7.15±2.9(2)	1.04±.09(2)	8.59±.49(1)
I-133	1.22±.04(2)	1.03±.08(2)	3.40±22.(2)	1.44±.04(2)	1.00±.04(2)
I-134	1.18±.21(2)	1.54±.81(2)	1.10±.42(3)	1.27±.19(2)	2.44±1.1(2)
I-135	1.16±.11(2)	1.23±.54(2)	>1.3(3)	1.54±.30(2)	1.20±.17(2)
RB-88	>2.5(-2)	1.00±.24(0)	1.07±.24(0)	2.60±.84(0)	8.33±6.4(-1)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.11±.02(0)	2.65±.05(0)	9.73±.11(-1)	1.06±.01(0)	8.87±.15(-1)
CS-136	6.54±.44(0)	6.39±.92(1)	1.66±.03(0)	1.06±.02(0)	9.71±16.(-1)
CS-137	1.09±.02(0)	2.52±.05(0)	9.95±.10(-1)	1.02±.01(0)	8.77±.11(-1)
CS-138	>3.8(0)	4.71±.68(0)	>3.2(1)	>4.4(0)	>2.2(0)
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	1.05±.04(2)	1.04±.28(2)	4.85±.56(2)	1.07±.05(2)	8.30±.45(1)
CR-51	>6.7(0)	>2.9(0)	3.44±.83(1)	2.75±.52(1)	3.93±.80(1)
MN-54	5.07±2.2(1)	1.24±.26(1)	1.02±.23(2)	4.71±.86(1)	<4.0(1)
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>1.5(0)
FE-59	>1.1(1)	>3.5(0)	1.41±.65(1)	>7.9(1)	1.10±.29(2)
CO-57	NOTE 1	NOTE 1	>1.1(1)	>3.1(0)	>6.7(1)
CO-58	2.66±.11(1)	2.86±.17(1)	9.71±.22(1)	4.22±.06(1)	7.03±.09(1)
CO-60	4.55±.73(1)	>2.7(1)	6.36±.87(1)	4.25±.33(1)	6.95±.34(1)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	>9.5(0)	>1.7(1)	>7.5(1)
NB-95	NOTE 1	NOTE 1	>2.3(1)	>1.8(1)	>7.3(1)
MO-99	2.18±.67(2)	>1.1(2)	8.14±3.5(1)	1.04±.40(2)	>6.0(1)
RU-103	NOTE 1	NOTE 1	>2.9(0)	>5.2(0)	>8.4(0)
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	>2.0(0)	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	2.71±.68(0)	1.16±.53(1)	<1.9(1)
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	>1.4(0)	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	>4.6(-1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	>1.5(1)	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	>1.0(1)	>6.8(0)	>1.2(1)	>6.8(0)	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	>1.6(0)	NOTE 1	>5.1(0)	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	>1.2(2)	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	>1.9(1)	NOTE 1	>2.0(1)	>6.2(0)	>1.4(1)
NP-239	NOTE 1	NOTE 1	<1.2(0)	>4.7(0)	>6.2(0)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 3.10 (cont'd)

DECONTAMINATION FACTORS FOR PURIFICATION DEMINERALIZER

REACTOR COOLANT LETDOWN DEMINERALIZER - DF

DATE	11/ 1	11/13	11/15	11/15	1/ 3
TIME	945	1153	308	802	1306
NUCLIDE	DECONTAMINATION FACTOR				
BR-84	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-131	1.09±.07(2)	1.94±.08(2)	1.17±.02(2)	1.24±.03(2)	1.18±.01(2)
I-132	6.61±.50(1)	1.05±.16(2)	1.21±.11(2)	1.11±.08(2)	1.58±.38(2)
I-133	1.02±.05(2)	2.44±.12(2)	1.15±.03(2)	1.31±.04(2)	1.09±.03(2)
I-134	7.30±1.3(1)	>2.5(2)	>4.2(1)	NOTE 1	1.21±.38(2)
I-135	1.07±.16(2)	1.78±.22(2)	1.04±.10(2)	1.43±.14(2)	1.81±.69(2)
RB-88	NOTE 1	NOTE 1	<1.2(-2)	1.50±.81(0)	2.84±.64(0)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	9.28±.18(-1)	9.62±.11(-1)	2.66±.03(0)	2.90±.04(0)	1.72±.03(0)
CS-136	9.85±1.5(-1)	1.54±.14(0)	4.45±.09(1)	4.19±.09(1)	2.64±.20(1)
CS-137	9.40±.14(-1)	9.73±.09(-1)	2.44±.03(0)	2.67±.06(0)	1.95±.03(0)
CS-138	NOTE 1	>4.9(0)	NOTE 1	NOTE 1	<3.7(0)
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	1.01±.11(2)	8.36±.61(1)	6.10±.62(1)	6.85±.75(1)	>2.1(2)
CR-51	3.67±1.6(1)	1.01±.08(2)	5.77±.15(1)	1.14±.02(2)	<1.7(0)
MN-54	>5.3(1)	8.61±.35(1)	6.55±.12(1)	2.06±.20(2)	2.59±.17(-1)
MN-56	>2.1(1)	>7.4(1)	>3.4(1)	>2.6(1)	NOTE 1
FE-59	>1.0(2)	1.05±.07(2)	6.14±.20(1)	1.93±.24(2)	1.27±.40(0)
CO-57	>9.4(0)	>5.0(1)	1.18±.31(2)	>6.9(0)	NOTE 1
CO-58	6.30±.31(1)	1.09±.02(2)	4.83±.07(1)	1.14±.02(2)	1.05±.04(0)
CO-60	6.60±1.4(1)	9.10±.16(1)	5.70±.10(1)	1.20±.03(2)	1.23±.06(0)
ZN-65	NOTE 1	>8.2(0)	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	>1.3(1)	>8.6(0)
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	>2.5(1)	>1.1(1)	>3.3(0)
ZR-95	>1.7(1)	1.37±.34(2)	5.60±.49(1)	>2.1(2)	<1.7(0)
NB-95	NOTE 1	1.01±.07(2)	5.24±.43(1)	>1.3(2)	<1.1(0)
MO-99	6.24±3.0(1)	>1.3(2)	1.05±.07(2)	1.05±.19(2)	>8.2(1)
RU-103	NOTE 1	>4.5(1)	7.15±1.7(1)	4.67±1.6(1)	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	>3.2(1)	3.50±1.3(1)	>2.9(1)	NOTE 1
SB-124	>1.4(1)	1.17±.39(2)	5.88±.80(1)	1.73±.63(2)	2.06±1.0(-1)
SB-125	NOTE 1	>3.9(0)	NOTE 1	>7.7(0)	<1.8(0)
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	>3.5(0)	NOTE 1	<1.9(0)	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	>5.0(0)	>1.8(1)	>1.3(1)	>6.0(1)
LA-140	NOTE 1	NOTE 1	>2.0(0)	>1.0(2)	NOTE 1
CE-141	NOTE 1	>1.7(1)	<2.8(1)	NOTE 1	<2.3(0)
CE-143	NOTE 1	>3.5(1)	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	>4.0(0)	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	>1.4(1)	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	>6.1(0)	>1.6(1)	>2.5(1)	>1.4(1)	>2.6(0)
NP-239	>4.5(0)	>3.7(1)	>6.2(1)	>5.7(1)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 3.10 (cont'd)

DECONTAMINATION FACTORS FOR PURIFICATION DEMINERALIZER

REACTOR COOLANT LETDOWN DEMINERALIZER - DF

DATE	1/11	1/17	1/20	1/20	1/20
TIME	956	1412	706	858	1116
NUCLIDE	DECONTAMINATION FACTOR				
BR-84	NOTE 1	>1.7(0)	NOTE 1	NOTE 1	NOTE 1
I-131	9.47±1.2(1)	1.03±.09(2)	9.39±1.6(1)	>6.9(1)	9.00±.35(1)
I-132	1.94±.61(2)	8.43±1.9(1)	>1.0(3)	8.30±1.8(1)	7.86±.82(1)
I-133	2.18±.21(2)	1.16±.16(2)	1.24±.64(3)	8.44±.65(1)	1.02±.03(2)
I-134	1.55±.38(2)	>7.4(1)	>5.2(2)	>5.8(1)	>4.7(1)
I-135	1.30±.36(2)	>4.8(1)	>1.4(3)	9.38±3.0(1)	1.40±.36(2)
RB-88	2.08±1.0(0)	3.27±2.1(-1)	>8.8(0)	>2.1(-1)	1.05±.33(0)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	6.98±.19(-1)	1.09±.02(0)	1.26±.03(0)	1.06±.03(0)	1.13±.02(0)
CS-136	8.42±.81(-1)	1.32±.06(0)	<2.2(0)	1.08±.57(0)	2.45±.72(0)
CS-137	7.07±.12(-1)	9.51±.14(-1)	1.27±.02(0)	1.07±.02(0)	1.08±.03(0)
CS-138	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	1.68±.29(2)	6.27±1.7(1)	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	>8.8(0)	NOTE 1	NOTE 1	NOTE 1
MN-54	8.37±3.1(0)	1.55±.31(1)	NOTE 1	NOTE 1	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	>7.8(0)	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	<4.2(-1)	NOTE 1	NOTE 1	NOTE 1
CO-58	5.90±.31(0)	1.73±.06(1)	1.00±.37(1)	>8.5(1)	>3.9(1)
CO-60	6.74±1.5(0)	1.75±.14(1)	NOTE 1	NOTE 1	NOTE 1
ZN-65	NOTE 1	>1.0(0)	NOTE 1	NOTE 1	NOTE 1
SR-91	>7.9(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	>5.4(0)	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	1.40±.63(1)	NOTE 1	NOTE 1	NOTE 1
MO-99	>6.0(1)	>4.8(1)	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	>2.0(0)	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	>1.0(0)	NOTE 1	NOTE 1	NOTE 1
SB-124	<4.1(-1)	1.04±.38(0)	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	<6.4(-1)	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	>1.6(1)	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	<5.5(-1)	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	>1.1(1)	>1.7(0)	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMATIC OPERATIONS WITH < NUMBERS

TABLE 3.10 (cont'd)

DECONTAMINATION FACTORS FOR PURIFICATION DEMINERALIZER

REACTOR COOLANT LETDOWN DEMINERALIZER - DF

DATE	1/20	1/20	1/20	1/20	1/21
TIME	1320	1509	1736	2105	100
NUCLIDE	DECONTAMINATION FACTOR				
BR-84	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-131	1.45±.06(2)	1.48±.07(2)	1.45±.02(2)	1.84±.08(2)	1.63±.08(2)
I-132	1.20±.08(2)	1.48±.22(2)	1.36±.08(2)	1.35±.18(2)	1.00±.34(2)
I-133	1.05±.04(2)	1.35±.07(2)	1.36±.03(2)	1.46±.06(2)	>6.4(1)
I-134	>2.4(1)	>4.9(0)	>4.7(1)	9.23±2.6(1)	>2.1(2)
I-135	1.25±.66(2)	2.95±.93(2)	1.47±.12(2)	>3.2(2)	>1.9(2)
RB-88	2.79±.61(0)	>6.3(-1)	1.63±.45(0)	>2.3(-1)	2.50±.54(0)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.31±.02(0)	1.25±.02(0)	1.51±.03(0)	1.36±.05(0)	1.36±.07(0)
CS-136	1.43±.22(1)	9.50±1.1(0)	2.95±.35(1)	>4.9(1)	3.37±2.9(1)
CS-137	1.19±.04(0)	1.23±.10(0)	1.74±.09(0)	1.52±.05(0)	1.44±.08(0)
CS-138	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	>7.3(1)	1.24±.05(1)	>3.5(1)	>9.7(0)	>8.8(0)
CO-60	NOTE 1	1.59±.14(1)	NOTE 1	NOTE 1	NOTE 1
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 3.10 (cont'd)

DECONTAMINATION FACTORS FOR PURIFICATION DEMINERALIZER

REACTOR COOLANT LETDOWN DEMINERALIZER - DF

DATE	1/26	2/ 2	2/ 8	2/14	2/21
TIME	1402	1335	1112	907	943
NUCLIDE	DECONTAMINATION FACTOR				
BR-84	>1.7(0)	NOTE 1	>1.1(0)	NOTE 1	NOTE 1
I-131	>1.8(1)	9.29±.60(1)	1.26±.13(2)	1.23±.11(2)	1.55±.34(2)
I-132	1.25±.73(2)	1.01±.08(2)	1.65±.27(2)	9.23±.78(1)	1.03±.02(2)
I-133	>3.4(1)	1.15±.09(2)	1.05±.06(2)	1.13±.11(2)	1.50±.07(2)
I-134	1.62±.46(2)	1.22±.41(2)	>1.1(2)	1.72±.26(2)	>5.5(1)
I-135	>1.7(2)	1.29±.24(2)	1.09±.17(2)	3.13±1.6(2)	4.74±1.9(2)
RB-88	3.05±.25(-1)	NOTE 1	>1.9(-1)	3.85±2.0(0)	NOTE 1
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	9.32±.22(-1)	1.00±.01(0)	1.10±.03(0)	1.03±.02(0)	9.89±.10(-1)
CS-136	1.49±.41(0)	1.07±.05(0)	1.06±.03(0)	1.27±.11(0)	1.14±.12(0)
CS-137	8.72±.19(-1)	1.01±.01(0)	1.01±.01(0)	1.03±.02(0)	8.80±.17(-1)
CS-138	7.15±2.8(0)	NOTE 1	>3.4(0)	>3.8(0)	>1.8(0)
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	>1.9(1)	5.70±.26(1)	7.62±.49(1)	8.24±.56(1)	1.03±.08(2)
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	NOTE 1	1.66±.49(1)	3.06±.52(0)	>2.1(1)	2.32±.43(0)
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1	>2.6(1)	>5.0(0)	>3.8(-1)
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	NOTE 1	2.50±.27(1)	>3.2(2)	4.17±1.0(1)	1.71±.40(1)
CO-60	NOTE 1	2.09±.32(1)	5.20±2.6(1)	>2.7(1)	>1.1(1)
ZN-65	NOTE 1	NOTE 1	>1.8(1)	NOTE 1	NOTE 1
SR-91	>1.9(0)	>7.6(0)	NOTE 1	NOTE 1	>9.1(0)
Y-91M	NOTE 1	>3.5(0)	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	>7.7(0)	NOTE 1	NOTE 1
ZR-95	NOTE 1	>2.5(0)	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	1.47±.84(1)	>3.0(1)	>2.3(1)	>2.3(1)
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	<6.0(0)	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1.	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	<1.5(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	>7.0(0)	>1.1(1)	>8.2(0)	>1.0(1)
LA-140	NOTE 1	NOTE 1	>2.7(0)	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	>1.2(1)	>5.0(0)	>1.4(1)	>7.4(0)	>1.7(1)
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

FIGURE 3.18

^{131}I DECONTAMINATION FACTOR FOR PURIFICATION DEMINERALIZER

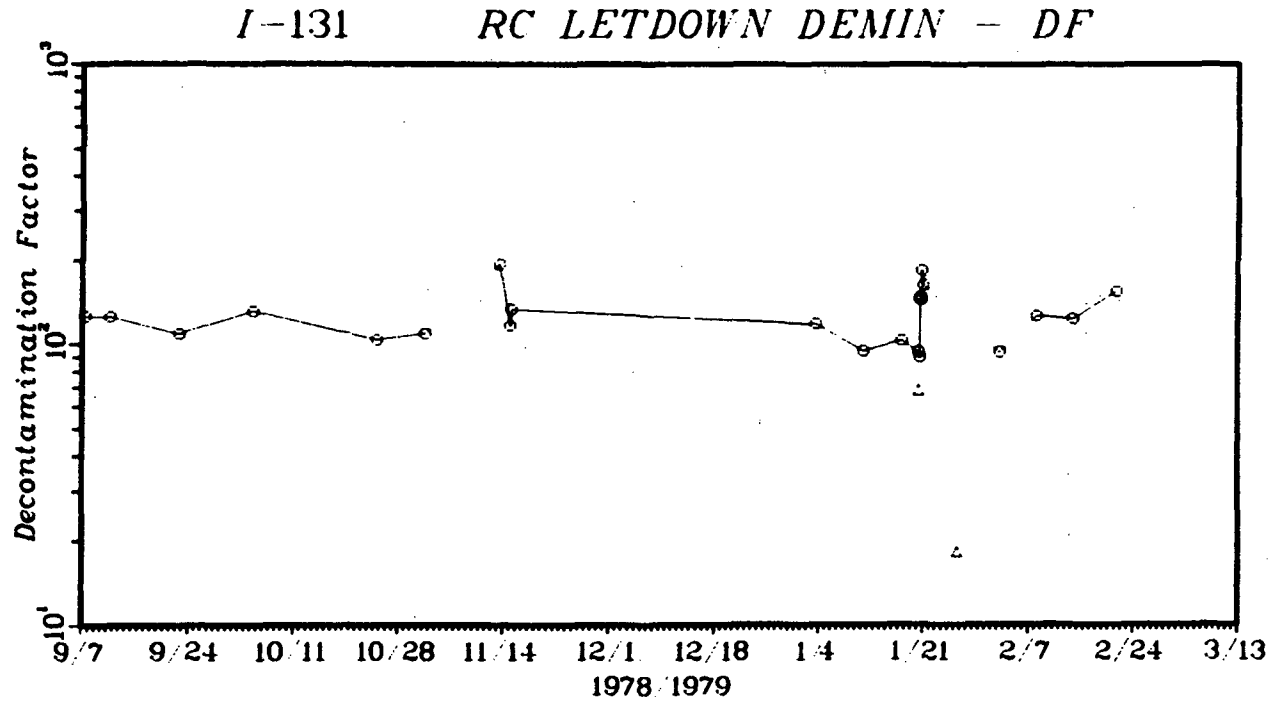


FIGURE 3.19

^{136}Cs DECONTAMINATION FACTOR FOR PURIFICATION DEMINERALIZER

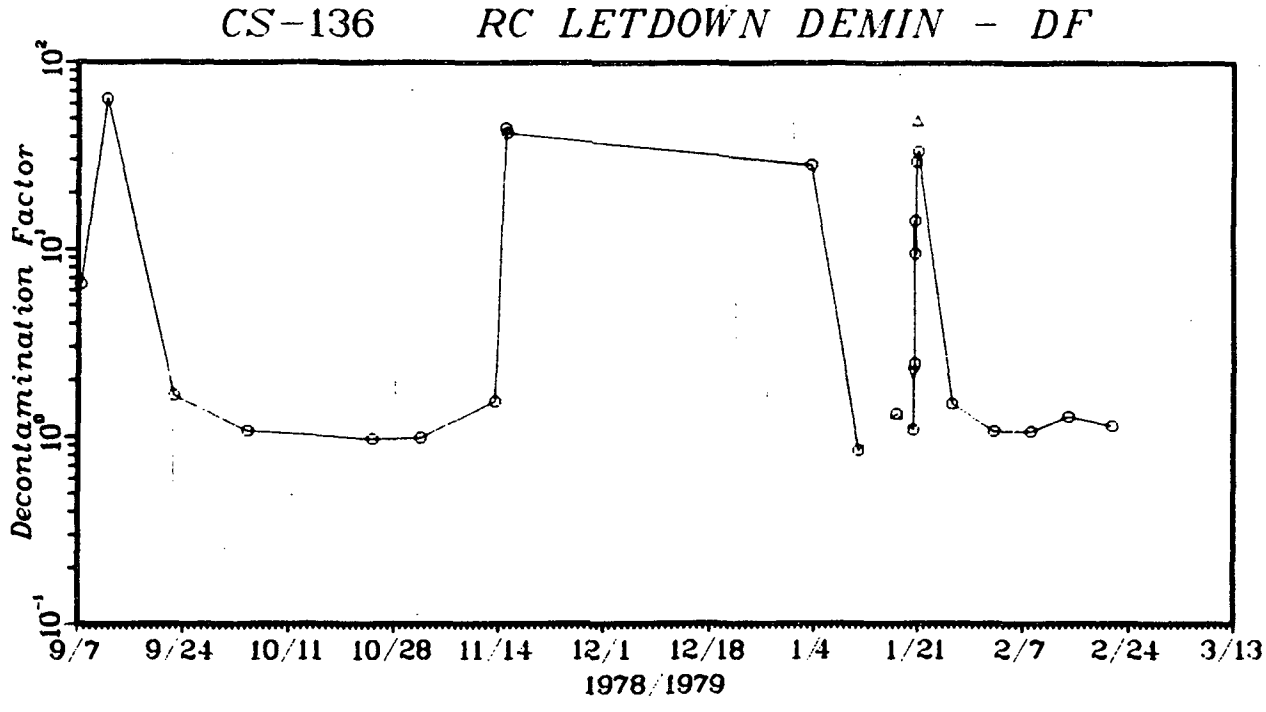


FIGURE 3.20

^{137}Cs DECONTAMINATION FACTOR FOR PURIFICATION DEMINERALIZER

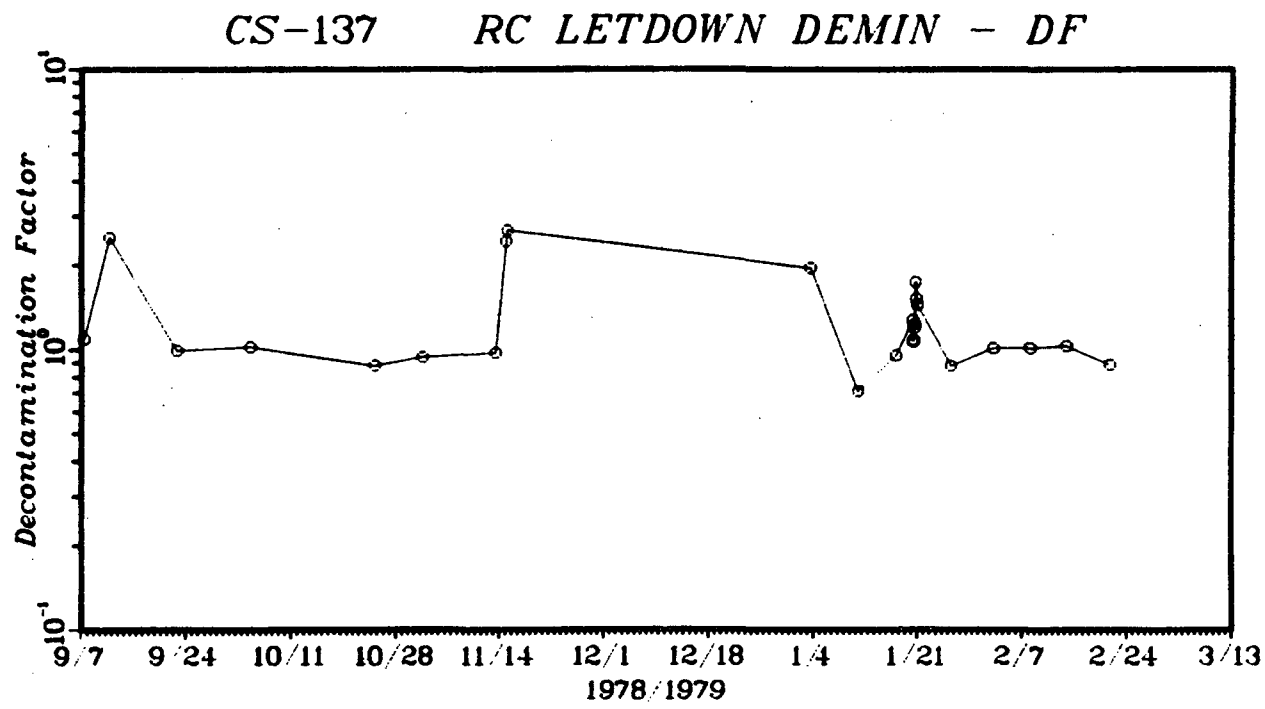


FIGURE 3.21

^{58}Co DECONTAMINATION FACTOR FOR PURIFICATION DEMINERALIZER

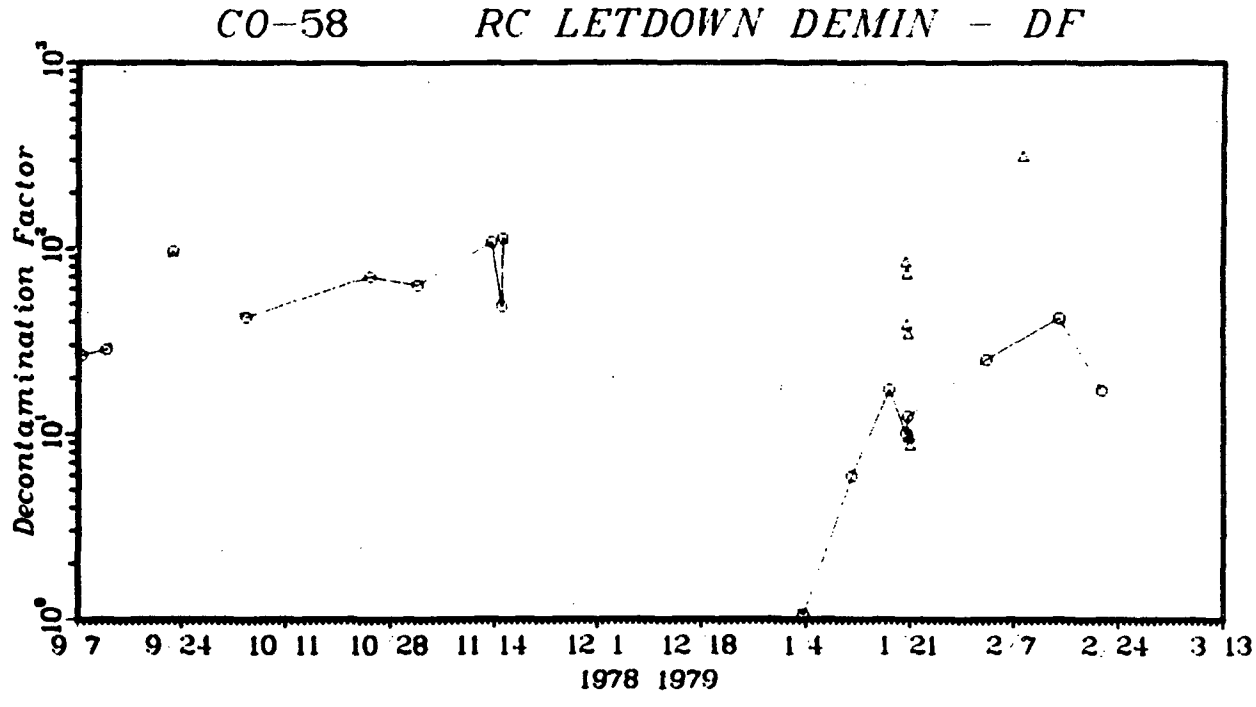
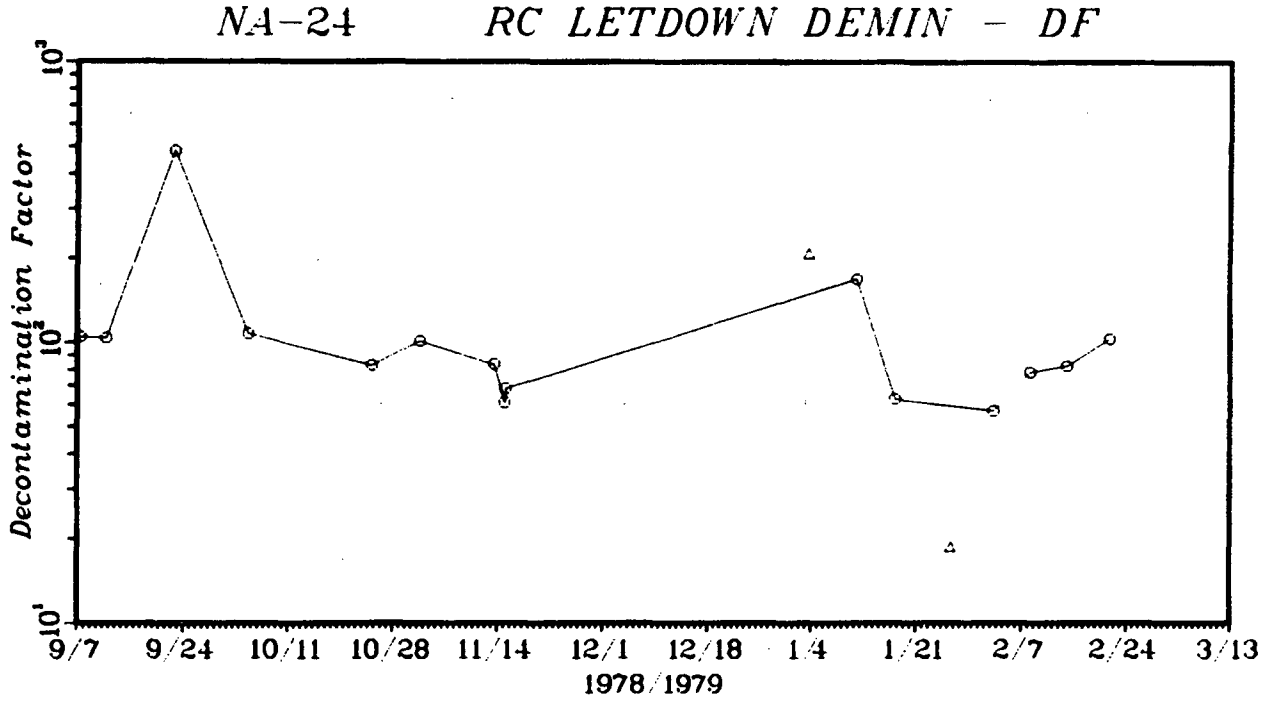


FIGURE 3.22

^{24}Na DECONTAMINATION FACTOR FOR PURIFICATION DEMINERALIZER



in the plots for the radiocesiums, and apparently to a lesser degree in the plots for the radioiodines and the radiocobalts are dramatic increases in the measured DF during reactor coolant spiking on 11/15/78 and 1/20/79. The elevated DF's registered at 9/11/78 were also measured during a period when the reactor coolant concentrations were high from power fluctuation on 9/10/78 and 9/11/78. Similarily, a hot shutdown on 1/3/79 elevated the reactor coolant concentrations during letdown sampling on 1/3/79 (see Figures 3.18 and 3.21 for example). This phenomenon of DF spiking and the positive correlation of demineralizer DF and inlet concentration are discussed in detail in section 2.6 of this paper. The magnitude of the effect is impressive primarily for the radiocesiums. Decontamination factors for ^{134}Cs, ^{136}Cs, and ^{137}Cs are nominally 1.0 for steady-state conditions; however, during the reactor coolant spike of 11/15/78, the measured DF's for these nuclides reached 2.9, 44.5, and 2.7, respectively.

Average decontamination factors have been calculated for the letdown demineralizer. Care was taken to select only those results obtained during steady-state power operations. Averages were computed using both the DF average method and the average inlet over average outlet method discussed previously (see section 3.3.2) for periods both before and after refueling. The results are presented in Table 3.11.

3.3.4 Other Components

3.3.4.1 Makeup Filters

The makeup filters (F-230A and F-230B on Figure 3.2) exist primarily to remove resin fines from the purification demineralizer effluent. Four sets of samples were obtained across the makeup filters, all during the period after refueling. No record was kept of which filter (A or B) was in service at the time of sampling. Results of analyses performed on the samples of makeup filter effluent are presented in Appendix Table B.5. Decontamination factors were computed by dividing the letdown demineralizer effluent results by comparable results on the makeup filter effluent, and are presented in Table 3.12. The "best value" DF's are presented in Table 3.13.

3.3.4.2 Makeup Tank

Radionuclide concentrations in the makeup tank (V-235 on Figure 3.2) were sampled four times during the measurement period. Results of these analyses are presented in Appendix Table B.6.

3.3.4.3 Borated Water Storage Tank

The borated water storage tank (BWST) provides a repository for highly borated water used primarily to flood the fuel transfer canal during refueling operations. The BWST (T-250 on Figure 3.2) was sampled twice during the in-plant measurement program. The

TABLE 3.11

DECONTAMINATION FACTORS MEASURED ACROSS THE LETDOWN DEMINERALIZER DURING POWER OPERATIONS

	Before Refueling		After Refueling	
Nuclide	$\overline{DF}$ †	$\overline{IN/OUT}$ ††	$\overline{DF}$ †††	$\overline{IN/OUT}$ ††
^{84}Br	*	>4.6(1)	*	>2.9(0)
^{131}I	1.07 ± 0.02(2)	1.32 ± 0.53(2)	1.04 ± 0.04(2)	1.13 ± 0.29(2)
^{132}I	8.09 ± 0.03(1)	9.7 ± 6.1(1)	1.02 ± 0.02(2)	1.11 ± 0.41(2)
^{133}I	1.22 ± 0.02(2)	1.31 ± 0.73(2)	1.09 ± 0.04(2)	0.80 ± 1.8(1)
^{134}I	9.4 ± 1.0(1)	1.28 ± 0.87(2)	1.58 ± 0.18(2)	1.2(2)
^{135}I	1.30 ± 0.10(2)	1.25 ± 0.47(2)	1.20 ± 0.13(2)	1.69 ± 0.89(2)
^{88}Rb	1.08 ± 0.16(0)	1.00 ± 0.73(0)	3.06 ± 0.25(-1)	6.0 ± 8.6(-1)
^{89}Rb	*	*	*	*
^{134}Cs	9.86 ± 0.01(-1)	1.00 ± 0.43(0)	1.01 ± 0.01(0)	9.6 ± 2.6(-1)
^{136}Cs	1.05 ± 0.01(0)	1.6 ± 1.7(0)	1.09 ± 0.02(0)	1.10 ± 0.67(0)
^{137}Cs	9.67 ± 0.01(-1)	9.9 ± 4.0(-1)	9.87 ± 0.01(0)	9.2 ± 2.5(-1)
^{138}Cs	*	*	*	*
^{139}Cs	*	*	*	*
^{24}Na	9.20 ± 0.28(1)	1.01 ± 0.62(2)	6.71 ± 0.20(1)	7.9 ± 4.1(1)
^{51}Cr	3.20 ± 0.37(1)	5.8 ± 9.8(1)	*	*
^{54}Mn	7.96 ± 0.31(1)	4.5(0)	2.89 ± 0.32(0)	7.0 ± 6.2(0)
^{56}Mn	*	*	*	*
^{59}Fe	1.04 ± 0.07(2)	7.3(1)	*	>8.1(0)
^{57}Co	*	>6.3(0)	*	*
^{58}Co	5.64 ± 0.05(1)	0.82 ± 1.4(2)	1.77 ± 0.06(1)	1.4 ± 1.6(1)
^{60}Co	6.79 ± 0.18(1)	0.79 ± 1.4(2)	1.81 ± 0.13(1)	1.8(1)
^{65}Zn	*	>3.0(0)	*	>4.9(0)
^{91}Sr	*	*	*	>9.1(0)
^{91m}Y	*	*	*	>3.4(0)
^{95}Zr	1.37 ± 0.34(2)**	3.0(1)	*	>2.9(0)
^{95}Nb	1.01 ± 0.07(2)**	7.7(1)	1.40 ± 0.63(1)**	>5.5(0)
^{99}Mo	7.5 ± 1.6(1)	8.3(1)	1.47 ± 0.84(1)**	4.7(1)
^{103}Ru	*	*	*	*
^{106}RuD	*	*	*	*

TABLE 3.11 (cont'd)

DECONTAMINATION FACTORS MEASURED ACROSS THE LETDOWN DEMINERALIZER DURING POWER OPERATIONS

	Before Refueling		After Refueling	
Nuclide	$\overline{DF}$ †	$\overline{IN/OUT}$ ††	$\overline{DF}$ †††	$\overline{IN/OUT}$ ††
^{110m}Ag	*	*	*	*
^{124}Sb	2.89 ± 0.67(0)	4.7(0)	1.04 ± 0.38(0)**	7.4(-1)
^{125}Sb	*	*	*	*
^{140}Ba	*	>6.1(0)	*	>1.5(1)
^{140}La	*	*	*	>8.1(0)
^{141}Ce	*	>4.3(0)	*	*
^{143}Ce	*	*	*	*
^{144}Ce	*	<3.9(0)	*	*
^{187}W	*	<2.3(1)	*	>1.3(1)
^{239}Np	*	>1.9(1)	*	*

† Computed as the error-weighted average of the instantaneous DF's measured on 9/22/78, 10/4/78, 10/24/78, 11/1/78, and 11/13/78. Statistical flyers were detected using the Dixon outlier test operating at a 5% significance level and were deleted from the data set.

†† Computed as the ratio of the average steady-state inlet concentration and the average steady-state outlet concentration.

††† Computed as the error-weighted average of the instantaneous DF's measured on 1/11/79, 2/2/79, 2/8/79, 2/14/79, and 2/21/79. Statistical flyers were detected using the Dixon outlier test operating at a 5% significance level and were deleted from the data set.

* No meaningful result can be computed.

** Average result based on only one real value.

TABLE 3.12

DECONTAMINATION FACTORS FOR MAKEUP FILTER

DATE	1/ 3	1/11	1/17	2/21
TIME	1308	958	1414	942
NUCLIDE	DECONTAMINATION FACTOR			
BR-84	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-131	7.45±.08(-1)	2.03±.70(0)	8.17±.83(-1)	1.26±.31(0)
I-132	1.27±.46(0)	1.00±.54(0)	1.38±.34(0)	1.87±1.2(0)
I-133	8.54±.28(-1)	7.78±1.7(-1)	7.10±.99(-1)	1.15±.13(2)
I-134	1.23±.78(0)	>1.2(0)	<2.2(0)	<5.5(0)
I-135	7.40±3.7(-1)	>1.2(0)	<2.9(0)	5.56±3.3(-1)
RB-88	4.63±1.7(-1)	4.80±2.3(-1)	2.89±1.5(0)	NOTE 1
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	9.24±.13(-1)	1.02±.03(0)	8.18±.12(-1)	1.16±.01(0)
CS-136	1.09±.10(0)	1.04±.07(0)	1.08±.05(0)	1.21±.13(0)
CS-137	9.28±.15(-1)	1.04±.03(0)	8.47±.13(-1)	1.25±.02(0)
CS-138	>8.8(-1)	NOTE 1	NOTE 1	NOTE 1
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	NOTE 1	1.52±.55(0)	1.34±.39(0)	1.48±.25(0)
CR-51	>5.7(0)	NOTE 1	NOTE 1	NOTE 1
MN-54	6.00±.75(1)	5.76±2.3(-1)	1.63±.37(0)	2.59±.47(-1)
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	>3.8(0)	NOTE 1	NOTE 1	<3.3(0)
CO-57	NOTE 1	NOTE 1	>2.9(0)	NOTE 1
CO-58	7.99±.23(0)	6.80±.40(-1)	6.79±.29(-1)	5.82±1.3(-2)
CO-60	7.24±.42(0)	4.78±1.2(-1)	8.77±.84(-1)	<5.5(-2)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	>2.2(0)	NOTE 1	<8.3(-1)	<1.1(0)
NB-95	>7.6(0)	NOTE 1	>2.6(0)	<5.4(-1)
MO-99	<8.3(-1)	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	1.11±.19(0)	1.50±.54(0)	1.14±.39(0)	NOTE 1
SB-125	1.85±1.1(0)	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	2.44±1.5(0)	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	<2.4(-1)	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	>2.9(0)	NOTE 1	>2.5(0)	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMITIC OPERATIONS WITH < NUMBERS

TABLE 3.13

MAKEUP FILTER

"BEST VALUE" DECONTAMINATION FACTORS

Nuclide	Average
^{131}I	1.0
^{132}I	1.4
^{133}I	0.9
^{134}I	1.2*
^{135}I	1.1
^{88}Rb	1.7
^{134}Cs	1.0
^{136}Cs	1.1
^{137}Cs	1.0
^{24}Na	1.3
^{54}Mn	2.1
^{58}Co	2.3
^{60}Co	2.2
^{124}Sb	1.3
^{125}Sb	1.9*

* Radionuclide detected in one sample set only.

first sample was obtained on 11/14/78 just prior to the refueling outage. The second sample was obtained on 12/13/78. By this date, refueling operations were nearing completion and on 12/12/78 the fuel transfer canal had been drained and pumped to the BWST. The results of analyses on the BWST water are presented in Appendix Table B.7.

4. COOLANT RADWASTE SYSTEM

4.1 System Description and Sample Points

The coolant radwaste system (CRWS) collects and processes water from the chemical and volume control system (CVCS) and the reactor coolant system drain tank (RCSDT). Water in the RCSDT can have several sources, most of which do not normally produce much liquid. The core flooding tanks and makeup tanks can, but do not normally, feed to the RCSDT. The main source is the reactor coolant system drain header which is fed from various points in the reactor coolant system. During refueling, the liquid in the fuel transfer canal can be drained to the header for processing before return to the demineralized reactor coolant storage tank. During normal operations the RCSDT would receive reactor coolant water only. Because the water entering the coolant radwaste system is from the reactor coolant system, the chemistry tends to be relatively constant and follows the reactor coolant chemistry.

The coolant radwaste system consists of demineralizers and holding tanks. The system components are listed in Table 4.1 and the system layout is shown in Figure 4.1. The large holding tanks allow for holdup times for the liquid which reduces the concentration of the short half-life radionuclides.

Most of the liquid entering the coolant radwaste system results from the removal of water from the reactor coolant to change the boron concentration. Boron concentration, at its maximum value during refueling operations, is generally reduced to approximately zero by the end of core cycle. To change the boron concentration, water is removed from the reactor coolant system downstream of the letdown filter and purification demineralizer. This liquid enters a flash tank (at atmospheric pressure) where the concentration of dissolved hydrogen and fission gases is reduced. The gases released in the flash tank are collected in the waste gas collection header and sent to the waste gas treatment system. Water pumped from the RCSDT also enters the flash tank.

Liquid from the flash tank is pumped through two series-connected mixed-bed demineralizers (primary ion exchangers D606 A & B shown in Figure 4.1) into one of two waste receiver tanks. The primary ion exchangers are each designed to process the maximum expected coolant bleed rate of 140 gal/min during plant heatup and startup dilution, and are operated in series. The liquid can be recirculated through the primary demineralizers if required, but this was not done during the in-plant measurement period. An air purge is maintained through the air space of the receiver tanks to the radwaste area ventilation exhaust duct to remove fission product gases and hydrogen.

The waste held in the receiver tank is pumped through a second series-connected set of mixed-bed demineralizers (secondary ion exchangers D609 A & B shown in Figure 4.1) to one of two waste holdup tanks. The secondary

TABLE 4.1

COOLANT RADWASTE SYSTEM COMPONENT DATA

Item No.	Name/Function	Type	Capacity (each) gals	Design Temp F	Design Press psig	Material Body	Material Lining	Vented To	Design Code	Seismic Class	Sample Point
V-600	Reactor coolant system drain tank/ drain coolant system	Horizontal	32,000	250	50	SS	None	R.D.	ASME Sec III/C	I	
V-604	Flash tank/contains reactor coolant let-down, removes gaseous fission products	Vertical	1,430	200	30	SS	None	G.H.	ASME	II	RWS520
T-607A T-607B	Coolant waste receiver tanks/ contain reactor coolant letdown	Horizontal	60,000	200	14.9	SS	None	R.D.	None	I	RWS539 RWS540
T-610A	Coolant waste holdup tanks/ contains reactor coolant letdown	Horizontal	60,000	200	14.9	SS	None	R.D.	None	I	RWS555 RWS556

G.H. - Waste gas collection header

R.D. - Radwaste area exhaust duct

TABLE 4.1 (cont'd)

COOLANT RADWASTE SYSTEM COMPONENT DATA

Item No.	Name/Function	Resin Volume Each ft^3	Design Flow Rate gpm	Type of Resin	Design Temp F	Design Press psig	Material	Vented to	Design Code	Seismic Class	Sample Point
D-606A D-606B	Primary ion exchanger/ removes fission products from primary coolant	50*	150	Mixed	150	150	SS	M.T.	ASME Sec III/C	II	RWS527 RWS530
D-609A D-609B	Secondary ion exchanger/ removes fission products from primary coolant	50*	150	Mixed	150	150	SS	M.T.	ASME Sec III/C	II	RWS551 RWS554

M.T. - miscellaneous wastes tank

* - 4 ft diameter and 4 ft high

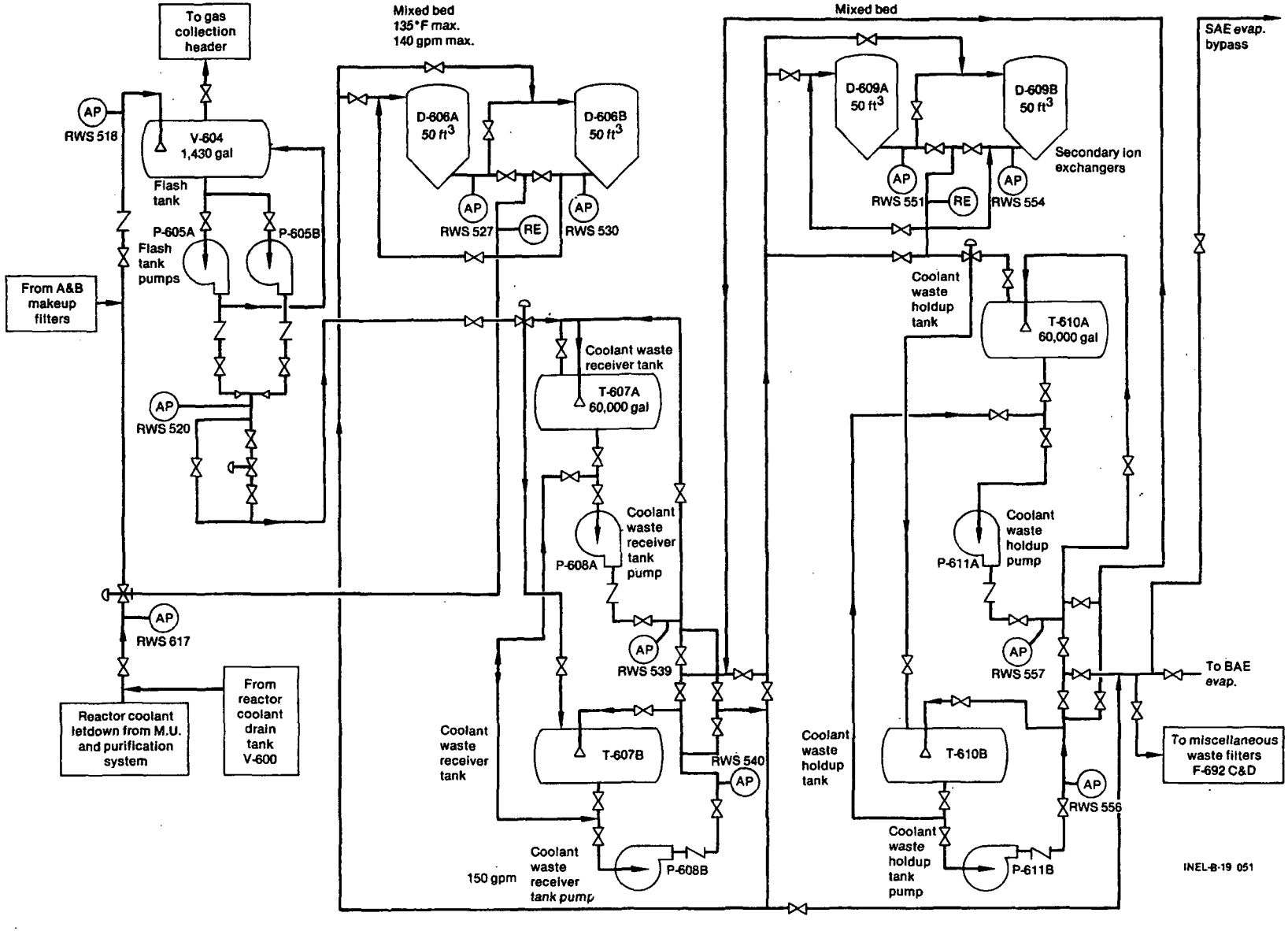
TABLE 4.1 (cont'd)

COOLANT RADWASTE SYSTEM COMPONENT DATA

Item No.	Name/Function	Type	Flow gpm	Design Head Ft H_2O	Design Temp F	Press psig	Material	Seismic Class
P-601A P-601B	Reactor coolant system drain tank pumps/ transfers contents for processing	Horizontal centrifugal with mechanical seals	100	235	70	450	SS	II
P-605A P-605B	Flash tank pumps/ transfers contents for processing	Horizontal centrifugal with mechanical seals	100	150	70	450	SS	II
P-608A P-608B	Coolant waste receiver tank pumps/ transfers contents for processing	Horizontal centrifugal with mechanical seals	150	235	70	450	SS	II
P-611A P-611B	Coolant waste holdup tank pumps/transfers contents for processing	Horizontal centrifugal with mechanical seals	150	235	70	450	SS	II

FIGURE 4.1

DIAGRAM OF COOLANT WASTE SYSTEM



ion exchangers are identical to the primary ion exchangers. The waste holdup tanks are vented in the same manner as the waste receiver tanks. The waste holdup tanks can also be recirculated through the secondary demineralizers, but this was not done during the in-plant measurement period.

The resin in these demineralizers is not regenerated but is replaced when spent and shipped off site for disposal.

4.2 Sampling Procedures

Ten bed volumes were pumped through the demineralizer before a sample was taken. An exception was made for the samples taken in September. Because the RCSDT was empty, water was taken from the letdown system. A run time of only 10 minutes could be allowed before sampling (3 bed volumes). To sample the inlet and outlet of a demineralizer, the samples were taken within 5 minutes of each other, taking the inlet sample first.

In all cases a 450 ml sample was taken after the sample line had been purged for 10 minutes. During the purge, the valving was not changed to avoid causing crud bursts. No samples for gases across the flash tank were taken because of the lack of proper sample connections.

The sample points used during the study of the coolant radwaste system are shown in Figure 4.1. All sample points are local sample points and have short sample lines.

Before refueling the RCSDT was empty, and only one set of samples was taken. After refueling, samples were taken at four different times from the primary demineralizers and three different times from the secondary demineralizers. Because of the large waste receiver tanks, the radionuclide concentrations in the outlet of primary demineralizer B need not be the same as the feed to the secondary demineralizer A, since mixing from previous processing can change the concentrations.

4.3 Discussion of Results

The radionuclide concentrations for all samples taken are listed in Appendix Tables B.8-B.13. Decontamination factors were calculated for all cases as detailed in Appendix A and are listed in Tables 4.2 through 4.5 for the four demineralizers. Table 4.6 presents the average inlet and outlet concentrations and the range for each demineralizer in the CRWS. "Best value" DF's for each demineralizer are shown in Table 4.7. The overall system "best value" DF was calculated using the inlet to primary A and outlet of secondary B and are also listed in Table 4.7. Because of the varying holdup times in the waste holdup tanks, the overall DF for short half-life nuclides could vary considerably.

Figures 4.2 and 4.3 show plots of the inlet ^{131}I concentration versus time for all four demineralizers. The ^{131}I concentration in the feed to the two primary demineralizers exhibited an increase on 2/28/79. This increase was due to a reactor coolant spike which occurred on 2/25/79.

TABLE 4.2

DECONTAMINATION FACTORS FOR CRWS PRIMARY DEMINERALIZER A

CRWS PRIMARY DEMIN A - DF

DATE	10/ 5	1/16	1/16	1/16	1/18
TIME	939	1028	1059	1131	1106
NUCLIDE	DECONTAMINATION FACTOR				
I-131	6.71±1.2(1)	>5.9(1)	>3.0(2)	>5.7(1)	>1.1(2)
I-132	>2.9(1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-133	>7.2(1)	>7.5(1)	>7.3(1)	>2.2(1)	>6.1(1)
I-134	>1.5(2)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-135	>1.5(1)	>1.5(1)	>3.0(0)	>1.3(0)	>1.0(2)
CS-134	9.44±.10(0)	1.31±.05(1)	1.03±.06(1)	8.48±2.8(0)	6.96±.26(0)
CS-136	>9.0(2)	>8.3(-1)	>1.7(1)	>3.9(-1)	>1.4(1)
CS-137	4.36±.05(0)	6.87±.25(0)	5.23±.43(0)	4.46±.20(0)	3.51±.15(0)
NA-24	>4.6(1)	>3.9(1)	>1.9(1)	>6.2(0)	>1.9(1)
CR-51	4.46±2.5(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	1.13±.13(0)	2.05±.17(0)	3.70±.42(0)	1.30±.10(0)	1.04±.09(1)
FE-59	<2.1(0)	2.33±.81(0)	4.20±2.6(0)	1.77±.91(0)	4.00±1.3(0)
CO-57	3.65±1.9(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	3.11±.16(0)	9.49±.35(-1)	1.38±.07(0)	7.90±.25(-1)	3.68±.08(0)
CO-60	9.53±.42(-1)	1.44±.13(0)	1.80±.16(0)	7.76±.50(-1)	5.22±.43(0)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<4.3(0)
ZR-95	NOTE 1	NOTE 1	<2.7(0)	NOTE 1	>2.5(0)
NB-95	>4.3(1)	1.13±.65(0)	1.30±.85(0)	9.38±1.7(-1)	2.95±.35(0)
MO-99	>1.9(0)	>1.4(0)	>5.5(-1)	>7.0(-1)	>1.4(0)
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	1.81±1.1(1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>2.8(0)
SB-124	>5.0(0)	>1.2(0)	>4.7(0)	NOTE 1	>2.3(0)
SB-125	<1.4(0)	NOTE 1	NOTE 1	NOTE 1	<2.0(0)
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	>6.3(0)	4.21±1.3(0)	2.50±.46(0)	>6.3(0)	3.70±.78(0)
CE-141	NOTE 1	NOTE 1	NOTE 1	<1.3(-1)	<1.3(0)
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 4.2 (cont'd)

DECONTAMINATION FACTORS FOR CRWS PRIMARY DEMINERALIZER A

CRWS PRIMARY DEMIN A - DF

DATE	2/ 9	2/28
TIME	1351	903
NUCLIDE	DECONTAMINATION FACTOR	
I-131	3.88±3.6(2)	7.23±1.1(2)
I-132	>3.3(0)	NOTE 1
I-133	>7.3(0)	>1.9(2)
I-134	NOTE 1	NOTE 1
I-135	>1.3(1)	<9.1(-1)
CS-134	5.65±.12(0)	3.47±.09(0)
CS-136	>3.9(1)	>5.0(1)
CS-137	3.08±.05(0)	2.07±.05(0)
NA-24	>7.0(1)	>4.3(0)
CR-51	<2.5(0)	<2.7(0)
MN-54	1.05±.04(0)	6.90±.51(-1)
FE-59	1.74±.48(0)	NOTE 1
CO-57	<2.2(-1)	<1.5(-1)
CO-58	6.77±.16(-1)	5.20±.10(-1)
CO-60	8.00±.20(-1)	5.00±.20(-1)
ZN-65	NOTE 1	NOTE 1
ZR-95	6.90±2.3(-1)	8.00±5.5(-1)
NB-95	1.00±.09(0)	<1.9(-1)
MO-99	2.00±1.8(1)	>4.2(0)
RU-103	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1
AG-110M	NOTE 1	<8.8(-1)
SB-124	3.38±2.2(-1)	1.56±1.1(-1)
SB-125	<2.4(0)	<1.2(0)
BA-140	NOTE 1	NOTE 1
LA-140	6.98±1.3(0)	3.36±.62(-1)
CE-141	>3.3(0)	<2.4(0)
CE-144	2.15±1.4(0)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 4.3

DECONTAMINATION FACTORS FOR CRWS PRIMARY DEMINERALIZER B

CRWS PRIMARY DEMIN B - DF

DATE	10/ 5	1/16	1/16	1/16	1/18
TIME	939	1018	1102	1133	1108
NUCLIDE	DECONTAMINATION FACTOR				
I-131	1.31±.31(0)	<4.2(0)	<9.1(-1)	<5.0(0)	<1.2(0)
I-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-133	NOTE 1	<2.3(0)	NOTE 1	NOTE 1	NOTE 1
I-134	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-135	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	7.94±.32(1)	1.11±.09(1)	1.37±.08(1)	1.59±.52(1)	1.84±.07(1)
CS-136	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-137	7.18±.17(1)	8.48±.41(0)	1.04±.08(1)	1.19±.06(1)	1.35±.06(1)
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	1.51±.70(0)	<5.9(0)	<1.2(0)	<5.9(0)	<3.6(0)
MN-54	1.03±.05(-1)	1.29±.10(0)	2.22±.24(0)	5.89±.64(0)	3.08±.26(0)
FE-59	>6.7(-1)	1.20±.43(0)	1.11±.62(0)	6.06±4.8(0)	2.81±.89(0)
CO-57	2.49±2.5(-1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	5.04±.24(-1)	1.11±.07(0)	1.92±.09(0)	3.80±.19(0)	6.45±.36(0)
CO-60	1.41±.04(-1)	1.05±.09(0)	2.31±.20(0)	6.13±.49(0)	2.78±.21(0)
ZN-65	<6.3(-1)	NOTE 1	NOTE 1	<1.0(1)	7.78±6.3(-1)
ZR-95	NOTE 1	<9.8(-1)	1.38±.77(0)	<2.9(0)	<3.6(0)
NB-95	<4.3(-1)	5.00±1.5(-1)	1.84±.31(0)	3.64±.61(0)	3.17±.37(0)
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	>3.6(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	<1.5(0)	NOTE 1	<3.6(0)
SB-124	NOTE 1	NOTE 1	<4.6(0)	NOTE 1	NOTE 1
SB-125	8.18±1.0(-1)	<3.6(0)	<1.6(0)	<1.0(1)	1.21±.63(0)
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	8.09±2.6(-1)	1.83±.48(0)	<8.0(-1)	2.45±.90(0)
CE-141	NOTE 1	NOTE 1	NOTE 1	>8.0(0)	>3.8(0)
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 4.3 (cont'd)

DECONTAMINATION FACTORS FOR CRWS PRIMARY DEMINERALIZER B

CRWS PRIMARY DEMIN B - DF

DATE	2/ 9	2/28
TIME	1356	904
NUCLIDE	DECONTAMINATION FACTOR	
I-131	8.57±8.2(-1)	1.88±.42(0)
I-132	NOTE 1	<4.3(-1)
I-133	NOTE 1	NOTE 1
I-134	NOTE 1	NOTE 1
I-135	NOTE 1	>5.5(-1)
CS-134	7.42±.20(0)	1.38±.03(1)
CS-136	NOTE 1	NOTE 1
CS-137	6.04±.08(0)	9.43±.32(0)
NA-24	NOTE 1	NOTE 1
CR-51	1.14±.60(0)	4.41±3.0(-1)
MN-54	1.05±.04(0)	9.42±.55(-2)
FE-59	8.50±2.0(-1)	<1.4(-1)
CO-57	6.67±4.3(-2)	>1.6(0)
CO-58	1.29±.03(0)	2.28±.05(-1)
CO-60	8.90±.18(-1)	1.03±.04(-1)
ZN-65	NOTE 1	NOTE 1
ZR-95	2.33±.46(0)	2.00±.82(-1)
NB-95	1.46±.11(0)	2.41±.29(-1)
MO-99	>1.8(0)	NOTE 1
RU-103	<1.5(0)	<1.2(0)
RUO-106	NOTE 1	NOTE 1
AG-110M	NOTE 1	>4.0(-1)
SB-124	4.10±2.2(0)	5.51±2.7(0)
SB-125	5.73±2.1(-1)	1.02±.44(0)
BA-140	NOTE 1	NOTE 1
LA-140	1.08±.24(0)	1.17±.32(0)
CE-141	NOTE 1	4.46±3.3(-1)
CE-144	>1.1(0)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 4.4

DECONTAMINATION FACTORS FOR CRWS SECONDARY DEMINERALIZER A

CRWS SECONDARY DEMIN A DF

DATE	10/10	1/24	1/24	2/ 9	2/28
TIME	1535	1101	1159	1412	1020
NUCLIDE	DECONTAMINATION FACTOR				
I-131	<3.7(0)	1.54±.12(0)	1.53±.13(0)	2.78±1.1(0)	1.34±.10(0)
I-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-133	<1.2(0)	4.60±4.5(0)	>3.7(-2)	>3.0(0)	2.60±2.6(0)
I-134	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-135	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	2.68±.41(1)	3.33±.33(1)	4.77±.74(1)	3.25±.41(1)	2.74±.28(1)
CS-136	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-137	1.63±.28(2)	3.46±.20(1)	3.31±.19(1)	2.83±.11(1)	2.30±.09(1)
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	4.00±1.6(0)	2.17±.24(0)	2.17±.28(0)	1.13±.25(0)	1.33±1.3(1)
MN-54	1.66±.10(0)	3.97±.15(0)	3.83±.15(0)	6.47±.18(-2)	2.44±.08(0)
FE-59	NOTE 1	4.42±.46(0)	3.00±.46(0)	2.17±.64(0)	4.18±1.8(0)
CO-57	<9.1(0)	6.16±3.5(0)	5.93±2.9(0)	NOTE 1	>1.8(0)
CO-58	2.29±.10(0)	2.56±.10(0)	2.53±.07(0)	1.50±.01(0)	1.45±.01(0)
CO-60	7.31±.39(-1)	2.28±.05(0)	2.18±.07(0)	1.41±.05(0)	1.51±.03(0)
ZN-65	NOTE 1	<2.7(0)	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	2.40±.28(0)	2.85±.47(0)	2.44±.52(0)	2.00±.33(0)
NB-95	1.72±1.4(0)	3.05±.17(0)	3.06±.19(0)	1.68±.16(0)	1.72±.12(0)
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	1.73±1.2(0)	3.05±2.0(0)	1.34±.90(0)	<4.5(-1)
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	<2.9(1)	5.00±4.1(-1)	6.67±6.0(-1)	5.27±3.2(-1)	5.73±2.1(-1)
SB-124	NOTE 1	<1.2(0)	9.73±7.4(-1)	5.24±2.6(-1)	3.91±2.9(-1)
SB-125	>8.9(1)	1.64±.46(0)	1.34±.38(0)	1.10±.14(0)	1.16±.11(0)
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	<6.3(0)	9.60±1.7(-1)	1.25±.28(0)	6.25±1.4(-1)	9.38±1.0(-1)
CE-141	NOTE 1	>1.9(0)	>2.0(0)	>1.3(0)	>2.5(0)
CE-144	NOTE 1	NOTE 1	NOTE 1	>8.8(0)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE 4.5

DECONTAMINATION FACTORS FOR CRWS SECONDARY DEMINERALIZER B

CRWS SECONDARY DEMIN B DF

DATE	10/10	1/24	1/24	2/ 9	2/28
TIME	1533	1104	1202	1417	1023
NUCLIDE	DECONTAMINATION FACTOR				
I-131	1.17±.24(0)	1.14±.05(0)	1.27±.06(0)	6.55±2.7(-1)	1.05±.08(0)
I-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-133	1.13±.16(0)	>1.7(0)	<8.6(-1)	NOTE 1	>6.0(-1)
I-134	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-135	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.65±.81(0)	>5.3(0)	>6.6(0)	8.89±4.7(0)	>1.8(1)
CS-136	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-137	>6.0(-1)	>7.4(0)	>9.2(0)	3.77±2.6(1)	>7.9(0)
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	9.38±2.6(-1)	1.41±.08(0)	1.08±.08(0)	2.05±.43(0)	1.74±.75(-1)
MN-54	9.86±.33(-1)	2.18±.06(0)	7.23±.26(-1)	4.05±.19(1)	2.58±.10(0)
FE-59	NOTE 1	2.08±.21(0)	9.12±1.0(-1)	1.54±.47(0)	1.72±.85(0)
CO-57	>5.5(-1)	>1.2(0)	1.09±.52(0)	NOTE 1	NOTE 1
CO-58	1.06±.04(0)	1.87±.08(0)	9.51±.28(-1)	1.12±.01(0)	1.68±.03(0)
CO-60	1.29±.04(0)	1.72±.02(0)	7.23±.11(-1)	1.14±.04(0)	2.01±.06(0)
ZN-65	NOTE 1	>1.9(0)	NOTE 1	NOTE 1	<2.7(0)
ZR-95	NOTE 1	2.42±.18(0)	1.03±.11(0)	1.74±.64(0)	1.79±.38(0)
NB-95	1.52±.52(0)	2.08±.08(0)	9.64±.35(-1)	1.48±.17(0)	1.85±.13(0)
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	1.96±.56(0)	6.08±2.2(-1)	3.36±3.8(0)	2.67±1.7(0)
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<3.3(0)
AG-110M	NOTE 1	1.07±.18(0)	1.93±.30(0)	9.38±3.9(-1)	2.74±.12(-1)
SB-124	NOTE 1	4.71±1.9(0)	3.13±.93(0)	>5.3(0)	1.03±.89(1)
SB-125	NOTE 1	8.39±5.2(0)	9.56±7.1(0)	>1.1(1)	>2.4(1)
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	>8.0(-1)	1.14±.09(0)	9.06±1.8(-1)	1.00±.18(0)	1.04±.10(0)
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 4.6

COOLANT RADWASTE DEMINERALIZER AVERAGE RADIONUCLIDE CONCENTRATIONS

	Primary Demineralizers			Secondary Demineralizers		
Nuclide	Inlet Demin A (μCi/ml)	Outlet Demin A (μCi/ml)	Outlet Demin B (μCi/ml)	Inlet Demin A (μCi/ml)	Outlet Demin A (μCi/ml)	Outlet Demin B (μCi/ml)
^{131}I	1.74 ± 3.4(-3)	4.13 ± 6.7(-6)	2.80 ± 1.9(-6)	7.48 ± 5.5(-6)	4.90 ± 4.2(-6)	4.33 ± 3.5(-6)
^{132}I	6.30 ± 13.5(-5)	<9.0(-6)	9.75 ± 0.28(-6)	<3.1(-6)	<7.9(-5)	<6.5(-5)
^{133}I	4.63 ± 3.2(-4)	<4.1(-6)	2.19 ± 1.92(-6)	4.31 ± 4.6(-6)	6.80 ± 3.2(-6)	1.45 ± 4.9(-5)
^{134}I	8.22 ± 2.28(-4)	<1.6(-4)	<1.3(-4)	<3.7(-5)	<3.0(-4)	<5.3(-6)
^{135}I	4.22 ± 7.4(-4)	1.79 ± 1.62(-5)	<2.7(-5)	<9.7(-6)	<2.6(-6)	<2.8(-6)
^{134}Cs	3.69 ± 0.45(-3)	5.05 ± 1.7(-4)	3.77 ± 2.7(-5)	5.96 ± 3.0(-5)	1.80 ± 1.0(-6)	1.64 ± 0.71(-7)
^{136}Cs	9.51 ± 9.9(-5)	<9.3(-6)	<6.9(-7)	<8.5(-7)	<3.2(-7)	<3.2(-7)
^{137}Cs	4.38 ± 0.44(-3)	1.14 ± 0.35(-3)	1.12 ± 0.77(-4)	1.79 ± 0.93(-4)	6.16 ± 4.0(-6)	3.44 ± 3.00(-7)
^{24}Na	7.07 ± 4.0(-5)	<1.9(-6)	<1.5(-6)	<9.4(-7)	<3.6(-7)	<3.2(-7)
^{51}Cr	3.70 ± 3.29(-5)	3.11 ± 0.52(-5)	1.88 ± 1.1(-5)	3.82 ± 3.6(-5)	1.75 ± 1.7(-5)	1.43 ± 1.3(-5)
^{54}Mn	4.32 ± 3.8(-5)	1.92 ± 1.4(-5)	3.07 ± 4.1(-5)	3.51 ± 3.4(-5)	4.37 ± 7.1(-5)	7.25 ± 4.2(-6)
^{59}Fe	8.76 ± 4.9(-6)	4.05 ± 2.7(-6)	3.06 ± 2.4(-6)	7.90 ± 9.3(-6)	2.12 ± 2.0(-6)	1.47 ± 1.4(-6)
^{57}Co	1.17 ± 0.46(-5)	9.26 ± 6.5(-6)	9.29 ± 0.23(-6)	2.24 ± 1.6(-6)	6.10 ± 2.0(-7)	3.28 ± 2.20(-7)
^{58}Co	3.65 ± 2.9(-4)	2.95 ± 2.1(-4)	2.44 ± 2.5(-4)	5.82 ± 5.8(-4)	2.65 ± 2.1(-4)	1.90 ± 1.3(-4)
^{60}Co	5.63 ± 4.4(-5)	4.21 ± 3.0(-5)	7.40 ± 10.0(-5)	6.42 ± 5.6(-5)	3.42 ± 2.2(-5)	2.59 ± 1.5(-5)
^{65}Zn	<1.6(-6)	1.54 ± 1.33(-6)	8.10 ± 0.59(-6)	<4.4(-6)	3.38 ± 1.90(-7)	2.00 ± 1.40(-7)
^{95}Zr	4.27 ± 4.2(-6)	3.27 ± 3.6(-6)	3.71 ± 3.3(-6)	7.36 ± 6.4(-6)	3.00 ± 2.6(-6)	1.73 ± 1.2(-6)
^{95}Nb	1.18 ± 0.78(-5)	7.81 ± 4.3(-6)	7.36 ± 7.1(-6)	1.53 ± 1.5(-5)	5.88 ± 4.7(-6)	3.72 ± 2.6(-6)
^{99}Mo	6.27 ± 7.4(-5)	1.29 ± 1.14(-5)	<8.5(-6)	<1.8(-6)	<1.7(-6)	<1.4(-6)
^{103}Ru	<2.9(-6)	<1.7(-6)	1.11 ± 0.53(-6)	1.01 ± 0.71(-6)	6.18 ± 2.9(-7)	4.20 ± 2.6(-7)
^{106}RuD	4.24 ± 2.39(-5)	1.29 ± 1.18(-5)	<3.1(-6)	<4.7(-6)	<2.0(-6)	1.18 ± 0.82(-6)
^{110m}Ag	3.67 ± 2.10(-6)	2.27 ± 2.04(-6)	1.05 ± 0.14(-6)	1.64 ± 0.44(-6)	1.87 ± 1.1(-6)	3.20 ± 2.6(-6)
^{124}Sb	1.94 ± 2.0(-6)	1.23 ± 0.78(-6)	2.67 ± 1.2(-7)	4.64 ± 2.2(-7)	5.98 ± 1.3(-7)	1.16 ± 0.77(-7)
^{125}Sb	<8.1(-6)	8.53 ± 1.8(-6)	6.51 ± 2.4(-6)	1.01 ± 0.14(-6)	6.49 ± 1.4(-6)	4.50 ± 1.3(-7)
^{140}Ba	<4.4(-5)	<6.2(-6)	<1.6(-6)	<2.3(-6)	<1.0(-6)	<1.1(-6)
^{140}La	1.72 ± 1.2(-5)	4.87 ± 2.74(-6)	4.27 ± 2.4(-6)	5.20 ± 4.2(-6)	5.39 ± 4.7(-6)	5.26 ± 4.0(-6)
^{141}Ce	1.64 ± 1.45(-5)	3.90 ± 8.10(-5)	1.58 ± 0.78(-5)	3.98 ± 2.5(-6)	<9.9(-7)	<1.1(-6)
^{144}Ce	3.43 ± 3.03(-5)	2.64 ± 2.46(-5)	<8.9(-6)	1.69 ± 0.63(-5)	<2.2(-6)	<1.5(-6)

TABLE 4.7

COOLANT RADWASTE DEMINERALIZER "BEST VALUE" DECONTAMINATION FACTORS

Nuclide	Primary Demineralizers Demin A DF	Primary Demineralizers Demin B DF	Secondary Demineralizers Demin A DF	Secondary Demineralizers Demin B DF	Overall System DF
^{131}I	4.21 ± 10.0(2)	1.48 ± 2.6(0)	1.53 ± 1.7(0)	1.13 ± 1.3(0)	4.02 ± 8.50(2)
^{132}I	>7.0(0)	<9.2(-1)	*	*	>0.97(0)
^{133}I	>1.1(2)	<1.9(0)	6.34 ± 7.4(-1)	4.69 ± 16.0(-1)	3.19 ± 11.0(1)
^{134}I	>5.0(0)	*	*	*	>1.6(2)
^{135}I	2.36 ± 4.7(1)	>6.5(-1)	*	*	>1.5(2)
^{134}Cs	7.31 ± 2.6(0)	1.34 ± 1.1(1)	3.31 ± 2.5(1)	1.10 ± 0.78(1)	2.25 ± 1.01(4)
^{136}Cs	>1.0(1)	*	*	*	>2.9(2)
^{137}Cs	3.84 ± 1.2(0)	1.02 ± 0.77(1)	2.91 ± 2.4(1)	1.79 ± 1.2(1)	1.27 ± 1.1(4)
^{24}Na	>3.7(1)	*	*	*	>2.2(2)
^{51}Cr	1.19 ± 1.08(0)	1.65 ± 1.0(0)	2.18 ± 3.0(0)	1.22 ± 1.6(0)	2.59 ± 3.29(0)
^{54}Mn	2.25 ± 2.6(0)	6.25 ± 9.6(-1)	8.03 ± 15.2(-1)	6.03 ± 10.4(0)	5.96 ± 6.28(0)
^{59}Fe	2.16 ± 1.9(0)	1.32 ± 1.4(0)	3.73 ± 5.6(0)	1.44 ± 1.9(0)	5.96 ± 6.58(0)
^{57}Co	1.26 ± 1.02(0)	9.97 ± 7.0(-1)	3.67 ± 2.9(0)	1.86 ± 0.62(0)	3.57 ± 2.77(1)
^{58}Co	1.24 ± 1.3(0)	1.21 ± 1.5(0)	2.20 ± 2.8(0)	1.39 ± 1.5(0)	1.92 ± 2.1(0)
^{60}Co	1.34 ± 1.4(0)	5.69 ± 8.7(-1)	1.88 ± 2.0(0)	1.32 ± 1.1(0)	2.17 ± 2.11(0)
^{65}Zn	<1.0(0)	1.90 ± 0.17(-1)	<1.3(1)	1.69 ± 0.00(0)	<8.0(0)
^{95}Zr	1.31 ± 1.9(0)	8.81 ± 12.5(-1)	2.45 ± 3.0(0)	1.73 ± 1.9(0)	2.47 ± 2.97(0)
^{95}Nb	1.51 ± 1.3(0)	1.06 ± 1.2(0)	2.60 ± 3.3(0)	1.58 ± 1.7(0)	3.17 ± 3.05(0)
^{99}Mo	4.86 ± 7.17(0)	>1.5(0)	*	*	>4.5(1)
^{103}Ru	*	<1.6(0)	1.63 ± 1.4(0)	1.47 ± 1.1(0)	<6.9(0)
^{106}RuD	3.29 ± 3.53(0)	>4.1(0)	*	<1.7(0)	3.59 ± 3.22(1)
^{110m}Ag	1.62 ± 1.72(0)	2.16 ± 1.76(0)	8.77 ± 5.7(-1)	5.84 ± 5.9(-1)	1.15 ± 1.14(0)
^{124}Sb	1.58 ± 1.9(0)	4.61 ± 3.5(0)	7.76 ± 4.1(-1)	5.16 ± 3.6(0)	1.67 ± 2.05(1)
^{125}Sb	<9.5(-1)	1.31 ± 0.55(0)	1.56 ± 0.41(-1)	1.44 ± 0.53(1)	<1.8(1)
^{140}Ba	*	*	*	*	*
^{140}La	3.53 ± 2.5(0)	1.14 ± 0.65(0)	9.65 ± 11.5(-1)	1.02 ± 1.2(0)	3.27 ± 3.37(0)
^{141}Ce	4.21 ± 9.49(-1)	2.47 ± 5.27(0)	>4.0(0)	*	>1.5(1)
^{144}Ce	1.30 ± 1.67(0)	>3.0(0)	>7.5(0)	*	>2.39(1)

* These data points have been left off due to half life corrections or other problems associated with arithmetic operations with < numbers.

FIGURE 4.2

^{131}I CONCENTRATIONS FOR CRWS PRIMARY DEMINERALIZERS

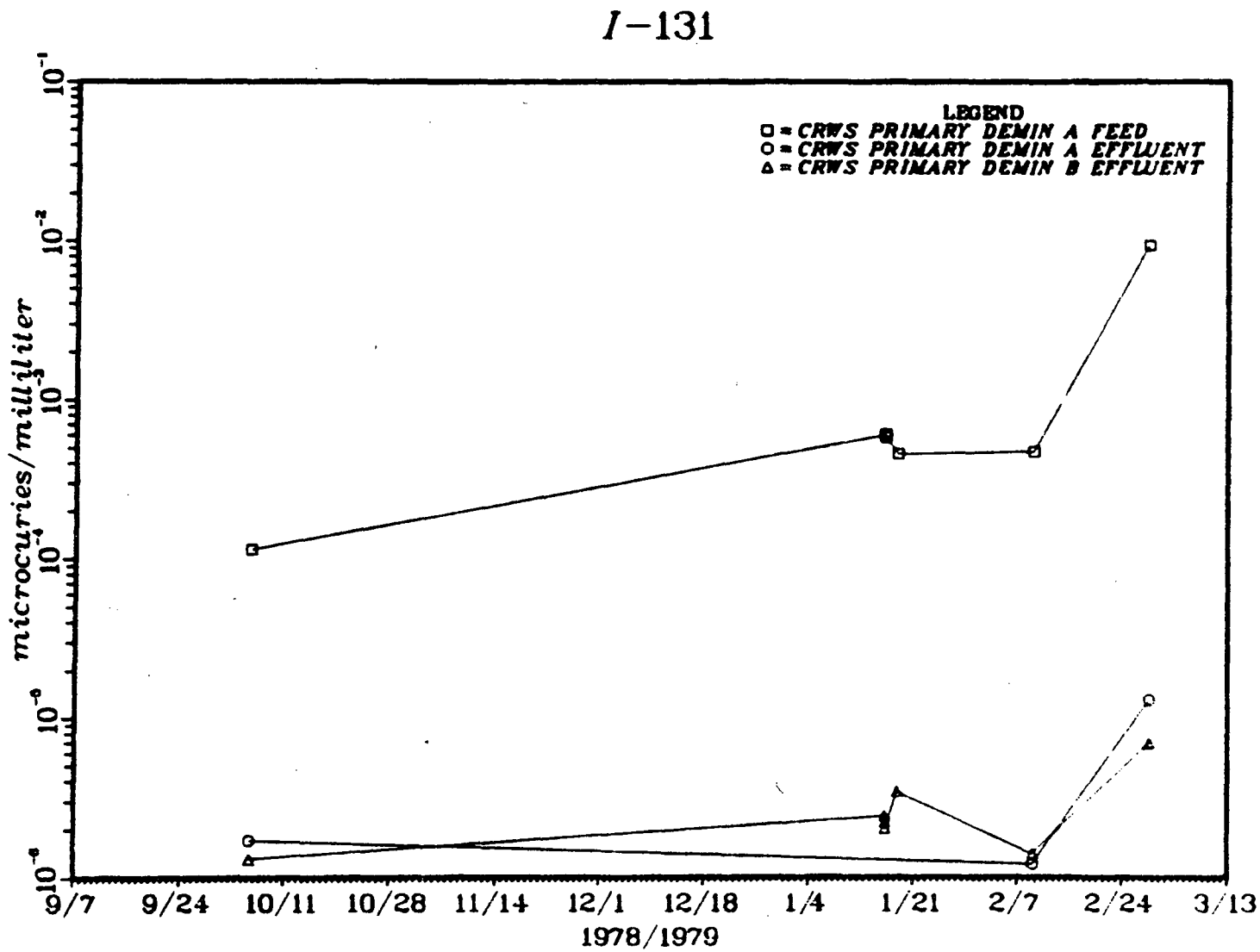
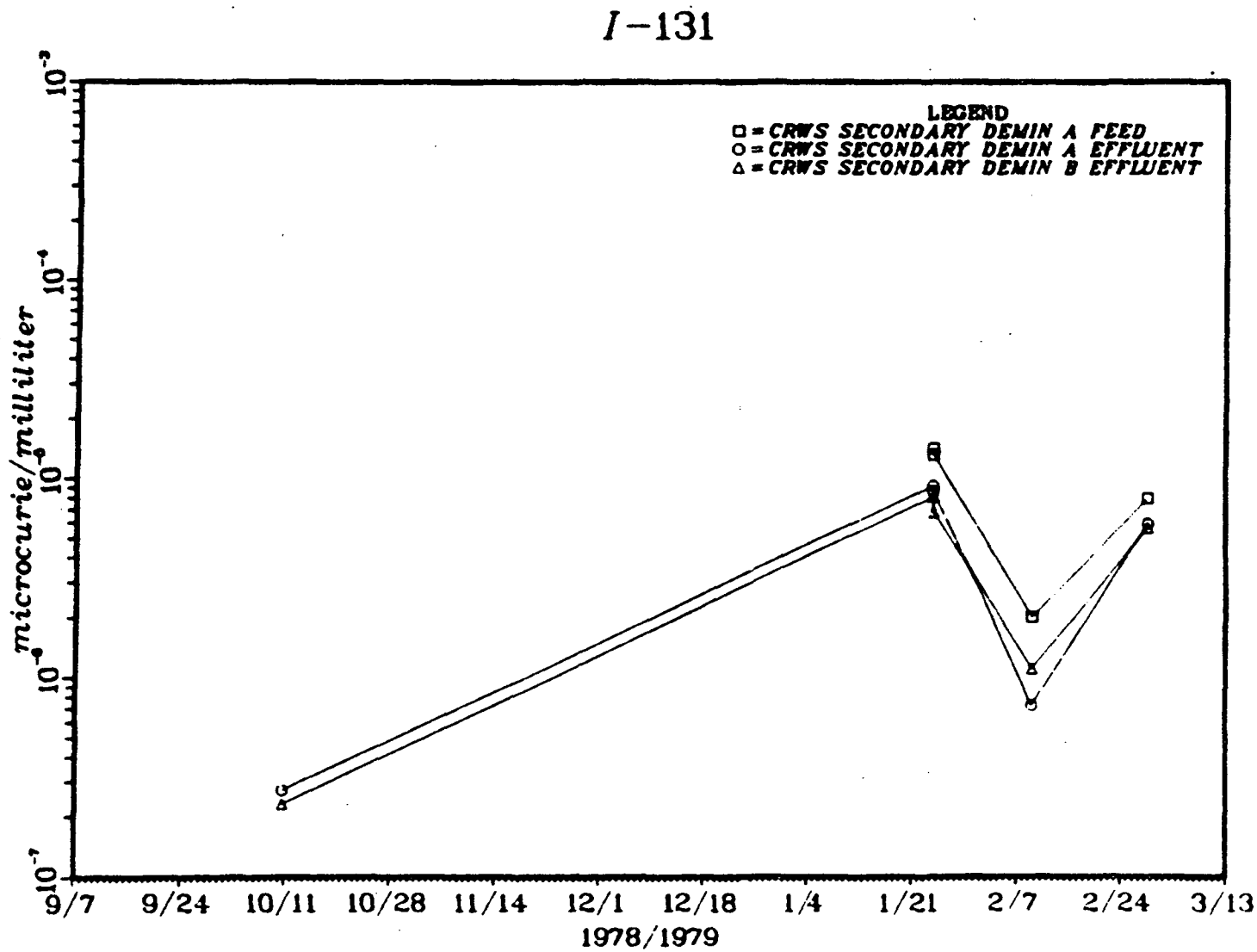


FIGURE 4.3

^{131}I CONCENTRATIONS FOR CRWS SECONDARY DEMINERALIZERS



The water containing the 2/25/79 spike had not been processed by the secondary demineralizers when sampled, and another sample after the in-plant measurements were complete would have been required to see if it would actually be propagated through all four demineralizers.

Figure 4.4 shows the ^{131}I DF's for all four demineralizers and the purification demineralizer, plotted as a function of the ^{131}I inlet concentration. The overall trend for all four CRWS demineralizers shows a correlation between feed concentration to a demineralizer and the decontamination factor. For all four demineralizers the slope is approximately one, but each demineralizer operates in a narrow range of inlet activities such that (except for the one spike) it is not possible to tell if each demineralizer would independently show a slope of one if fed water with varying ^{131}I concentrations. Figures 4.5 and 4.6 show ^{134}Cs and ^{137}Cs decontamination factors for the four coolant waste demineralizers and purification demineralizer plotted as a function of inlet concentration.

Although the feed to the coolant radwaste system did not show a wide range of concentration and the DF for each demineralizer did not show a large range, the DF did show a slight decrease during the sampling period. The slope of the inlet concentration vs. DF data from four of the five demineralizers is negative. The DF tended to increase as the feed concentration decreased for each successive demineralizer, starting from the purification demineralizer. The data for the secondary demineralizer B is difficult to compare with the other three because the effluent concentration from this demineralizer is mostly below detectable levels. For cesium there appears to be a correlation between the feed concentration and the DF, the higher the demineralizer inlet concentration the lower the DF. The purification demineralizer appears to have reached a point where it was not able to absorb a large amount of cesium and the DF has dropped to approximately 1.

Figure 4.7 shows the DF plotted as a function of the inlet concentration of ^{60}Co for the four coolant waste demineralizers. The data indicate that the crud-associated radionuclides are generally distributed evenly through all four demineralizers and each demineralizer has a DF close to 1. Most of the liquid processed by the coolant radwaste system has passed through the letdown filter and purification demineralizer which would tend to remove cruds large enough to be physically stopped or which are ionic. The material which reaches the coolant radwaste system appears to be in a form which is not removed by any of the demineralizers or filters. The known soluble ionic species tend to have a high DF in a demineralizer whereas cruds tend to migrate through the resin, not being stopped on any single demineralizer. With a given feed and constant migration rate the DF would reach 1, but with a large increase or decrease in feed concentration one would expect the instantaneous DF to become greater than or less than 1, respectively.

FIGURE 4.4

^{131}I DF VS. INLET CONCENTRATION FOR CRWS AND PURIFICATION DEMINERALIZERS

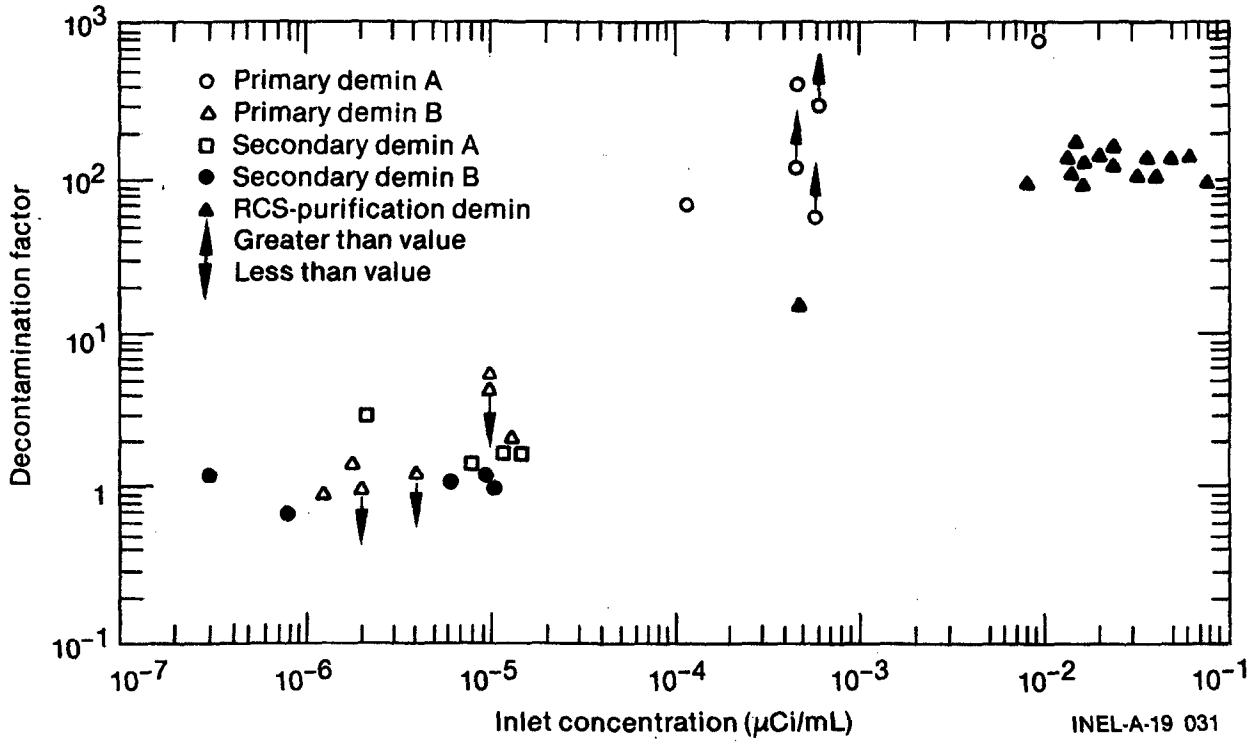


FIGURE 4.5

^{134}Cs DF VS. INLET CONCENTRATION FOR CRWS AND PURIFICATION DEMINERALIZERS

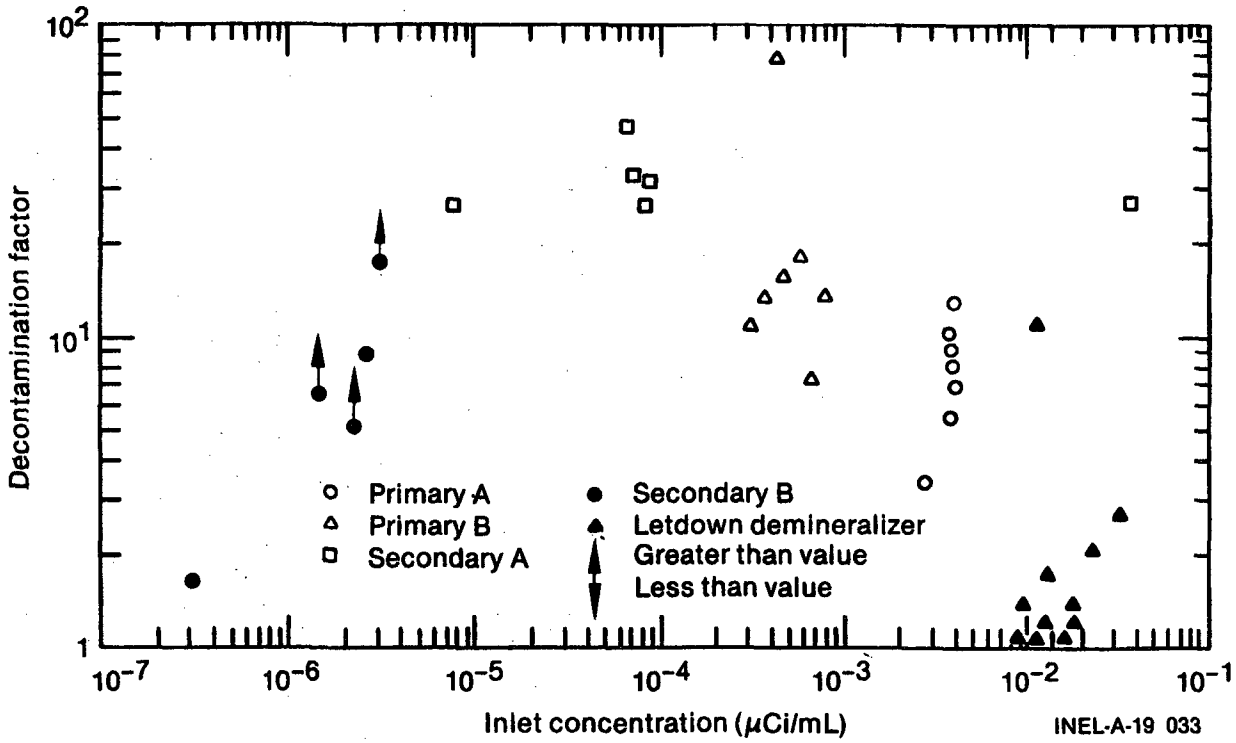


FIGURE 4.6

^{137}Cs DF VS. INLET CONCENTRATION FOR CRWS AND PURIFICATION DEMINERALIZERS

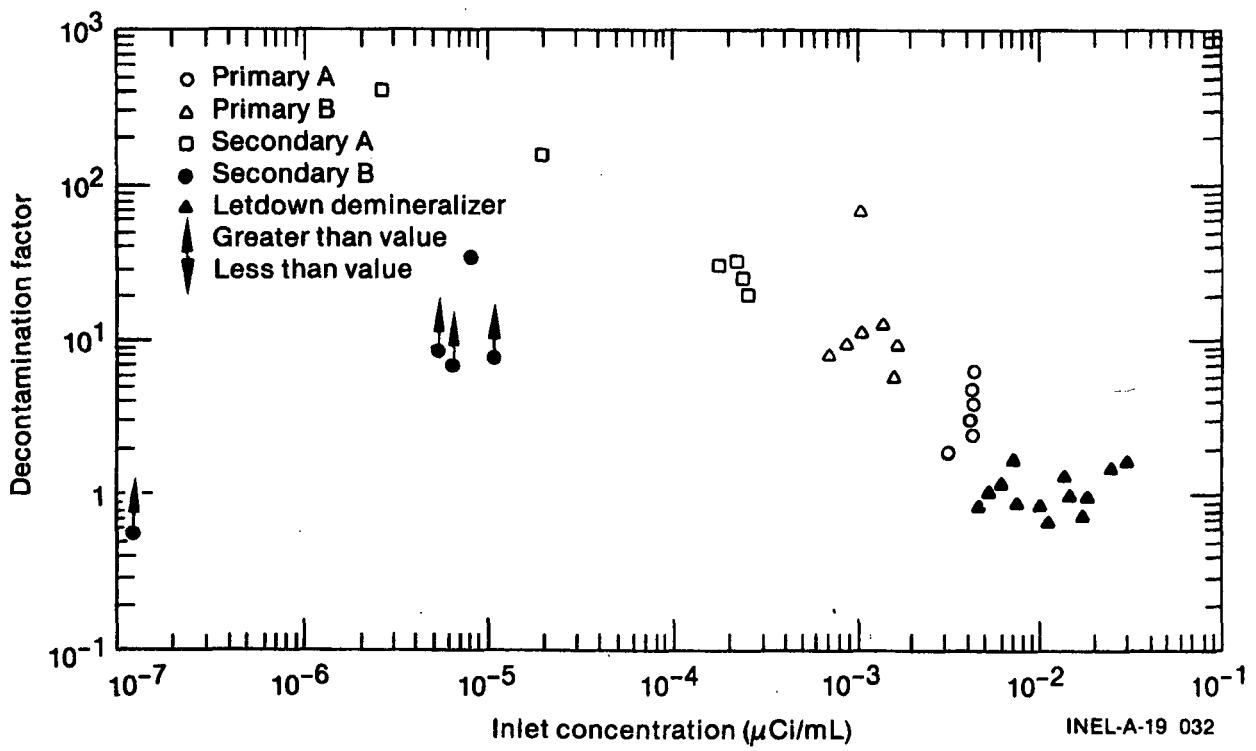
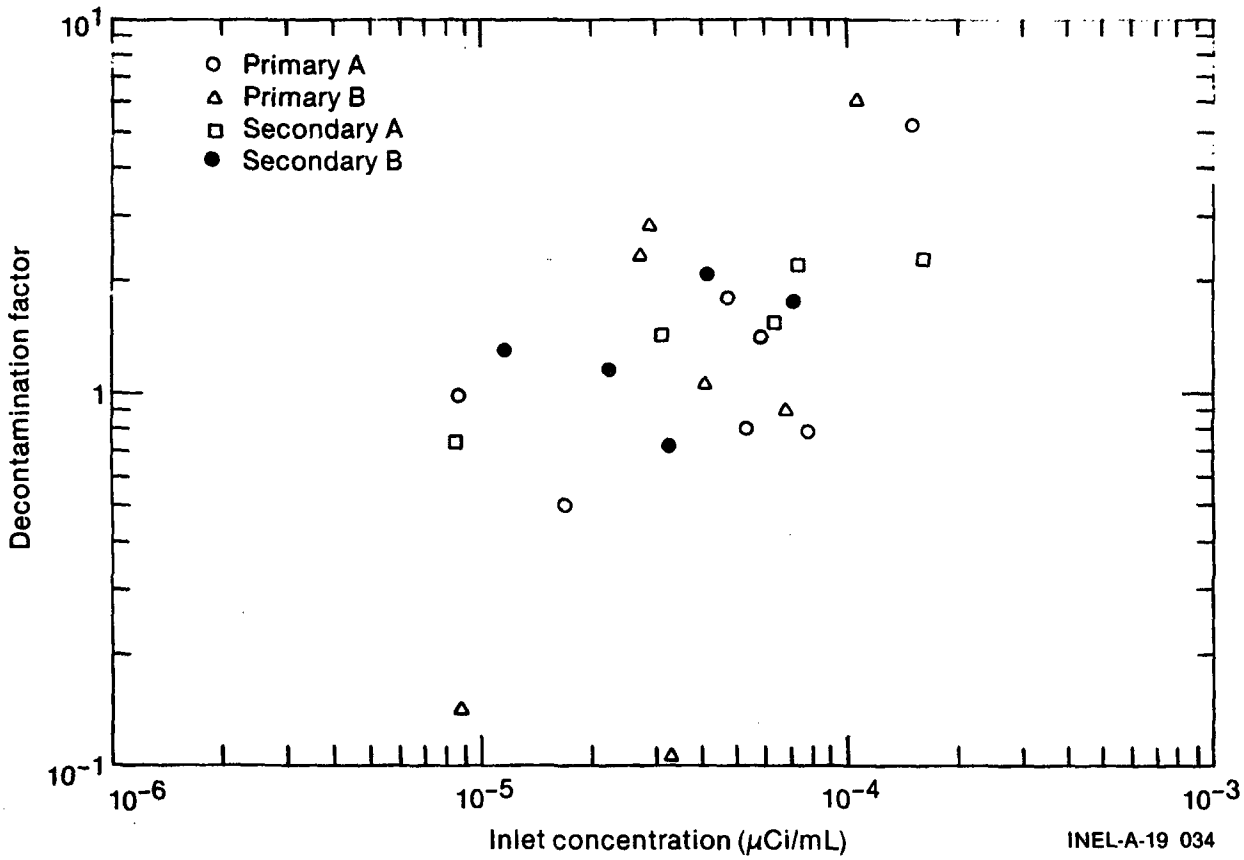


FIGURE 4.7

^{60}Co DF VS. INLET CONCENTRATION FOR CRWS DEMINERALIZERS



4.4 Conclusions

It is useful to examine the behavior of ion exchange resins so that the results of the measurements can be explained. This examination will show that the behavior of both the iodines and cesiums (which appear to be quite different) is the same. The iodines and cesiums can be shown to be at different stages of adsorption on the resin.

If a demineralizer of length L is broken up into increments of length ΔL and the radionuclide concentration on the resin ($\mu Ci/g$) is determined for each increment ΔL, the shape or adsorption curve would be as shown in Figure 4.8, assuming the demineralizer has not reached full equilibrium.

Figure 4.9 shows how the absorption curve progresses across the demineralizer with time. In Figure 4.9A the concentration in ΔL_1 has almost reached equilibrium with the feed and the DF has almost reached 1. As the column continues to load (Figure 4.9B) the feed to increment ΔL_2 will increase until the concentration in the increment ΔL_2 approaches equilibrium with the feed concentration and is now equal to the feed concentration to increment ΔL_1. This process will continue until the last column increment, ΔL_4, has reached equilibrium with the feed to ΔL_1 (Figure 4.9C). The DF of the entire demineralizer is now 1, and the inlet and outlet of each column increment is equal. The system has reached the break point in Figure 4.9B when significant activity begins to come through the column.

The coolant radwaste system demineralizers can be thought of as one demineralizer with sample points at each increment, ΔL. During the period of sampling these systems, the purification demineralizer had reached equilibrium and had a DF of 1 for cesium, except in the case of a spike or decrease in activity as explained above. The coolant radwaste system primary demineralizer A can be thought of as the increment ΔL_2. This demineralizer is approaching but has not fully come to equilibrium. If this increment, ΔL_2, could be examined, we would see that the demineralizer is not evenly loaded with activity. Until the increment ΔL_2 reaches the same concentration as the purification demineralizer effluent, there will be a DF greater than 1.

This process would continue for each demineralizer until the last one would reach a DF of 1. The actual rate and mechanism of the adsorption process, the nature of the adsorption equilibrium, the fluid velocity, the concentration of solute in the feed, and the length of the adsorber bed all contribute to the shape of the curve.

This behavior is in accordance with the design principles for chemical removal by ion exchange beds (11). The detailed mathematical description of the behavior of a given chemical specie is complex and could be formulated only after considerably more detailed laboratory and field investigations.

FIGURE 4.8

ADSORPTION CURVE FOR DEMINERALIZERS

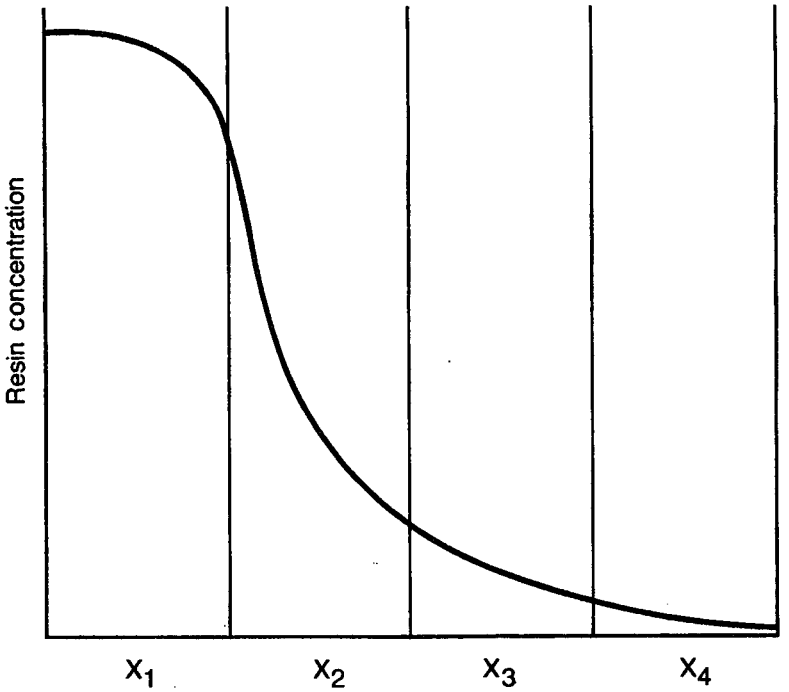
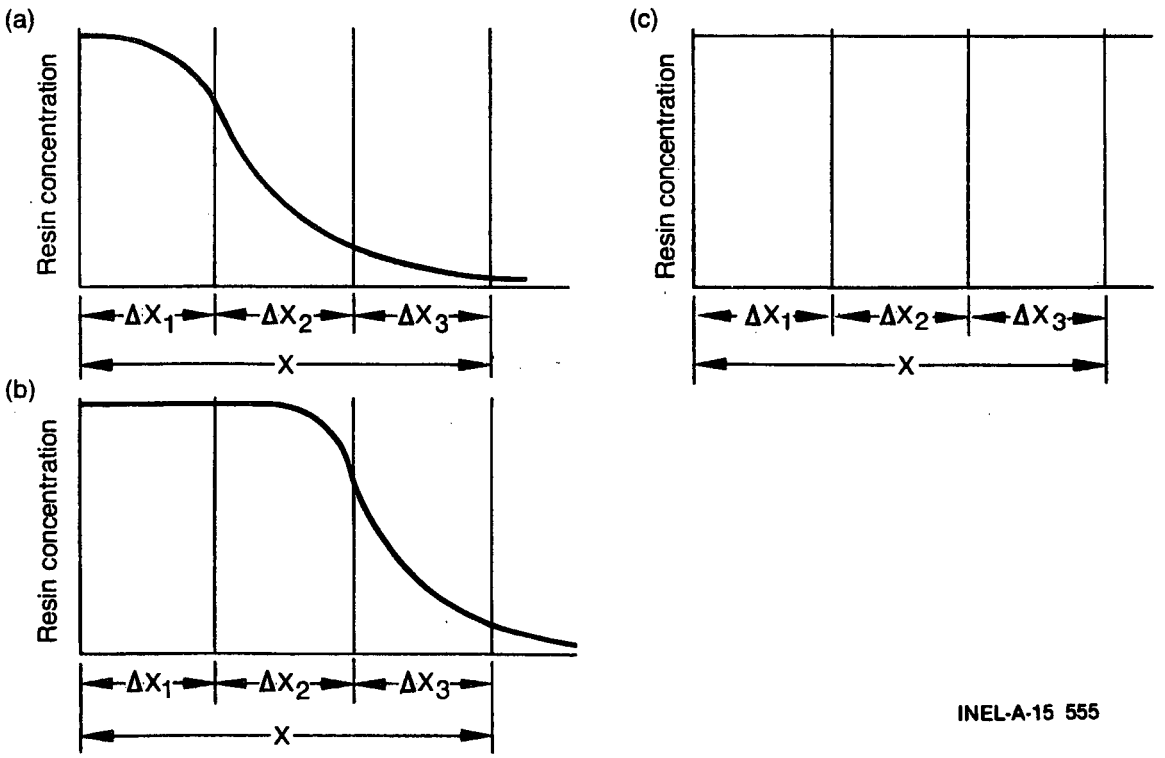


FIGURE 4.9

PROGRESSION WITH TIME FOR DEMINERALIZER ADSORPTION



Referring to the ion exchange equilibrium equation discussed in section 2.6, it is possible to discuss the reaction of iodines and cesiums in the demineralizers. Recall that for a system there is an equilibrium between the inlet radionuclide concentration and the concentration on the resin. This constant will be different for the different ionic species. If it is large, a small percentage of the species will be held on the resin, and if it is small, a large percentage will be held on the resin. A new resin bed is not in equilibrium when it is put in service, and a high DF will be observed for all nuclides. The DF for a particular nuclide will drop as the bed concentration begins to reach the constant ratio for that nuclide. There will be fluctuations in the DF whenever the inlet concentration increases or decreases drastically because the resin concentration will change to maintain equilibrium.

The time it takes for any short-lived radionuclide to migrate through the demineralizer can be long enough that it decays to very low levels before release from the demineralizer. This appears to be the case with ^{133}I which was not seen in the effluent of the primary demineralizer. By using the inlet and outlet concentrations for ^{131}I and ^{133}I along with their half-lives, it is possible to estimate how long iodine is held on a demineralizer. Since ^{133}I did not show up in the outlet of the primary demineralizers, one can only calculate a minimum holdup time on the resin. Using eq. A-1 from Appendix A the holdup time, ΔT, for an element can be calculated.

from 2/9/79 ^{131}I data

$$DF = \frac{x}{y}$$

$$DF_1 = \frac{x_1}{y_1}$$

x = 4.66(-4) µCi/ml ^{131}I inlet
y = 5.80(-5) µCi/ml ^{131}I outlet
x_1 = 1.2(-6) µCi/ml ^{133}I inlet
y_1 = <8(-6) µCi/ml ^{133}I outlet

$$\Delta T = \frac{\ln \frac{DF}{DF_1}}{\lambda_1 - \lambda} \qquad \Delta T = \frac{\ln \frac{8.03(2)}{>0.15(0)}}{(0.815)-(0.086)} > 5.4 \text{ days}$$

The holdup time for iodine is greater than 5.4 days which would indicate that even ^{131}I would be reduced by decay.

A large increase in the concentration of ^{134}Cs occurred in the fuel pool during refueling. This increase in the feed concentration to the demineralizer caused the DF to increase. As the activity was removed from the water the DF returned to one and a new equilibrium concentration was reached. The system contains the total amount of activity that was present before the refueling plus the increase during refueling. At first the added activity is in the water, but the demineralizer which now has a high DF because of the unbalanced condition, removes activity

from the water until the activity in the water and resin return to the equilibrium condition for cesium. With equilibrium re-established, the DF will return to one but the concentration in the water and the resin must be higher because of the added activity to the system. The slope of the plot of DF vs. inlet concentration is one during the period the demineralizer is collecting material in order to reach the new equilibrium level.

The purification demineralizer showed the effect of a decreased inlet ^{134}Cs concentration after water was added to the refueling cavity from the BWST, which added to the effective reactor coolant volume. The reduced concentration in the feed would require that the demineralizer release cesium from its inventory to maintain the equilibrium constant. This requires that the DF be less than one so that there is a net loss of activity from the resin. The DF did drop to 0.7 for ^{134}Cs and ^{137}Cs at this time.

5. BORIC ACID RECOVERY AND LIQUID RADWASTE SYSTEMS

5.1 System Description and Sample Points

5.1.1 Boric Acid Recovery System

The boric acid recovery system is a subsystem of the coolant radwaste system and functions to recover concentrated boric acid and purified water from the reactor coolant system wastes.

The flow diagram of the boric acid recovery system is shown in Figure 5.1. The flow diagram of the demineralized reactor coolant storage system is presented in Figure 5.2.

The reactor coolant wastes processed by the boric acid recovery system are reactor coolant letdown and reactor coolant drain tank effluent. The letdown is removed from the makeup and purification system downstream of the letdown filter. The reactor coolant drain tank is a receiving tank for the reactor coolant system drain and vent headers, borated water storage tank overflow, letdown line relief, core flooding tanks, and makeup tank relief. Both the letdown and drain tank inventory enter the coolant radwaste system through an atmospheric pressure flash tank (see section 4.1).

The flow path from the flash tank normally takes the wastes through the primary ion exchangers into one of two coolant waste receiver tanks, then through the secondary ion exchangers and into one of two coolant waste holdup tanks. The waste holdup tanks are feed tanks for the boric acid concentrator (BAC) and as such may be considered the headwaters of the boric acid recovery system stream. There are two alternate routings from the waste holdup tanks are either directly to the deborating ion exchangers bypassing the BAC or to the miscellaneous radwaste system filters (F-692C or D in Figure 5.3). Each holdup tank has enough capacity for one reactor coolant volume and each of the holdup tank pumps has a capacity of 150 gpm and may be used to transfer the contents of either of the holdup tanks.

Two cartridge-type filters in parallel in the waste holdup tanks' common effluent line pass feed to the boric acid concentrator. The filters are disposable pleated epoxy-impregnated cellulose elements and are designed for 98% retention of 5 micron particles. A filter is replaced when the pressure drop across the filter exceeds 25 psig.

The boric acid concentrator (BAC) is an AMF vacuum distillation evaporator with integral gas stripper. Process water enters via the gas stripper at a normal rate of 30 gpm and drains to the BAC feed tank. The flow rate to the BAC feed tank is controlled by the BAC feed tank level control valve. One of two BAC feed tank pumps transfers the volume being concentrated to the BAC.

FIGURE 5.1

BORIC ACID RECOVERY SYSTEM FLOW DIAGRAM

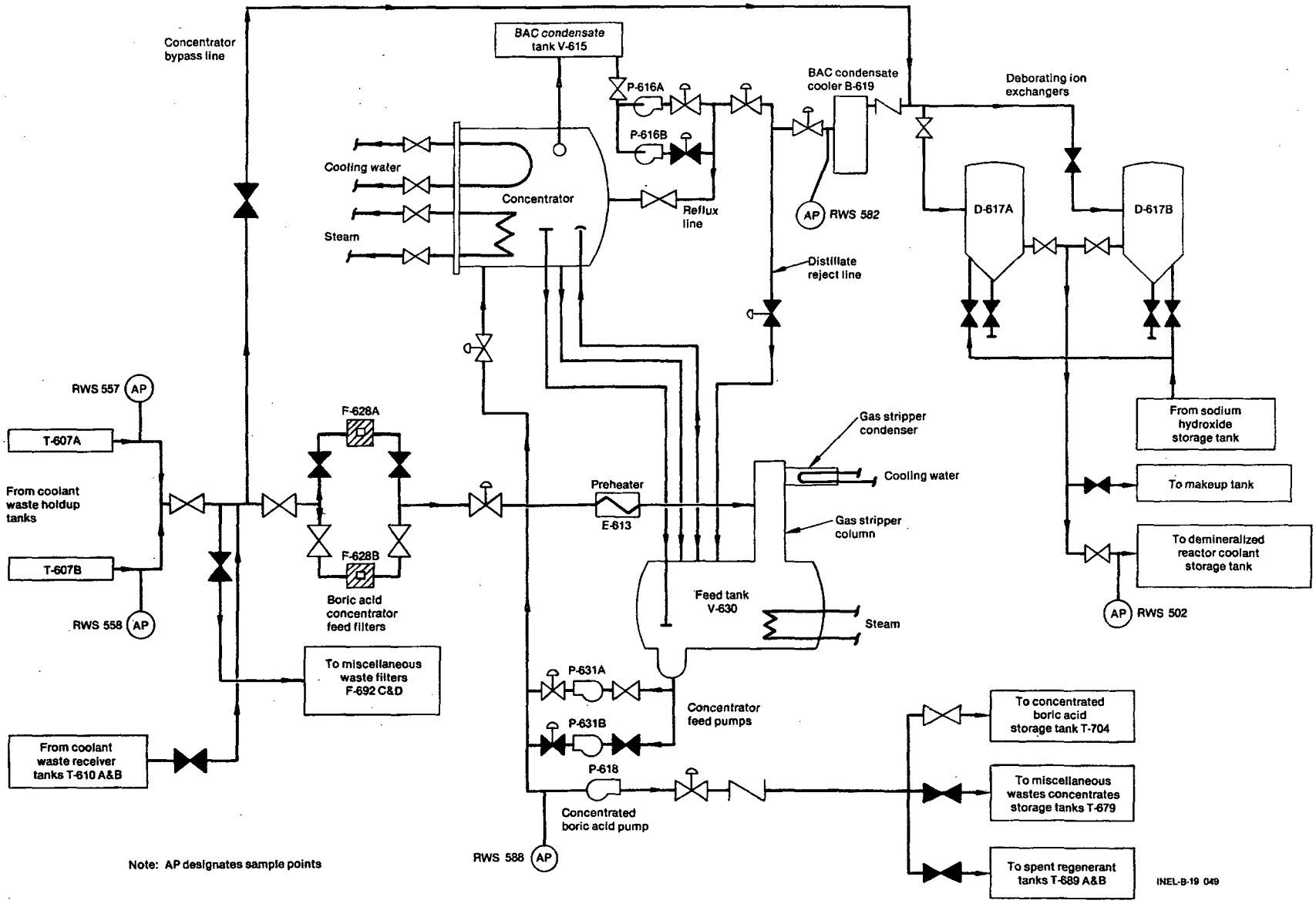
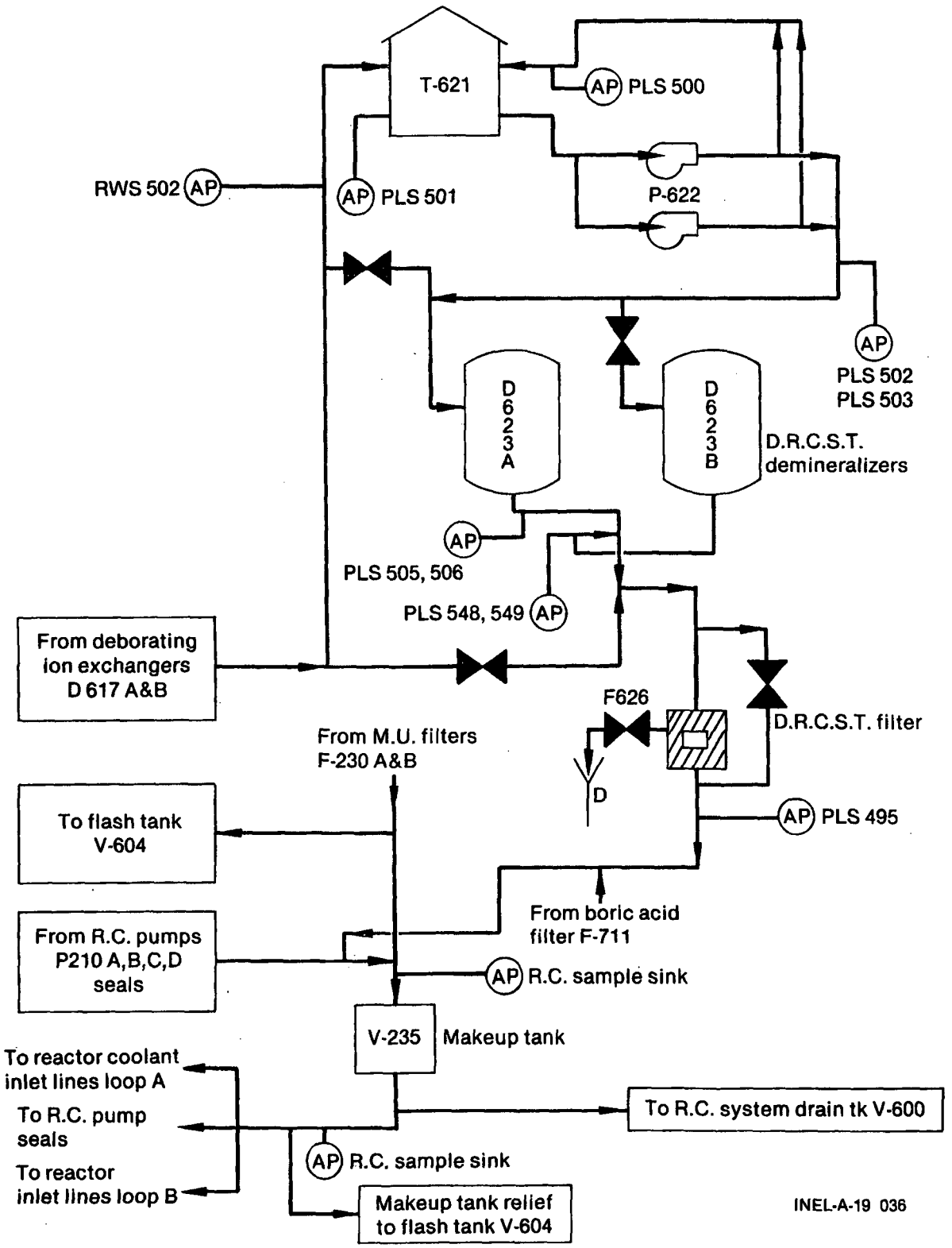


FIGURE 5.2

DEMINERALIZED REACTOR COOLANT STORAGE SYSTEM FLOW DIAGRAM



Note: AP designates sample points

The evaporator bottoms are concentrated to 4 weight percent boric acid (8500 ppm boron) and are normally pumped by the concentrated boric acid pump to the concentrated boric acid storage tank for reuse in the reactor coolant system. The bottoms may also be directed to the miscellaneous waste concentrates storage tanks or to the spent regenerant tanks.

Condensate from the evaporator enters the BAC condensate tank from which it may be returned to the BAC feed tank for further deborating. If the condensate boron concentration is sufficiently low, the condensate is pumped through the BAC condensate cooler to one of two identical deborating ion exchangers for the removal of trace amounts of boric acid. Each demineralizer is charged with 70 ft^3 of strong base anion resin. The resin bed surface area is 12.5 ft^2 and depth is 5 ft. 7 in. The deborating demineralizer output normally is sent to the demineralized reactor coolant storage tank (DRCST), but it can be sent directly to the makeup tank.

The usual flow path of demineralized reactor coolant to the makeup tank is through one of two demineralized reactor coolant storage tank demineralizers and then through the demineralized reactor coolant storage tank filter to the makeup tank. Each demineralizer is charged with 50 ft^3 of anion-cation resin and each resin bed has a surface area of 12.5 ft^2 and depth of 4 ft. The filter is of the same type as the BAC feed tank filters. The filtered demineralized reactor coolant joins the stream from the reactor coolant pump seals and together they join the stream from the makeup filters before entering the makeup tank.

The flow of demineralized water to the makeup tank is controlled remotely by the makeup control valve. During normal operation, reactor coolant dilution is terminated by the batch controller, the control rod drive interlock, or the operator.

Table 5.1 presents the deborating system components information with the components listed in the usual order that they function within the system.

Liquid sample points are denoted by circled AP's (analysis points) in Figures 5.1 and 5.2. Table 5.2 lists per sample point the sample point valve(s), the location of the sample point in the process stream, and the type of sample that could be collected at the sample point. During the in-plant measurement period it was not possible to obtain a sample of the BAC feed filters effluent because the effluent line was subjected to the BAC vacuum and no workable sampling valves were installed during the period. Samples were collected in 50 ml or 450 ml bottles as described in the Source Term Procedures (6).

BAC samples were collected during six separate BAC operations spanning the time period 9/13/78 to 2/7/79. A given sample set usually included the evaporator feed, bottoms, distillate, and the effluent of the BAC deborating ion exchanger. At the time of sampling the values of the evaporator operating parameters and sample chemistry information

TABLE 5.1

DEBORATING SYSTEM COMPONENTS

Identity No.	Name	Tank/Pump Capacity (Gal/GPM)	Filter Micron	Filter Design Flow (GPM)
T-610A & B	Coolant Waste Holdup-Up Tanks (2)	60,000		
P-611A & B	Coolant Waste Hold-Up Tank Pumps (2)	150		
F-628A & B	BAC Feed Filters (2)		3	50
E-613	BAC Feed Preheater (1)			
V-603	BAC Gas Stripper/ Feed Tank (1)	1,000		
P-631A & B	BAC Feed Pumps (2)	50		
E-612	BA Concentrator (1)			
P-618	Conc. Boric Acid Pump (1)			
T-704	Conc. Boric Acid Storage Tank (1)	60,000		
V-615	BAC Cond. Tank (1)	100		
P-616A & B	BAC Cond. Tank Pumps (2)			
E-619	BAC Cond. Cooler (1)			
D-617A & B	Deborating Ion Exchangers (2)*			
T-621	Demineralized Reactor Coolant Storage Tank (1)	450,000		
P-622A & B	DRCST Pumps (2)	175		
D-623A & B	DRCST Demineralizers (2)**			
F-626	DRCST Filter (1)		1/2	175

* Resin Type: ES-109 A109 ARA-372(OH^-), Strong Base Anion; 70 ft^3

** Resin Type: ARM-381 Mixed Bed; 50 ft^3

TABLE 5.2

BORIC ACID RECOVERY SYSTEM SAMPLE POINTS

Sample Point Valve(s)	Location	Type of Sample
RWS 557	Downstream from coolant waste holdup tank pump P-611A at pump.	Coolant waste holdup tank A. Influent to BAC feed filters.
RWS 558	Downstream from coolant waste holdup tank pump P-611B at pump.	Coolant waste holdup tank B. Influent to BAC feed filters.
RWS 588	Downstream from BAC feed pumps, P-631A & B, upstream from conc. BA pump, P-618. (in BAC cubicle)	BAC bottoms.
RWS 582	Downstream from BAC cond. tank pumps, P-616A & B, upstream from BAC cond. cooler, E-619. (in BAC cubicle)	BAC distillate. Influent to deborating Ion Exchanger D-617A or B.
RWS 502	Downstream from deborating IX's D-617A & B upstream from DRCST, T-621 (across hall from BAC at demineralizer)	Effluent of deborating Ion Exchanger D-617A or B. Influent to dem. reactor coolant storage tank, T-621.
PLS 500	Downstream from DRCST pumps, P-622 A & B on DRCST recirc. line	Recirculated dem. reactor coolant storage tank water.
PLS 501	DRCST (at tank)	Bottoms of DRCST
PLS 502 and PLS 503	Downstream from DRCST pumps, P-622 A & B, upstream from DRCST demineralizers, D-623A & B.	Influent to DRCST demineralizer D-623A or B.
PLS 505 and PLS 506	Downstream from DRCST demineralizer D-623A at demin.	Effluent of DRCST demineralizer D-623 A. Influent to DRCST filter, F-626.

TABLE 5.2 (cont'd)

BORIC ACID RECOVERY SYSTEM SAMPLE POINTS

Sample Point Valve(s)	Location	Type of Sample
PLS 548 and PLS 549	Downstream from DRCST demineralizer D-623B at demin.	Effluent of DRCST demineralizer D-623B. Influent to DRCST filter, F-626.
PLS 495	Downstream from DRCST filter, upstream from boric acid addition line.	Effluent of DRCST filter, F-626.

were recorded on BAC sample information sheets. During the 9/13-14/78 and 2/6-7/79 evaporator operations, samples of feed, bottoms, and distillate were collected shortly after holdup tank processing began, near the middle of processing, and near the end of processing. The samples of a given sample set were collected as close together in time as was feasible.

Sample sets of the demineralized reactor coolant storage system were taken on 10/16/78 and 1/31/79. Each set consisted of three 450 ml samples which were the demineralized reactor coolant collected from the storage tank recirculation line, the effluent of the DRCST demineralizer (D-623), and the effluent of the DRCST filter (F-626). The above samples were collected as close together in time as was possible (normally several minutes apart).

5.1.2 Miscellaneous Liquid Radwaste System

The miscellaneous liquid radwaste system is used to purify wastes that are not as clean as reactor coolant quality water. Most of these wastes are collected from sumps in the auxiliary building and will contain all types of impurities, from oil and floor dirt to detergents used in cleaning operations. These wastes are collected in either of two spent regenerant receiver tanks (T689A and B) or the miscellaneous waste storage tank (T667).

Figure 5.3 shows the flow diagram for the miscellaneous liquid radwaste system. The basic functional unit of this system is the miscellaneous wastes evaporator.

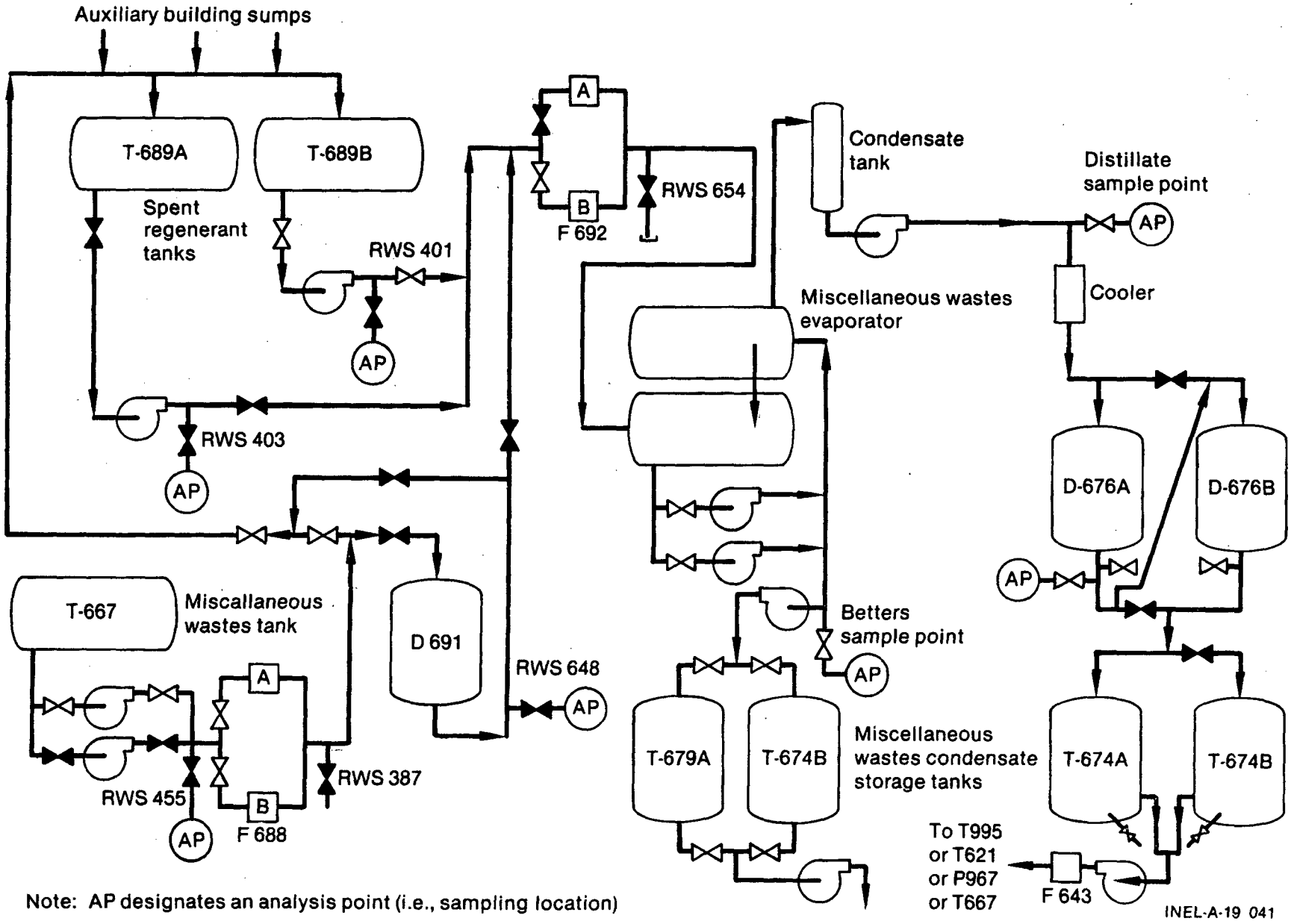
Waste from the miscellaneous waste tank is always filtered through either of two charcoal impregnated filters (F688A and F688B) and then is normally sent to the spent regenerant receiver tanks. On occasion, however, the water may also be processed through a mixed-bed demineralizer (D691) before being sent to the spent regenerant receiver tanks. The miscellaneous waste tank is not used as a feed tank for the waste evaporator operation even though that flow stream is available.

The content of one of the spent regenerant receiver tanks is processed through the evaporator system when one of the tanks has been filled to capacity. The feed solution is passed through one of two feed filters (F692A or F692B), through the preheater-gas stripper and into the evaporator feed tank. The condensate is routed through two demineralizers (D676A and D676B) in series and held in the miscellaneous wastes condensate storage tanks (T674A and T674B) for testing before transfer to its final location. The normal path is to the miscellaneous water holdup tank. The evaporator bottoms (or concentrate) is pumped to the miscellaneous wastes concentrate storage tanks and held until shipped offsite for disposal.

Liquid sample points are shown on Figure 5.3 and are designated by AP (analysis point). Samples were drawn from the spent regenerant tank pump discharge (RWS 401 or 403) and are called the evaporator feed. Samples were also drawn from the evaporator distillate sample

FIGURE 5.3

MISCELLANEOUS LIQUID RADWASTE SYSTEM FLOW DIAGRAM



Note: AP designates an analysis point (i.e., sampling location)

point and evaporator bottoms sample point, and the discharge from each of the two condensate demineralizers. Normally a full set of samples was pulled at the beginning and the end of the run and extra bottoms samples pulled during the run in order to provide a mass balance. On occasion, however, only one set of samples was taken due to operational difficulties encountered with the evaporator.

Six sets of samples were taken from the miscellaneous waste evaporator (MWE) during the course of the investigation. These were on 9/25/78, 10/25/78, and 11/14/78 before shutdown and on 1/16/79, 2/3/79 and 2/15/79 after refueling. Sufficient samples were taken from all except the 10/25/78 and 11/14/78 sample periods to provide a mass balance in the system.

Only one data set was taken during operation of the miscellaneous waste demineralizer (D691), due to the infrequent nature of this operation. The single run was on 1/10/79 after refueling was complete.

5.1.3 AMF Evaporator Functional Description

Rancho Seco utilizes two AMF evaporator systems to treat radioactive liquids. One system, the boric acid concentrator (BAC), processes borated reactor coolant quality water to produce a purified water distillate and a boric acid concentrate, both of which may be reused in the reactor cooling system. The miscellaneous waste evaporator (MWE) processes radioactive wastes containing boric acid and potentially containing considerable corrosion products, dirt, cleaning chemicals and detergents. The MWE concentrate is prepared for off-site disposal, and the distillate may be suitable for reuse in the reactor system.

Although the two evaporator systems are used to process different types of liquids, they are identical in design and hence the functional description which follows is valid for both. Also pertinent to both systems are the AMF evaporator internal arrangement schematics presented in Figures 5.4 and 5.5 and the equipment specifications presented in Appendix Table C.1.

Prior to system operation the evaporator is evacuated by actuating the gas stripper and concentrator vacuum pumps and the 1000 gallon evaporator feed tank is filled through the gas stripper system using the process liquid storage tank pump. Indicator and chart readout of temperature in the feed tank and at key points in the system are provided on the control equipment panel. After startup, the liquid level in the concentrator feed tank is automatically controlled by a flow control valve which responds to a feed tank level controller.

Water which is to be processed enters the concentrator feed tank through the gas stripper column. Feed to the stripper is pre-heated to 195°F and sprays into a packed column which drains into the feed tank. Non-condensible gases are removed by the gas stripper vacuum

FIGURE 5.4

AMF EVAPORATOR INTERNAL ARRANGEMENT

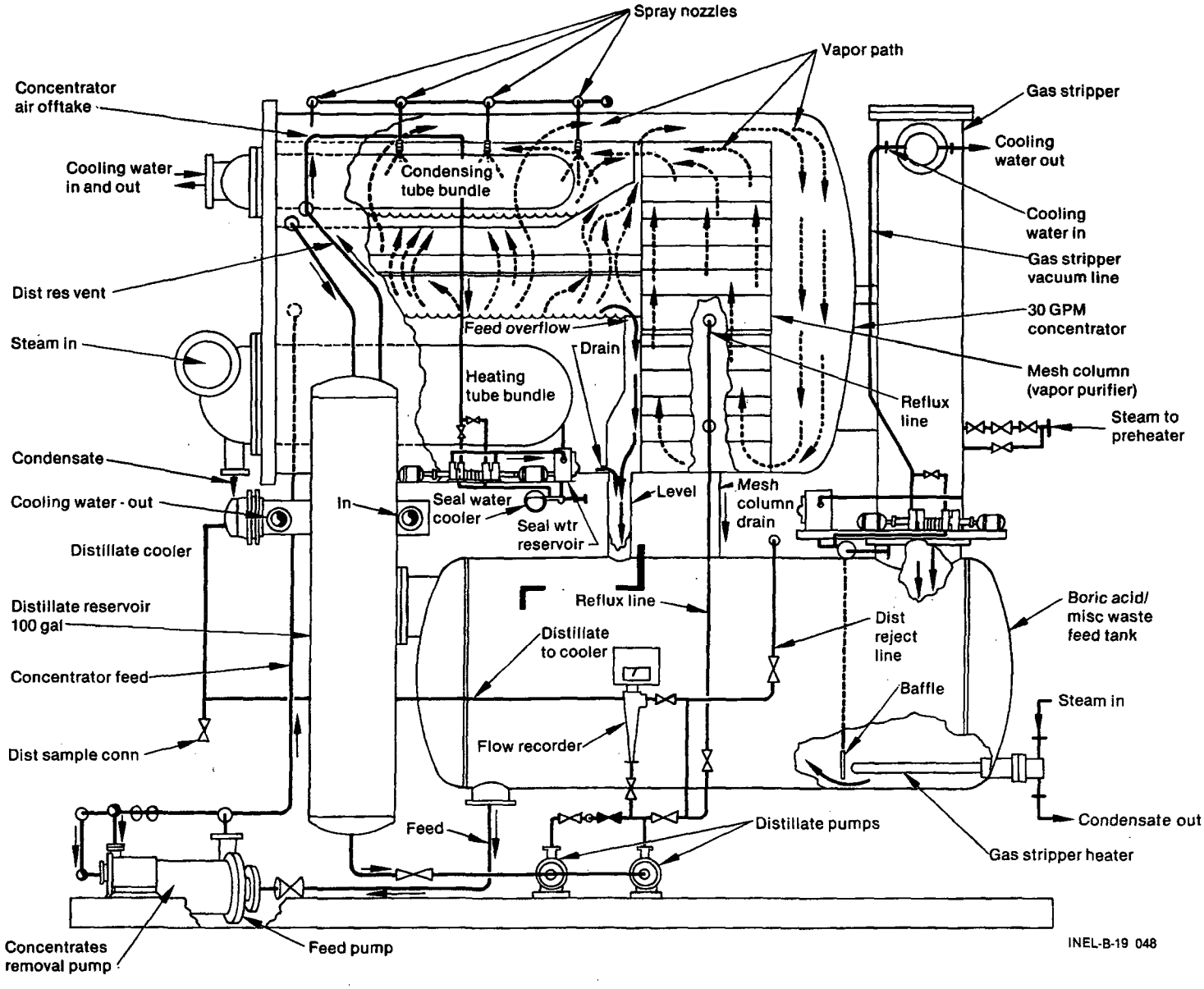
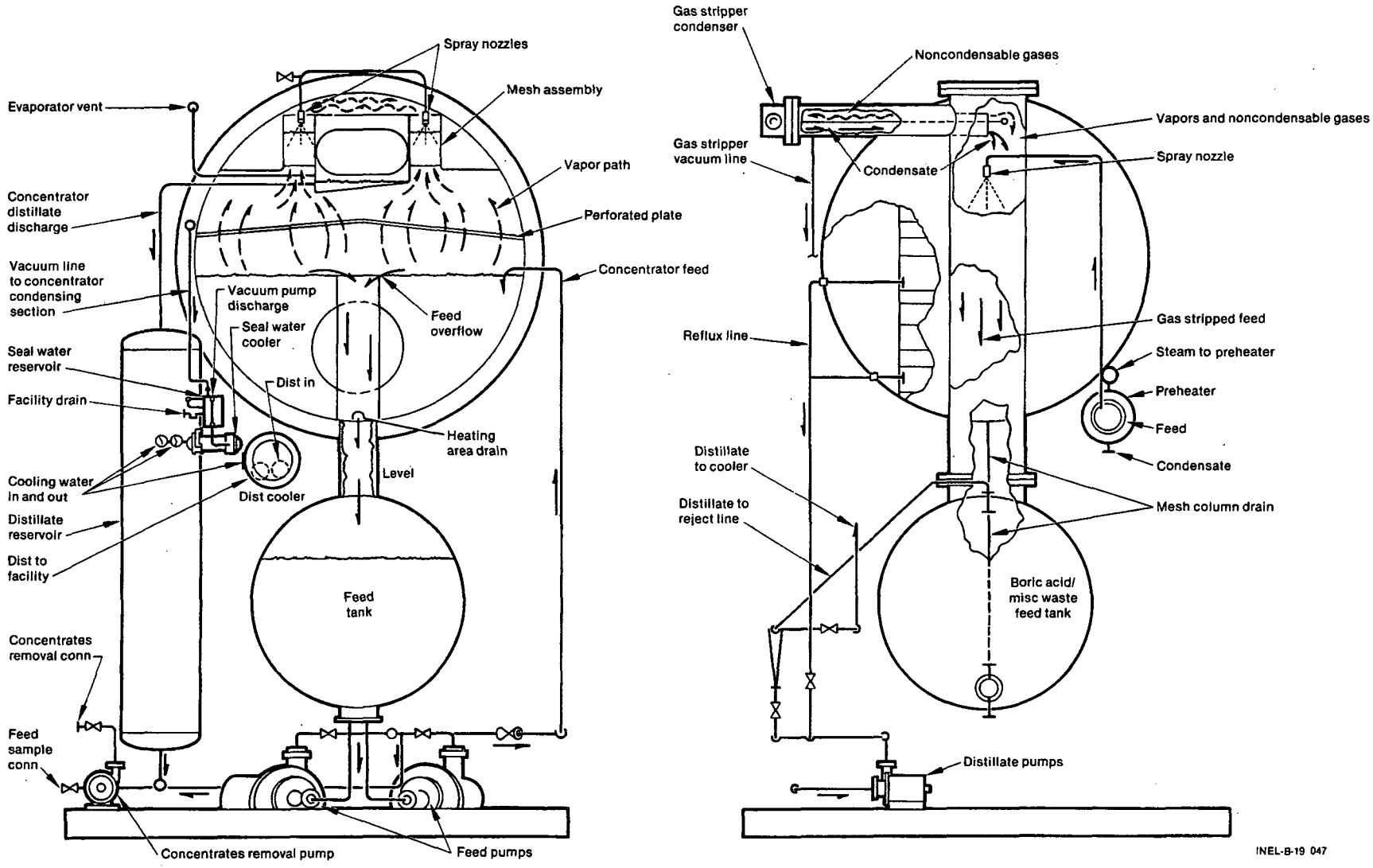


FIGURE 5.5

AMF EVAPORATOR INTERNAL ARRANGEMENT



line and discharged to the waste gas collection header or to the radwaste exhaust duct. Condenser vapor and residual feed liquid refluxes down through the packing, stripping vapors from the gas stripper heater below.

The concentrator feed tank receives degassed liquid from the gas stripper for processing through the evaporator and also serves as a container for the concentrator bottoms. Vacuum equalization between the feed tank and concentrator is achieved by means of a two-inch pipe connecting the two. A feed pump circulates the liquid waste between the feed tank and the evaporator, discharging feed into the boiling section of the concentrator just above the liquid level. A six-inch diameter stand pipe functions to maintain proper boiling level and to return concentrator bottoms to the feed tank to minimize the concentration difference between the concentrator and feed tank. A high level probe in the concentrator when activated de-energizes the feed pump and initiates heating shutdown.

The heating medium for evaporation is low pressure, saturated steam. The submerged U-tube, two-pass type stainless steel heating tubes and sheet assembly bundle has an effective heating surface of 635 square feet. The heating surface consists of 331 No. 18 BWG 5/8 inch diameter tubes.

A perforated plate installed above the concentrator boiling water level separates entrained particulate impurities and liquid droplets from the vapor. Two demisters and a sieve tray are located beyond the moisture separator to receive reflux distillate and to further wash the vapors. A vacuum line near the top of the condenser discharges non-condensible gases to the waste gas collection header. The U-tube, four-pass stainless steel condenser tube and sheet assembly bundle has an effective condensing surface of 1040 square feet and contains 464 No. 18 BWG 5/8 inch diameter tubes.

Distillate discharge is controlled automatically. Distillate generated with a purity that is out of specification is automatically rejected and returned to the concentrator feed tank. A conductivity cell located in the 100-gallon distillate tank controls (through the conductivity indicator controller located on the control equipment panel) the operation of the distillate reject valve and discharge valve. The desired distillate purity is set on the conductivity indicator controller. A portion of the distillate, nominally 3 gpm, is continuously returned to the sieve tray section of the evaporator as reflux. The distillate pump discharges the distillate to facility storage or returns it to the feed tank.

Upon shutdown, the concentrator automatically drains to the feed tank through the heating area drain. The feed tank heater maintains the temperature in the feed tank to prevent boric acid crystallization. Evaporator bottoms are discharged to a facility storage tank by opening the respective concentrate discharge pump discharge valve and activating one of the feed pumps and the concentrate discharge pump. These pumps are stopped when the feed tank indicated level has decreased to 7.5 inches.

Following concentrate transfer, the concentrator may be flushed with demineralized water using internal spray nozzles provided for this purpose. The rinse is continued until the feed tank level is approximately 24 inches. Each of the feed pumps in turn is allowed to run for 5 minutes and the concentrator to drain to the feed tank. The rinse water is then discharged in the same manner as concentrates are discharged.

The BAC and MWE are normally operated to achieve a bottoms boron concentration of 8500 ppm boron. During concentrator operation with relatively high ppm boron feed, the desired concentrator boron concentration will be attained quickly and the concentrator operation will be continuous with cycling bottoms discharging. The start time, duration, and frequency of bottoms discharging are determined by the operator using the boron concentration of the feed and the initial bottoms boron concentration. He then sets the three concentrate discharge timers to achieve and maintain a bottoms concentration of 8500 ppm boron.

5.2 Evaporator - Feed Filter - Gas Stripper DF Calculations

Three sample points were used to collect liquid samples of influent and effluent of the two evaporators. The liquid samples collected were the following: (1) concentrator feed tank influent sampled upstream of the feed filters, (2) distillate collected downstream of the distillate reservoir, and (3) bottoms sampled upstream from the concentrated boric acid pump (bottoms discharge pump). It was not possible to obtain a sample of the feed filter effluent because the filter effluent line was subjected to the evaporator vacuum and no workable sampling system was available during the in-plant measurement period.

Integral to the evaporator system is a gas stripper column which removes non-condensible gases from the evaporator feed liquid. Those gases are discharged to either the waste gas collection header or to the radwaste exhaust duct. The latter path is chosen if the liquid being processed has a high oxygen content. Non-condensible gases which are not removed by the gas stripper are removed from the concentrator condenser compartment through a vacuum line which discharges to the waste gas collection header.

A measured evaporator system decontamination factor (DF), feed activity divided by respective distillate activity, reflects the cumulative radioisotope removal efficiencies of the feed filter, gas stripper column, and concentrator (evaporator). The DF's for the individual components could not be measured due to the lack of adequate sample points. However, the DF of the feed filter plus gas stripper may be calculated using a concentrator system mass balance equation. The concentration of a radionuclide or boron in the bottoms at time t, $\rho_B(t)$, is given by

$$\rho_B(t) = \rho_B(o)\frac{V_B(o)}{V_B} + \frac{dV_F}{dt}\frac{\Delta t}{V_B}\left\{\bar{\rho}_F(1/DF) - \bar{\rho}_D\right\} + \sum_N\left\{\frac{dV_D}{dt}\frac{\bar{\rho}_F}{V_B}(1/DF)\Delta t_D\right\}$$

$$- \sum_N\left\{\rho_B(t_N)\frac{dV_D}{dt}\frac{\Delta t_D}{V_B}\right\}$$

where

$\rho_B(o)$ = initial bottoms concentration

$V_B(o)$ = initial bottoms volume

V_B = conc. feed tank volume (1,000 gal)

$\frac{dV_F}{dt}$ = flow rate to conc. feed tank

$\frac{dV_D}{dt}$ = concentrates pump discharge rate (30 gpm)

$\rho_B(t_N)$ = bottoms concentration at time of Nth discharge

N = number of bottoms discharges

Δt = elapsed time since evaporator was put into service

$\bar{\rho}_F$ = mean concentration of feed

$\bar{\rho}_D$ = mean concentration of distillate

DF = decontamination factor of feed filter and gas stripper together

Δt_D = concentrates discharge pump on time

The bottoms concentration at the time of the Nth discharge is given by

$$\rho_B(t_N) = \left[\rho_B(o)\frac{V_B(o)}{V_B} + \left\{\frac{dV_F}{dt}\frac{1}{V_B}\left(\bar{\rho}_F(1/DF) - \bar{\rho}_D\right)\right\}\Delta T\right]\left(1 - \frac{dV_D}{dt}\frac{1}{V_B}\Delta t_D\right)^{N-1}$$

$$+ \sum_{m=0}^{N-2}\left\{\frac{dV_D}{dt}\frac{\Delta t_D}{V_B}\frac{\bar{\rho}_F}{DF} + \left[\frac{dV_F}{dt}\frac{1}{V_B}\left(\bar{\rho}_F(1/DF) - \bar{\rho}_D\right)\right](\Delta t_D + \Delta t_o)\right\}\left(1 - \frac{dV_D}{dt}\frac{\Delta t_D}{V_B}\right)^m$$

where

Δt_o = time in the concentrates discharge cycle that the discharge pump is off (1 minute).

ΔT = elapsed time before first bottoms discharge

N = number of bottoms discharges = $\frac{(\Delta t - \Delta T)}{\Delta t_D + \Delta t_o}$

Let $K = \frac{dV_F}{dt} \frac{1}{V_B} \left\{ \bar{\rho}_F (1/DF) - \bar{\rho}_D \right\}$,

$$C = \frac{dV_D}{dt} \frac{\Delta t_D}{V_B} ,$$

and $A = \left[C\, \bar{\rho}_F (1/DF) + K(\Delta t_D + \Delta t_o) \right]$;

then the bottoms concentration at time t may be written

$$\rho_B(t) = \rho_B(o) \frac{V_B(o)}{V_B} + K\Delta t + C \left\{ N\bar{\rho}_F(1/DF) - \sum_{L=1}^{N} \left[(\rho_B(o) \frac{V_B(o)}{V_B} + K\Delta T)\ (1-C)^{L-1} + \sum_{m=0}^{L-2} A(1-c)^m \right] \right\}$$

and the difference in bottoms concentration between t_1 and t_2 is

$$\rho_B(t_2) - \rho_B(t_1) = K(\Delta t_2 - \Delta t_1) + C\bar{\rho}_F(1/DF)(N_2 - N_1)$$

$$- C \sum_{L=N_1+1}^{N_2} \left[(\rho_B(o) \frac{V_B(o)}{V_B} + K\Delta T)(1 - C)^{L-1} + \sum_{m=0}^{L-2} A(1 - C)^m \right] .$$

The feed-filter plus gas-stripper DF may then be written

$$DF = \frac{\bar{\rho}_F}{\left\{\dfrac{\rho_B(t_2)-\rho_B(t_1)+\dfrac{dV_F}{dt}\dfrac{\bar{\rho}_D}{V_B}\left\{(\Delta t_2-\Delta t_1)-C\Delta T\Sigma(1-C)^{L-1}-C(\Delta t_D+\Delta t_o)\Sigma\Sigma(1-C)^m\right\}+C\rho_B(o)\dfrac{V_B(o)}{V_B}\Sigma(1-C)^{L-1}}{\dfrac{dV_F}{dt}\dfrac{1}{V_B}\left\{(\Delta t_2-\Delta t_1)-C\Delta T\Sigma(1-C)^{L-1}-C(\Delta t_D+\Delta t_o)\Sigma\Sigma(1-C)^m\right\}+C(N_2-N_1)-C^2\Sigma\Sigma(1-C)^m}\right\}} \quad (1)$$

5.2.1 Boric Acid Evaporator Mass Balance

During two sample periods, 9/13-14/78 and 2/6-7/79, the operation of the evaporator was such as to allow sufficient collection of data to perform calculations of feed-filter plus gas-stripper DF's. Data for these samples can be found in Appendix Tables B.14-B.16. Figure 5.6 is a plot of bottoms concentration vs. elapsed time for the BAC operating on 9/13-9/14/78. Three samples of the BAC bottoms were collected during processing of an isolated coolant waste holdup tank for the purpose of determining radionuclide concentrations. The sample collection times when referenced to the time at which distillate was first discharged correspond to elapsed times of 2.07, 6.42, and 24.67 hours. Also collected during the process cycle were three bottoms samples used to determine bottoms boron concentrations.

The low concentration of boron in the feed, 157 ppm, allowed the concentrator to be operated in a batch mode with no bottoms discharging during its 9/13-14/78 operation. The bottoms boron concentration is to a very good approximation a linear function of time ($\rho_B = 260.12\ \Delta t + 94.53$; $r^2 = 0.9995$). For the case of no bottoms discharging, $N_1 = N_2 = 0$ and all summed terms are zero, so equation 1 takes the simplified form

$$DF = \frac{\bar{\rho}_F}{\dfrac{[\rho_B(t_2) - \rho_B(t_1)]}{(\Delta t_2 - \Delta t_1)}\dfrac{V_B}{\left(\dfrac{dV_F}{dt}\right)} + \bar{\rho}_D} \quad (2)$$

The 9/13-14/78 feed-filter plus gas-stripper DF's listed in Table 5.3 were calculated using the above formula. Values of $[\rho_B(t_2) - \rho_B(t_1)]/(\Delta t_2 - \Delta t_1)$ were obtained using linear regression by the method of least squares and a value of $V_B/(dV_F/dt)$, which is the feed tank fill time, was calculated using the rate of boron concentration.

FIGURE 5.6

BOTTOMS CONCENTRATION VS. ELAPSED TIME FOR BAC, 9/13-14/78

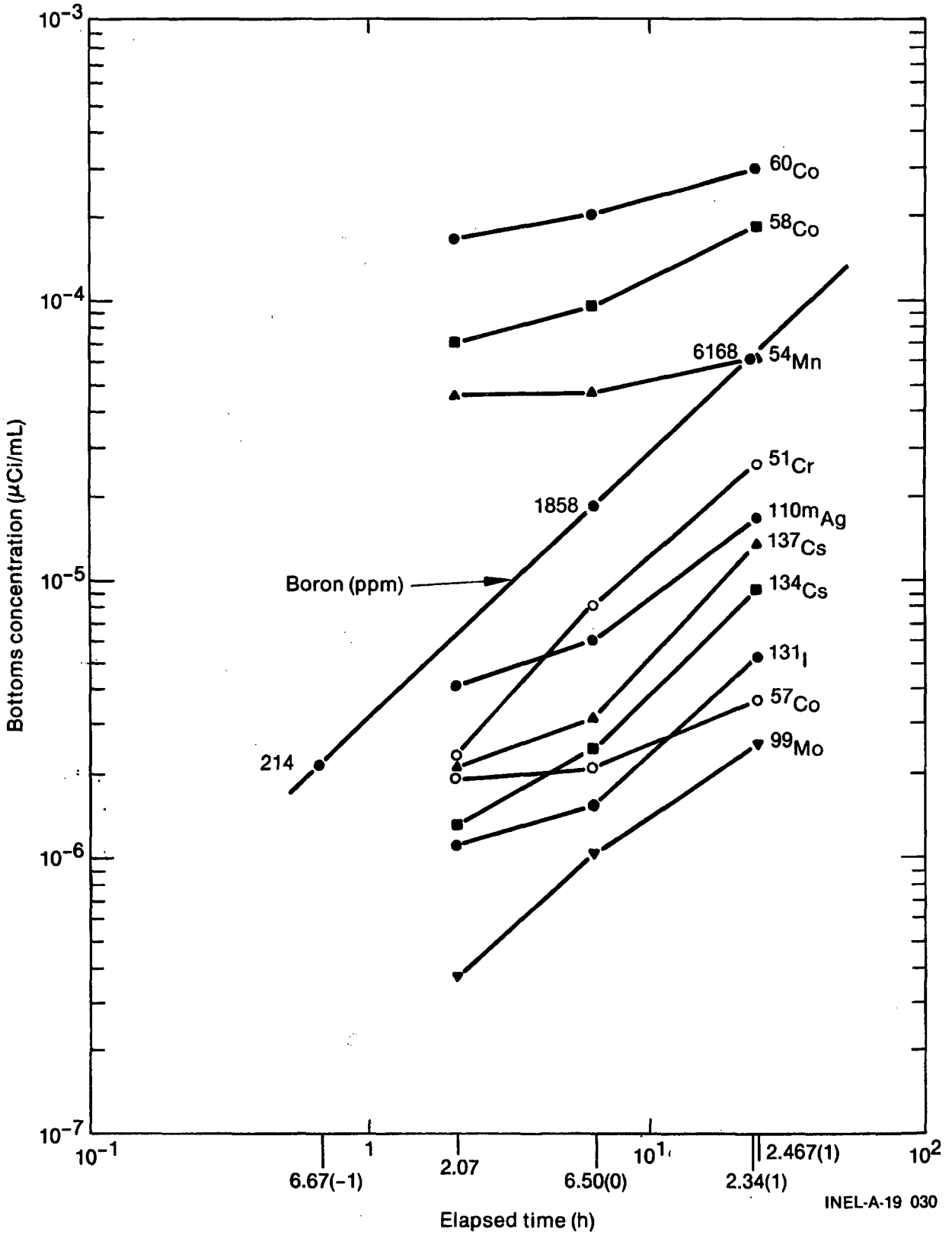


TABLE 5.3

BAC FEED FILTER - GAS STRIPPER DF's *

Nuclide	9/13-14/78 DF	2/6-7/79 DF
^{131}I	1.6	1.7
^{51}Cr	1.4	1.3
^{54}Mn	9.6	1.3
^{59}Fe	---	0.9
^{57}Co	3.7	1.3
^{58}Co	3.5	1.1
^{60}Co	5.9	1.2
^{110m}Ag	1.3	---

* Calculated using mass-balance equation.

$$\rho(t)_{BORON} = \rho(o)_{BORON} + [\overline{\rho}_F - \overline{\rho}_D] \left(\frac{dV_F}{dt}\right) \Delta t/V_B$$

$$\frac{\Delta\rho_{BORON}}{\Delta t} = [\overline{\rho}_F - \overline{\rho}_D] \left(\frac{dV_F}{dt}\right)/V_B = 260.12 \text{ ppm/hr}$$

$$\frac{V_B}{\frac{dV_F}{dt}} = \frac{[\overline{\rho}_F - \overline{\rho}_D]}{260.12} = \frac{[157 - 0.4]}{260.12} = 0.602 \text{ hr}$$

Figure 5.7 is a plot of bottoms concentration vs. elapsed time for the BAC operating on 2/6-7/79. Four samples of the bottoms were collected during processing. The times at which the samples were collected when referenced to the time at which distillate was first discharged correspond to elapsed times of 0.30, 1.98, 8.48, and 19.70 hours. An additional sample was taken concurrently with each of the above samples for determination of the boron concentration of the bottoms.

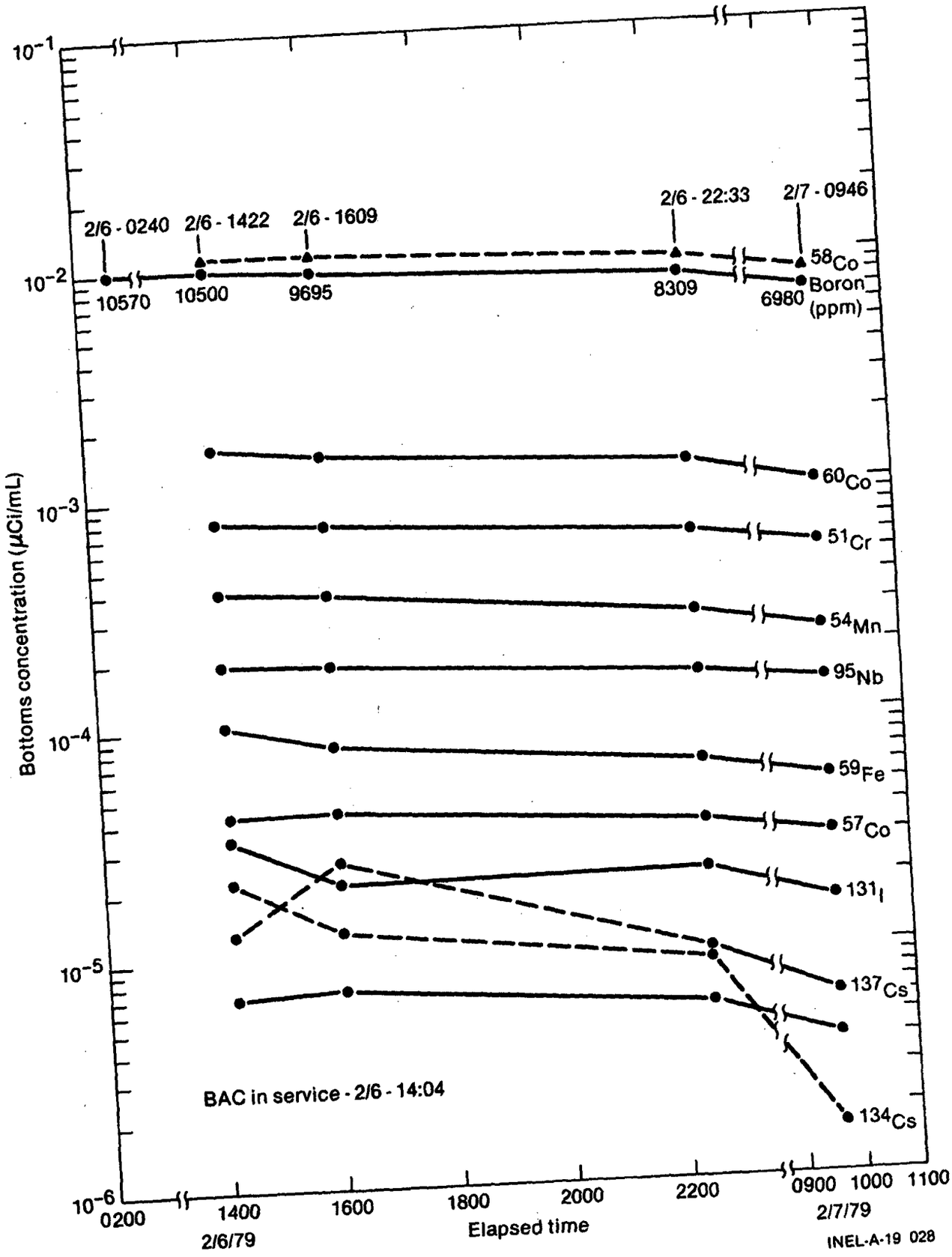
The evaporator was put into service on 2/6/79 with the concentrator feed tank containing the concentrate of liquid processed on 2/5/79. The high initial boron concentration in the bottoms, 10,570 ppm, required the concentrator operation to be concurrent with cycling bottoms discharging. The concentrates discharge pump timers were set such that the discharge pump operated for a duration of 1 minute every 14 minutes beginning 19 minutes after evaporator operation began.

The 2/6-7/79 feed-filter plus gas-stripper DF's listed in Table 5.3 were calculated using equation 1. Except for the DF of ^{131}I, each DF is an average of two DF's, one computed using the concentration difference between 1.98 hours and 8.48 hours and the other computed using the concentration difference between 8.48 hours and 19.70 hours. The DF for ^{131}I shown in Table 5.3 is that calculated using only the concentration difference between 8.48 hours and 19.70 hours. The ^{131}I DF calculated using the concentration difference between 1.98 hours and 8.48 hours is 0.6. This value of less than one may be attributed to the anomalously low ^{131}I concentration measured at 1.98 hours.

Referring to Table 5.3 a comparison of September and February DF's shows the calculated DF's of ^{131}I agree very well. So also does the DF for ^{51}Cr. The DF's of ^{54}Mn, ^{57}Co, ^{58}Co, and ^{60}Co are significantly smaller in February than they were in September. We have no explanation for the difference.

FIGURE 5.7

BOTTOMS CONCENTRATION VS. ELAPSED TIME FOR BAC, 2/6-7/79



The average DF for ^{131}I indicates that 40% of the ^{131}I in the BAC feed was removed by the feed filter and/or gas stripper. As the ^{131}I removal efficiency of filters is commonly poor, it is likely that nearly all of the ^{131}I removed was discharged as a noncondensible gas via the vacuum discharge lines of the gas stripper and condenser compartment.

5.2.2 Miscellaneous Radwaste Evaporator Mass Balance

The miscellaneous radwaste evaporator was sampled four times for a mass balance determination of the feed filter-gas stripper DF's. Table 5.4 lists the calculated DF's from the mass balance using equation (2). The data from January and February are reasonably consistent, but the September DF's are much larger. We have no explanation for this difference, except that it is consistent with the data from the boric acid evaporator.

5.3 Discussion of Measurement Data

5.3.1 Boric Acid Evaporator

Measurements of radionuclide concentrations in liquid streams of the boric acid evaporator system commenced 9/13/78 and ended 2/7/79. A summary of pertinent chemistry and operating parameters for the sample sets is presented in Table 5.5 and may be viewed graphically in Figure 5.8. Feed rate ranged from 17 to 32 gpm, the average being approximately 27 gpm. The evaporator boiling section temperature ranged from 48.9 to 79.4°C, the average being 65°C. Internal evaporator pressure ranged from 120 to 323 mm Hg, the average being 210 mm Hg. Boiling section temperatures were such that vapor pressure was frequently 20 to 30 mm Hg below the internal evaporator pressure as indicated by the evaporator vacuum gauge.

The concentration of boron in the evaporator feed ranged from 34 ppm two weeks prior to the refueling shutdown to 3,200 ppm three weeks following startup. The low boron concentration in the bottoms on 9/13/78 at 11:19 reflects a measurement made soon after the evaporator was put in service. The high initial bottoms boron concentration measured on 2/6/79 is due to the fact that the concentrator feed tank contained the concentrate of liquid processed on 2/5/79.

The variations in the above-mentioned operating parameters do not appear to be correlated with the concentration of radionuclides in the evaporator feed. Evaporator operating procedures require that distillate conductivity be maintained at values less than 2 μmhos/cm. A distillate conductivity meter located in the distillate reservoir causes distillate which does not meet this specification to be recycled through the evaporator. After evaporator startup the operator may make adjustments to the initial values of feed flow rate, boiling section temperature, and evaporator vacuum so as to produce distillate of sufficient quality. The rate of vaporization of liquid in the concentrator boiling section is determined by the boiling section temperature and vacuum (pressure) and that rate, of course, determines the distillate discharge rate, which under equilibrium conditions is equal to the evaporator feed flow rate.

TABLE 5.4

MISCELLANEOUS RADWASTE EVAPORATOR FEED FILTER - GAS STRIPPER DF's*

Nuclide	9/25/78	1/16/79	2/3/79 †		2/15/79 ††	
^{131}I	2.1	1.7	1.0	1.1	1.0	0.76
^{134}Cs	4.3	1.1	1.0	1.0	1.0	0.73
^{136}Cs	11.6	0.87	0.87	3.3	0.52	4.7
^{137}Cs	3.9	1.8	0.95	1.06	0.90	0.68
^{51}Cr	37.8	3.6	2.1	3.3	3.5	1.3
^{54}Mn		4.4	2.1	3.7	1.6	
^{59}Fe	31.5	2.1	2.0	3.6	1.0	
^{57}Co	24.8	1.5	1.8	2.9	2.0	
^{58}Co	16.9	2.5	1.7	2.5	1.9	2.8
^{60}Co		3.1	1.8	2.9	1.4	
^{65}Zn		1.5	2.2	3.2	2.8	
^{95}Zr	63.7		2.4	3.7	3.0	7.0
^{95}Nb	28.4	1.4	2.1	3.5	1.9	
^{99}Mo	1.7	1.9				
^{103}Ru	9.4		1.2	3.3		0.54
^{110m}Ag	9.3	3.2	1.9	2.3	2.1	1.2
^{124}Sb	3.7	2.0	1.2	1.1	1.2	0.70
^{125}Sb		0.93	1.2	1.2		0.64
^{140}Ba			0.88		1.1	
^{140}La	8.3	2.7	0.70	0.52	0.25	
^{141}Ce			1.2	2.5	3.5	5.2
^{143}Ce					2.6	
^{144}Ce			3.1	0.99		0.43

* DF's calculated from Mass Balance.

† Two determinations of DF's were made, first one using data obtained at 0844 and 1231 and the second using data obtained at 1231 and 1454.

†† Two determinations of DF's were made, first one using data obtained at 0902 and 1122 and the second using data obtained at 1122 and 1411.

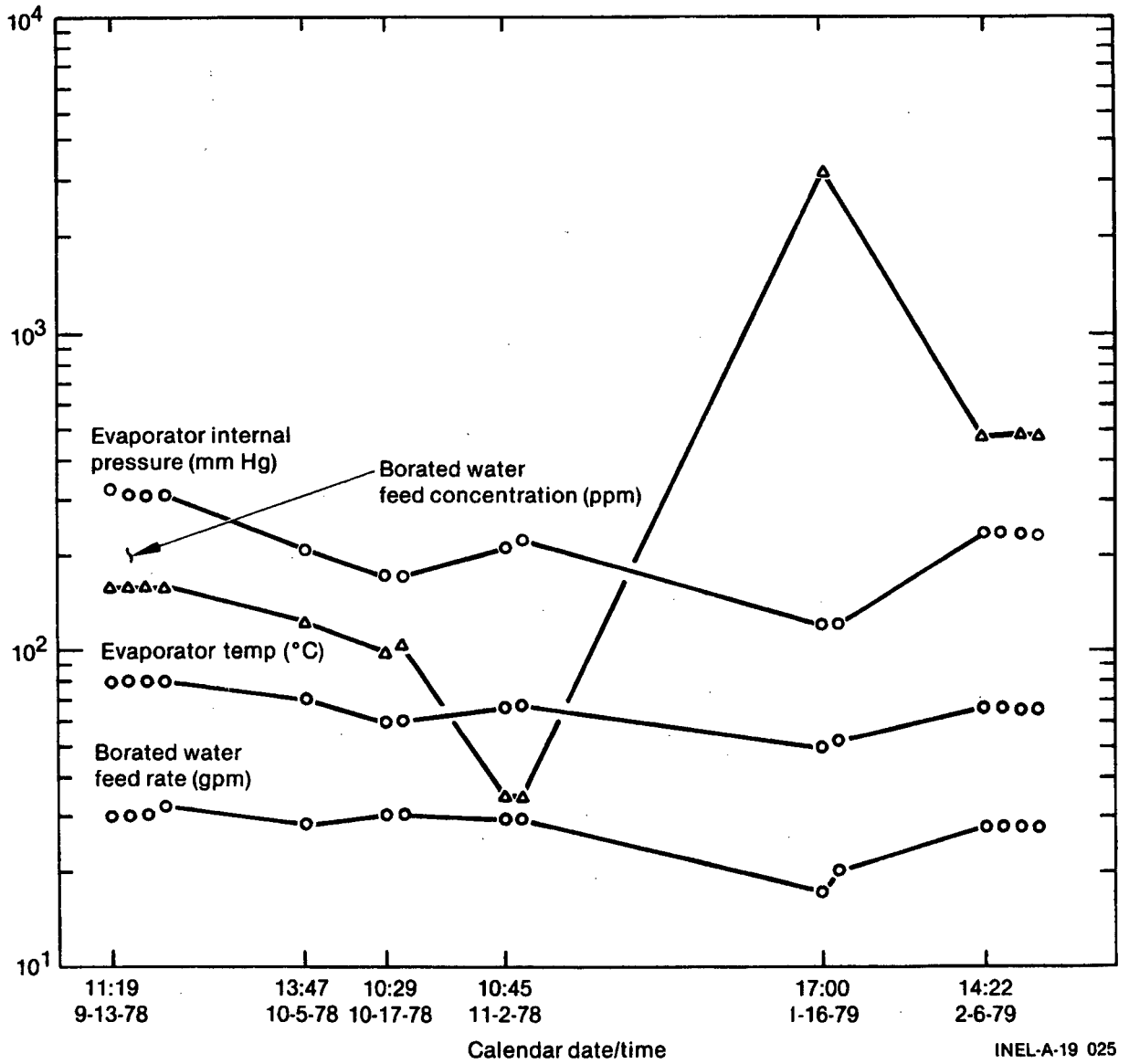
TABLE 5.5

BORIC ACID EVAPORATOR OPERATING PARAMETERS

Time	Date	GPM Feed Flow Rate	IN Feed Tank Level	°C Evap. Boiling Section Temp.	mm Hg Evap. Vacuum	mm Hg Internal Evap. Pressure	mm Hg Evap. Vapor Pressure	Feed Filter	DEB I X	Boron ppm			Conductivity µmhos/cm		
										Feed	Bottoms	Dist.	Feed	Bottoms	Dist.
1119	9/13/78	30	31	79.4	431.8	323.2	346.6	B	B	157	214	0.4	1.5	2.0	0.3
1349	9/13/78	30	31	79.4	444.5	310.5	346.6	B	B	157		0.4			0.28
1540	9/13/78	30	31	79.4	444.5	310.5	346.6	B	B	157	1858				0.28
0955	9/14/78	32	31	79.4	444.5	310.5	346.6	B	B	157	6168				0.33
1347	10/5/78	28		70.0	546.1	208.9	233.7	A	B	121	3000	1.1		12.	0.98
1029	10/17/78	30	33	58.9	584.2	170.8	141.9	A	B	96.8	4936				0.23
1057	10/18/78	30	32	59.4	584.2	170.8	145.2	A	B	102	7597				0.21
1045	11/2/78	29	32	65.6	456.1	208.9	192.6	A	A	34	3629	1.1	0.90	20.	0.23
1537	11/2/78	29	32	66.7	533.4	221.6	202.2	A	B	34	4403				0.23
1700	1/16/79	17		48.9	635.0	120.0	87.6	A		3200					
0955	1/17/79	20		51.7	635.0	120.0	100.6	A							
1422	2/6/79	27.5	32	65.6	523.2	231.8	192.6	B		470	10800	4.5	40		0.45
1603	2/6/79	27.5	31	65.6	520.7	234.3	192.6	B			9695				0.33
2233	2/6/79	27.5	31.3	64.4	523.2	231.8	182.5	B		472	8309	2.5	41		0.29
0946	2/7/79	27.5	31.5	64.4	525.8	229.2	182.5	B		468	6980	2.1	32	415	0.27

FIGURE 5.8

BORIC ACID EVAPORATOR OPERATING PARAMETERS



It was found that the evaporator feed flow rate (i.e., distillate discharge rate) correlated very well with the sum of concentrations of six radionuclide particulates (^{51}Cr, ^{54}Mn, $^{57,58,60}Co$, ^{110m}Ag) in the feed. A linear fit to the data yielded the following coefficient and constant:

$$\frac{dV}{dt} = -2.11(3)\ \rho_F + 29.8$$

with a coefficient of determination of 0.96, where

$\frac{dV}{dt}$ = feed flow rate

ρ_F = sum of concentrations of six particulates.

The constraint of distillate purity was met by setting the vaporization rate in proportion to the particulate concentration of the feed. This is so because the probability of particulate carryover to the evaporator condenser via entrainment (liquid suspended in the vapor as fine droplets) increases with increasing boilup rate.

Samples of boric acid evaporator feed, distillate, and bottoms were collected during six separate boric acid evaporator operations. Measured radionuclide concentrations in these samples can be found in Appendix Tables B.14-B.16. The means and ranges for the radionuclide concentrations measured are given in Table 5.6. "Best value" DF's for the boric acid evaporator are listed in Table 5.7. A "best value" DF of a radionuclide is equal to the ratio of its mean feed activity to its mean distillate activity. Mean activities are arithmetic means which were computed using one-sigma less-than values. Values of instantaneous DF's (feed concentration divided by distillate concentration) are presented in Table 5.8 and the instantaneous bottoms/distillate ratios are listed in Table 5.9.

The four radionuclides having the highest mean concentration in the BAE distillate are (in order of decreasing concentration) ^{58}Co, ^{51}Cr, ^{60}Co, and ^{54}Mn, an order which is identical to that which the mean concentrations of these nuclides exhibit in the evaporator feed. The mean concentration of ^{58}Co in the distillate is about a factor of two higher than the mean concentration of ^{51}Cr and a factor of five higher than the mean concentration of ^{54}Mn.

TABLE 5.6

MEANS AND RANGES FOR RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR FEED, DISTILLATE, AND BOTTOMS

	Feed		Distillate		Bottoms	
Nuclide	Mean (μCi/ml)	Range (μCi/ml)	Mean (μCi/ml)	Range (μCi/ml)	Mean (μCi/ml)	Range (μCi/ml)
^{131}I	8.1(-7)	1.6-52.(-7)	2.5(-8)	6.0-86.(-9)	1.2(-5)	1.1-34.(-6)
^{134}Cs	4.6(-7)	9.3-6600.(-9)	3.3(-8)	1.4-18.(-8)	1.0(-5)	6.6-254.(-7)
^{137}Cs	1.7(-6)	4.6-2300.(-8)	5.2(-8)	2.3-38.(-8)	1.6(-5)	2.1-54.(-6)
^{51}Cr	9.7(-5)	1.0-580.(-6)	1.4(-7)	2.7-55.(-8)	7.8(-4)	2.3-2540.(-6)
^{54}Mn	2.2(-5)	1.9-107.(-6)	5.4(-8)	1.9-25.(-8)	2.2(-4)	4.6-40.(-5)
^{59}Fe	6.7(-6)	2.1-500.(-7)	3.4(-8)	4.5-150.(-9)	4.8(-5)	9.8-1200.(-7)
^{57}Co	5.4(-6)	1.5-360.(-7)	1.9(-8)	2.6-77.(-9)	2.5(-5)	1.9-79.(-6)
^{58}Co	8.2(-4)	1.0-500.(-5)	2.7(-7)	3.6-71.(-8)	6.3(-3)	7.1-1170.(-5)
^{60}Co	8.6(-5)	8.6-443.(-6)	1.1(-7)	2.0-24.(-8)	9.2(-4)	1.7-15.3(-4)
^{65}Zn	7.4(-7)	5.1-520.(-8)	4.2(-8)	1.8-220.(-9)	4.9(-6)	6.0-200.(-7)
^{95}Zr	6.1(-6)	1.3-336.(-7)	3.3(-8)	3.1-140.(-9)	4.5(-5)	4.6-990.(-7)
^{95}Nb	1.3(-5)	1.2-770.(-7)	1.7(-8)	2.6-66.(-9)	9.6(-5)	6.9-1970.(-7)
^{99}Mo	3.9(-7)	6.6-320.(-8)	2.3(-8)	1.3-200.(-9)	2.8(-6)	4.9-124.(-7)
^{103}Ru	3.6(-6)	9.1-4000.(-8)	1.5(-8)	2.3-58.(-9)	1.7(-5)	3.3-480.(-7)
^{110m}Ag	7.0(-6)	4.1-540.(-7)	3.3(-8)	5.0-120.(-9)	5.2(-5)	4.1-109.(-6)
^{124}Sb	4.4(-7)	1.2-280.(-8)	2.4(-8)	2.3-110.(-9)	3.5(-6)	1.7-73.(-7)
^{125}Sb	1.4(-6)	4.1-1000.(-8)	4.1(-8)	2.7-170.(-9)	7.7(-6)	7.4-560.(-7)
^{140}Ba	1.7(-6)	1.0-2600.(-8)	5.8(-8)	1.1-240.(-9)	9.4(-6)	8.7-780.(-7)
^{140}La	3.5(-7)	3.3-200.(-8)	3.5(-8)	2.4-320.(-9)	3.3(-6)	2.1-73.(-7)
^{141}Ce	7.4(-7)	6.0-560.(-8)	2.4(-8)	1.5-91.(-9)	5.8(-6)	2.9-190.(-7)
^{144}Ce	4.0(-6)	2.6-3200.(-8)	1.3(-7)	1.5-610.(-9)	2.1(-5)	9.4-630.(-7)
^{239}Np	1.3(-6)	1.2-120.(-7)	1.0(-7)	2.1-810.(-9)	6.6(-6)	6.1-340.(-7)

TABLE 5.7

"BEST VALUE" DF's FOR BORIC ACID EVAPORATOR

Nuclide	"Best Value" DF
^{131}I	3.3(1)
^{134}Cs	1.4(1)
^{137}Cs	3.2(1)
^{51}Cr	7.0(2)
^{54}Mn	4.1(2)
^{59}Fe	2.0(2)
^{57}Co	2.9(2)
^{58}Co	3.0(3)
^{60}Co	8.2(2)
^{65}Zn	1.8(1)
^{95}Zr	1.9(2)
^{95}Nb	7.7(2)
^{99}Mo	1.7(1)
^{103}Ru	2.3(2)
^{110m}Ag	2.1(2)
^{124}Sb	1.8(1)
^{125}Sb	3.3(1)
^{140}Ba	2.9(1)
^{140}La	1.0(1)
^{141}Ce	3.1(1)
^{144}Ce	3.1(1)
^{239}Np	1.3(1)

* "Best value" DF = mean feed activity/ mean distillate activity

TABLE 5.8

INSTANTANEOUS DF's FOR BORIC ACID EVAPORATOR

P. A. E. DECONTAMINATION FACTOR

DATE	9/13	9/13	9/13	9/13	10/ 5
TIME	1230	1351	1447	1154	1246
NUCLIDE	DECONTAMINATION FACTOR				
I-131	>7.2(0)	>6.6(0)	>7.7(0)	>3.9(0)	>1.1(1)
CS-134	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-137	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>3.3(0)
CR-51	>5.0(0)	>4.8(0)	>4.8(0)	>2.2(0)	>4.2(1)
MN-54	>6.9(1)	>1.1(2)	>1.1(2)	>6.8(1)	1.49±.72(2)
FE-59	>4.7(0)	>3.4(0)	>4.2(0)	>1.8(0)	NOTE 1
CO-57	>9.7(0)	>1.1(1)	>1.0(1)	>5.2(0)	>1.4(1)
CO-58	>2.6(2)	2.10±.80(2)	>2.9(2)	>7.5(1)	4.51±1.4(2)
CO-60	>1.7(2)	1.68±.85(2)	>1.6(2)	>1.7(2)	1.86±.57(2)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>1.4(1)
MO-99	>3.4(0)	>4.3(0)	>5.2(0)	>2.7(0)	NOTE 1
RU-103	>2.2(0)	>2.7(0)	>2.9(0)	>1.7(0)	>8.1(0)
AG-110M	>1.3(1)	8.26±2.9(0)	>1.3(1)	4.75±2.0(0)	>3.2(1)
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>2.3(0)
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>4.6(0)
BA-140	<2.5(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	>1.6(0)	>1.7(0)	>2.0(0)	>1.7(0)	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<2.0(0)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.8 (cont'd)

INSTANTANEOUS DF's FOR BORIC ACID EVAPORATOR

B. A. E. DECONTAMINATION FACTOR

DATE	10/17	10/18	11/ 2	11/ 2	1/16
TIME	1039	1107	1046	1532	1707
NUCLIDE	DECONTAMINATION FACTOR				
I-131	4.17±.71(1)	<1.9(1)	NOTE 1	>2.2(0)	5.08±1.8(1)
CS-134	4.05±1.0(-1)	<6.0(0)	<1.8(1)	>1.3(0)	<7.3(1)
CS-137	<9.8(-1)	<5.2(0)	NOTE 1	NOTE 1	NOTE 1
CR-51	3.63±.64(2)	1.87±.23(2)	>3.2(2)	>2.0(2)	>2.5(3)
MN-54	1.56±.13(1)	2.88±.57(1)	4.78±1.0(1)	>1.1(2)	2.97±1.5(3)
FE-59	>5.8(1)	NOTE 1	>3.6(1)	>1.9(1)	>7.0(2)
CO-57	5.52±.62(1)	6.15±2.6(1)	NOTE 1	1.46±.46(1)	1.76±1.4(3)
CO-58	1.66±.24(2)	1.39±.25(2)	1.11±.14(3)	7.33±1.2(2)	7.04±.42(3)
CO-60	3.58±.46(1)	8.78±.35(1)	1.94±.70(2)	3.66±2.2(2)	2.01±.46(3)
ZN-65	>2.8(1)	NOTE 1	NOTE 1	NOTE 1	>2.1(1)
ZR-95	>4.2(1)	NOTE 1	2.30±1.5(1)	>1.3(1)	7.81±4.5(2)
NB-95	>3.0(2)	>9.3(1)	>7.7(1)	>9.2(1)	>2.1(3)
MO-99	3.18±.98(2)	<6.5(2)	NOTE 1	>1.9(0)	NOTE 1
RU-103	>9.2(1)	>5.5(1)	NOTE 1	>3.0(1)	>1.2(3)
AG-110M	3.41±.29(1)	8.60±8.6(1)	NOTE 1	>3.4(1)	1.50±.92(3)
SB-124	NOTE 1	NOTE 1	NOTE 1	>3.5(0)	>6.1(1)
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>6.4(1)
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	>1.4(1)	NOTE 1	NOTE 1	NOTE 1	>6.2(1)
CE-141	>4.0(1)	NOTE 1	NOTE 1	>2.8(0)	>8.9(1)
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>9.5(1)
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.8 (cont'd)

INSTANTANEOUS DF's FOR BORIC ACID EVAPORATOR

B. A. E. DECONTAMINATION FACTOR

DATE	1/17	2/ 6	2/ 6	2/ 7
TIME	957	1424	2235	948
NUCLIDE	DECONTAMINATION FACTOR			
I-131	<1.1(2)	3.41±2.2(1)	>1.1(2)	4.76±4.1(1)
CS-134	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-137	NOTE 1	<1.1(1)	NOTE 1	NOTE 1
CR-51	2.53±1.6(3)	>2.1(2)	7.67±5.2(2)	3.91±2.2(2)
MN-54	3.67±1.9(3)	>4.2(2)	8.58±4.1(2)	>1.7(3)
FE-59	>8.4(2)	8.36±5.4(1)	>1.3(2)	1.12±.71(2)
CO-57	>3.0(3)	>7.9(1)	>2.8(2)	>1.8(2)
CO-58	5.37±.20(3)	1.73±.12(3)	4.39±.63(3)	7.26±2.3(3)
CO-60	4.48±1.2(3)	1.91±1.8(3)	3.50±2.8(3)	>1.8(3)
ZN-65	>1.9(2)	>3.9(0)	NOTE 1	NOTE 1
ZR-95	>9.0(2)	1.97±1.9(2)	>2.9(2)	>2.8(2)
NB-95	>3.1(3)	>3.4(2)	>9.2(2)	>5.4(2)
MO-99	<1.4(2)	NOTE 1	NOTE 1	<2.3(1)
RU-103	>5.1(2)	>2.7(1)	>1.2(2)	>2.6(1)
AG-110M	2.13±1.6(3)	1.00±.62(2)	>1.7(2)	>1.0(2)
SB-124	>6.5(1)	>5.2(0)	>1.2(1)	>1.3(1)
SB-125	>2.8(2)	NOTE 1	<3.5(1)	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	<3.7(1)
LA-140	>4.9(1)	>4.7(0)	>8.5(0)	>2.6(0)
CE-141	<2.5(2)	NOTE 1	NOTE 1	>1.1(1)
CE-144	NOTE 1	<6.3(0)	>2.3(1)	>1.2(1)
NP-239	NOTE 1	NOTE 1	>2.9(1)	<1.6(1)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.9

INSTANTANEOUS BOTTOMS/DISTILLATE RATIOS FOR BORIC ACID EVAPORATOR

B.A.E. BOTTOMS/DISTILLATE DF

DATE	9/13	9/13	9/14	10/ 5	10/17
TIME	1121	1542	957	1346	1024
NUCLIDE	BOTTOMS/DISTILLATE				
I-131	>3.4(1)	>5.1(1)	>8.8(1)	>2.3(2)	2.05±.31(3)
CS-134	>3.0(1)	>5.7(1)	>5.1(1)	NOTE 1	1.22±.06(3)
CS-137	>2.7(1)	>4.6(1)	>1.0(2)	NOTE 1	6.85±.46(2)
CR-51	>9.6(0)	>3.2(1)	>4.7(1)	>6.9(2)	1.04±.23(4)
MN-54	>8.2(2)	>1.1(3)	>8.6(2)	5.49±2.7(3)	2.39±.16(3)
FE-59	NOTE 1	>3.8(1)	>3.2(1)	>2.3(2)	>2.4(3)
CO-57	>6.3(1)	>7.1(1)	>6.5(1)	>4.4(2)	5.48±.62(3)
CO-58	>1.8(3)	>2.6(3)	>1.3(3)	1.10±.35(4)	8.43±1.2(3)
CO-60	>1.4(3)	>1.6(3)	>2.5(3)	6.62±2.0(3)	5.79±.73(3)
ZN-65	NOTE 1	>9.0(0)	NOTE 1	>1.0(2)	>3.9(3)
ZR-95	NOTE 1	>9.6(0)	>1.3(1)	>9.7(1)	>1.9(3)
NB-95	NOTE 1	>2.2(1)	NOTE 1	>5.6(2)	>8.1(3)
MO-99	>1.3(1)	>4.1(1)	>5.2(1)	>2.4(1)	4.23±1.3(3)
RU-103	NOTE 1	>1.2(1)	>1.7(1)	>9.5(1)	>2.4(3)
AG-110M	>9.5(1)	>1.3(2)	1.39±.58(2)	>7.8(2)	2.63±.23(3)
SB-124	NOTE 1	>2.7(0)	>4.1(0)	NOTE 1	>8.7(2)
SB-125	NOTE 1	>8.1(0)	>1.5(1)	>7.9(1)	>2.7(3)
BA-140	<1.3(1)	>7.9(0)	>4.3(0)	NOTE 1	NOTE 1
LA-140	NOTE 1	>1.8(1)	>4.4(1)	>2.4(1)	>4.6(2)
CE-141	NOTE 1	>7.0(0)	>5.8(0)	>4.2(1)	>1.3(3)
CE-144	NOTE 1	NOTE 1	>3.4(0)	NOTE 1	NOTE 1
NP-239	NOTE 1	>6.2(0)	>6.0(0)	<1.0(1)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.9 (cont'd)

INSTANTANEOUS BOTTOMS/DISTILLATE RATIOS FOR BORIC ACID EVAPORATOR

B.A.E. BOTTOMS/DISTILLATE DF

DATE	10/18	11/ 2	11/ 2	1/16	1/17
TIME	1059	1043	1535	1657	952
NUCLIDE	BOTTOMS/DISTILLATE				
I-131	1.76±.18(3)	NOTE 1	>8.3(1)	2.37±1.5(2)	1.50±.79(2)
CS-134	1.81±.13(3)	<1.7(2)	>9.0(1)	<7.0(2)	>1.9(2)
CS-137	1.32±.06(3)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	8.69±1.0(3)	>6.8(3)	>5.0(3)	>6.1(3)	6.00±3.9(3)
MN-54	2.24±.44(3)	8.94±1.8(2)	>2.5(3)	8.28±4.1(3)	9.86±5.2(3)
FE-59	>3.4(3)	>6.4(2)	>3.8(2)	>1.7(3)	>2.7(3)
CO-57	4.46±1.7(3)	>3.8(2)	2.74±.87(2)	4.65±3.6(3)	>2.3(3)
CO-58	8.94±1.6(3)	2.10±.26(4)	1.64±.30(4)	1.58±.09(4)	1.55±.05(4)
CO-60	1.06±.04(4)	4.80±1.7(3)	9.53±5.8(3)	5.18±1.2(3)	1.20±.33(4)
ZN-65	>1.4(3)	NOTE 1	NOTE 1	>2.3(2)	NOTE 1
ZR-95	>1.9(3)	3.50±2.1(2)	>3.0(2)	2.30±1.4(3)	>2.5(3)
NB-95	>6.0(3)	>2.0(3)	>2.0(3)	>5.1(3)	>9.6(3)
MO-99	8.27±2.8(3)	>1.2(2)	NOTE 1	NOTE 1	8.70±8.3(1)
RU-103	>3.0(3)	>7.3(2)	>9.0(2)	>1.1(3)	>2.0(3)
AG-110M	7.90±7.6(3)	>6.3(2)	>8.3(2)	3.03±1.9(3)	7.00±5.1(3)
SB-124	>7.6(2)	NOTE 1	>8.2(1)	NOTE 1	>2.7(2)
SB-125	>2.4(3)	NOTE 1	NOTE 1	NOTE 1	>2.2(2)
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	>6.7(1)	NOTE 1	>1.7(1)	NOTE 1	>1.8(2)
CE-141	>1.6(3)	>3.0(2)	>1.5(2)	NOTE 1	6.82±6.2(2)
CE-144	NOTE 1	NOTE 1	>6.9(1)	>3.2(2)	>2.2(2)
NP-239	>9.4(2)	>1.4(2)	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.9 (cont'd)

INSTANTANEOUS BOTTOMS/DISTILLATE RATIOS FOR BORIC ACID EVAPORATOR

B.A.E. BOTTOMS/DISTILLATE DF

DATE	2/ 6	2/ 6	2/ 7
TIME	1420	2230	942
NUCLIDE	BOTTOMS/DISTILLATE		
I-131	7.73±5.0(2)	>1.5(3)	7.62±6.0(2)
CS-134	>2.8(2)	>4.4(2)	>2.9(1)
CS-137	1.43±.71(2)	>3.5(2)	>1.6(1)
CR-51	>3.2(3)	1.02±.69(4)	2.34±1.3(3)
MN-54	>8.2(3)	1.49±.71(4)	>6.8(3)
FE-59	1.82±1.2(3)	>3.0(3)	6.62±4.1(2)
CO-57	>1.2(3)	>4.4(3)	>8.8(2)
CO-58	2.79±.20(4)	6.73±.96(4)	4.36±1.4(4)
CO-60	3.56±3.4(4)	5.60±4.5(4)	>9.5(3)
ZN-65	>1.0(2)	NOTE 1	>2.2(1)
ZR-95	2.34±3.2(3)	>4.3(3)	>1.4(3)
NB-95	>6.0(3)	>1.4(4)	>2.7(3)
MO-99	NOTE 1	NOTE 1	2.26±2.7(1)
RU-103	>7.4(2)	>1.3(3)	>3.6(2)
AG-110M	2.24±1.4(3)	>3.6(3)	>1.2(3)
SB-124	>1.4(2)	>2.3(2)	>7.4(1)
SB-125	NOTE 1	<2.0(2)	NOTE 1
BA-140	>1.4(2)	NOTE 1	<1.2(2)
LA-140	>4.1(1)	>1.9(2)	>6.8(1)
CE-141	NOTE 1	>2.4(2)	>7.9(1)
CE-144	<1.5(2)	>3.9(2)	>1.1(2)
NP-239	NOTE 1	>9.0(1)	<3.9(1)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

The range in mean concentration of these dominant radionuclides is much smaller in the distillate than it is in the feed. An examination of Table 5.6 reveals that mean feed concentrations among all radionuclides vary by a factor of 2300 while mean distillate concentrations vary by only a factor of 18.

5.3.2 Miscellaneous Radwaste Evaporator

Samples of miscellaneous radwaste evaporator feed, distillate, and bottoms were collected and measured during six separate evaporator operations. The measured concentrations of radionuclides in these samples are listed in Appendix Tables B.19-B.21. Figures 5.9 through 5.17 display the changes in concentrations of ^{131}I, ^{137}Cs and ^{58}Co for the feed, bottoms and distillate, respectively, during the entire measurement period. As can be seen from these figures, the feed to the evaporator was fairly constant over the six-month measurement period. However, there was enough difference to provide a distillate concentration to feed concentration correlation for ^{131}I (compare Figures 5.9 and 5.11). There was no correlation for either ^{137}Cs or ^{58}Co with respect to distillate concentration against either feed or bottoms concentration for the data from the miscellaneous radwaste evaporator.

The means and ranges for the entire data set are given in Table 5.10. Decontamination factors (DF's) for the evaporator were calculated as the feed concentration divided by the distillate concentration for each series of samples taken during the measurement period. The measured instantaneous DF's are given in Table 5.11. Plots of the DF's for ^{131}I, ^{137}Cs and ^{58}Co over the measurement period are shown in Figures 5.18-5.20. "Best value" DF values are given in Table 5.12. Previous studies (4), have shown that some DF measurements are strongly correlated to the feed concentration. Although the feed concentrations for the miscellaneous radwaste evaporator did not show large variations, the correlations still appear to be true when data from both evaporators are included as shown in section 5.4.

Although the feed/distillate DF's are those that are most important from the users standpoint, the bottoms concentration is the more important factor in the operation of the evaporator. Figures 5.21, 5.22 and 5.23 show the bottoms/distillate ratio for ^{131}I, ^{137}Cs and ^{58}Co, respectively. These figures show large differences in the bottoms-to-distillate ratio which show correlation with the bottoms concentrations for ^{137}Cs and ^{58}Co as shown in Figures 5.24 and 5.25.

FIGURE 5.9

^{131}I CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR FEED

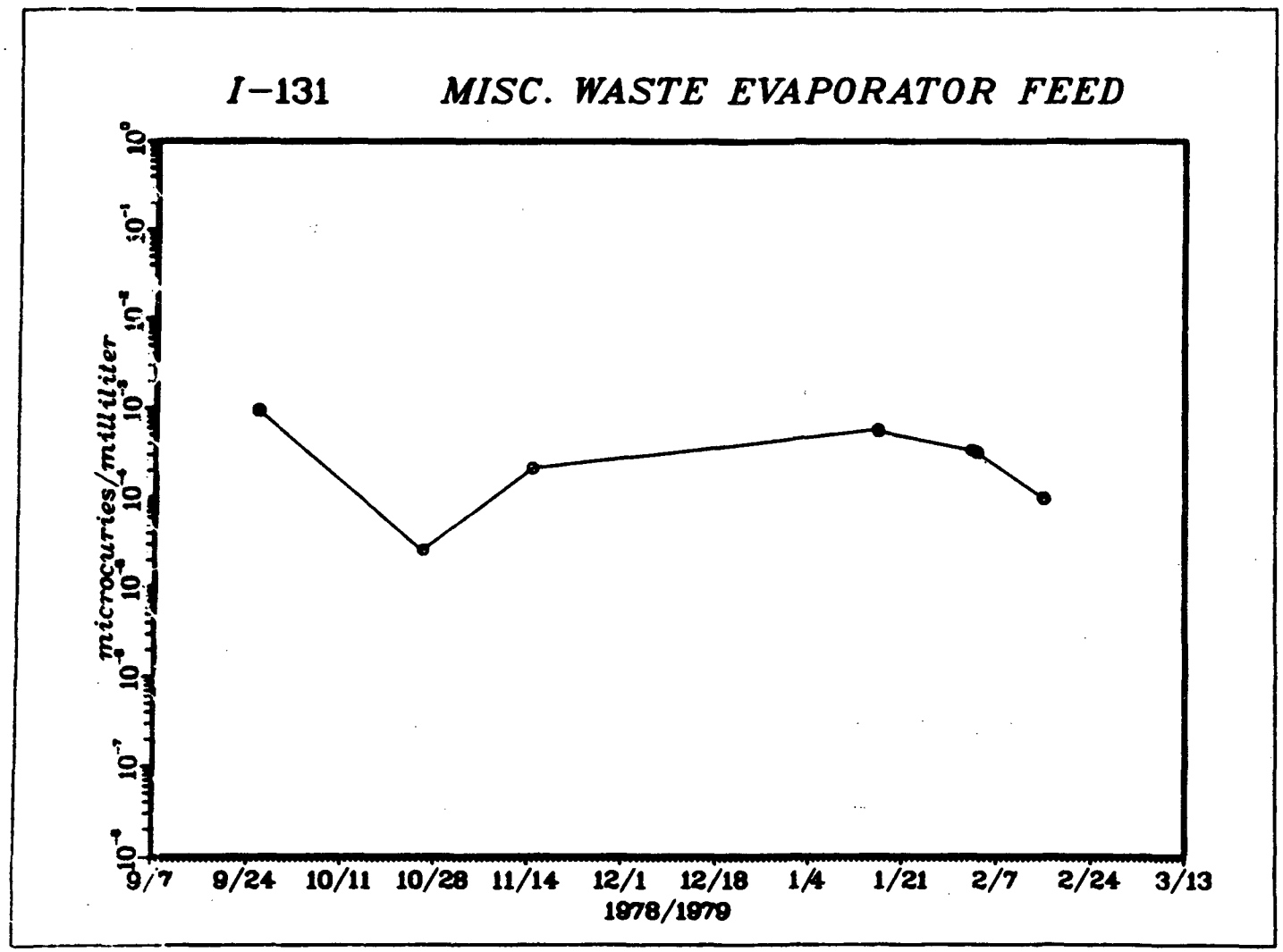


FIGURE 5.10

^{131}I CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR BOTTOMS

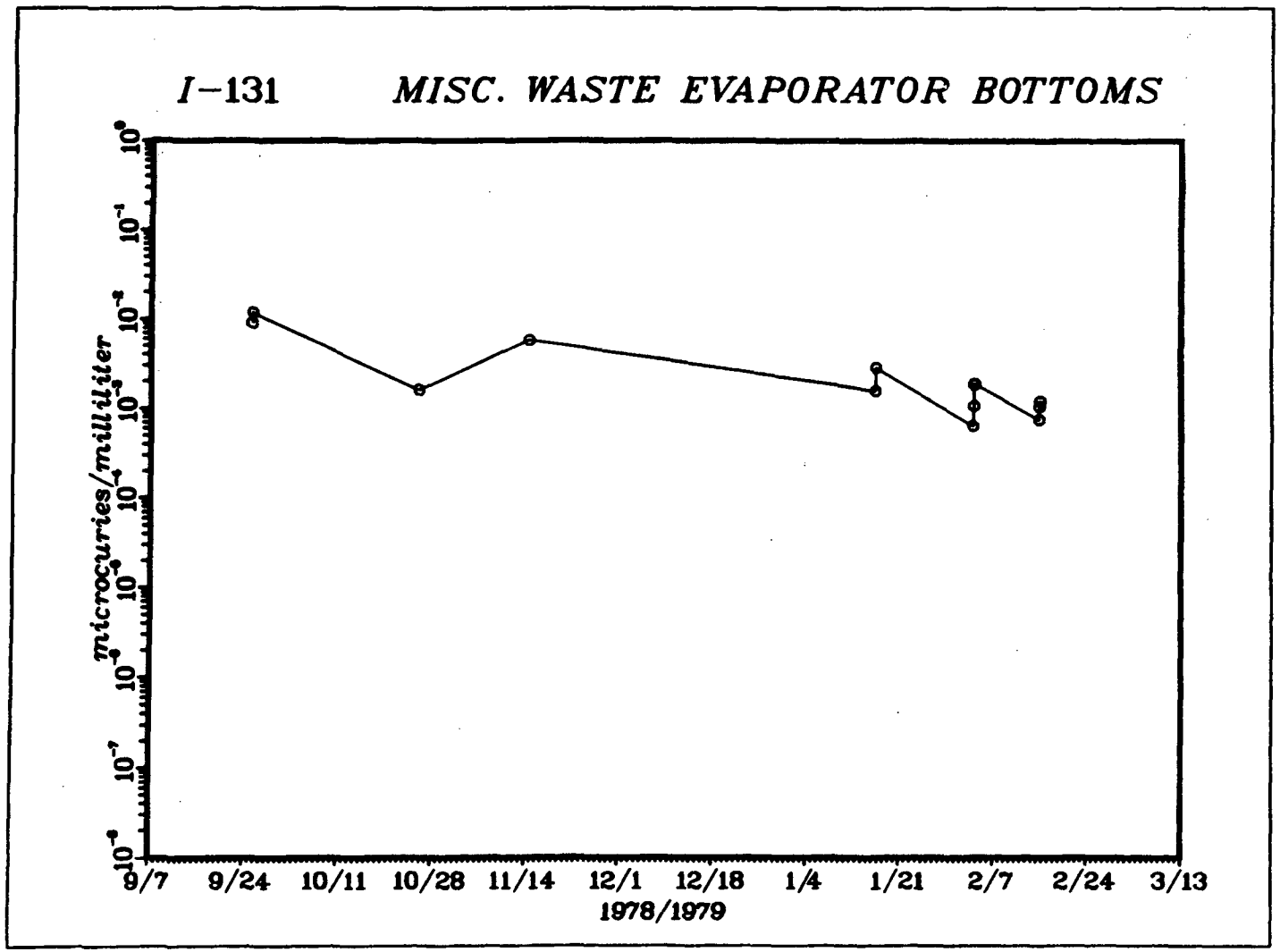


FIGURE 5.11

^{131}I CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR DISTILLATE

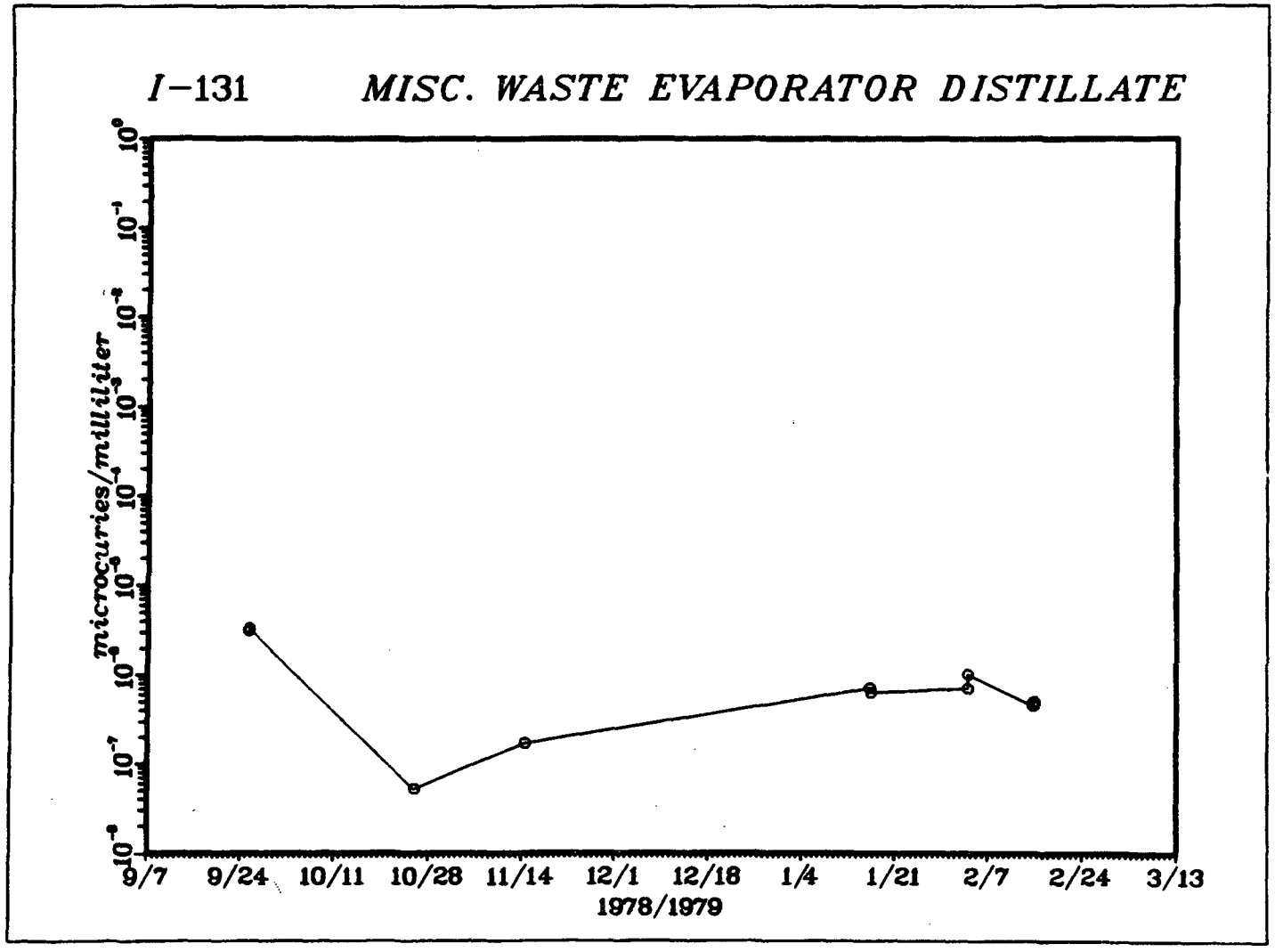


FIGURE 5.12

^{137}Cs CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR FEED

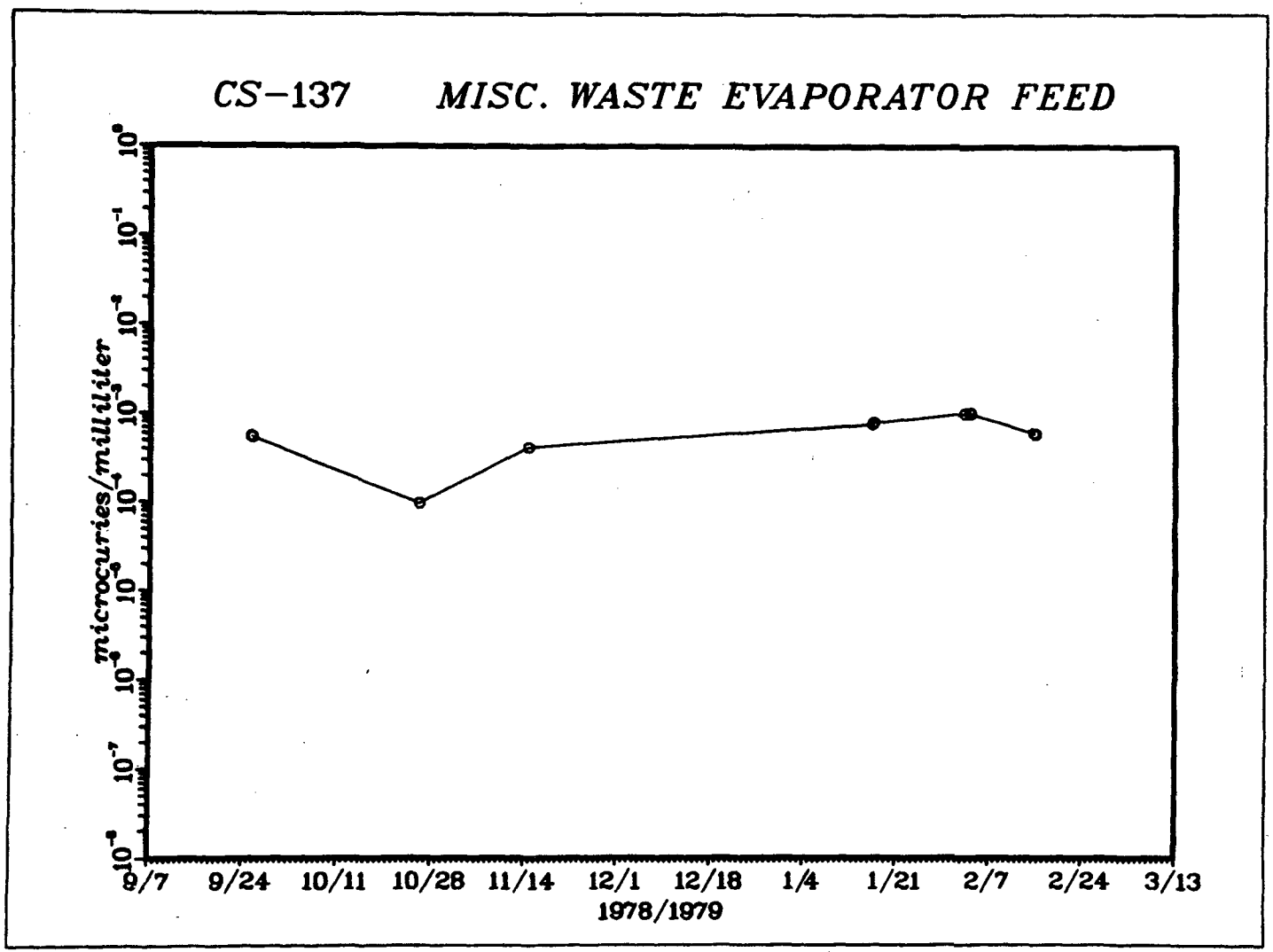


FIGURE 5.13

^{137}Cs CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR BOTTOMS

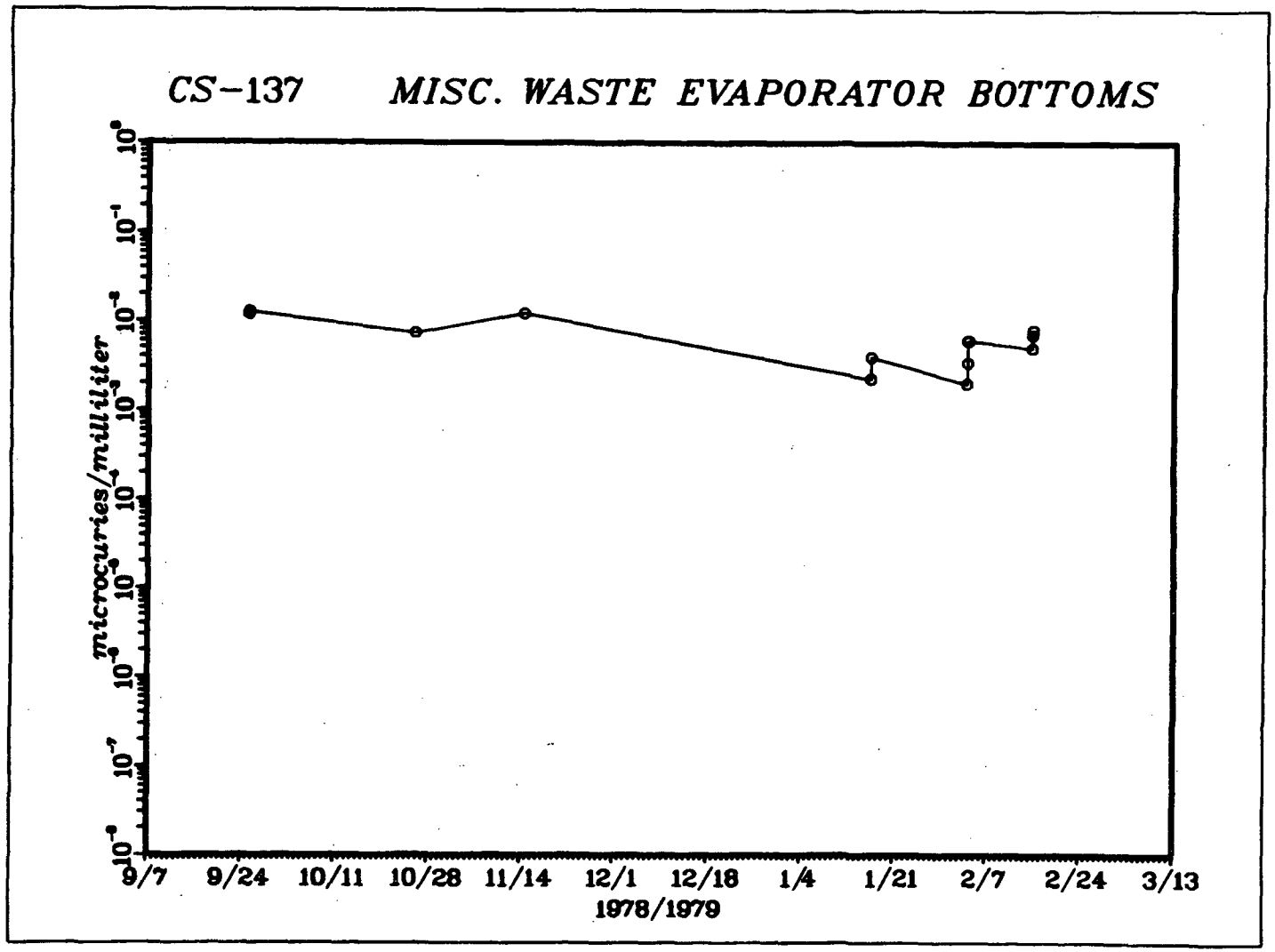


FIGURE 5.14

^{137}Cs CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR DISTILLATE

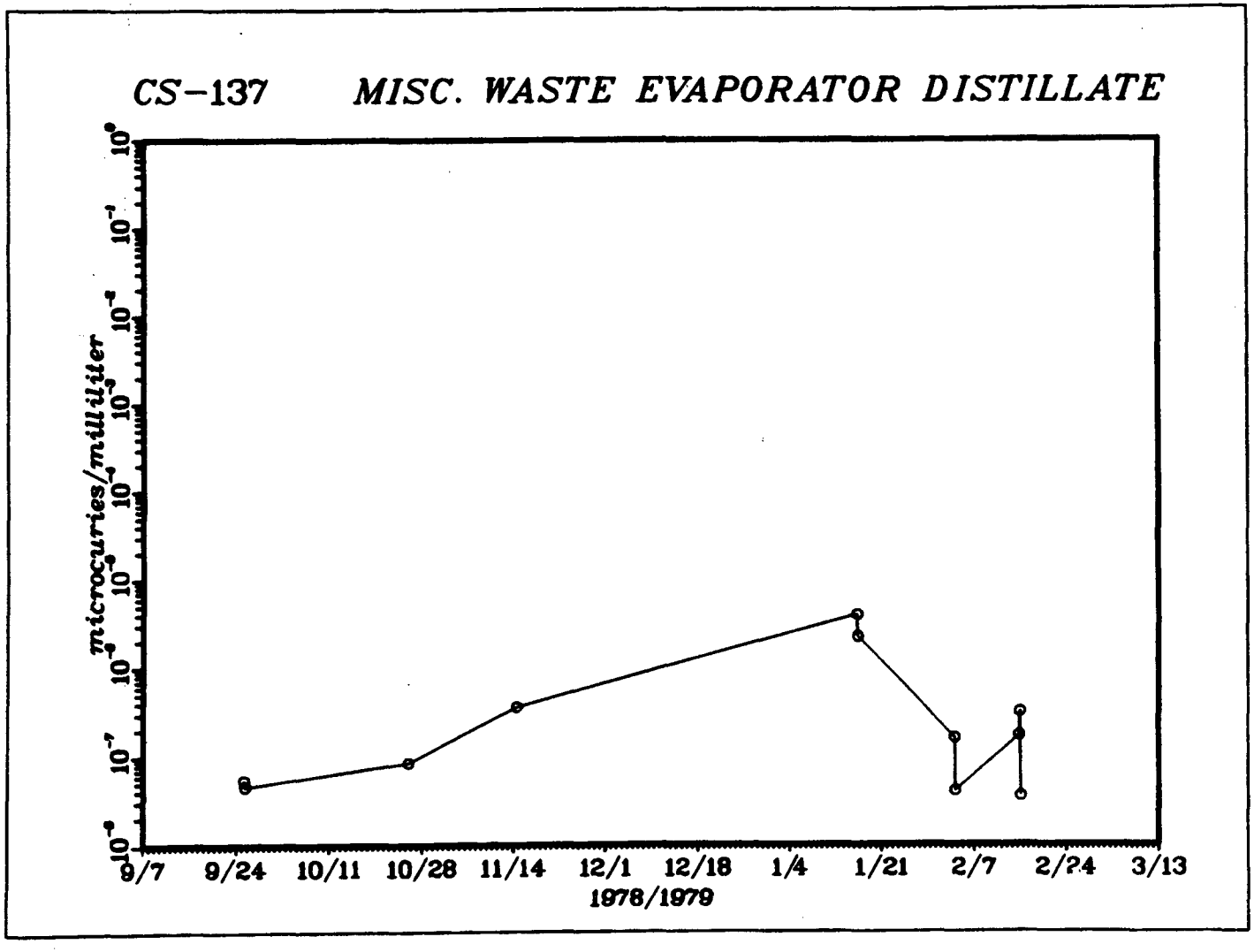


FIGURE 5.15

^{58}Co CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR FEED

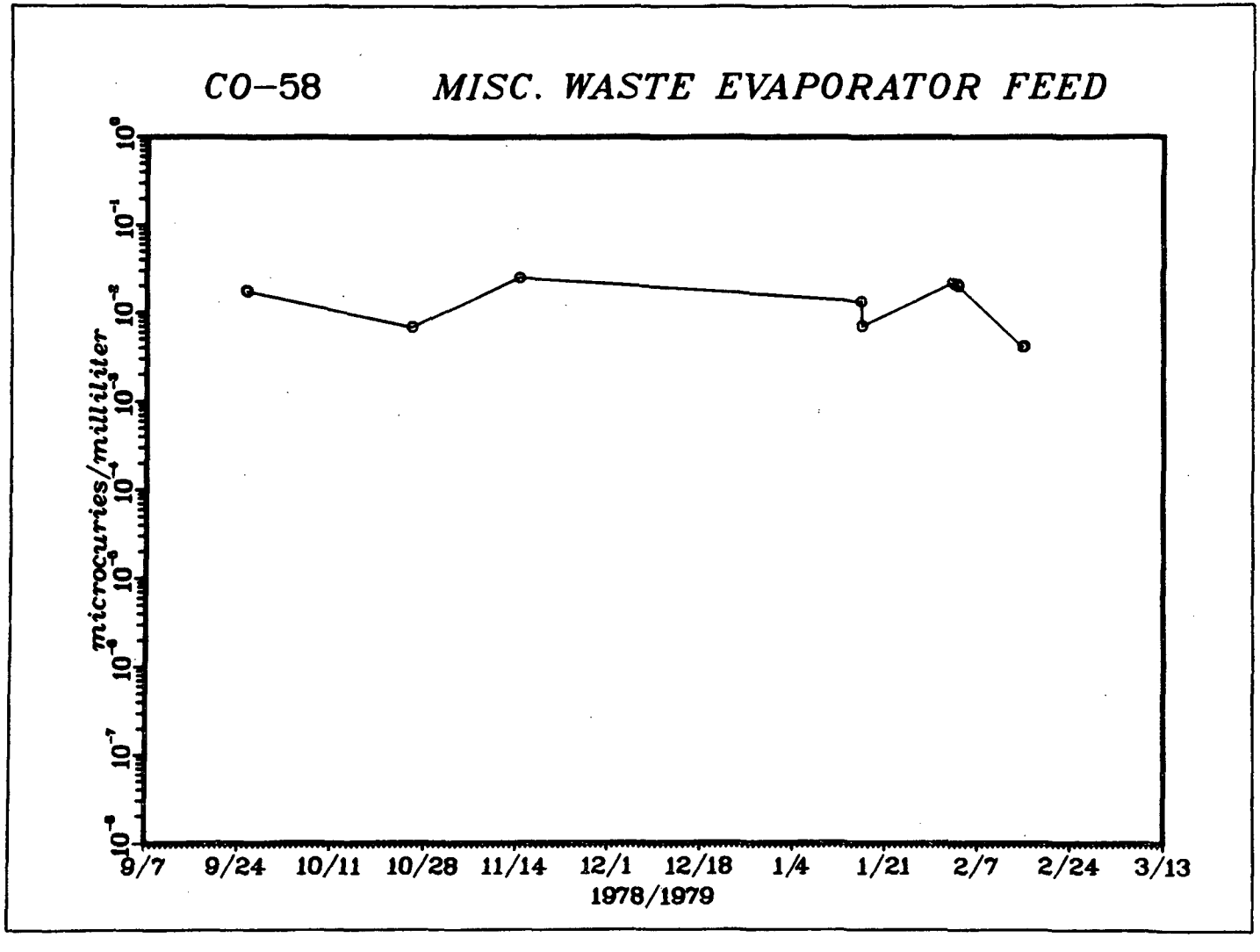


FIGURE 5.16

^{58}Co CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR BOTTOMS

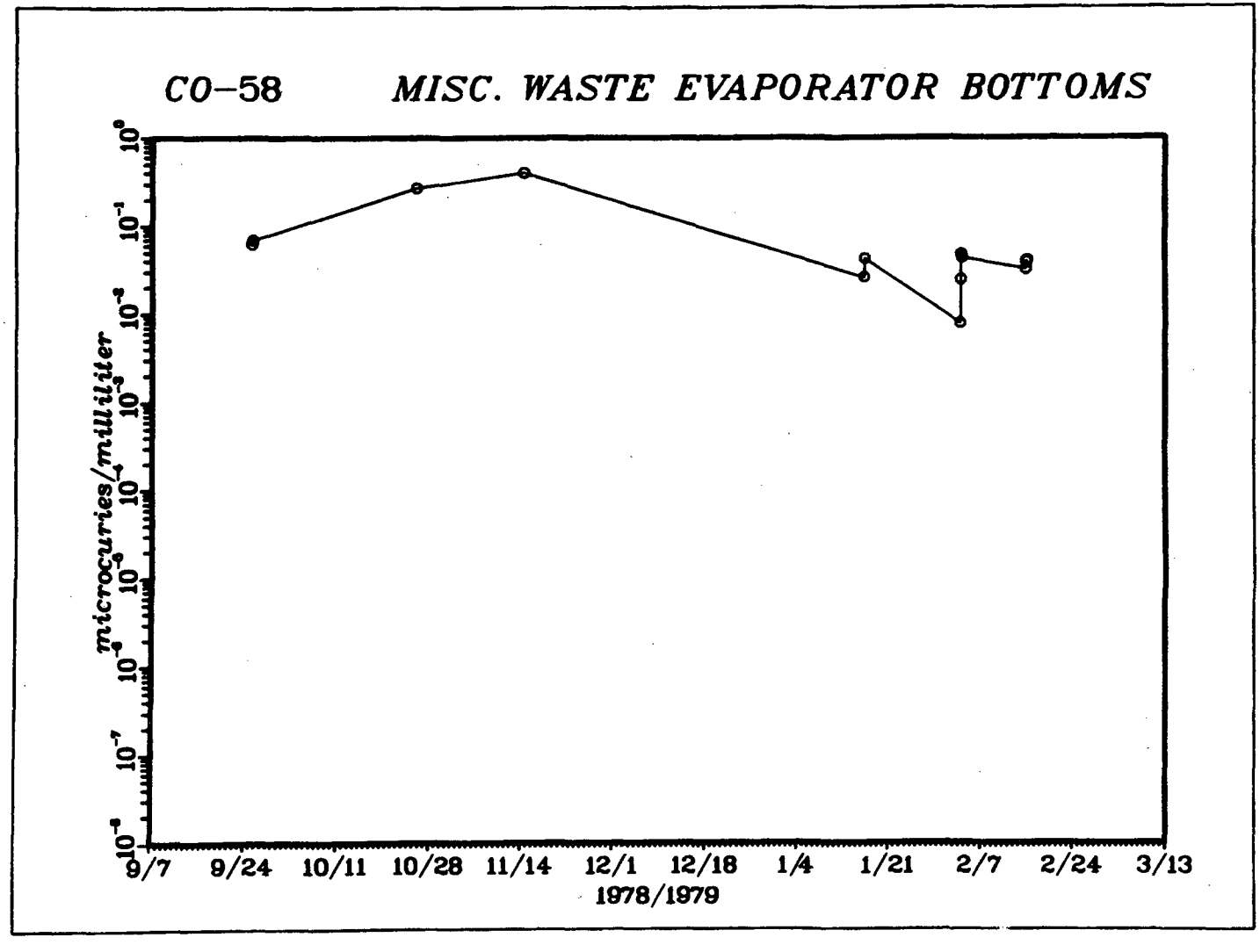


FIGURE 5.17

^{58}Co CONCENTRATION IN MISCELLANEOUS RADWASTE EVAPORATOR DISTILLATE

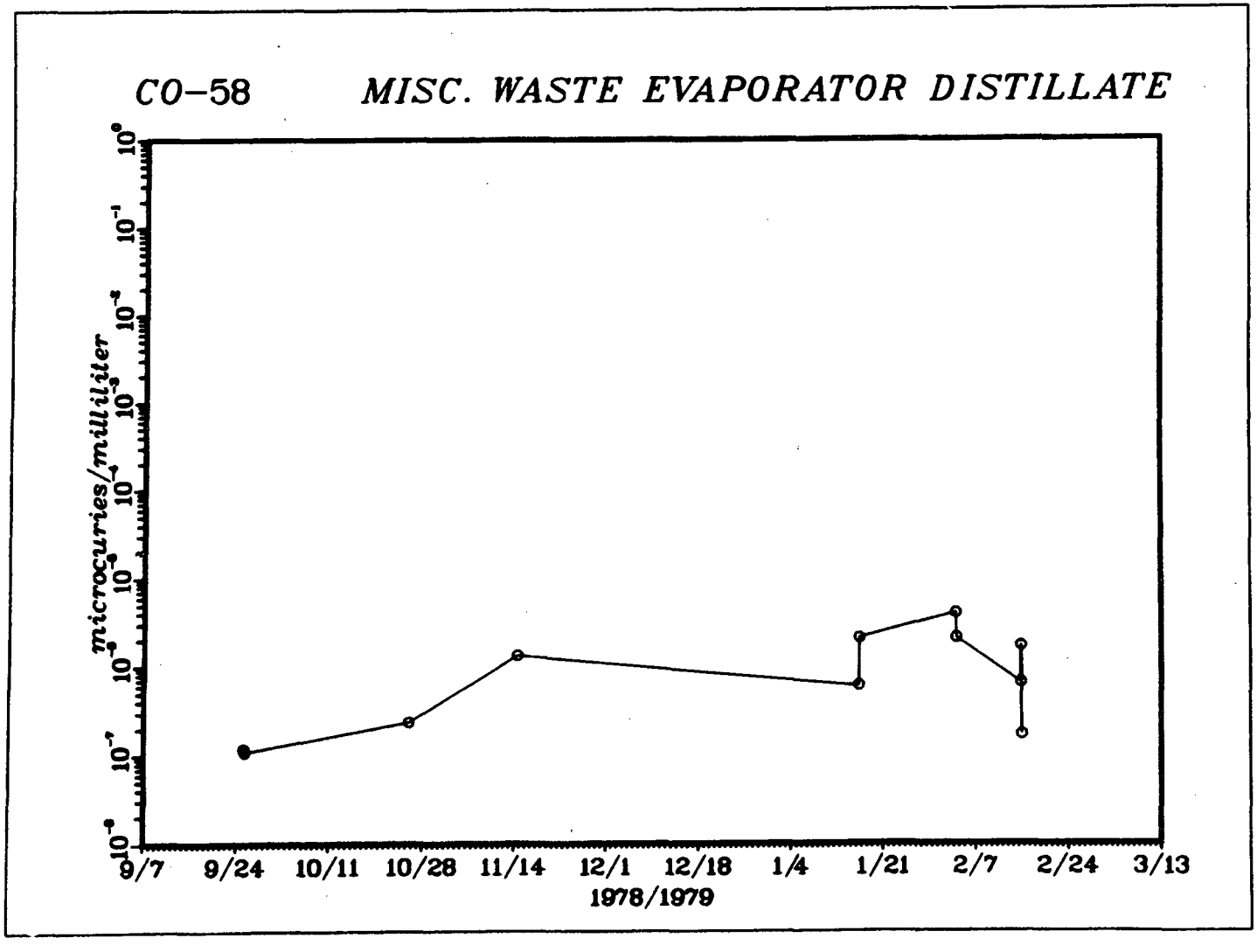


TABLE 5.10

MEANS** AND RANGES FOR RADIONUCLIDE CONCENTRATIONS IN THE MISCELLANEOUS RADWASTE EVAPORATOR FEED, BOTTOMS, AND DISTILLATE

	Feed		Bottoms		Distillate	
Nuclide	Mean (μCi/ml)	Range (μCi/ml)	Mean (μCi/ml)	Range (μCi/ml)	Mean (μCi/ml)	Range (μCi/ml)
^{131}I	4.0(-4)	2.6-95(-5)	3.2(-3)	6.5-120(-4)	1.0(-6)	5.2-330(-8)
^{133}I	1.3(-5)	4.3-67(-6)	2.7(-5)	6.6-140(-6)	2.8(-8)	2.0-5.0(-8)
^{134}Cs	5.0(-4)	6.5-73(-5)	5.2(-3)	1.6-9.9(-3)	5.1(-7)	<3.0-300(-8)
^{136}Cs	7.1(-5)	3.9-57(-6)	1.8(-4)	3.3-83(-5)	3.6(-8)	1.6-12(-8)
^{137}Cs	6.7(-4)	9.7-100(-5)	6.8(-3)	2.0-13(-3)	6.7(-7)	3.5-390(-8)
^{51}Cr	1.6(-3)	2.1-36(-4)	9.1(-3)	2.2-380(-4)	2.0(-7)	<2.0-3.5(-7)
^{54}Mn	7.6(-4)	2.3-17(-4)	2.5(-3)	1.7-68(-4)	1.2(-7)	<2.0-36(-8)
^{59}Fe	1.7(-4)	3.4-26(-5)	5.0(-4)	3.5-170(-5)	4.8(-8)	2.7-5.9(-8)
^{57}Co	5.4(-5)	1.5-13(-5)	2.1(-4)	2.2-80(-5)	2.5(-8)	1.1-14(-8)
^{58}Co	1.45(-2)	4.1-25(-3)	8.5(-2)	7.8-400(-3)	1.2(-6)	1.0-40(-7)
^{60}Co	1.37(-3)	4.6-29(-4)	6.3(-3)	4.8-220(-4)	3.3(-7)	<6.0-92(-8)
^{65}Zn	1.6(-5)	4.3-100(-6)	3.0(-5)	2.3-110(-6)	3(-8)	<4.0-* (-8)
^{95}Zr	9.3(-5)	2.4-17(-5)	2.1(-4)	9.5-1200(-6)	2.7(-8)	<3.0-6.6(-8)
^{95}Nb	2.0(-4)	5.1-37(-5)	7.4(-4)	3.4-280(-5)	2.6(-8)	<2.0-12(-8)
^{99}Mo	1.6(-5)	2.0-59(-6)	9.7(-5)	4.8-510(-6)	1.3(-8)	<2.0-* (-8)
^{103}Ru	2.7(-5)	4.5-67(-6)	2.5(-4)	1.1-130(-5)	1.5(-8)	<2.0-2.4(-8)
^{110m}Ag	8.4(-5)	3.1-15(-5)	8.3(-4)	5.1-430(-5)	5.4(-8)	<5.0-18(-8)
^{124}Sb	5.3(-5)	1.0-13(-5)	6.8(-4)	1.5-36(-4)	1.9(-8)	<2.0-* (-8)
^{125}Sb	8.2(-5)	2.9-13(-5)	9.8(-4)	3.4-36(-4)	4.1(-8)	<4.0-* (-8)
^{140}Ba	1.5(-5)	5.8-33(-6)	7.2(-5)	1.5-14(-5)	5(-8)	<6.0-* (-8)
^{140}La	2.1(-5)	1.8-140(-6)	7.3(-5)	1.7-28(-5)	1.7(-8)	<2.0-4.2(-8)
^{141}Ce	8.7(-6)	3.7-31(-6)	9.3(-5)	4.6-650(-6)	2.4(-8)	<3.0-4.4(-8)
^{143}Ce	7.2(-6)	<4-10(-6)	3.3(-5)	<3.3-57(-6)	4(-8)	<4.0-* (-8)
^{144}Ce	1.6(-4)	2.4-140(-5)	2.8(-4)	<1.1-130(-5)	9(-8)	<1.0-* (-7)
^{239}Np	7(-6)	<6-29(-6)	3.7(-5)	<6-240(-6)	2(-6)	<7.0-13(-8)

* All data points were measured as less-thans and no upper value for the range can be established.

** Calculated in accordance with the procedure in Appendix A.

TABLE 5.11

INSTANTANEOUS DF's FOR MISCELLANEOUS RADWASTE EVAPORATOR

MWE FEED/DISTILLATE DF

DATE	9/25	9/25	10/25	11/14	1/16
TIME	1005	1426	1506	1420	1400
NUCLIDE	DECONTAMINATION FACTOR				
I-131	3.06±.08(2)	2.83±.04(2)	5.00±2.3(2)	1.25±.29(3)	8.13±.36(2)
I-133	NOTE 1	NOTE 1	NOTE 1	>6.1(2)	NOTE 1
CS-134	>6.9(3)	5.73±1.1(3)	8.55±4.8(2)	1.32±.11(3)	1.97±.07(2)
CS-136	>2.1(4)	>1.4(3)	>1.7(2)	>2.0(2)	1.50±.38(2)
CS-137	1.00±.40(4)	1.19±.67(4)	1.14±.38(3)	1.14±.16(3)	1.93±.05(2)
CR-51	>1.7(4)	>1.2(4)	>3.2(3)	>8.3(3)	>3.6(3)
MN-54	1.63±.50(4)	>2.1(4)	>4.5(3)	2.44±.24(3)	1.33±1.1(4)
FE-59	>6.0(3)	>5.0(3)	>1.5(3)	>2.5(3)	>2.2(3)
CO-57	>1.2(3)	>2.0(3)	>7.5(2)	>1.5(3)	>1.2(3)
CO-58	1.48±.12(5)	1.61±.29(5)	2.86±.36(4)	1.88±.20(4)	2.21±.18(4)
CO-60	>1.6(4)	>6.9(3)	>6.6(3)	1.39±.18(3)	6.36±2.7(3)
ZN-65	>6.4(1)	>7.2(1)	NOTE 1	>1.3(3)	>7.6(1)
ZR-95	>2.4(3)	>2.5(3)	>9.6(2)	2.00±.57(3)	1.88±1.9(3)
NB-95	>1.1(4)	>1.1(4)	>2.1(3)	>7.3(3)	>2.9(3)
MO-99	>3.0(3)	>3.0(3)	NOTE 1	>5.8(2)	>3.0(2)
RU-103	>1.9(3)	>2.3(3)	>7.0(2)	>1.3(3)	>6.3(2)
AG-110M	>1.3(3)	>8.5(2)	>5.9(2)	>1.0(3)	3.44±.98(2)
SB-124	>1.3(3)	>1.0(3)	>2.0(2)	>3.2(3)	>1.6(3)
SB-125	>9.0(2)	>5.1(2)	>4.1(2)	>9.6(2)	>5.5(2)
BA-140	>3.0(2)	>3.3(2)	NOTE 1	NOTE 1	>5.5(1)
LA-140	>8.8(2)	>2.7(3)	NOTE 1	>3.0(2)	6.19±2.8(2)
CE-141	>3.4(2)	>3.8(2)	>1.6(2)	>5.2(2)	>1.2(2)
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	>1.8(2)	NOTE 1	>7.0(3)	NOTE 1
NP-239	NOTE 1	NOTE 1	<7.7(1)	>1.5(2)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE 5.11 (cont'd)

INSTANTANEOUS DF's FOR MISCELLANEOUS RADWASTE EVAPORATOR

MWE FEED/DISTILLATE DF

DATE	1/16	2/ 3	2/ 3	2/15	2/15
TIME	1727	1232	1453	853	1244
NUCLIDE	DECONTAMINATION FACTOR				
I-131	8.63±.42(2)	4.55±.20(2)	3.09±.10(2)	2.20±.09(2)	1.98±.24(2)
I-133	>3.3(2)	<5.0(2)	8.60±6.5(1)	3.57±3.7(2)	>1.1(2)
CS-134	3.69±.61(2)	4.51±.57(3)	>2.4(4)	3.31±.95(3)	1.96±.06(3)
CS-136	2.25±.50(2)	>2.4(2)	>3.0(2)	>1.4(2)	>1.3(2)
CS-137	3.59±.46(2)	6.38±1.2(3)	2.50±1.3(4)	3.52±.22(3)	1.85±.06(3)
CR-51	3.46±2.2(3)	3.90±1.4(3)	4.28±1.6(3)	1.11±.48(3)	1.53±.93(3)
MN-54	1.55±.28(3)	7.23±.99(3)	1.78±.67(4)	5.11±2.3(3)	7.78±1.2(2)
FE-59	>2.3(3)	4.00±1.6(3)	>5.8(2)	1.26±.90(3)	8.29±1.1(2)
CO-57	>4.3(3)	>4.1(3)	5.72±3.3(2)	1.55±1.0(3)	>9.2(2)
CO-58	3.38±.78(3)	5.24±.13(3)	9.57±.35(3)	6.21±.54(3)	2.46±.58(3)
CO-60	2.02±.23(3)	6.02±.41(3)	9.29±1.0(3)	4.23±1.3(3)	6.09±.61(2)
ZN-65	>1.8(2)	>2.8(2)	>1.2(2)	NOTE 1	>8.8(1)
ZR-95	1.71±1.9(3)	>3.2(3)	>3.8(3)	>8.0(2)	>4.9(2)
NB-95	>2.8(3)	2.83±.48(3)	>1.1(4)	>2.6(3)	>1.8(3)
MO-99	>3.8(2)	NOTE 1	NOTE 1	>6.7(1)	NOTE 1
RU-103	3.68±4.6(2)	>8.3(2)	>1.4(3)	>2.3(2)	>2.4(2)
AG-110M	>1.4(3)	>1.6(3)	>1.9(3)	>3.9(2)	5.30±4.1(2)
SB-124	>1.3(3)	>3.2(3)	>2.0(3)	>9.0(2)	>3.4(2)
SB-125	>1.2(3)	>1.8(3)	>1.8(3)	>1.1(3)	>7.2(2)
BA-140	NOTE 1	NOTE 1	NOTE 1	>8.0(1)	>5.8(1)
LA-140	>5.7(2)	>2.1(2)	>1.9(2)	>1.0(2)	>9.0(1)
CE-141	NOTE 1	>2.1(2)	NOTE 1	1.18±1.1(2)	>9.3(1)
CE-143	NOTE 1	NOTE 1	NOTE 1	>1.5(2)	>1.0(2)
CE-144	NOTE 1	>8.8(2)	>3.9(2)	NOTE 1	>1.2(2)
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.11 (cont'd)

INSTANTANEOUS DF's FOR MISCELLANEOUS RADWASTE EVAPORATOR

MWE FEED/DISTILLATE DF

DATE 2/15
TIME 1409

NUCLIDE	DECONTAMINATION FACTOR
I-131	1.94±.16(2)
I-133	>2.1(2)
CS-134	>8.8(3)
CS-136	2.44±2.0(2)
CS-137	1.67±.33(4)
CR-51	>1.2(3)
MN-54	>1.2(4)
FE-59	>7.5(2)
CO-57	1.42±1.2(3)
CO-58	2.46±.73(4)
CO-60	>9.3(3)
ZN-65	>6.3(1)
ZR-95	>8.2(2)
NB-95	>2.8(3)
MO-99	NOTE 1
RU-103	>1.6(2)
AG-110M	>7.0(2)
SB-124	>5.6(2)
SB-125	>1.1(3)
BA-140	>9.7(1)
LA-140	>6.0(1)
CE-141	>1.2(2)
CE-143	>1.0(2)
CE-144	>2.4(2)
NP-239	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

FIGURE 5.18

^{131}I DF FOR MISCELLANEOUS RADWASTE EVAPORATOR

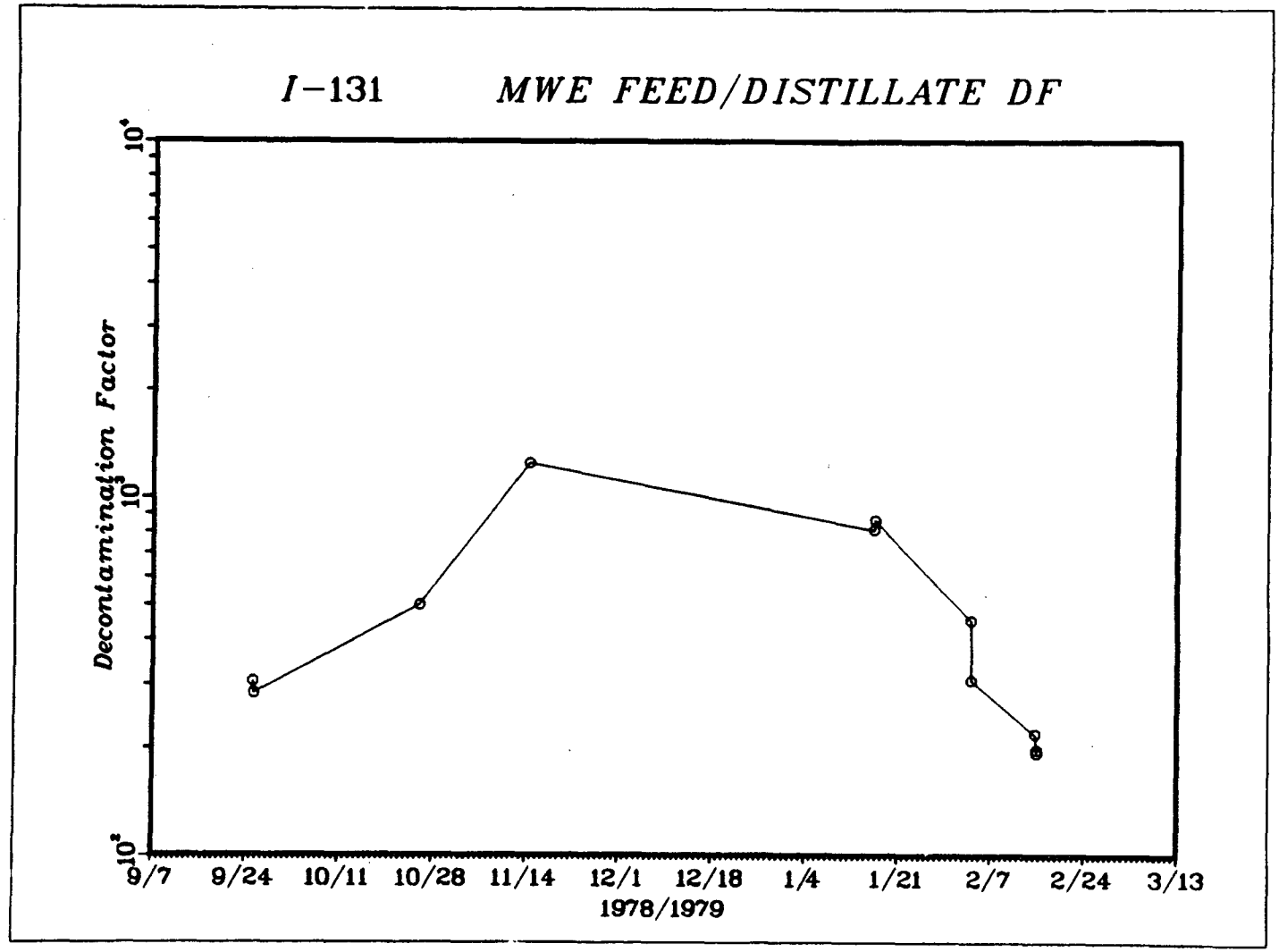


FIGURE 5.19

^{137}Cs DF FOR MISCELLANEOUS RADWASTE EVAPORATOR

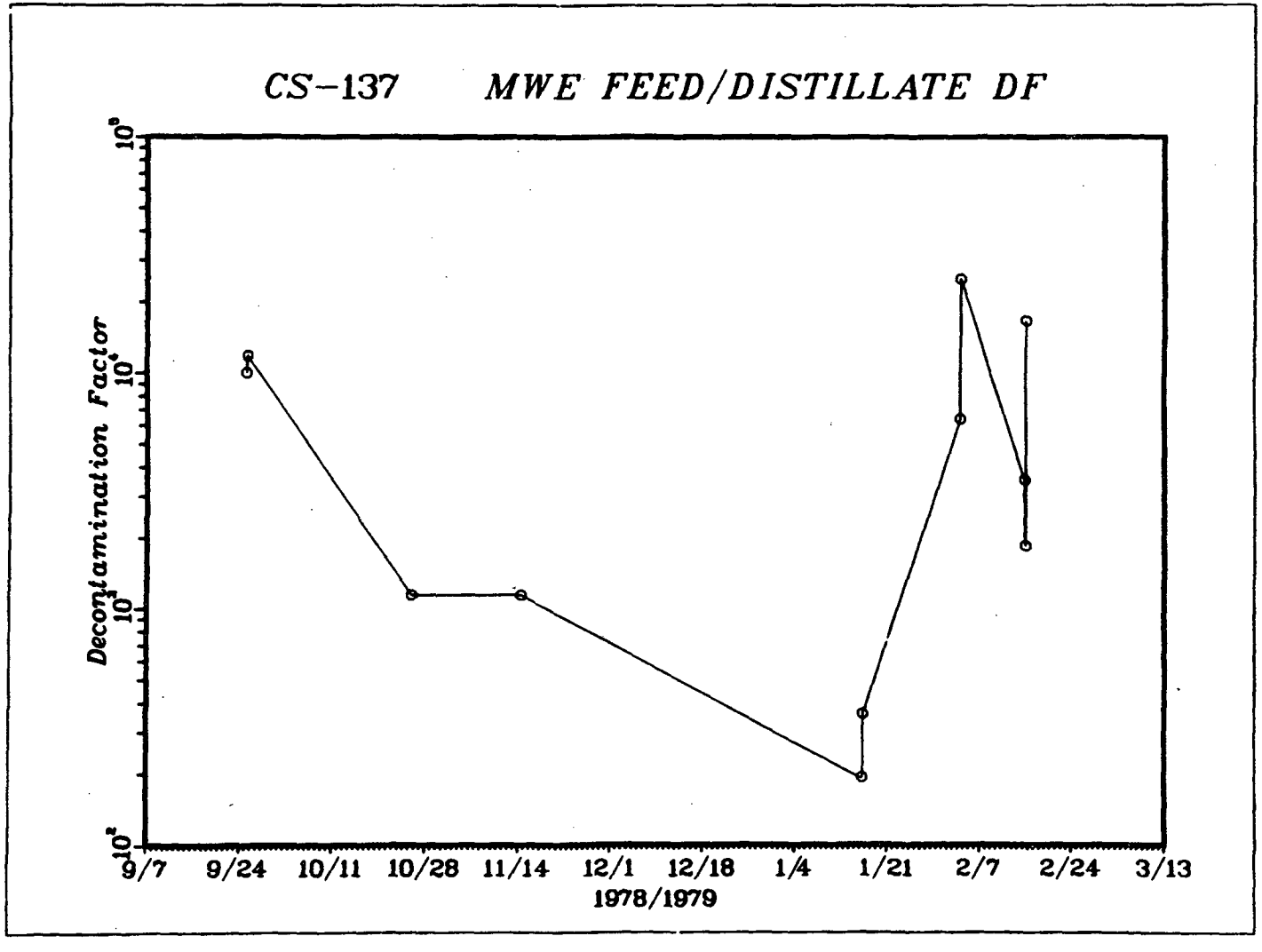


FIGURE 5.20

^{58}Co DF FOR MISCELLANEOUS RADWASTE EVAPORATOR

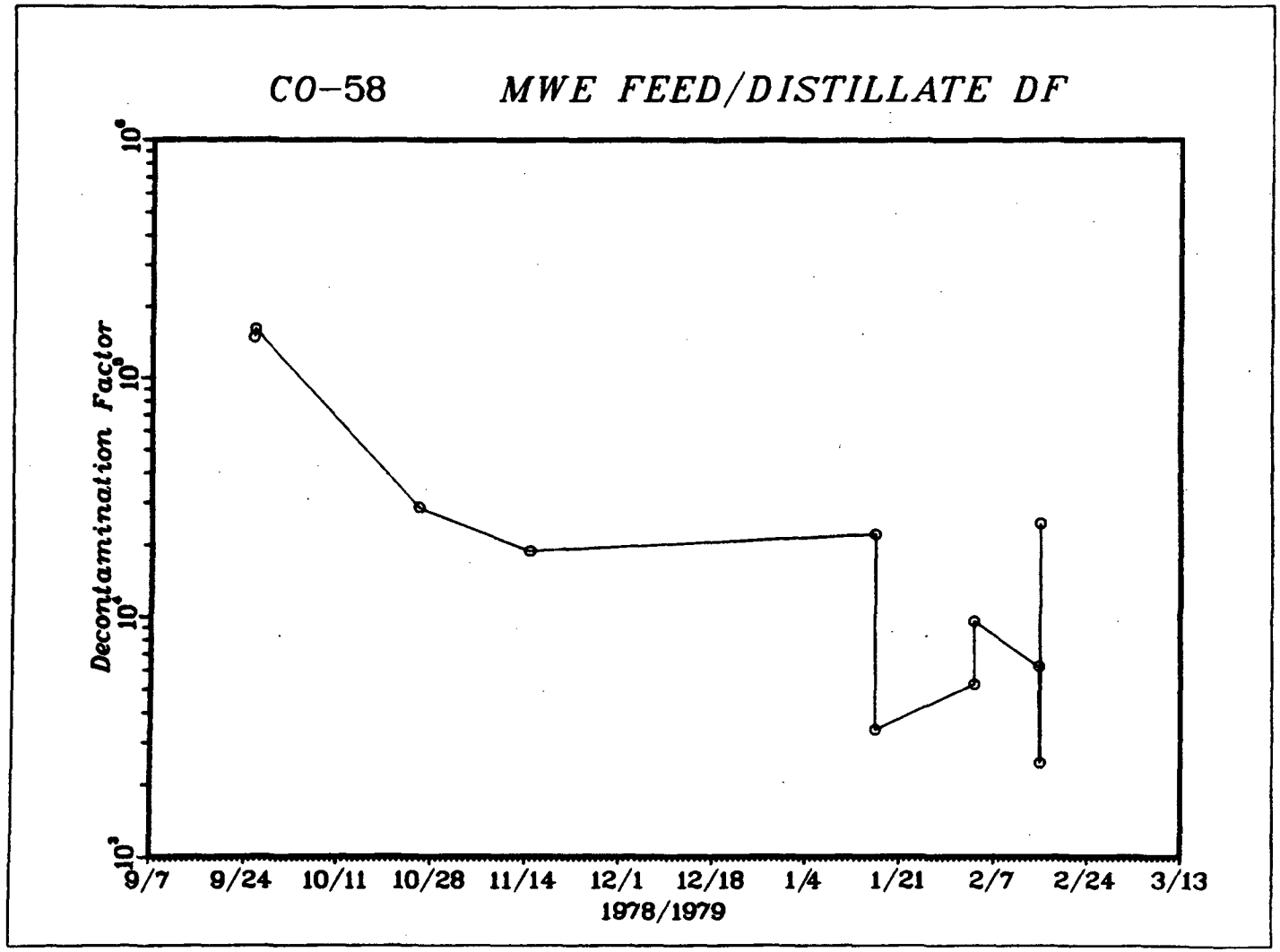


TABLE 5.12

"BEST VALUE" DECONTAMINATION FACTORS FOR MISCELLANEOUS WASTE EVAPORATOR

Nuclide	DF
^{131}I	4.0(2)
^{133}I	4.6(2)
^{134}Cs	9.8(2)
^{136}Cs	2.0(3)
^{137}Cs	1.0(3)
^{51}Cr	8.0(3)
^{54}Mn	6.3(3)
^{59}Fe	3.5(3)
^{57}Co	2.2(3)
^{58}Co	1.2(4)
^{60}Co	4.2(3)
^{65}Zn	5.3(2)
^{95}Zr	3.4(3)
^{95}Nb	7.7(3)
^{99}Mo	1.2(3)
^{103}Ru	1.8(3)
^{110m}Ag	1.6(3)
^{124}Sb	2.8(3)
^{125}Sb	2.0(3)
^{140}Ba	3.0(2)
^{140}La	1.2(3)
^{141}Ce	3.6(2)
^{143}Ce	1.8(2)
^{144}Ce	1.8(3)

FIGURE 5.21

^{131}I BOTTOMS/DISTILLATE RATIO FOR MISCELLANEOUS RADWASTE EVAPORATOR

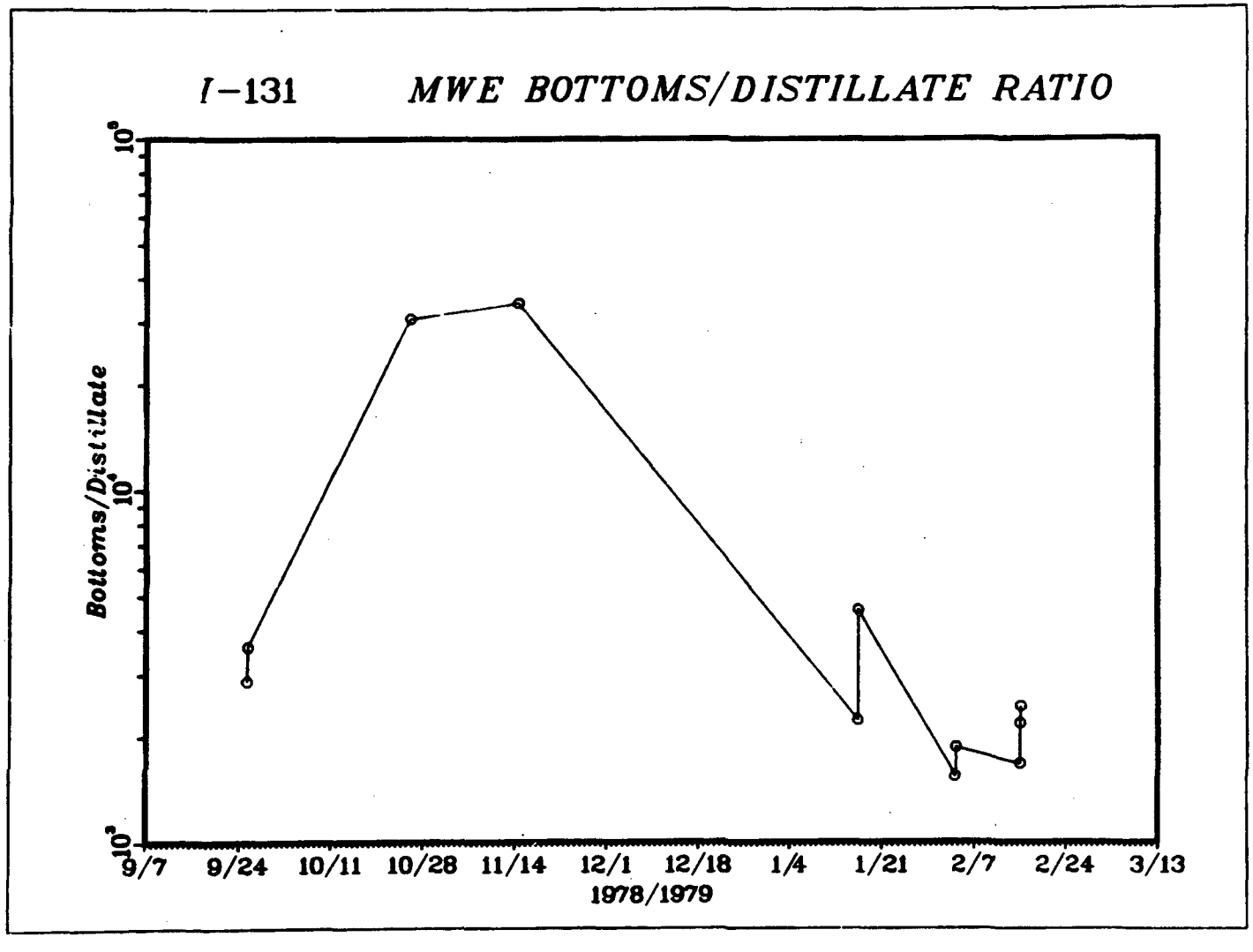


FIGURE 5.22

^{137}Cs BOTTOMS/DISTILLATE RATIO FOR MISCELLANEOUS RADWASTE EVAPORATOR

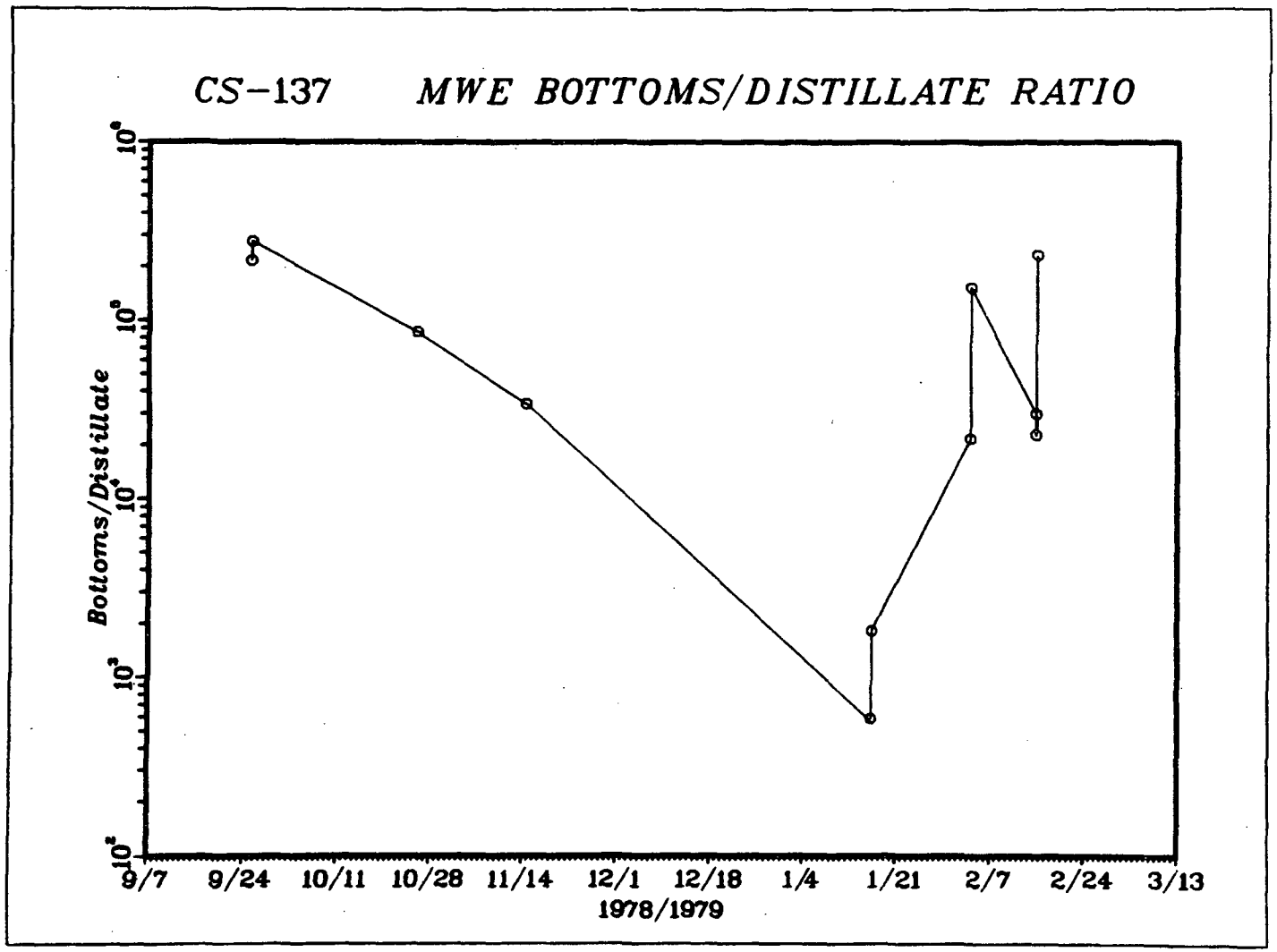


FIGURE 5.23

^{58}Co BOTTOMS/DISTILLATE RATIO FOR MISCELLANEOUS RADWASTE EVAPORATOR

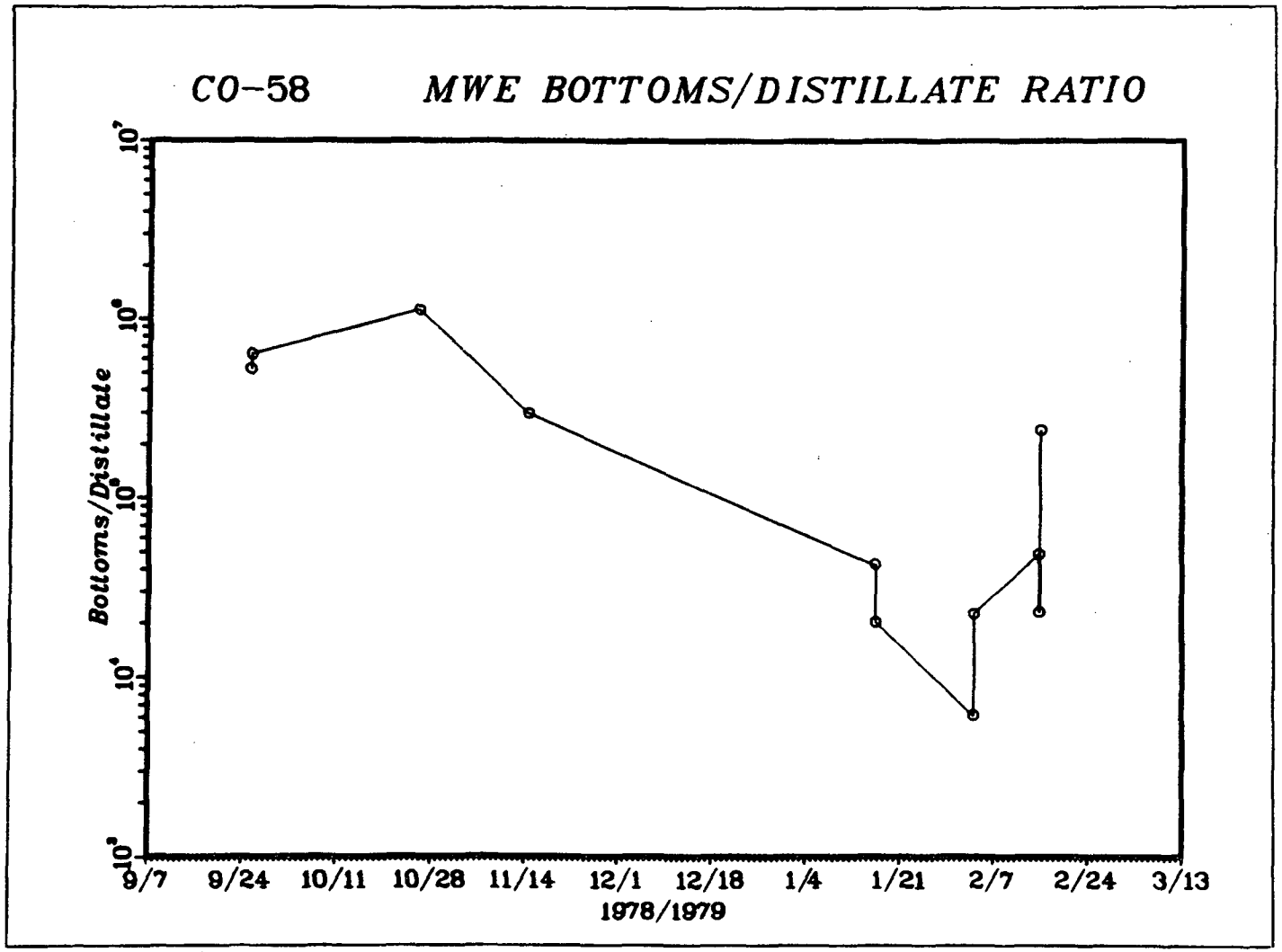


FIGURE 5.24

^{137}Cs BOTTOMS/DISTILLATE RATIO VS. BOTTOMS CONCENTRATION FOR MISCELLANEOUS RADWASTE EVAPORATOR

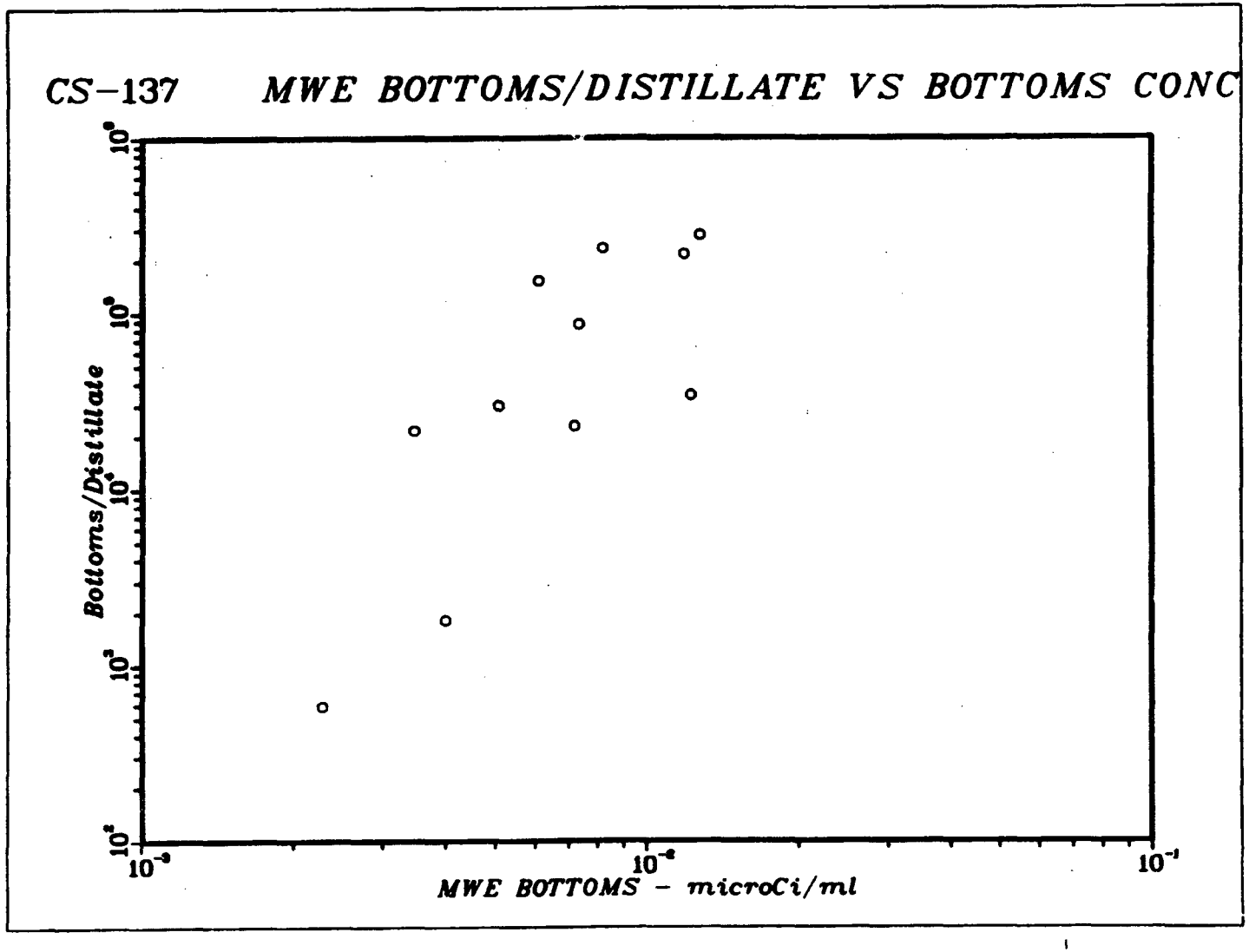
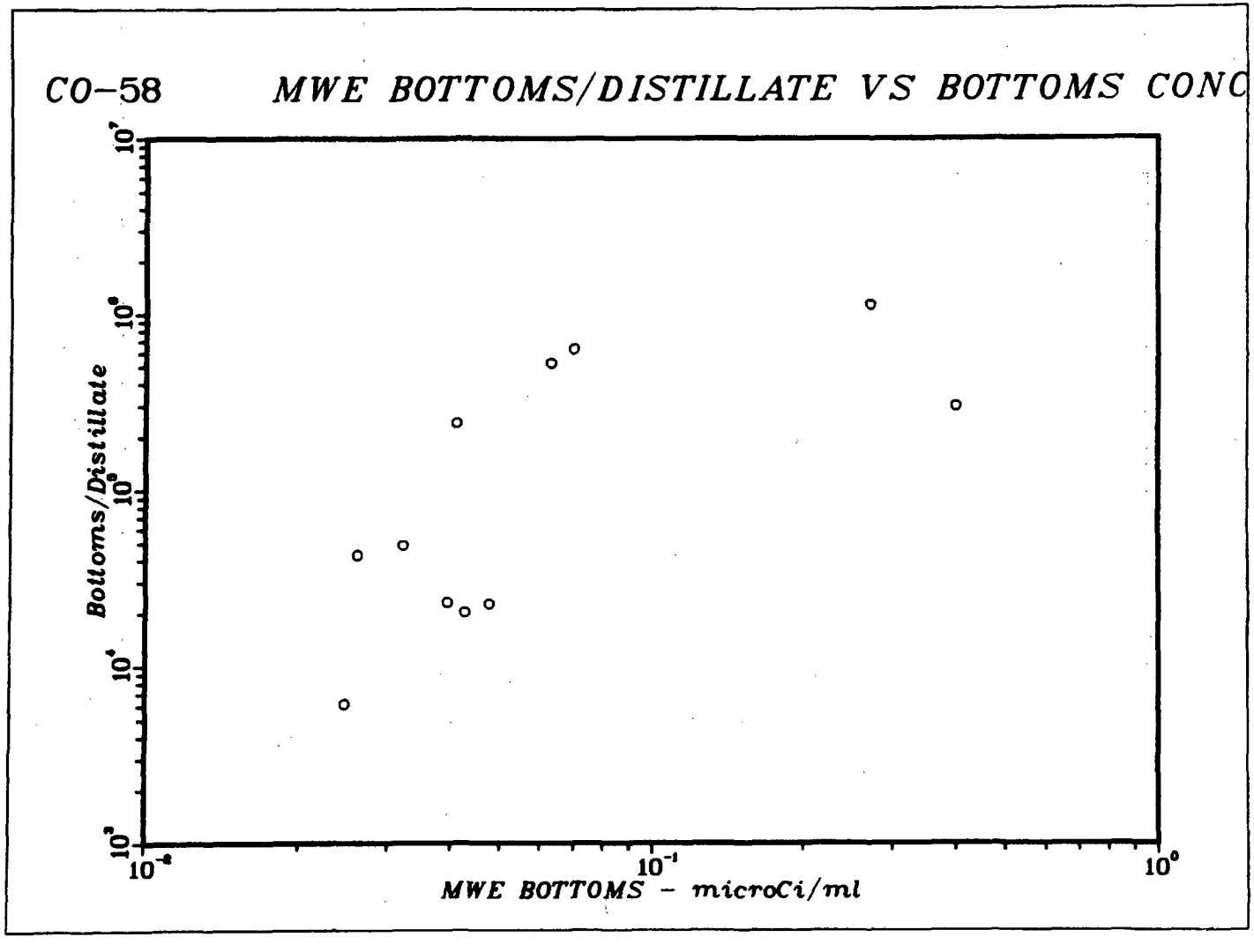


FIGURE 5.25

^{58}Co BOTTOMS/DISTILLATE RATIO VS. BOTTOMS CONCENTRATION FOR MISCELLANEOUS RADWASTE EVAPORATOR



5.4 Evaluation of Combined Data

More useful data correlations can be made by combining the data from the two evaporators. In particular, the dynamic ranges can be increased several decades for an overall evaluation.

Distillate concentration vs. feed or bottoms concentration is plotted for ^{58}Co and ^{131}I in Figures 5.26 and 5.27 and for the sum of concentrations of five particulate radionuclides, ^{51}Cr, ^{54}Mn, ^{57}Co, ^{60}Co, and ^{110m}Ag, in Figure 5.28. These plots include data from both the miscellaneous radwaste evaporator and the boric acid evaporator. Those data points which are connected by solid lines represent samples collected during a given evaporator operation and the numbers adjacent to the data points indicate the chronological sequence of sampling.

Although distillate concentration may vary considerably over a small range of feed concentration, the combined data for both evaporators indicates that distillate concentration increases slowly with increasing feed or bottoms concentration. If the data in these figures are fit with straight lines, i.e., with power functions of the form

$$\rho_D = a\ \rho_F^{\ b}$$

where

ρ_D = distillate concentration

a,b = constants

ρ_F = feed concentration,

the approximate slopes (i.e., constant b) are 0.6 for ^{131}I, 0.3 for ^{58}Co, and 0.1 for the sum of five particulates. The straight solid lines in the figures show the fits of the above equation to the data (less-than values were omitted from fits). We may also examine the dependence of distillate concentration on bottoms concentration in a similar manner by fitting the data to an equation of the form

$$\rho_D = a'\ \rho_B^{\ b'}$$

where

ρ_B = bottoms concentration

The approximate slopes for ^{131}I and ^{58}Co are the same as those determined for distillate dependence on evaporator feed. The dashed straight lines in the Figures 5.26 and 5.27, show the fits of the above equation to the data.

FIGURE 5.26

^{58}Co DISTILLATE VS. FEED AND BOTTOMS CONCENTRATION FOR AMF EVAPORATORS

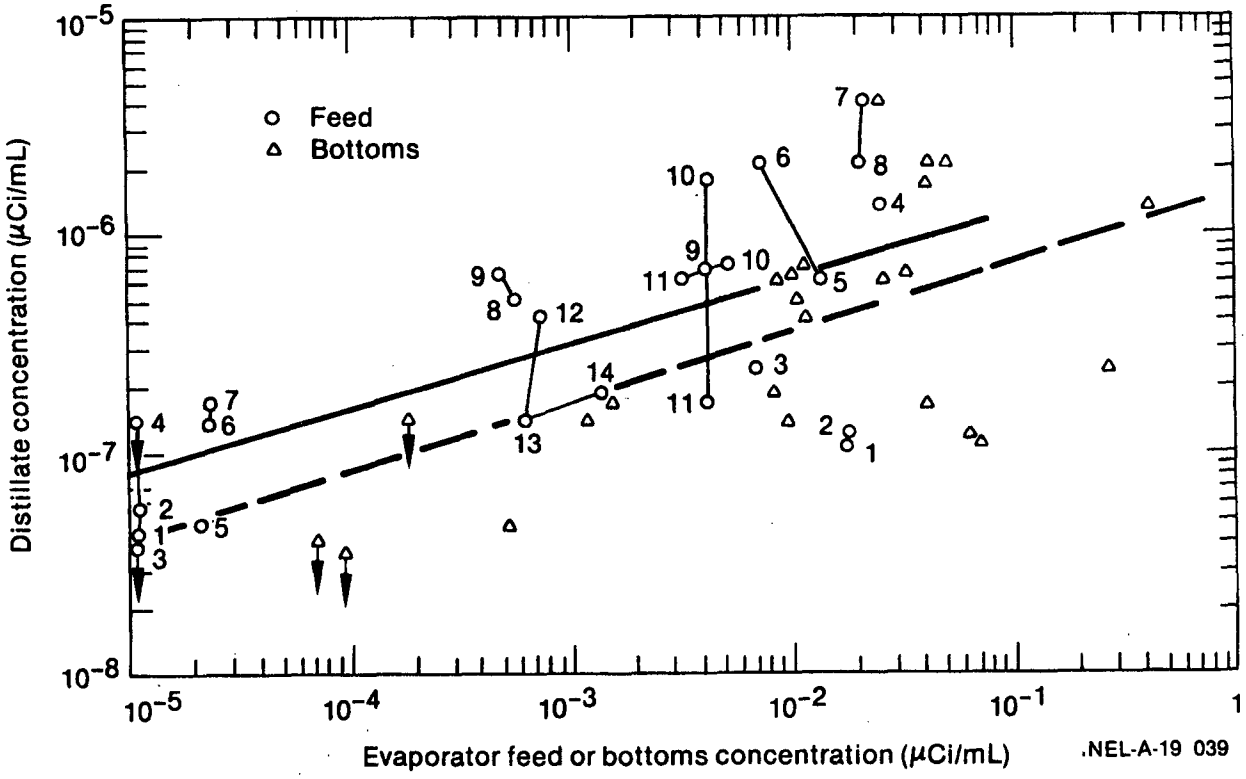


FIGURE 5.27

^{131}I DISTILLATE VS. FEED AND BOTTOMS CONCENTRATION FOR AMF EVAPORATORS

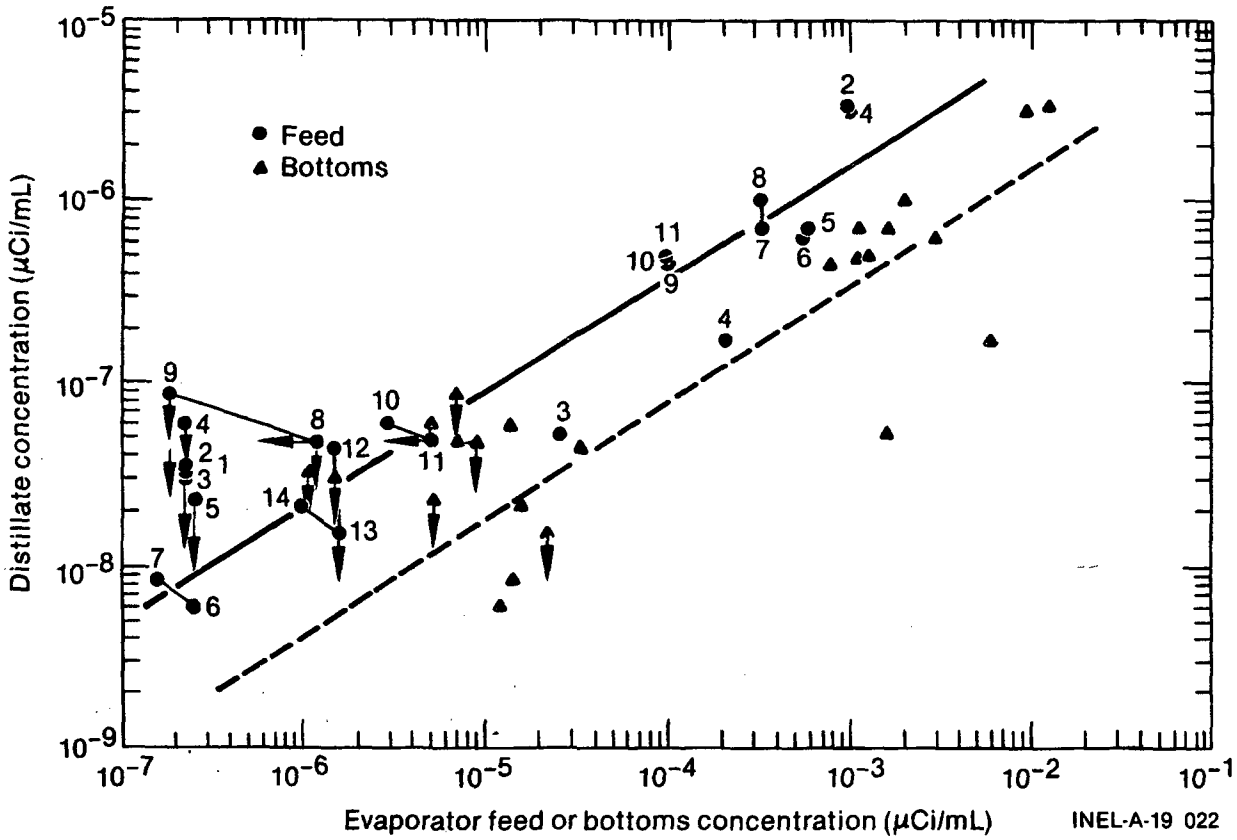
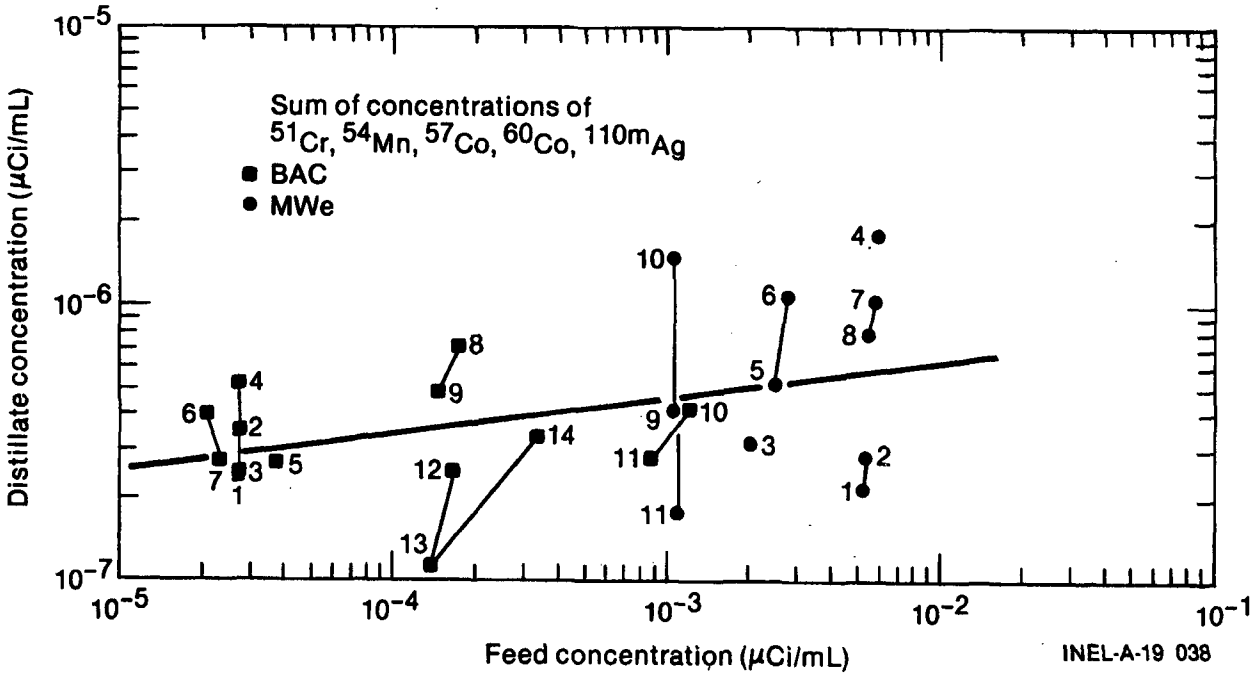


FIGURE 5.28

DISTILLATE VS. FEED CONCENTRATION FOR SUM OF PARTICULATE RADIONUCLIDES



Of ten nuclides for which both power functions were fit to the data, seven showed a better correlation between distillate concentration and feed concentration than between distillate concentration and bottoms concentration. Coefficients a and b of the equation $\rho_D = a \ \rho_F^{\ b}$ for the ten nuclides are listed in Table 5.13. The coefficients determined for ^{131}I distillate concentration show it to be considerably more sensitive to changes in ^{131}I feed concentration than the other nine nuclides are sensitive to changes in their respective feed concentrations. Distillate concentrations which are least responsive to changes in feed concentrations are those of ^{54}Mn and ^{59}Fe. Over the ranges of feed concentrations of these nuclides, their distillate concentrations remained nearly constant.

A constant or slowly varying distillate concentration implies that the respective evaporator decontamination factor, DF, defined as the ratio of feed concentration to distillate concentration, is primarily dependent on feed concentration. That dependence has been previously formalized in the Turkey Point Measurements Report (4) and was given functional form in the equation

$$DF = a_1 \ \rho_F^{\ b_1}$$

where

DF = decontamination factor

a_1, b_1 = constants

ρ_F = feed concentration.

Figures 5.29-5.32 are plots of DF vs. feed concentration for ^{131}I, ^{137}Cs, ^{58}Co, and for the sum of ^{51}Cr, ^{54}Mn, ^{57}Co, ^{60}Co, and ^{110m}Ag. If the data in these figures (less-than and greater-than data were omitted) are fit with the above power function, the approximate slopes (i.e., constant b_1) obtained are 0.4 for ^{131}I, 0.5 for ^{137}Cs, 0.7 for ^{58}Co, and 0.9 for the sum of the five particulates. Coefficients, a_1 and b_1, are listed for ten nuclides in Table 5.13.

The two nuclides with the largest slopes are ^{59}Fe and ^{54}Mn, both of which have slopes near 1.0, which implies concentrations of these nuclides in the distillate are nearly constant over a wide range of feed concentrations. That implication is obvious from the definition of DF, i.e., if $DF = a_1 \ \rho_F^{\ b_1}$, then

$$\frac{\rho_F}{\rho_D} = a_1 \ \rho_F^{\ b_1} \text{ and } \rho_D = [\frac{1}{a_1}] \ \rho_F^{\ 1-b_1}.$$

In general the correlation of DF, as defined by the ratio of evaporator bottoms to distillate concentrations, with evaporator bottoms concentration was found not to be as good as the correlation of DF with feed concentration which

TABLE 5.13

COEFFICIENTS OF POWER FUNCTIONS WHICH APPROXIMATE EVAPORATOR DF AND DISTILLATE CONCENTRATION

	$DF = a_1 \rho_F^{b_1}$		$\rho_D = a \rho_F^{b}$	
Nuclide	a	b	a	b
^{131}I	7.75(3)	0.363	1.17(-4)	0.626
^{134}Cs	4.20(5)	0.730	3.02(-6)	0.304
^{137}Cs	1.57(5)	0.527	6.52(-6)	0.473
^{51}Cr	1.77(5)	0.575	5.64(-6)	0.425
^{54}Mn	5.78(6)	0.916	1.72(-7)	0.084
^{59}Fe	3.38(7)	1.05	2.96(-8)	-0.048
^{57}Co	5.72(5)	0.617	1.75(-6)	0.383
^{58}Co	3.54(5)	0.690	2.51(-6)	0.301
^{60}Co	5.95(5)	0.737	1.68(-6)	0.263
^{110m}Ag	3.15(6)	0.824	3.18(-7)	0.175

DF = feed concentration/distillate concentration

ρ_F = feed concentration

ρ_D = distillate concentration

FIGURE 5.29

^{131}I DF VS. FEED CONCENTRATION FOR AMF EVAPORATORS

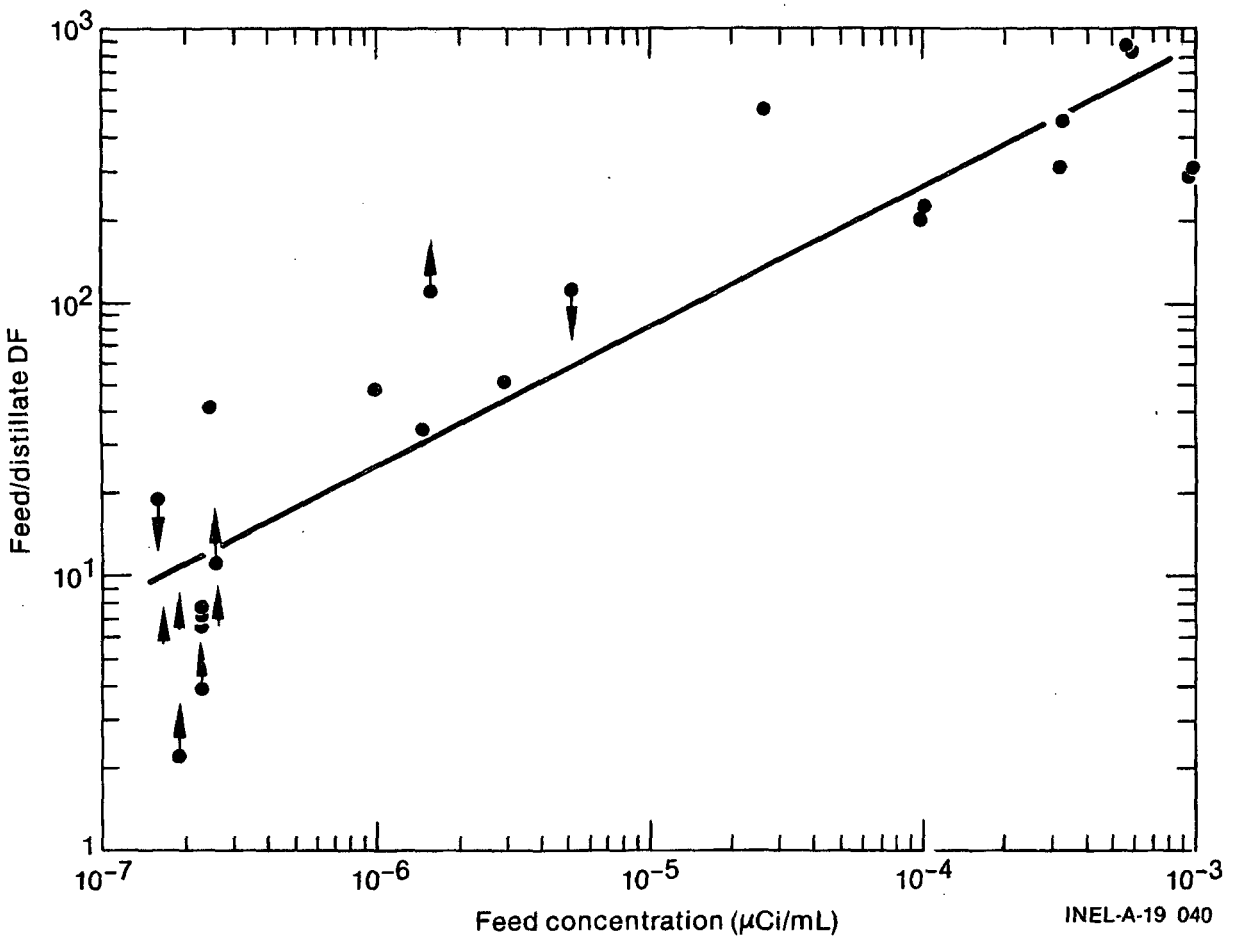


FIGURE 5.30

^{137}Cs DF VS. FEED CONCENTRATION FOR AMF EVAPORATORS

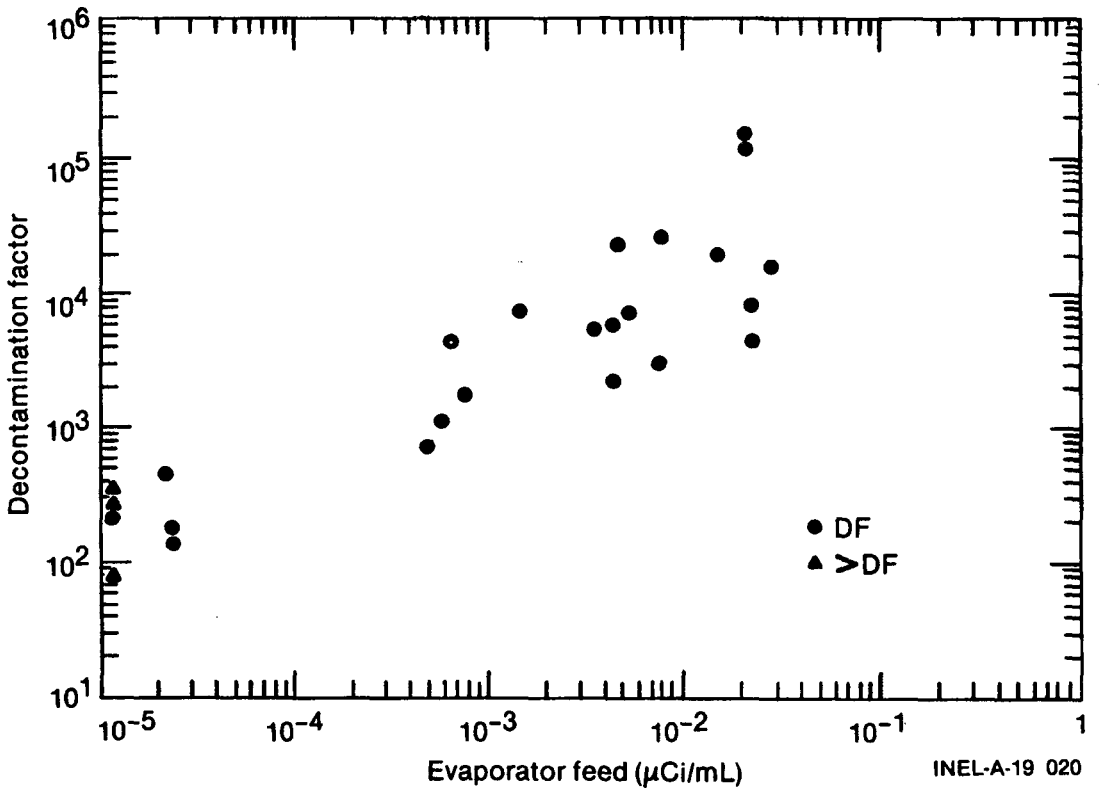


FIGURE 5.31

^{58}Co DF VS. FEED CONCENTRATION FOR AMF EVAPORATORS

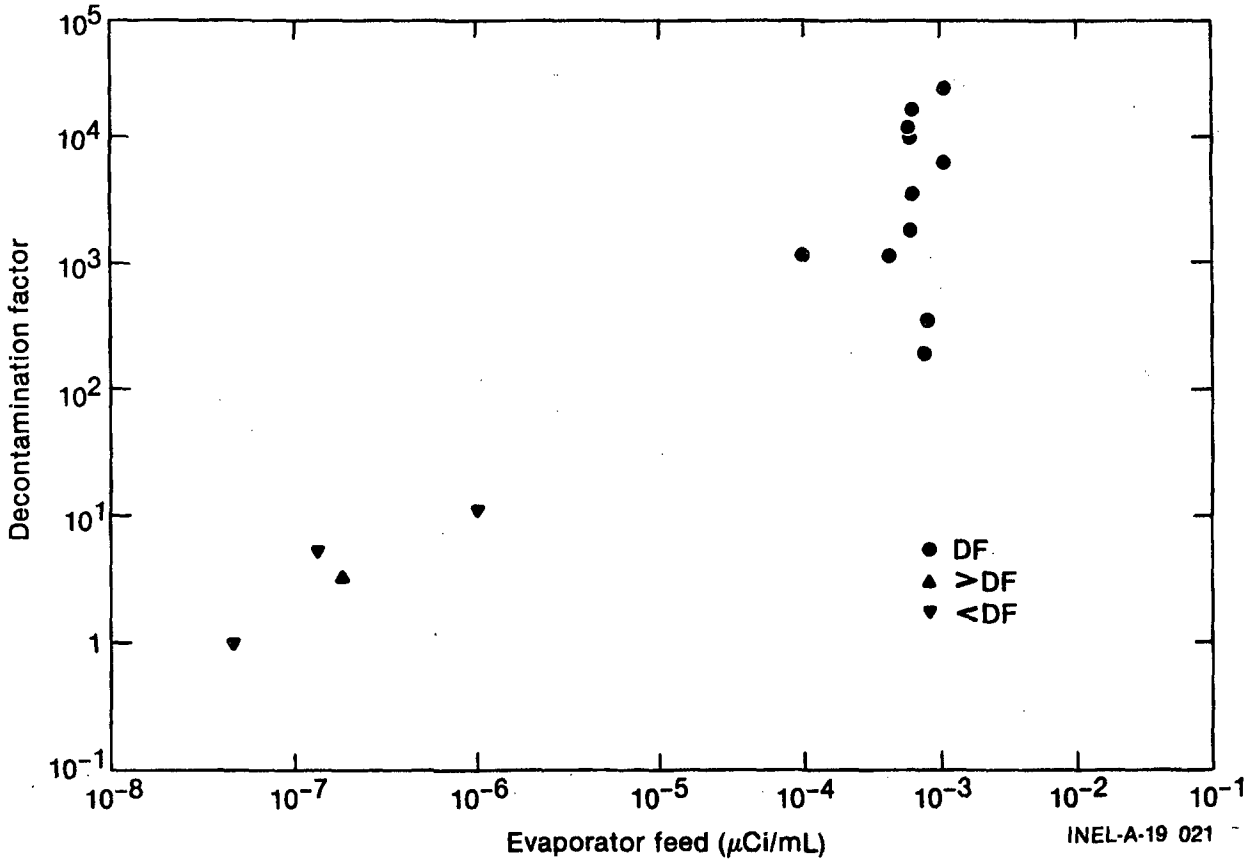
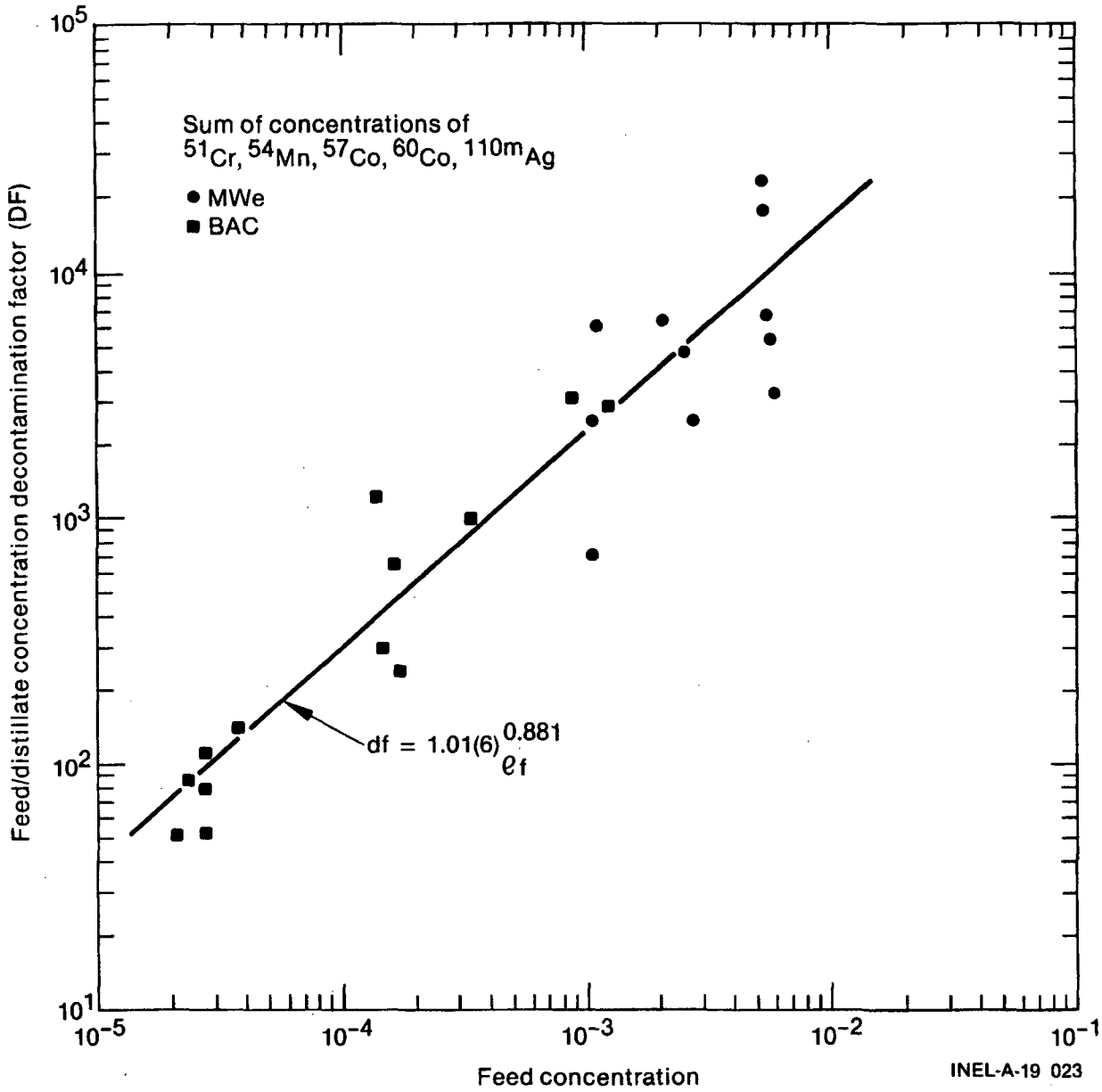


FIGURE 5.32

DF VS. FEED CONCENTRATION FOR SUM OF PARTICULATE RADIONUCLIDES, AMF EVAPORATORS



was previously explained when the data were fit with a power function of the form $DF = a\ \rho_B^{\ b}$, where ρ_B equals the bottoms concentration. However, the goodness of fit of this power function to the ^{137}Cs data did improve significantly over the fit of the feed concentration power function to the ^{137}Cs data because the feed data consisted largely of less-than values. The slope thus calculated for ^{137}Cs has a value of approximately 0.8.

"Best value" DF's of most radionuclides as measured for both the BAC and MWE are plotted against mean feed concentration in Figure 5.33. The straight line in the figure shows the fit of a power function to the data for both evaporators. The slope of that line is approximately 0.6.

The dependence of the evaporator system efficiency on nuclide ionic form is evident in the variance in values of DF's among ^{131}I, ^{134}Cs and ^{137}Cs, and ^{58}Co, ^{60}Co, ^{59}Fe, ^{51}Cr, and ^{54}Mn over a small range in mean feed concentration. Semi-volatile iodine and the soluble cesiums are less efficiently removed by the evaporator system than are the corrosion product insolubles. The higher DF's of the corrosion products is due in part to the higher feed-filter DF's of these nuclides compared to those of the solubles.

5.5 Evaporator Condensate Demineralizer

5.5.1 Boric Acid Evaporator Condensate Demineralizer

Two condensate (deborating) demineralizers are part of the boric acid recovery system and serve to remove trace amounts of boric acid from the BAE distillate. During the measurement period seven sample sets were collected of influent and effluent of condensate demineralizer B. BAC condensate demineralizer outlet concentrations are presented in Appendix Table B.17 and BAC condensate demineralizer DF's are listed by sample date in Table 5.14. Means and ranges for radionuclide concentrations in the BAE distillate and condensate demineralizer B effluent are presented in Table 5.15. Mean concentrations are arithmetic means which were computed using one-sigma less-than values. Among the nuclides having the highest concentration in the distillate are ^{58}Co, ^{51}Cr, ^{60}Co, and ^{54}Mn (in order of decreasing concentration). "Best value" DF's for the BAE condensate demineralizer B are listed in Table 5.16 for twelve nuclides. Only the DF's of ^{54}Mn, ^{57}Co, ^{58}Co, and ^{110m}Ag are greater than one and that of ^{58}Co is highest with a value of 1.6. The DF's for ^{134}Cs and ^{137}Cs are significantly less than one, 3.5(-2) and 3.1(-2), respectively, and reflect the fact that the demineralizer was a source of these nuclides. To a lesser degree the demineralizer was also a source of ^{131}I, ^{51}Cr, ^{60}Co, ^{99}Mo, ^{140}Ba, and ^{239}Np.

FIGURE 5.33

"BEST VALUE" DF VS. MEAN FEED CONCENTRATION FOR AMF EVAPORATORS

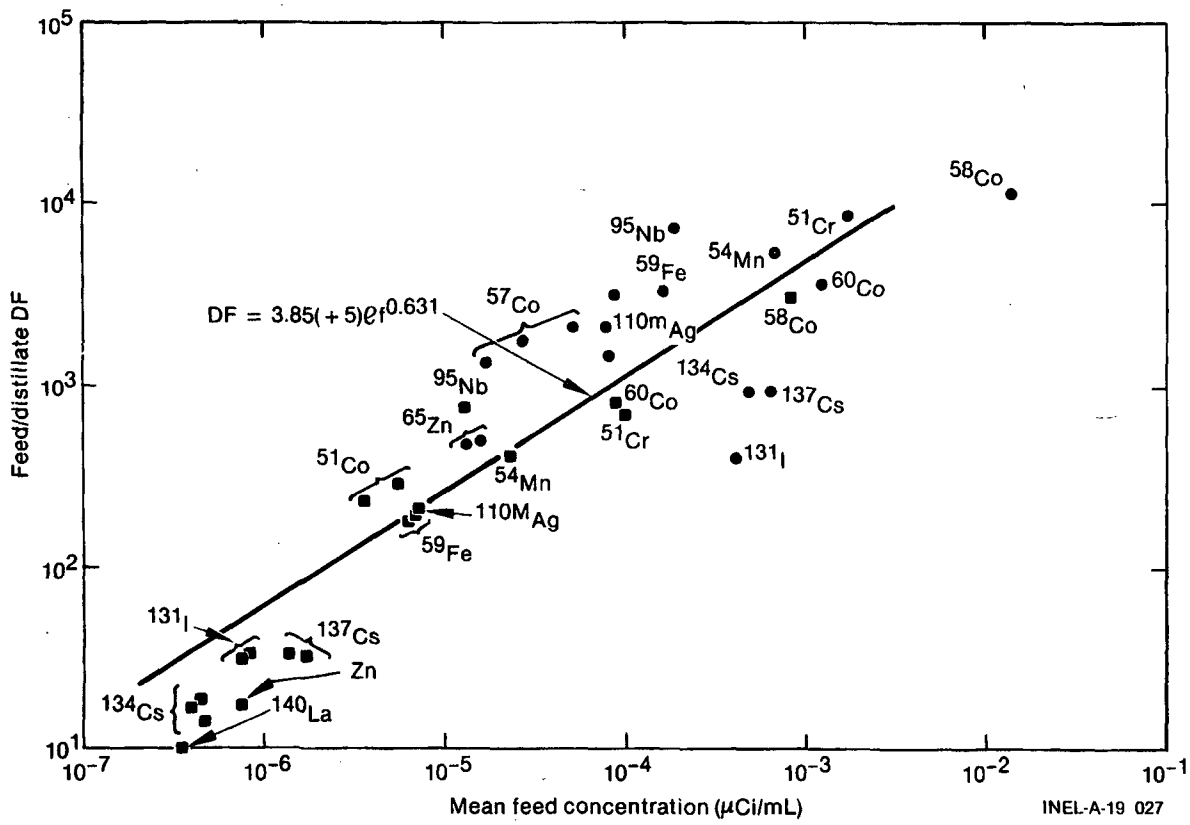


TABLE 5.14

INSTANTANEOUS DF's FOR BORIC ACID EVAPORATOR CONDENSATE DEMINERALIZER B

B.A.E CONDENSATE DEMINERALIZER DF

DATE	9/13	9/13	9/14	10/ 5	10/17
TIME	1124	1545	959	1349	1035
NUCLIDE	DECONTAMINATION FACTOR				
I-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>1.7(-1)
CS-134	<2.7(-2)	<3.3(-2)	<1.7(-1)	<5.5(-2)	2.82±.18(-2)
CS-137	<3.6(-2)	<4.0(-2)	<9.2(-2)	<4.6(-2)	4.85±.34(-2)
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>5.9(-1)
MN-54	NOTE 1	NOTE 1	NOTE 1	9.46±6.0(-1)	3.21±2.9(0)
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>1.3(-1)
CO-58	<3.1(-1)	<1.7(0)	<3.0(0)	>9.8(-1)	>2.8(0)
CO-60	<5.0(-1)	<1.9(0)	<7.1(-1)	2.45±1.6(0)	2.55±.77(0)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>2.6(-2)
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	>2.4(0)	NOTE 1	>1.5(-1)
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	>7.5(-1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	>1.1(0)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH APITHERITIC OPERATIONS WITH < NUMBERS

TABLE 5.14 (cont'd)

INSTANTANEOUS DF's FOR BORIC ACID EVAPORATOR CONDENSATE DEMINERALIZER B

B.A.E CONDENSATE DEMINERALIZER DF

DATE	10/18	11/ 2
TIME	1104	1537
NUCLIDE	DECONTAMINATION FACTOR	
I-131	>2.3(-1)	NOTE 1
CS-134	2.34±.26(-2)	<1.5(-1)
CS-137	2.91±.26(-2)	<9.8(-2)
CR-51	>2.3(-1)	NOTE 1
MN-54	2.04±1.0(0)	<8.2(-1)
FE-59	NOTE 1	NOTE 1
CO-57	>1.1(-1)	>1.5(0)
CO-58	>3.2(0)	1.53±.33(0)
CO-60	>1.3(0)	2.84±1.9(-1)
ZN-65	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1
MO-99	>2.8(-2)	NOTE 1
RU-103	NOTE 1	NOTE 1
AG-110M	>7.4(-2)	NOTE 1
SB-124	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.15

MEANS AND RANGES FOR RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR DISTILLATE AND CONDENSATE DEMINERALIZER B EFFLUENT

	Distillate		Condensate Demin B Effluent	
Nuclide	Mean (μCi/ml)	Range (μCi/ml)	Mean (μCi/ml)	Range (μCi/ml)
^{131}I	1.9(-8)	6.0-86.(-9)	2.6(-8)	2.6-13.(-8)
^{134}Cs	3.4(-8)	1.4-18.(-8)	9.65(-7)	5.9-16.6(-7)
^{137}Cs	4.1(-8)	2.5-13.(-8)	1.30(-6)	8.6-20.3(-7)
^{51}Cr	1.3(-7)	2.7-55.(-8)	1.4(-7)	4.6-60.(-8)
^{54}Mn	5.4(-8)	3.5-12.2(-8)	4.1(-8)	3.7-8.7(-8)
^{59}Fe	3.0(-8)	4.5-150.(-9)	3.5(-8)	4.7-14.(-8)
^{57}Co	2.1(-8)	2.6-74.(-9)	1.6(-8)	2.1-4.8(-8)
^{58}Co	1.6(-7)	3.6-65.(-8)	1.0(-7)	2.1-42.(-8)
^{60}Co	1.1(-7)	9.0-24.(-8)	1.4(-7)	5.3-32.(-8)
^{65}Zn	3.7(-8)	1.8-180.(-9)	4.2(-8)	6.2-16.(-8)
^{95}Zr	2.8(-8)	3.1-140.(-9)	3.5(-8)	4.5-11.(-8)
^{95}Nb	1.6(-8)	2.6-66.(-9)	1.9(-8)	2.6-6.5(-8)
^{99}Mo	2.4(-8)	1.3-200.(-9)	3.1(-8)	2.6-19.(-8)
^{103}Ru	1.5(-8)	2.3-58.(-9)	1.9(-8)	2.6-6.7(-8)
^{110m}Ag	3.3(-8)	5.0-120.(-9)	2.9(-8)	3.5-7.9(-8)
^{124}Sb	2.4(-8)	2.3-110.(-9)	3.0(-8)	4.8-11.(-8)
^{125}Sb	4.1(-8)	2.7-170.(-9)	5.4(-8)	7.1-16.(-8)
^{140}Ba	6.4(-8)	1.1-240.(-9)	7.2(-8)	7.4-30.(-8)
^{140}La	3.7(-8)	2.4-320.(-9)	1.2(-7)	3.5-130.(-8)
^{141}Ce	2.2(-8)	1.5-91.(-9)	3.0(-8)	4.0-11.(-8)
^{144}Ce	1.1(-7)	1.5-610.(-9)	1.0(-7)	4.3-40.(-8)
^{239}Np	1.1(-7)	2.1-810.(-9)	1.4(-7)	6.2-110.(-8)

TABLE 5.16

"BEST VALUE"* DF's FOR BAE CONDENSATE DEMINERALIZER B

Nuclide	"Best Value" DF
^{131}I	7.1(-1)
^{134}Cs	3.5(-2)
^{137}Cs	3.1(-2)
^{51}Cr	9.3(-1)
^{54}Mn	1.3(0)
^{57}Co	1.3(0)
^{58}Co	1.6(0)
^{60}Co	7.7(-1)
^{99}Mo	7.8(-1)
^{110m}Ag	1.1(0)
^{140}Ba	8.8(-1)
^{239}Np	8.2(-1)

* "Best value" DF = mean feed activity/mean distillate activity

The demineralizer acting as a source may in part be explained by the fact that occasionally the evaporator is bypassed and process water is sent directly to the condensate demineralizer from the coolant waste holdup tanks. This procedure is used if the boron concentration of the process water is less than 100 ppm and it was in fact used on 10/20/78 and 10/23/78. The apparent effect of loading the demineralizer using the bypass was to decrease the demineralizer boron and radionuclide DF's during subsequent processing. Boron DF's on the following dates were 8.5(-2) on 9/13/78, 3.1(-1) on 10/5/78, and 4.6(-2) on 11/2/78. Decontamination factors for ^{54}Mn, ^{58}Co, and ^{60}Co also show significant decreases on 11/2/78 relative to values measured on 10/17/78 and 10/18/78.

Demineralizer outlet concentrations of ^{134}Cs and ^{137}Cs are seen in Figures 5.34 and 5.35 to decrease gradually with time with the exception of the slight increase in concentration of ^{137}Cs measured on 11/2/78. Outlet concentrations of ^{54}Mn, ^{58}Co, and ^{60}Co remained approximately constant until the 11/2/78 sample at which time they showed substantial increases.

5.5.2 Miscellaneous Radwaste Evaporator Condensate Demineralizers

Two demineralizers in series are used to remove any radioactive material that may be carried over in the condensate water from the miscellaneous radwaste evaporator. This allows the condensate to be reused in any of a number of applications. During the in-plant measurement period six samples from four different runs were obtained from the effluent of each of the two demineralizers. The measurement data are presented in Appendix Tables B.22-B.23. The measured DF's are listed in Tables 5.17 and 5.18. Table 5.19 presents the "best value" DF's. Plots of the demineralizer DF's for ^{131}I, ^{137}Cs, and ^{58}Co are provided in Figures 5.36-5.38 for condensate demineralizer A and in Figures 5.39-5.41 for condensate demineralizer B. The bulk of the DF's for these two demineralizers are very close to 1.0 with one notable exception. The ^{131}I DF's for demineralizers A and B are high (38 to 50). The significance of these numbers is in the conclusion that must be reached to rationalize these numbers. The chemical form of the iodine that came from the evaporator must be ionic and in order to be brought over in the condensate it must have some volatility.

5.6 Demineralized Reactor Coolant Demineralizer and Filter

The demineralized reactor coolant storage tank (DRCST) is the repository to which BAE distillate is sent if it is not routed directly to the reactor coolant makeup tank. The normal path from the DRCST to the makeup tank takes the coolant through a demineralizer and a filter. Two sample sets were collected of influent and effluent of the DRCST demineralizer and DRCST filter. Decontamination factors for these components were measured on 10/16/78 and 1/31/79. Radionuclide concentrations of DRCST demineralizer influent, demineralizer effluent, and filter effluent are presented for eight nuclides for both sample dates in Appendix Table B.18. Decontamination factors for the demineralizer and filter for both sample dates are listed in Tables 5.20 and 5.21.

FIGURE 5.34

^{134}Cs CONCENTRATION IN BAE CONDENSATE DEMINERALIZER B OUTLET

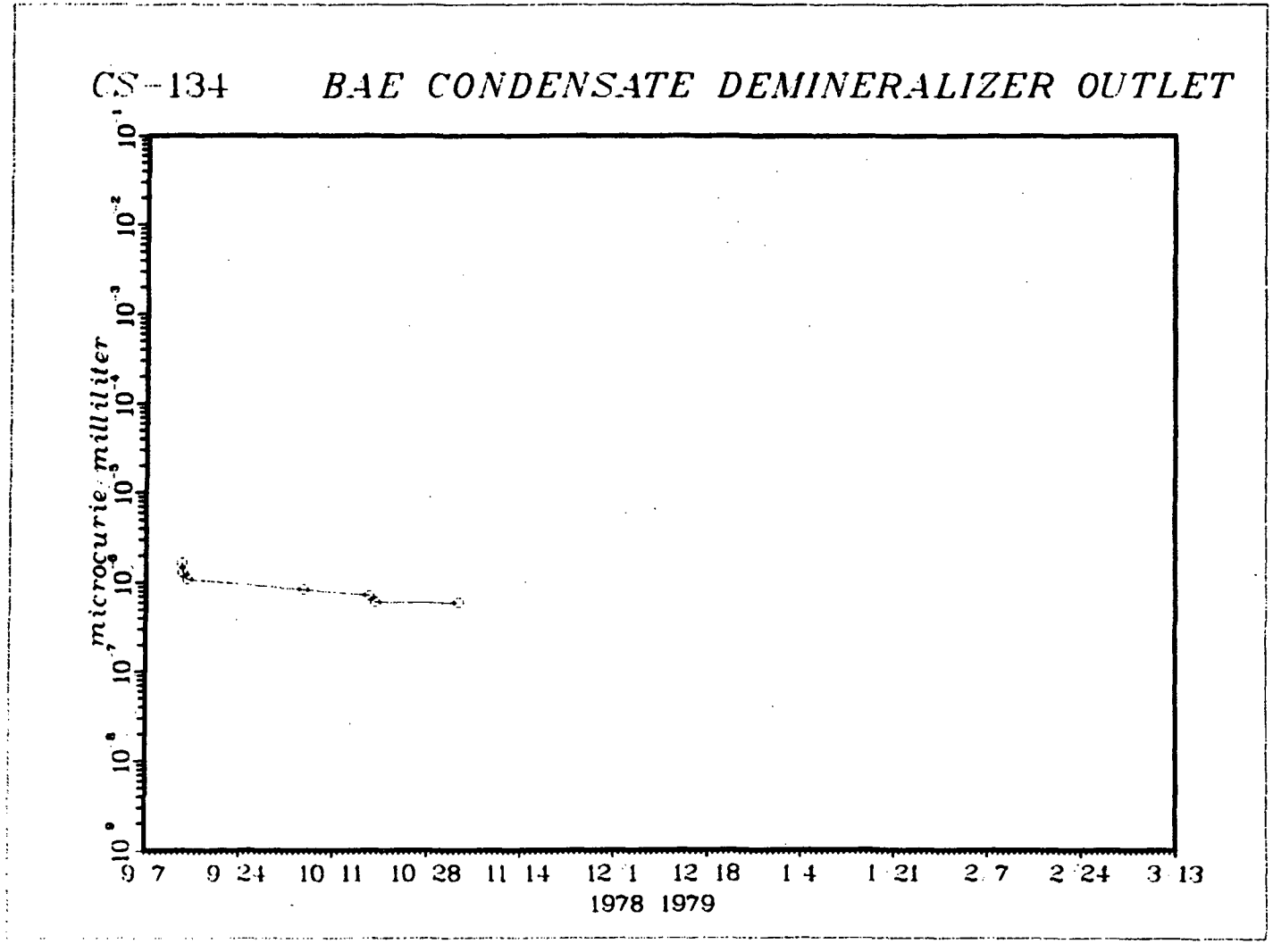


FIGURE 5.35

^{137}Cs CONCENTRATION IN BAE CONDENSATE DEMINERALIZER B OUTLET

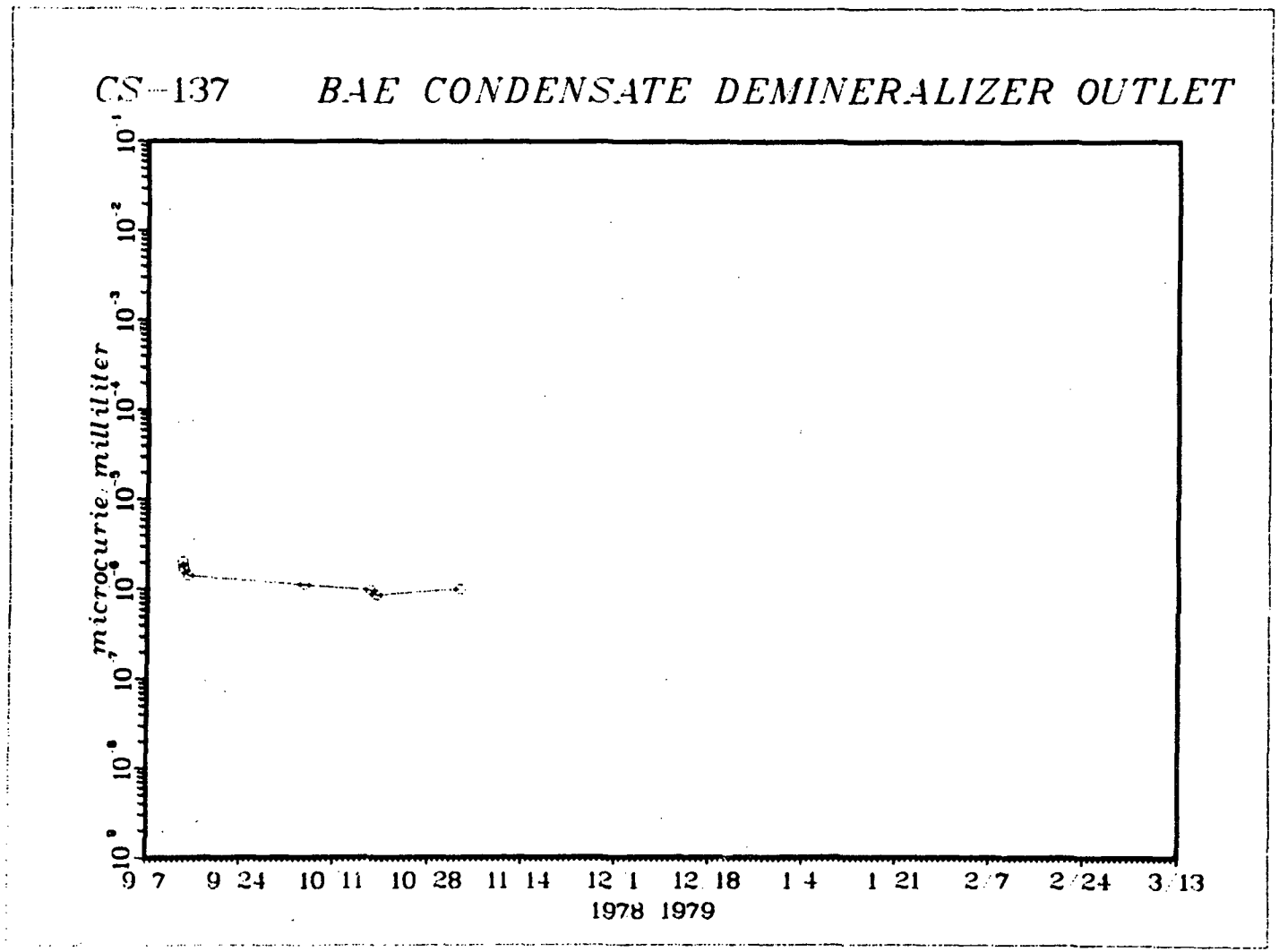


TABLE 5.17

INSTANTANEOUS DF's FOR MISCELLANEOUS RADWASTE EVAPORATOR CONDENSATE DEMINERALIZER A

MWE CONDENSATE DEMIN-A - DF

DATE	9/25	9/25	10/25	11/14	2/15
TIME	1011	1430	1451	1417	905
NUCLIDE	DECONTAMINATION FACTOR				
I-131	6.64±1.6(1)	4.71±.68(1)	>1.7(0)	>4.3(0)	1.20±.41(1)
I-133	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>2.3(-1)
CS-134	NOTE 1	>3.9(0)	>1.9(0)	1.85±1.4(0)	9.33±3.3(-2)
CS-136	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<4.7(-1)
CS-137	>5.2(-1)	>1.2(0)	>1.4(0)	3.60±1.5(0)	8.95±2.0(-2)
CR-51	NOTE 1	NOTE 1	<1.8(0)	<8.7(-1)	3.11±2.3(-1)
MN-54	>2.0(0)	<6.1(-1)	NOTE 1	8.78±8.0(0)	6.71±5.7(-1)
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>9.0(-1)
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>5.5(-1)
CO-58	>4.0(0)	1.86±.46(0)	7.06±3.6(0)	1.56±.20(0)	3.30±1.2(0)
CO-60	NOTE 1	NOTE 1	NOTE 1	7.19±2.0(0)	5.91±5.4(-1)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	5.08±3.4(-1)	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<3.7(-1)
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>1.5(0)
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	>1.3(0)	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE 5.17 (cont'd)

INSTANTANEOUS DF's FOR MISCELLANEOUS RADWASTE EVAPORATOR CONDENSATE DEMINERALIZER A

MWE CONDENSATE DEMIN-A - DF

DATE 2/15
TIME 1411

NUCLIDE	DECONTAMINATION FACTOR
I-131	3.85+.67(1)
I-133	NOTE 1
CS-134	NOTE 1
CS-136	>5.3(-1)
CS-137	>8.8(-1)
CR-51	<1.8(0)
MN-54	<1.1(0)
FE-59	NOTE 1
CO-57	>1.3(0)
CO-58	>5.7(0)
CO-60	NOTE 1
ZN-65	NOTE 1
ZR-95	NOTE 1
NB-95	NOTE 1
MO-99	NOTE 1
RU-103	NOTE 1
AG-110M	NOTE 1
SB-124	NOTE 1
SB-125	NOTE 1
BA-140	NOTE 1
LA-140	NOTE 1
CE-141	NOTE 1
CE-143	NOTE 1
CE-144	NOTE 1
NP-239	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMITIC OPERATIONS WITH < NUMBERS

TABLE 5.18

INSTANTANEOUS DF's FOR MISCELLANEOUS RADWASTE EVAPORATOR CONDENSATE DEMINERALIZER B

FWF CONDENSATE DEMIN-B - DF

DATE	9/25	9/25	10/25	11/14	2/15
TIME	1015	1444	1446	1419	913
NUCLIDE	DECONTAMINATION FACTOR				
I-131	>2.4(0)	9.09±2.5(-1)	NOTE 1	NOTE 1	>1.9(0)
I-133	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	NOTE 1	<4.0(-1)	<8.5(-1)	1.63±1.3(0)	1.42±.29(0)
CS-136	NOTE 1	NOTE 1	NOTE 1	NOTE 1	2.46±2.6(0)
CS-137	NOTE 1	<6.2(-1)	<2.3(0)	9.09±6.1(-1)	1.27±.28(0)
CR-51	NOTE 1	NOTE 1	>7.3(-1)	>1.5(0)	>3.1(0)
MN-54	<6.3(-1)	>9.8(-1)	NOTE 1	>1.4(0)	1.79±1.6(0)
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	<3.4(-1)	2.91±.62(-1)	>1.1(0)	>8.6(0)	3.45±1.5(0)
CO-60	NOTE 1	NOTE 1	<7.0(0)	>2.3(0)	>4.4(0)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	>2.6(0)	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	>1.8(0)
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.18 (cont'd)

INSTANTANEOUS DF's FOR MISCELLANEOUS RADWASTE EVAPORATOR CONDENSATE DEMINERALIZER B

MWE CONDENSATE DEMIN-B - DF

DATE 2/19
TIME 1414

NUCLIDE	DECONTAMINATION FACTOR
I-131	5.20±2.4(-1)
I-133	NOTE 1
CS-134	<7.5(-2)
CS-136	NOTE 1
CS-137	<6.5(-2)
CR-51	>5.5(-1)
MN-54	1.36±1.4(0)
FE-59	NOTE 1
CO-57	NOTE 1
CO-58	<7.7(-1)
CO-60	NOTE 1
ZN-65	NOTE 1
ZR-95	NOTE 1
NB-95	NOTE 1
MO-99	NOTE 1
RU-103	NOTE 1
AG-110M	NOTE 1
SB-124	NOTE 1
SB-125	NOTE 1
BA-140	NOTE 1
LA-140	NOTE 1
CE-141	NOTE 1
CE-143	NOTE 1
CE-144	NOTE 1
NP-239	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 5.19

MISCELLANEOUS RADWASTE EVAPORATOR CONDENSATE DEMINIERALIZER "BEST VALUE" DECONTAMINATION FACTORS

Nuclide	Condensate Demin. A	Condensate Demin. B
^{131}I	3.8(1)	5.0(1)
^{134}Cs	3.5(-1)	3.6(-1)
^{137}Cs	3.6(-1)	3.2(-1)
^{54}Mn	2.4(0)	3.5(0)
^{58}Co	2.2(0)	5.7(0)
^{60}Co	2.8(0)	8.0(0)

FIGURE 5.36

^{131}I DF FOR MWE CONDENSATE DEMINERALIZER A

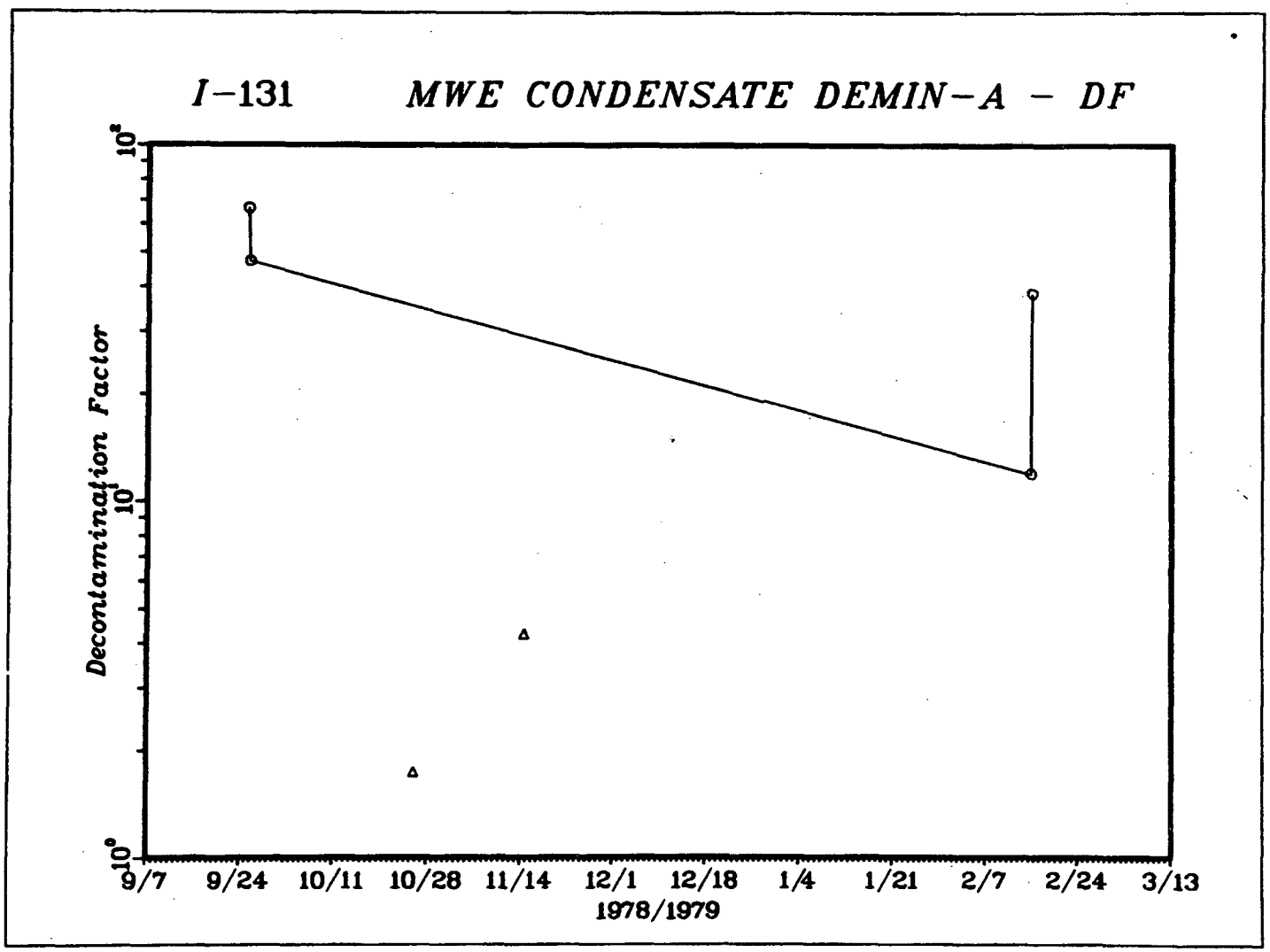


FIGURE 5.37

^{137}Cs DF FOR MWE CONDENSATE DEMINERALIZER A

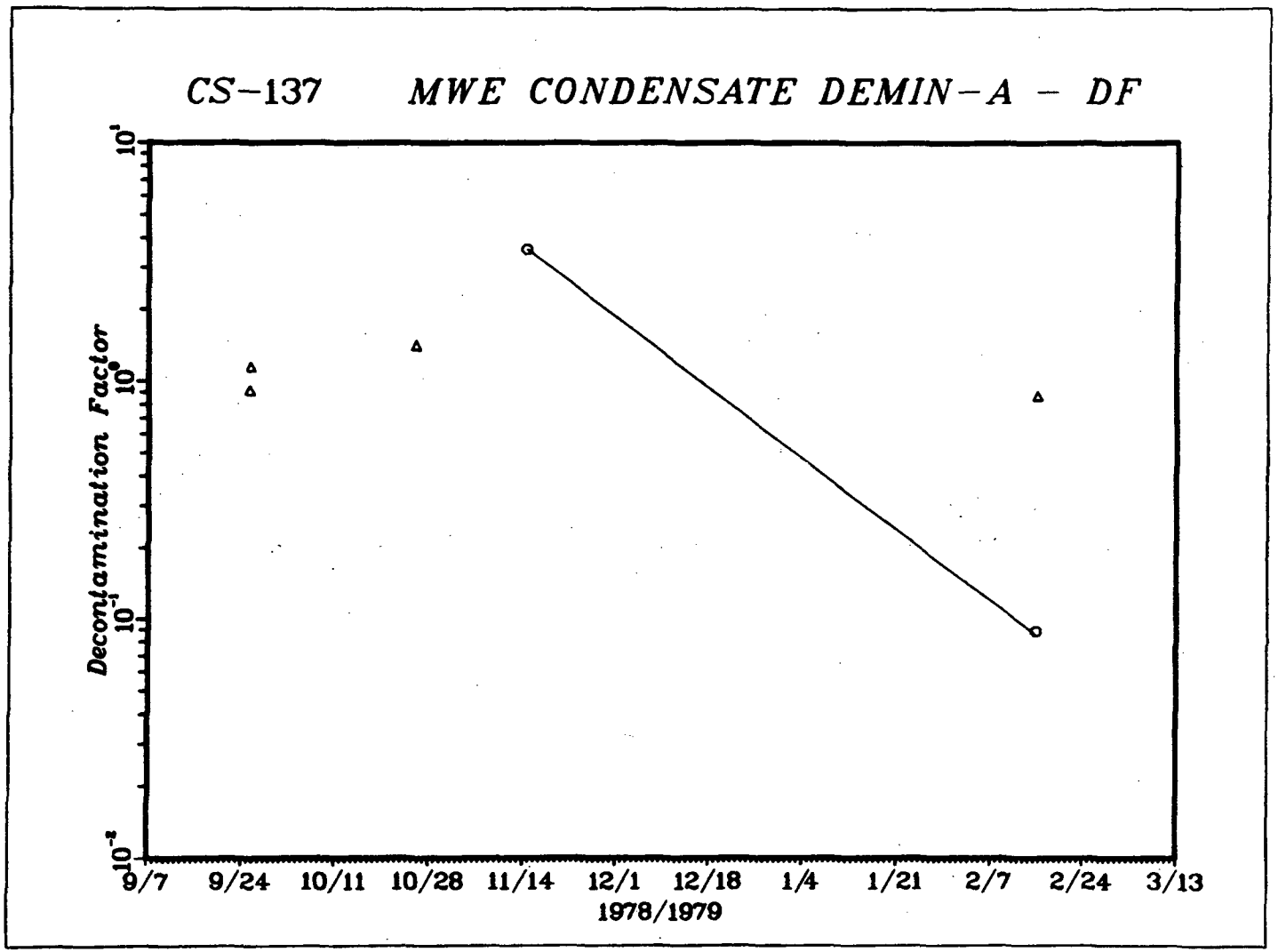


FIGURE 5.38

^{58}Co DF FOR MWE CONDENSATE DEMINERALIZER A

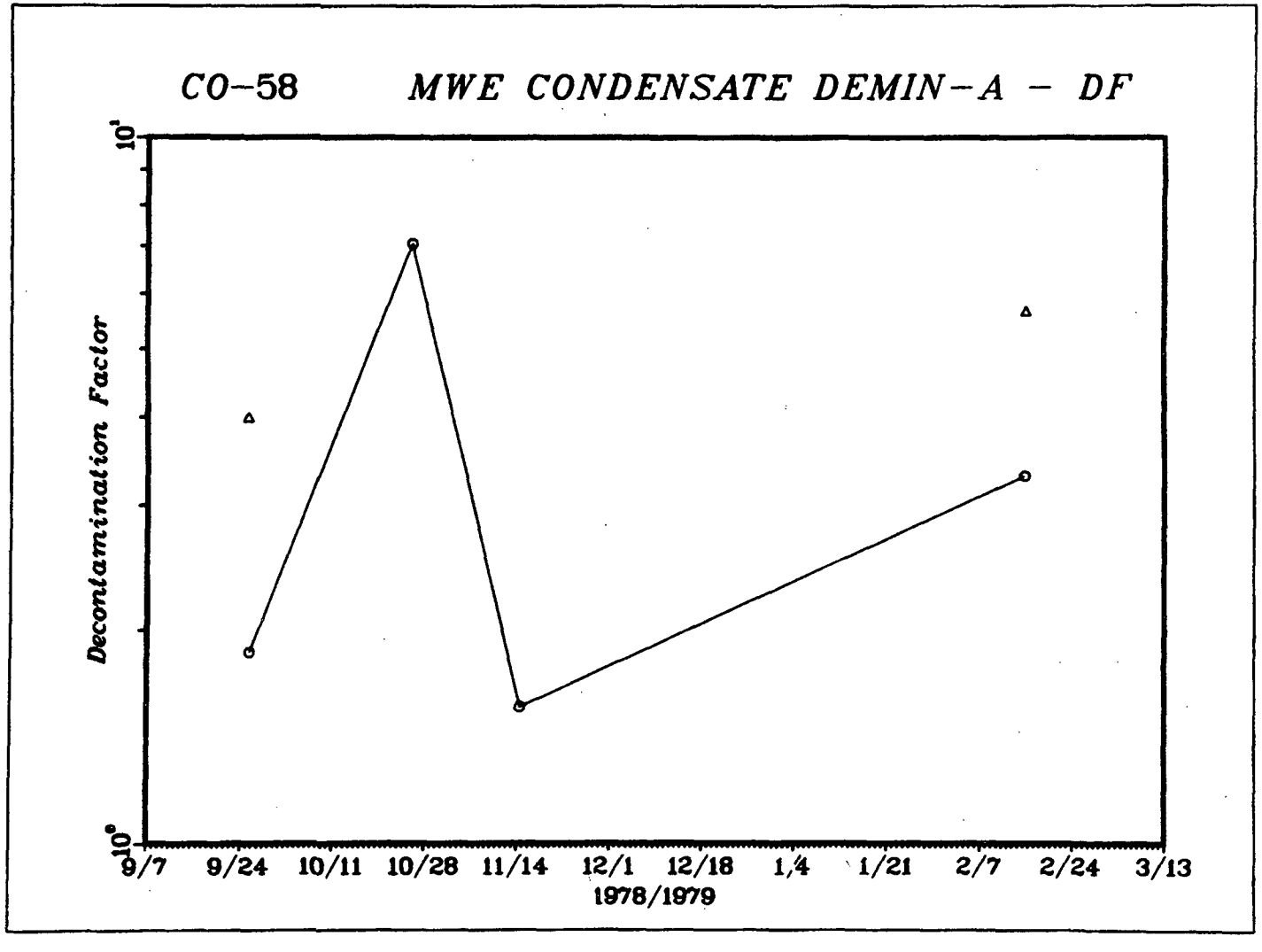


FIGURE 5.39

^{131}I DF FOR MWE CONDENSATE DEMINERALIZER B

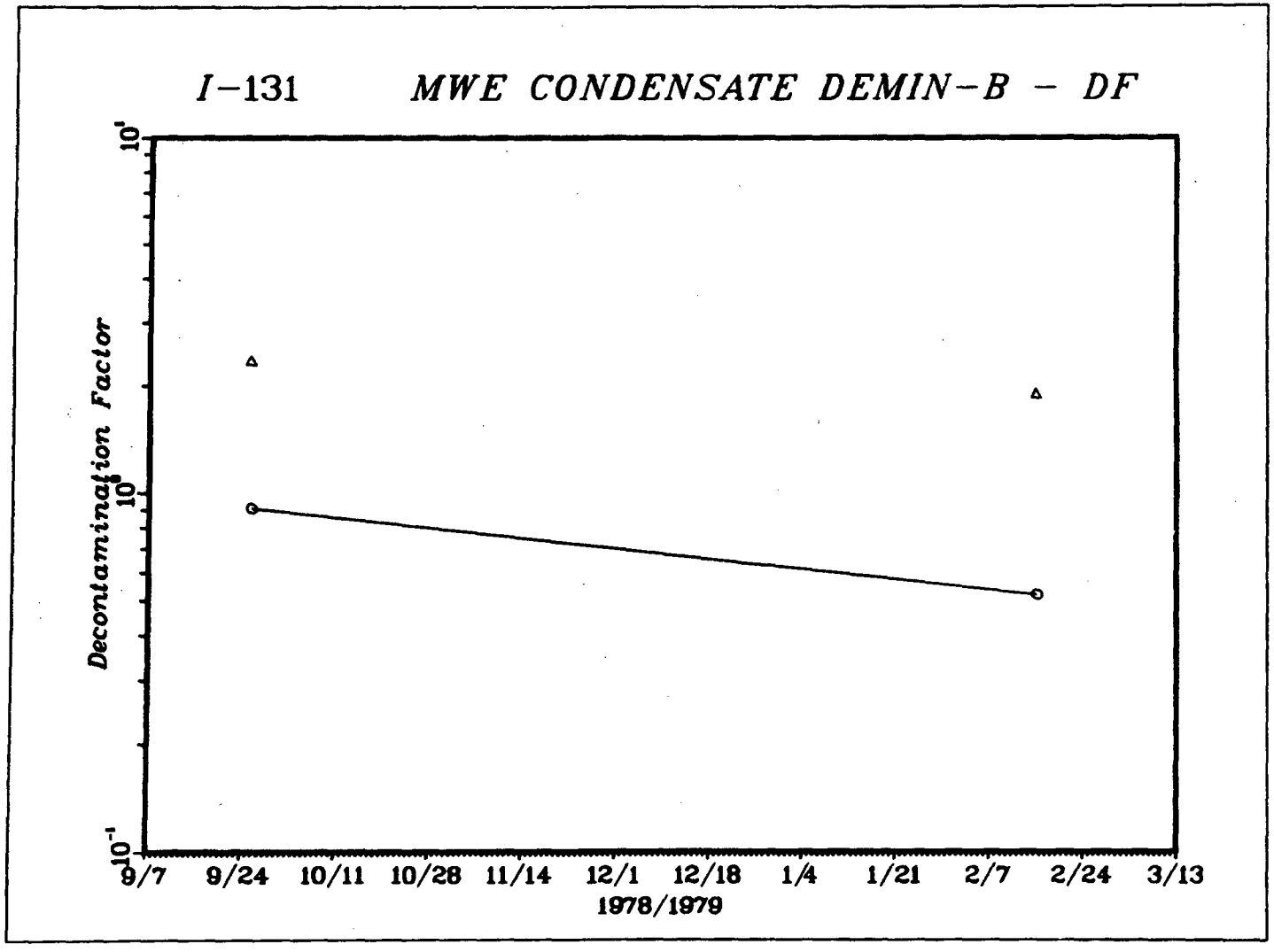


FIGURE 5.40

^{137}Cs DF FOR MWE CONDENSATE DEMINERALIZER B

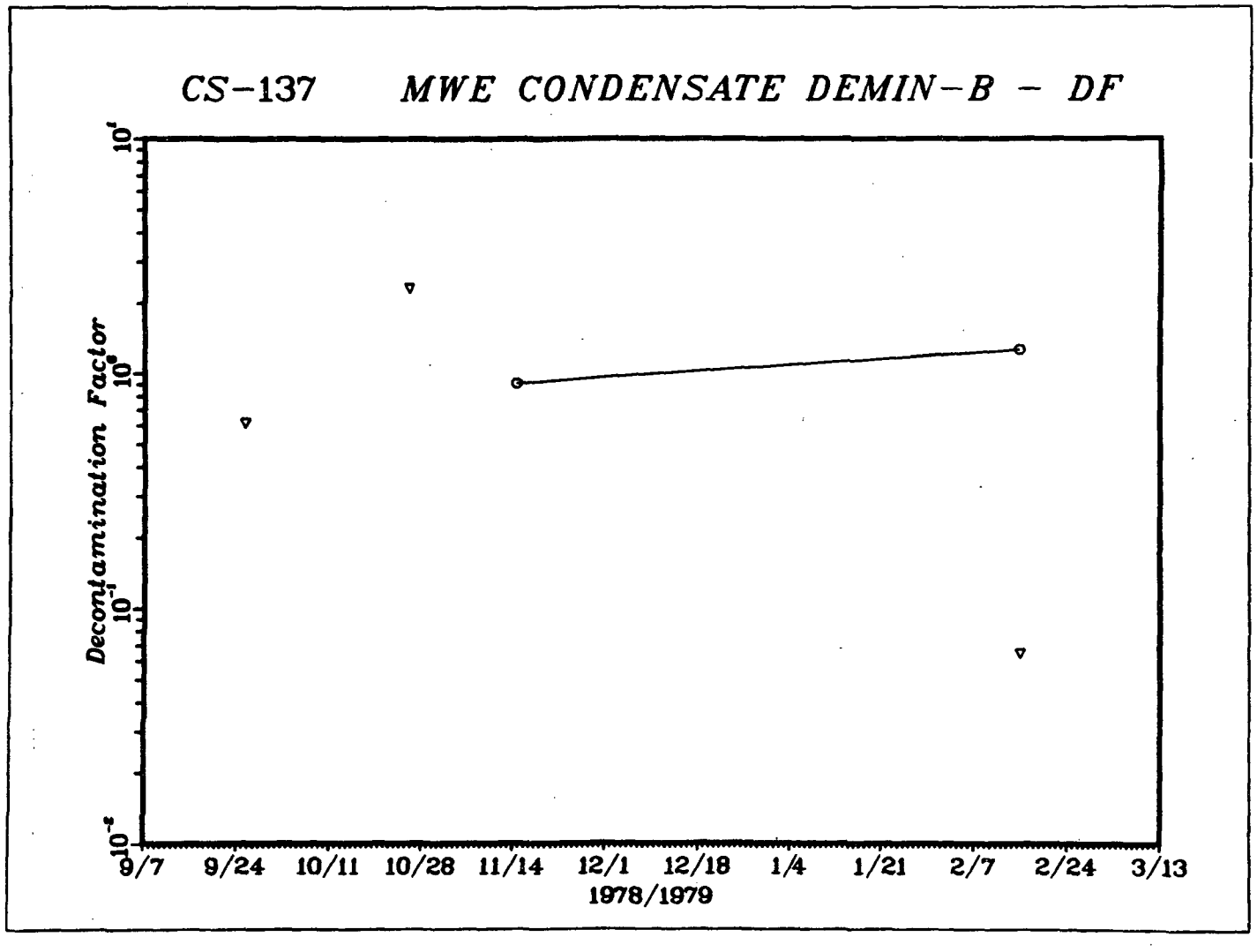


FIGURE 5.41

^{58}Co DF FOR MWE CONDENSATE DEMINERALIZER B

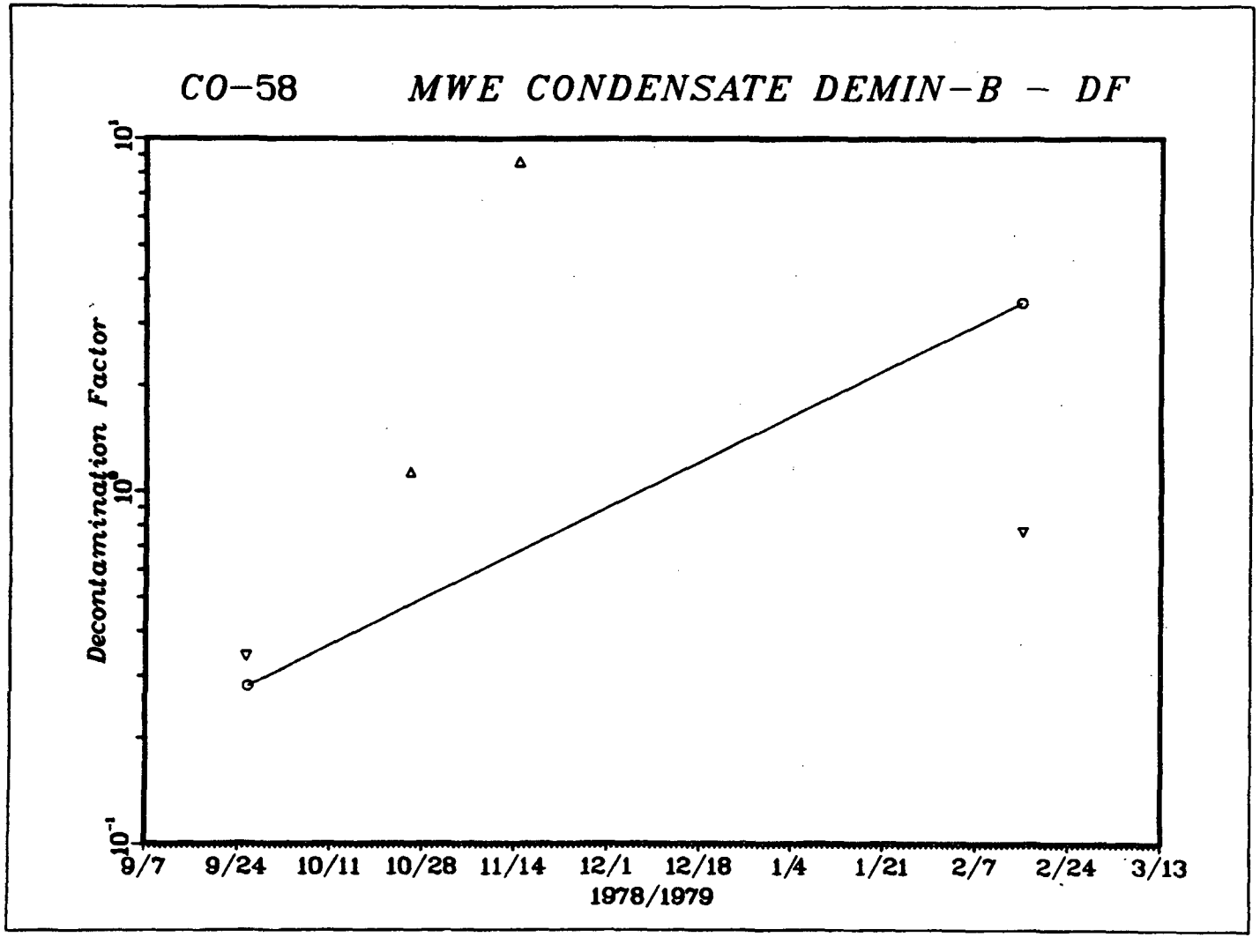


TABLE 5.20

DECONTAMINATION FACTORS FOR DRCST DEMINERALIZER

DRCST DEMINERALIZER DF

DATE	10/16	1/31
TIME	1527	1341
NUCLIDE	DECONTAMINATION FACTOR	
I-131	NOTE 1	NOTE 1
CS-134	>2.2(1)	2.28±.37(0)
CS-137	>2.3(1)	2.39±.31(0)
CR-51	NOTE 1	<9.4(-1)
MN-54	>1.0(0)	NOTE 1
FE-59	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1
CO-58	7.71±4.1(-1)	1.75±.38(0)
CO-60	>5.3(-1)	>5.3(-1)
ZN-65	NOTE 1	NOTE 1
ZR-95	3.64±2.1(-1)	NOTE 1
NB-95	NOTE 1	NOTE 1
MO-99	NOTE 1	>8.8(-1)
RU-103	>4.0(-1)	NOTE 1
AG-110M	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1
CE-144	NOTE 1	<1.4(0)
NP-239	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE 5.21

DECONTAMINATION FACTORS FOR DRCST FILTER

	DRCST DEMIN FILTER DF	
DATE	10/16	1/31
TIME	1520	1336
NUCLIDE	DECONTAMINATION FACTOR	
I-131	NOTE 1	NOTE 1
CS-134	NOTE 1	1.50±.30(0)
CS-137	NOTE 1	1.38±.24(0)
CR-51	NOTE 1	>1.1(0)
MN-54	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1
CO-58	>1.4(0)	>2.0(0)
CO-60	<1.1(0)	NOTE 1
ZN-65	NOTE 1	NOTE 1
ZR-95	>1.4(0)	NOTE 1
NB-95	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1
CE-144	NOTE 1	>7.0(-1)
NP-239	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

Cesium-134 and ^{137}Cs display the highest concentrations of all radionuclides measured in the demineralized reactor coolant in the storage tank due to the washing of these nuclides from the BAE and MWE condensate demineralizers. The decreases in the demineralizer Cs DF's from 10/16/78 to 1/31/79 are primarily due to the four-fold increases in concentrations of these nuclides in the demineralizer effluent on 1/31/79. These increases vis a vis the decreases in influent concentrations of ^{134}Cs and ^{137}Cs on 1/31/79 are very likely due to the contributions of reverse ion-exchange processes within the demineralizers.

5.7 Miscellaneous Waste Tank Filter-Demineralizer

Only one set of samples was taken from the miscellaneous waste tank filter demineralizer for DF measurements. Due to the lack of a sample point between the filter and the demineralizer, only the combined DF for both components was measured. The data for the run are in Appendix Tables B.24 and B.25 and the calculated DF's are in Table 5.22. The resin has had little use and has a good DF for all of the soluble species ^{131}I, $^{134,137}Cs$, and ^{24}Na and reasonable ones for the crud-associated radionuclides.

TABLE 5.22

DF's FOR MISCELLANEOUS WASTE TANK FILTER-DEMINERALIZER

MISC WASTE OIL ABS. FILTER-DEMIN. DF

DATE	1/10
TIME	1355

NUCLIDE	DECONTAMINATION FACTOR
I-131	>5.5(2)
I-133	>4.2(1)
CS-134	1.11±.19(2)
CS-136	>2.1(1)
CS-137	2.65±1.2(2)
NA-24	>3.5(1)
CR-51	4.17±.35(0)
MN-54	1.04±.03(1)
FE-59	2.16±.60(1)
CO-57	>5.0(1)
CO-58	5.76±.09(0)
CO-60	6.36±.17(0)
ZN-65	3.11±2.2(0)
ZR-95	1.11±.23(1)
NB-95	5.58±.48(0)
MO-99	>8.7(1)
RU-103	>1.7(1)
AG-110M	3.27±.63(0)
SB-124	9.21±1.2(0)
SB-125	2.18±.53(1)
LA-140	1.35±.37(1)
CE-141	>5.0(0)
CE-144	>4.4(0)

6. SPENT FUEL POOL

6.1 System Description and Sample Points

The spent fuel pool (SFP) demineralizer loop contains a demineralizer pump, a disposable cartridge filter and a nonregenerative mixed-bed ion exchanger. A skimmer system can also be valved into the loop. The demineralizer loop takes suction on the SFP cooling system loop downstream of the cooler and discharges back into the SFP. The borated water storage tank (BWST) can also be valved into the demineralizer loop. Figure 6.1 shows a simplified diagram of the system. The design flow rates for the cooling system and demineralizer loops are 1000 gpm and 160 gpm, respectively. The SFP and the BWST nominally contain 605,880 and 425,000 gallons of water, respectively. The SFP and the BWST are maintained at a boron concentration of approximately 1800 ppm. The SFP is kept at less than 120°F by its cooling system.

The demineralizer loop is used to remove fission products from leaking fuel assemblies stored in the SFP and from water in the BWST after being mixed with reactor coolant in the fuel transfer canal (FTC) during refueling. Cooling and demineralizer loop component leakage is routed to the miscellaneous radwaste system.

The nominal particle size retained by the demineralizer filter is three microns. The filter was changed out on 8/10/78, before sampling began, and on 11/30/78, 12/4/78, 12/9/78 and 12/13/78 during refueling. The demineralizer loop ion exchanger contains 50 ft^3 of resin (a 1:1 mixture of C-20 and A101D) and has a cross sectional area of 12.57 ft^2. The ion exchanger was put into service on 1/10/78, before sampling began, and was not changed out during sampling. The ion exchanger processed approximately 366 bed volumes per day with an assumed flow of 95 gpm.

The normal sample points for the system consisted of a filter inlet sample, a filter outlet sample (which also served as the ion exchanger inlet) and the ion exchanger outlet sample. These three sample points are shown in Figure 6.1 and are designated by AP. During refueling two other samples were taken; dip samples of the fuel pool and the transfer canal water.

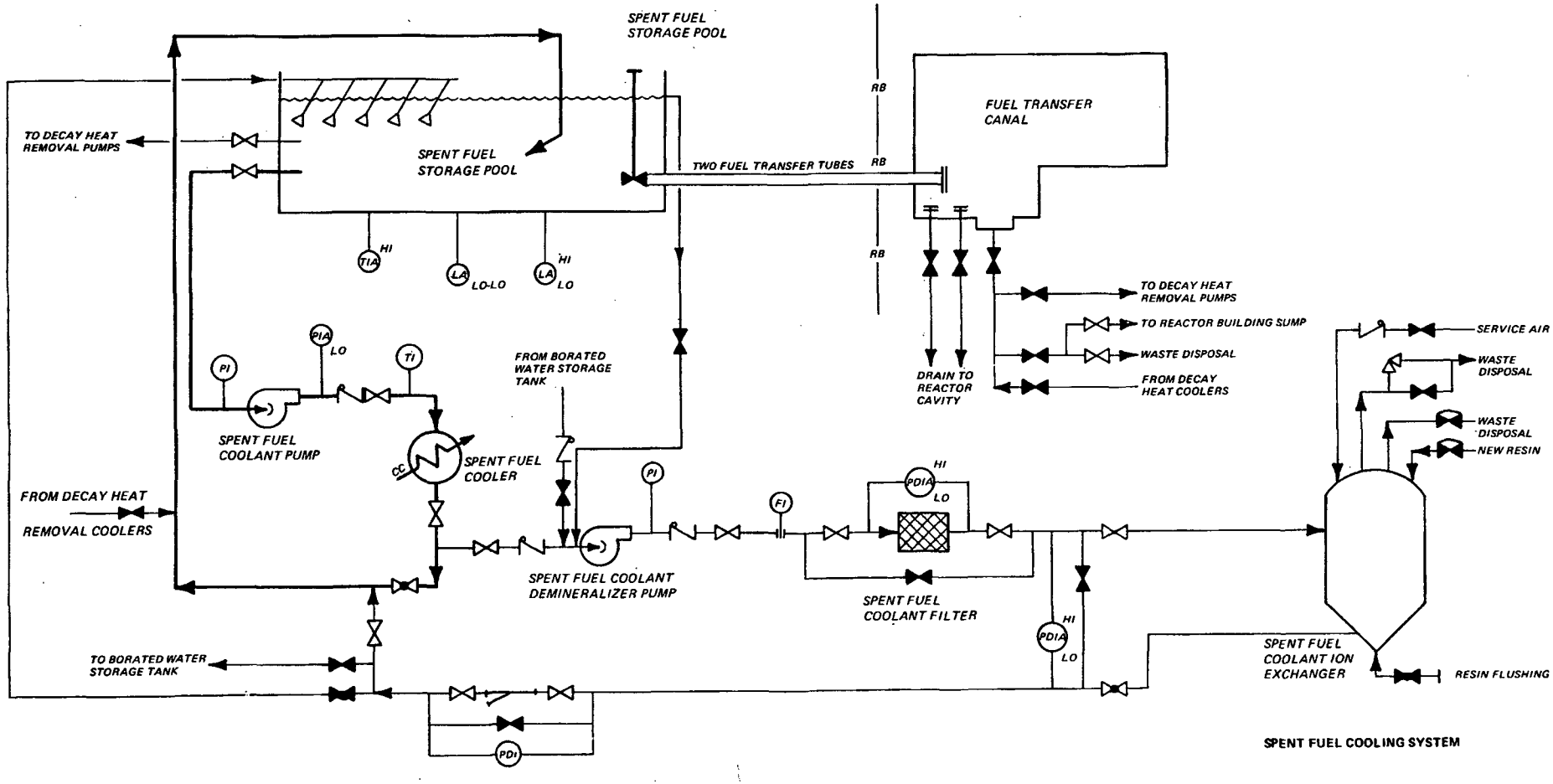
6.2 Sampling Procedures

All of the sample lines for the three sample points are short, on the order of a few feet, so that purge times of two minutes or more provided consistent samples. All samples were taken into plastic containers and transferred into 450 ml bottles in accordance with source term procedures (6).

Filter inlet, filter outlet, and ion exchanger outlet samples were drawn from permanent sample lines at their respective components. Four sets of samples were taken before refueling on 9/21/78, 10/11/78, 11/8/78

FIGURE 6.1

DIAGRAM OF SPENT FUEL POOL COOLING AND PURIFICATION SYSTEM



SPENT FUEL COOLING SYSTEM

and 11/16/78 with a SFP dip sample used as a filter inlet sample on 11/8/78. Filter outlet and ion exchanger outlet samples were also taken on 9/12/78. Two sets of samples were taken during refueling on 11/29/78 and 12/6/78. The ion exchanger outlet sample taken on 12/6/78 was not valid and another sample was taken on 12/7/78 and used in its place. Three sets of samples were taken after refueling on 12/13/78, 1/23/79 and 2/27/79. The filter was bypassed during sampling on 12/13/78.

The fuel transfer canal (FTC) was filled with water from the reactor coolant system (RCS) and the borated water storage tank (BWST) for the plant's second refueling on 11/22/78. The water was pumped back to the BWST on 12/12/78 after refueling. A dip sample of the FTC was taken on 11/22/78 prior to fuel transfer, and two samples were taken during refueling on 11/29/78 and 12/6/78.

Two SFP dip samples were taken before refueling on 10/11/78 and 11/8/78, two samples were taken during refueling on 11/29/78 and 12/6/78, and one sample was taken immediately after refueling on 12/12/78. The SFP dip samples compare very closely to filter inlet samples taken on the same days.

6.3 Discussion of Results

The results of the measurements on individual samples for the SFP filter inlet, filter outlet and ion exchanger outlet are presented in Appendix Tables B.26 to B.28. The results of the SFP dip samples and the FTC dip samples are presented in Appendix Tables B.29 and B.30. Figures 6.2 to 6.10 show the SFP filter inlet, filter outlet and ion exchanger outlet sample measurement results for ^{131}I, ^{137}Cs and ^{60}Co, respectively.

I-131 is plotted to show the behavior of halogens in the SFP demineralizer, the SFP and the FTC before, during and after refueling. Cs-137 is plotted to show the behavior of alkali metals and ^{60}Co to show the behavior of crud-associated radionuclides.

6.3.1 Fuel Transfer Canal

The ^{131}I concentration in the FTC decreased rapidly with time after reactor shutdown and was about a factor of two higher than the SFP due to the mixing of primary coolant in the FTC. The ^{137}Cs concentration in the FTC remained nearly constant. It was about a factor of four higher than the concentration in the SFP before refueling and decreased to less than a factor of two by the end of refueling. During refueling, the ^{60}Co concentration in the FTC was about a factor of two higher than the concentration in the SFP.

6.3.2 Spent Fuel Pit Dip Samples

The concentrations found in the SFP dip samples compare closely to the filter inlet concentrations on days where both types of samples were taken.

FIGURE 6.2

^{131}I CONCENTRATION IN SFP FILTER INLET

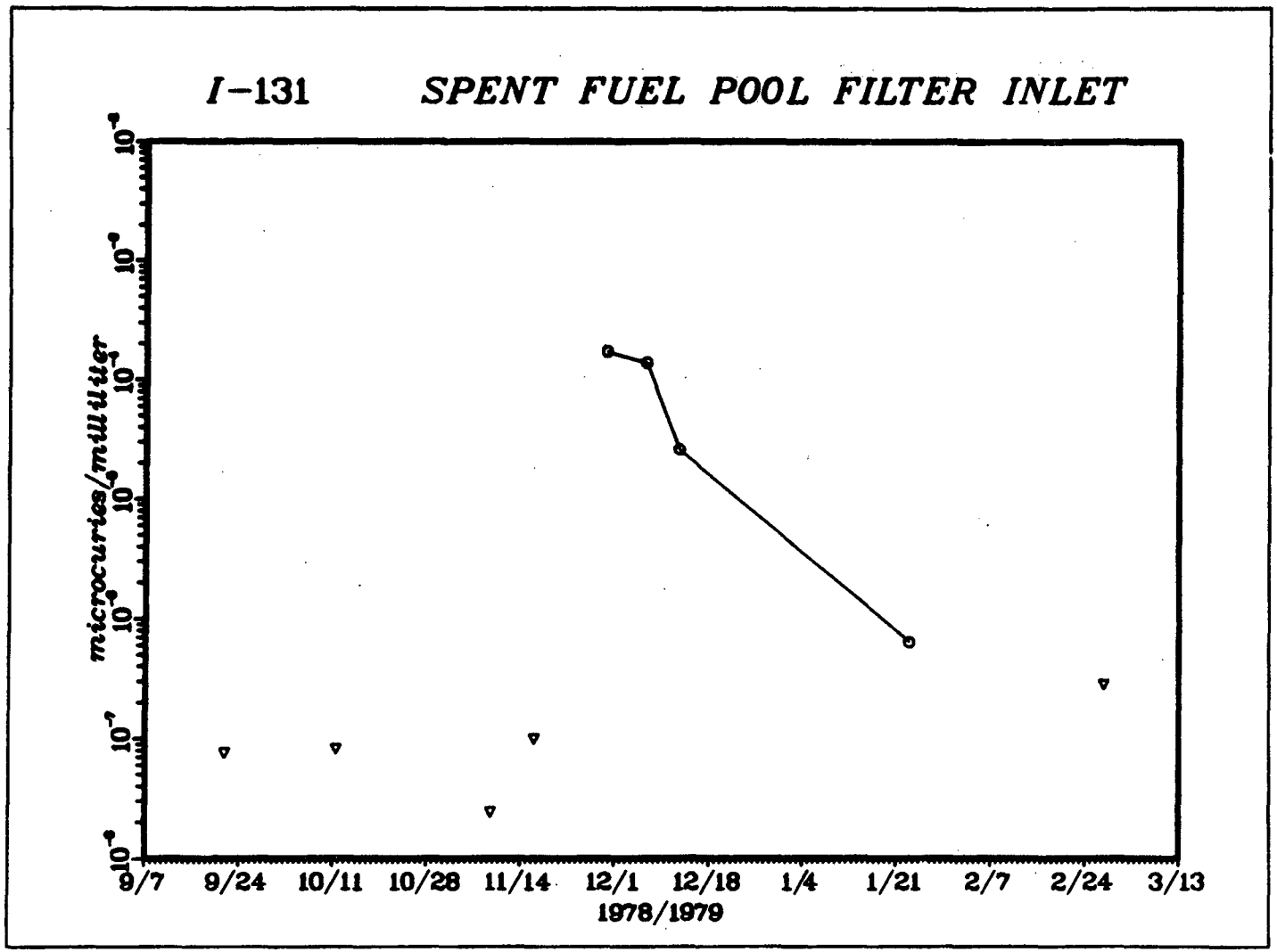


FIGURE 6.3

^{131}I CONCENTRATION IN SFP FILTER OUTLET

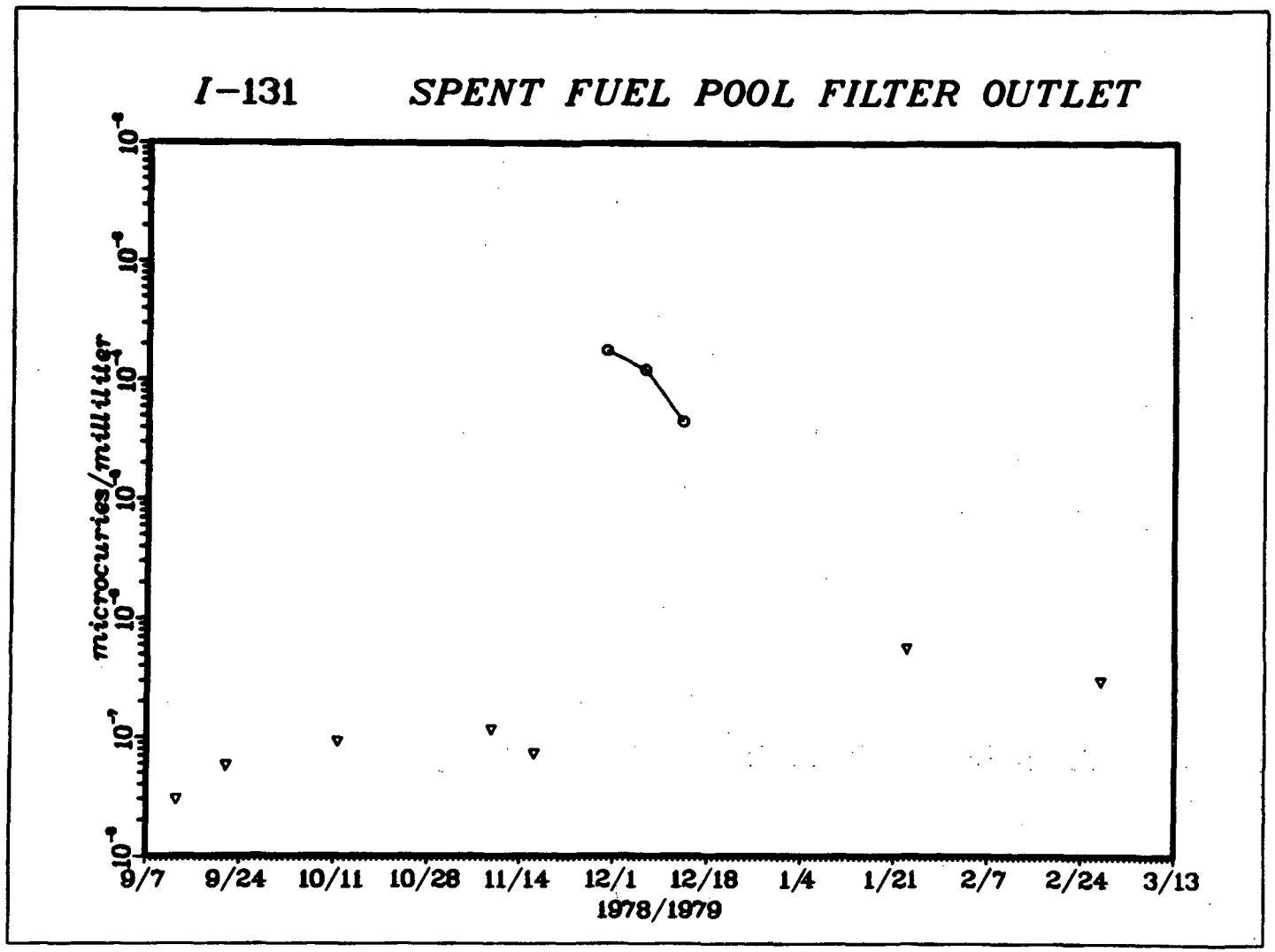


FIGURE 6.4

^{131}I CONCENTRATION IN SFP DEMINERALIZER OUTLET

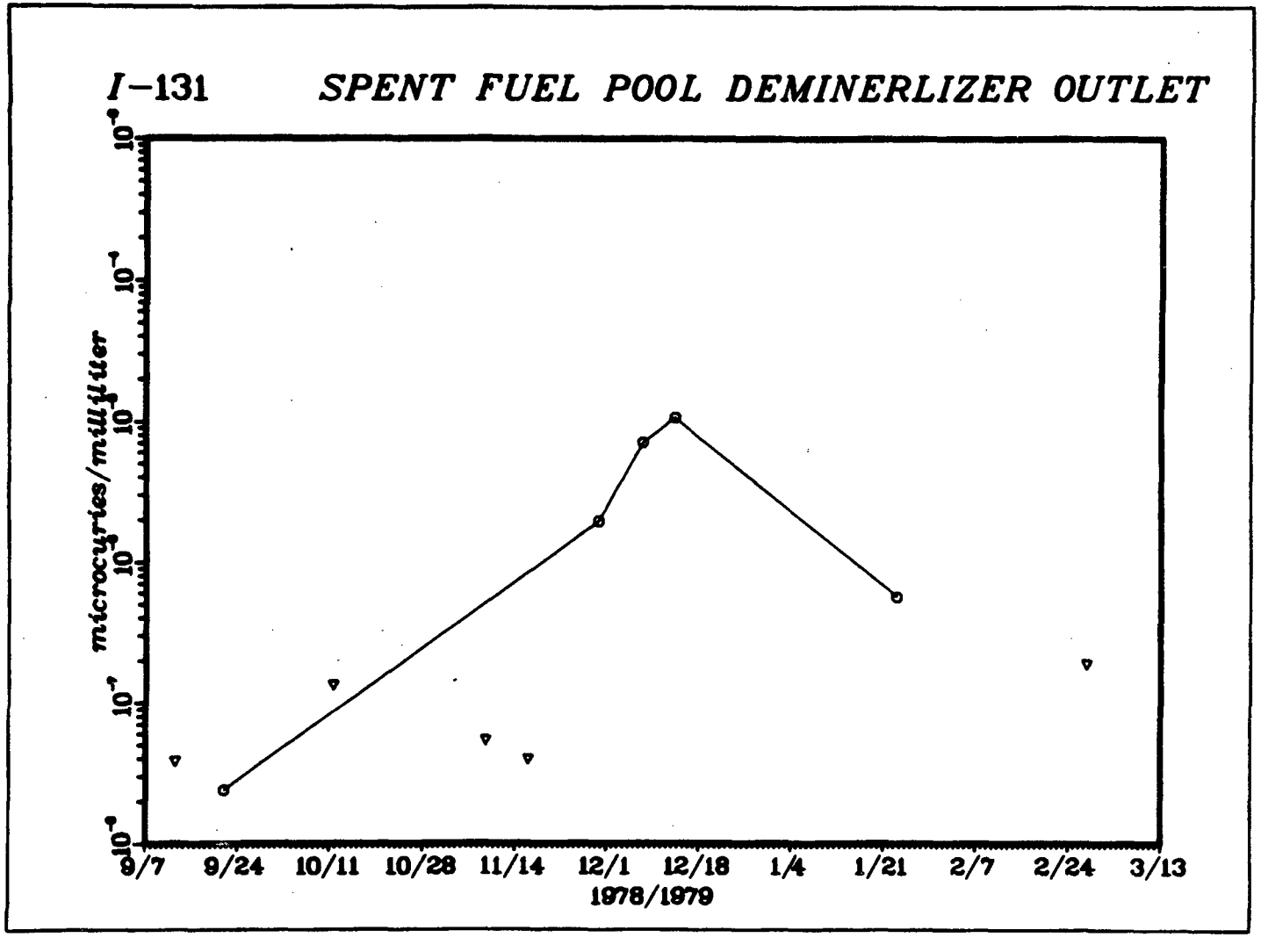


FIGURE 6.5

^{137}Cs CONCENTRATION IN SFP FILTER INLET

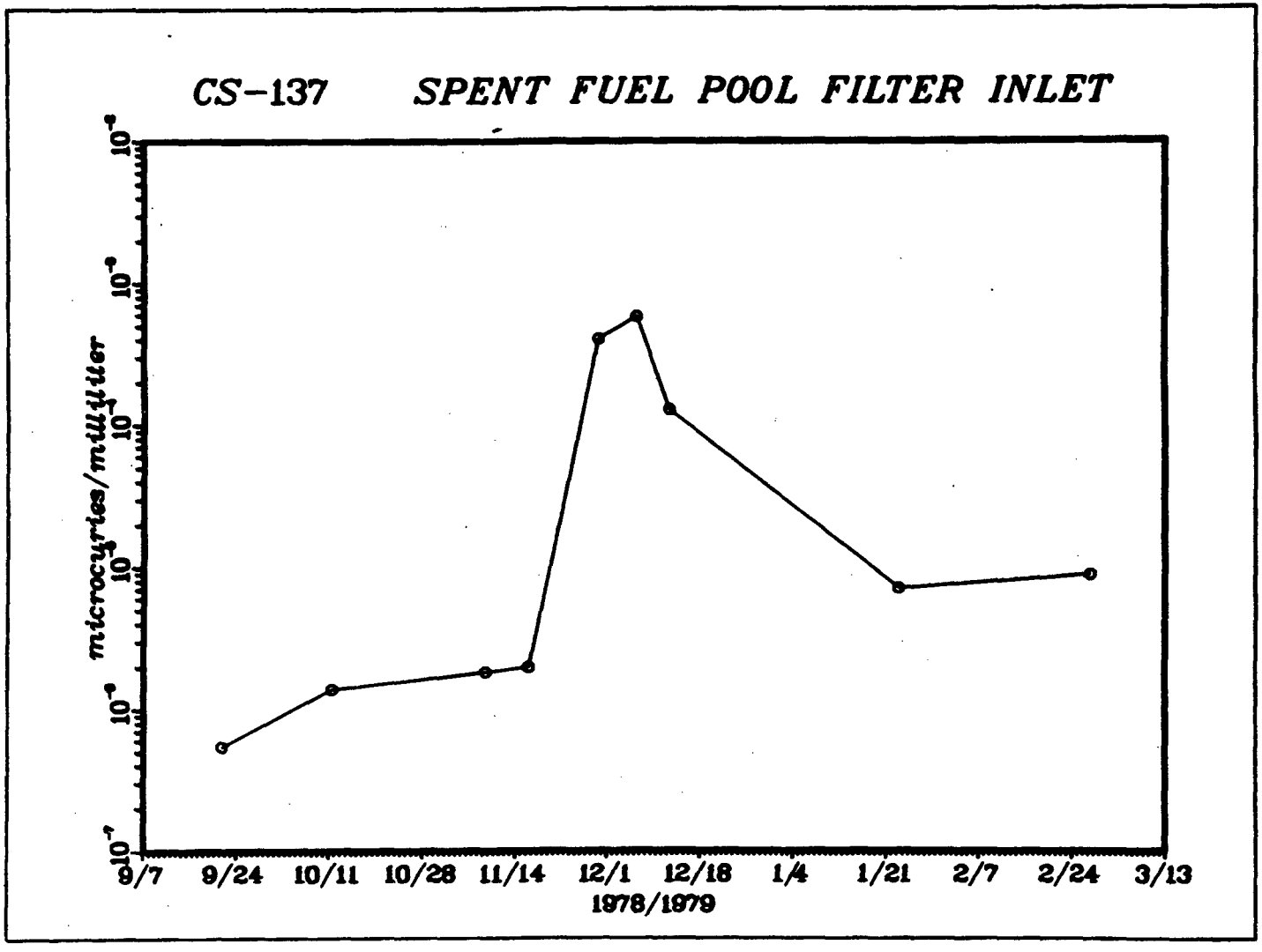


FIGURE 6.6

^{137}Cs CONCENTRATION IN SFP FILTER OUTLET

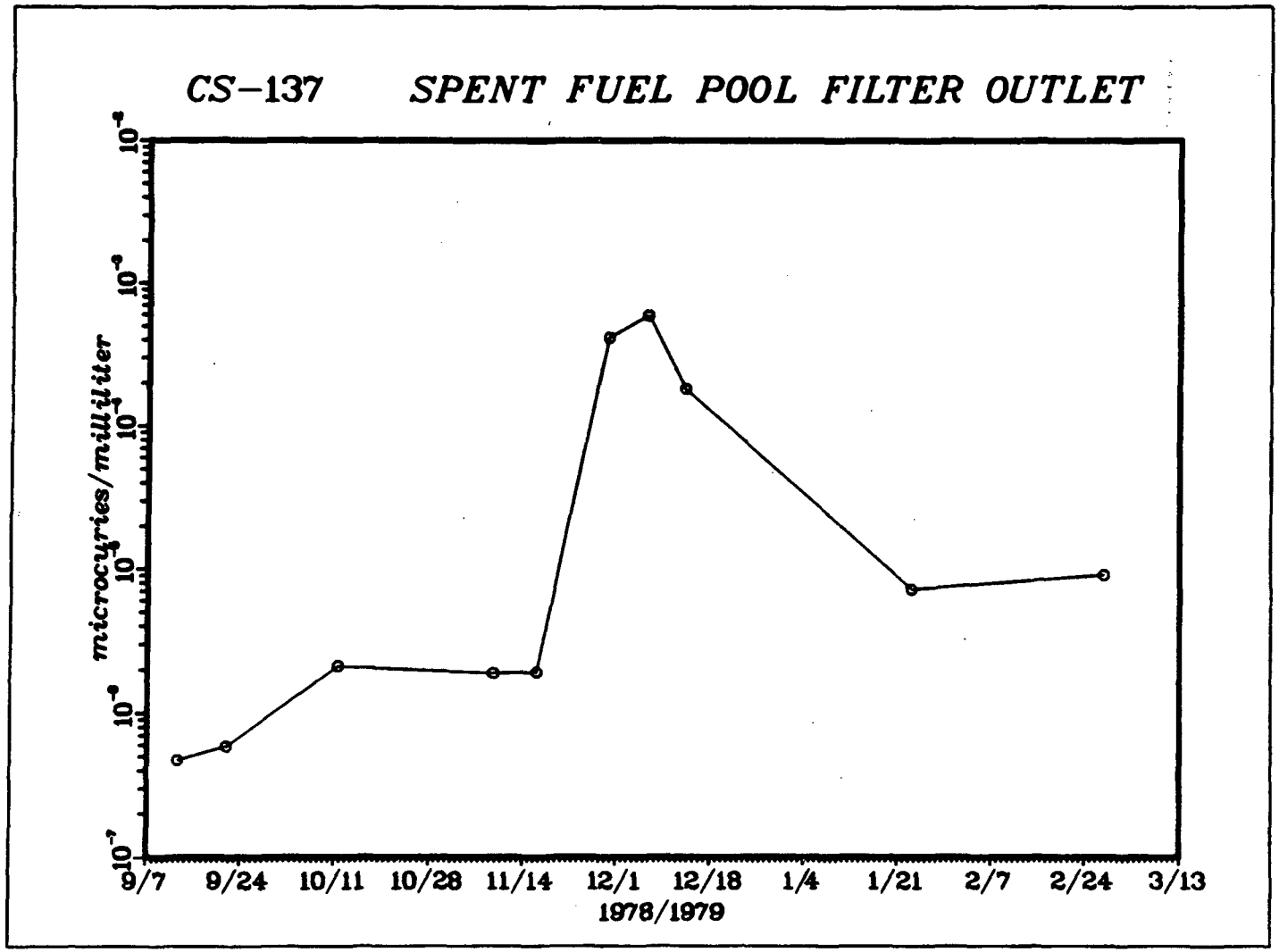


FIGURE 6.7

^{137}Cs CONCENTRATION IN SFP DEMINERALIZER OUTLET

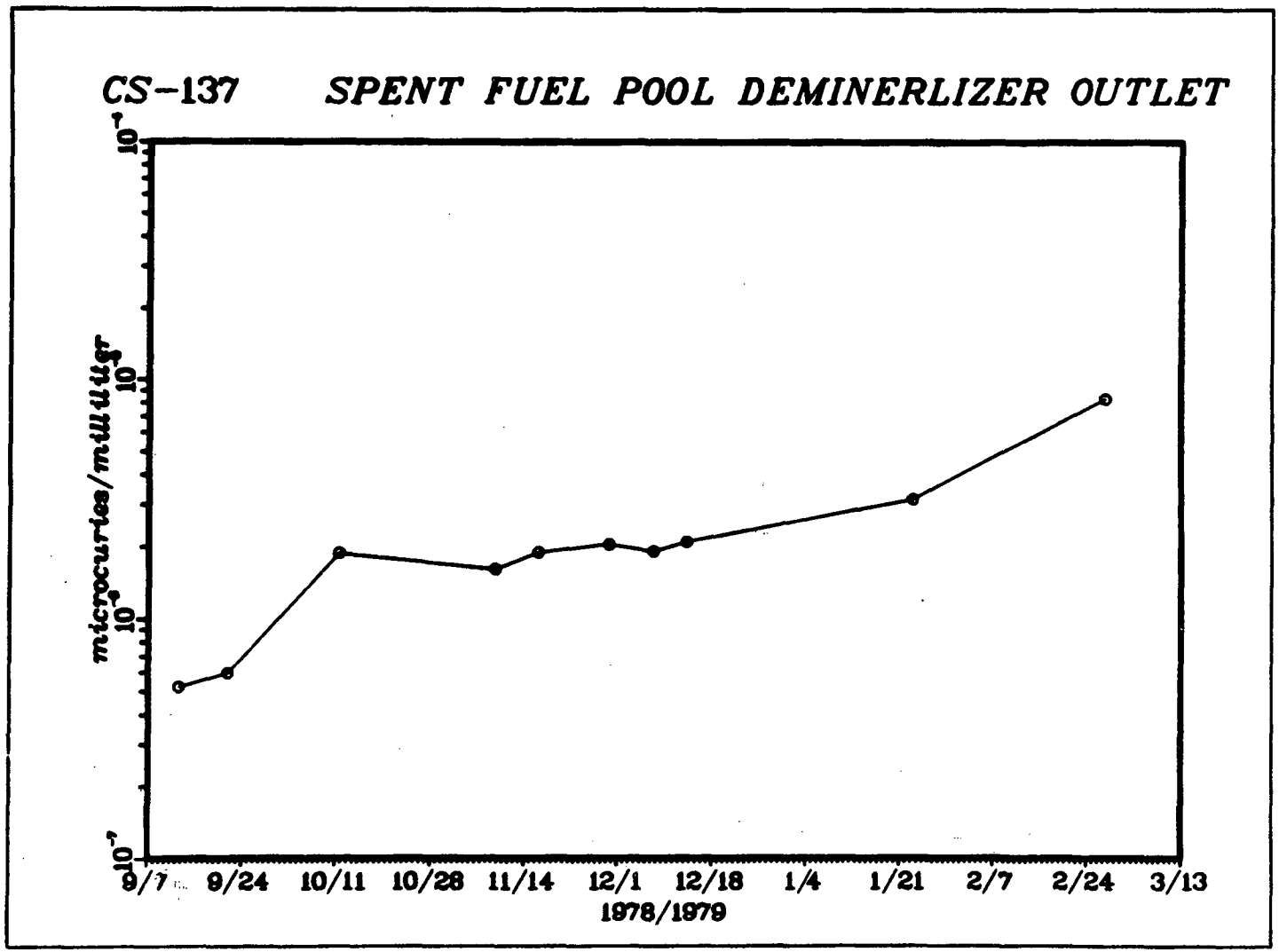


FIGURE 6.8

^{60}Co CONCENTRATION IN SFP FILTER INLET

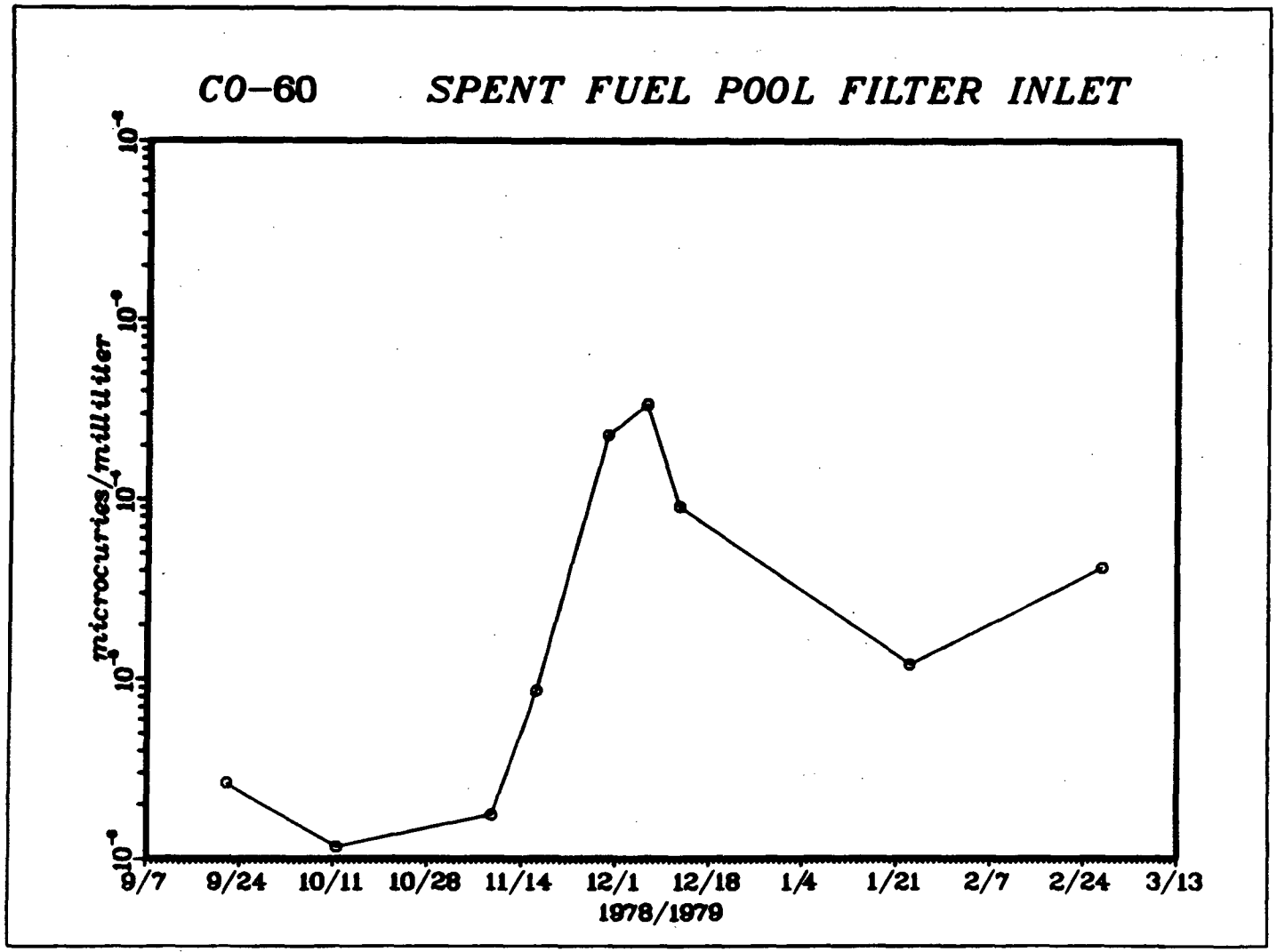


FIGURE 6.9

^{60}Co CONCENTRATION IN SFP FILTER OUTLET

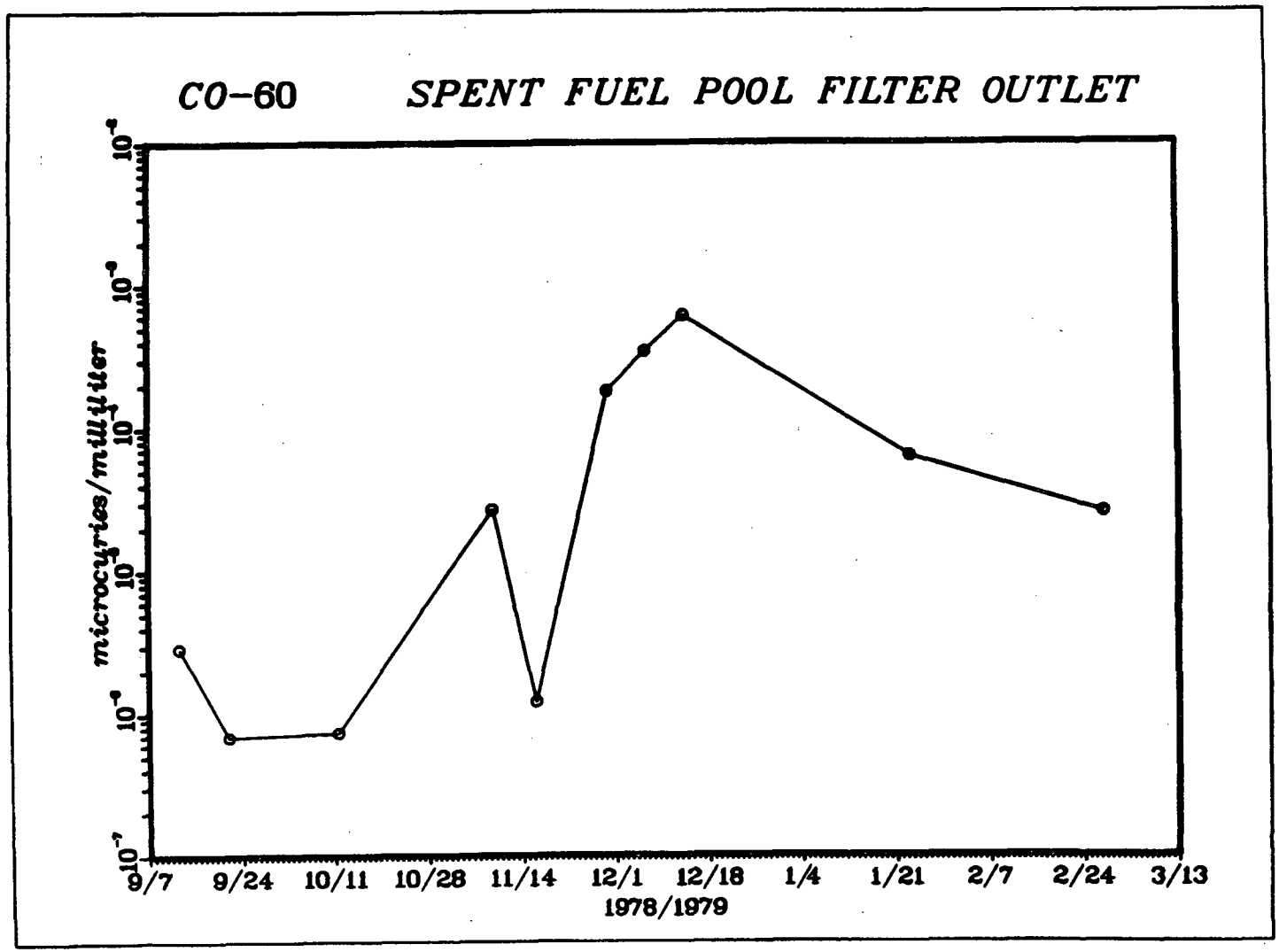
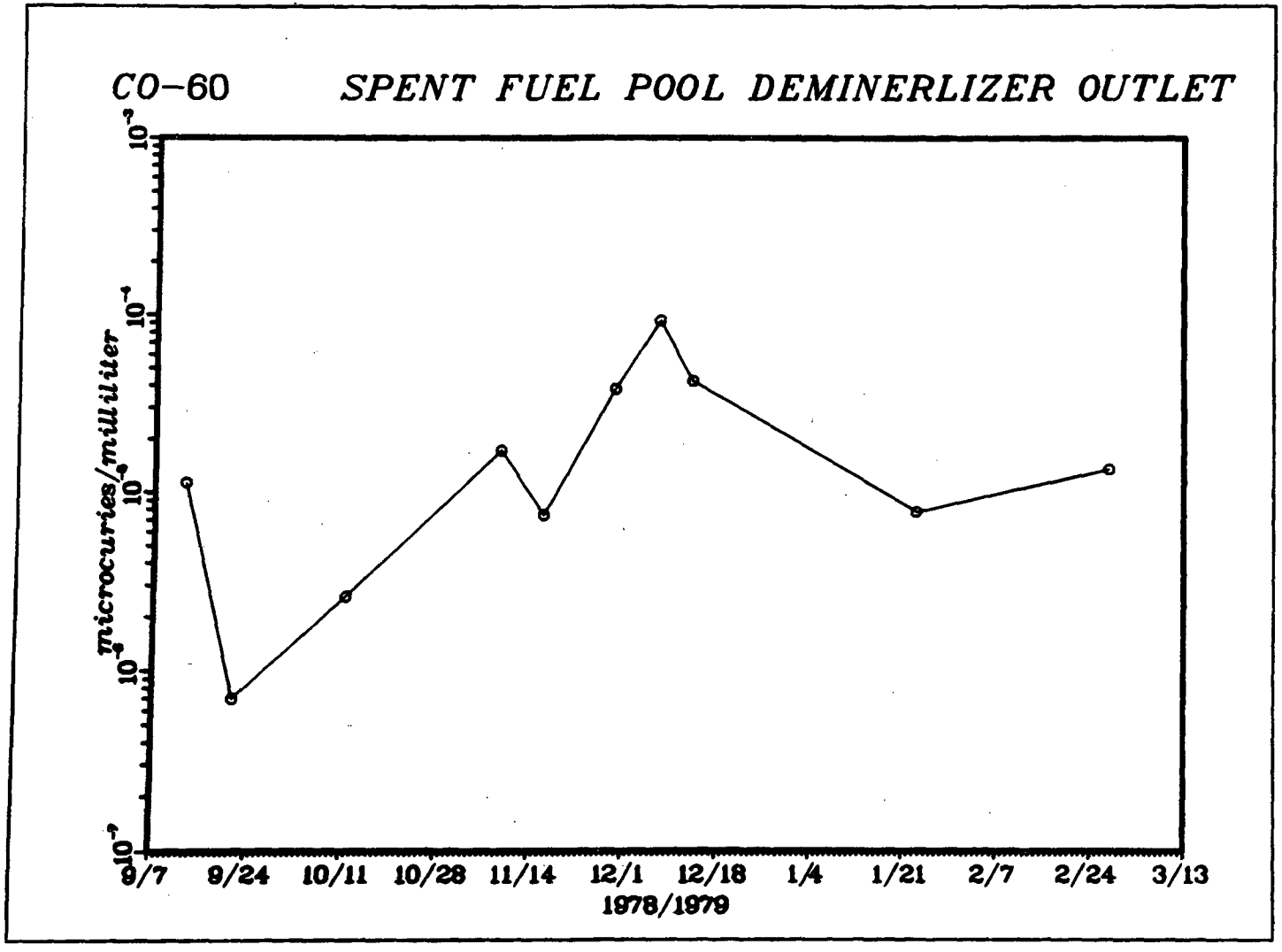


FIGURE 6.10

^{60}Co CONCENTRATION IN SFP DEMINERALIZER OUTLET



6.3.3 Spent Fuel Pool Filter

The spent fuel pool filter DF's are presented in Table 6.1. The filter outlet concentration for ^{131}I and ^{137}Cs follows the inlet concentration and the filter DF's are approximately one regardless of inlet concentration. The two sets of samples taken during refueling (11/29/78 and 12/6/78) show that the outlet ^{60}Co concentration follows the inlet concentration and the DF is approximately one for high inlet concentrations. The 11/29/78 sample was taken one day after the filter was changed out and the 12/6/78 sample was taken two days after the filter was changed out. The filter was valved out and bypassed during sampling on 12/13/78. The filter DF's for ^{60}Co converge to one for higher inlet concentrations. Table 6.2 presents the "best value" filter DF's.

6.3.4 Spent Fuel Pool Demineralizer

The measured DF's for the SFP demineralizer are presented in Table 6.3. The ion exchanger DF's for ^{131}I before and long after refueling are approximately one. During and immediately after refueling the DF's increase very rapidly with inlet concentration. The ion exchanger DF's for ^{137}Cs before and long after refueling are also approximately one. During refueling the filter outlet concentration for ^{137}Cs spikes while the ion exchanger outlet remains nearly constant and then increases slowly after refueling. The ^{137}Cs DF increases to over 300 during refueling and has an exponential increase with filter outlet concentration above a DF of one. The detailed explanation of this phenomena is discussed in section 2.6. The ion exchanger DF for ^{60}Co increases to about ten during refueling and shows an increase with inlet concentration. Table 6.4 provides the "best value" demineralizer DF's.

6.4 Tritium Activity Balance

Sets of samples were taken before, during, and after refueling of major volumes of water in order to obtain a tritium activity balance for the plant as shown in Table 6.5. Samples were also taken of the reactor coolant system letdown, radwaste and demineralized reactor coolant storage tank (DRCST) water to measure the tritium concentration around the reactor coolant processing loop before and after refueling as shown in Table 6.6.

The borated water storage tank (BWST), the spent fuel pool (SFP), the reactor coolant and the demineralized reactor coolant storage tank (DRCST) were analyzed for tritium to measure the plant inventory before refueling. The volume associated with the DRCST is the fraction of the cold reactor coolant volume pumped into the reactor system during reactor cooldown to refueling temperature.

During refueling, the SFP and fuel transfer canal (FTC) samples were analyzed for tritium and to measure changes in concentrations due to mixing with reactor coolant. A residual heat removal system (RHR) sample was analyzed for tritium because of dilution of the water in the reactor vessel with water from the BWST. The volume associated with stagnant

TABLE 6.1

INSTANTANEOUS DF's FOR SPENT FUEL POOL FILTER

SPENT FUEL POOL FILTER DF

DATE	9/21	10/11	11/ 8	11/16	11/29
TIME	1049	1346	1522	1205	938
NUCLIDE	DECONTAMINATION FACTOR				
I-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	9.66±.25(-1)
I-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<7.6(-1)
I-134	<2.6(0)	9.62±1.1(-2)	NOTE 1	NOTE 1	9.14±.62(-1)
CS-134	1.94±.41(0)	5.62±.72(-1)	8.87±1.2(-1)	1.42±.18(0)	9.55±.21(-1)
CS-136	NOTE 1	<1.2(0)	NOTE 1	NOTE 1	<1.2(0)
CS-137	9.22±.67(-1)	6.53±1.9(-1)	9.58±.66(-1)	1.03±.10(0)	9.67±.18(-1)
CS-138	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.81±.09(0)
MN-54	7.15±1.1(0)	2.12±.44(0)	3.13±.19(-2)	1.01±.60(1)	1.22±.04(0)
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	>1.1(0)	1.95±.80(0)	7.31±2.7(-2)	<1.9(0)	1.29±.12(0)
CO-58	2.27±.16(0)	1.11±.07(0)	1.12±.05(-1)	3.75±.40(0)	1.11±.01(0)
CO-60	3.80±.24(0)	1.55±.21(0)	6.53±.35(-2)	7.03±.70(0)	1.27±.03(0)
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	2.19±.87(0)
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.98±.17(0)
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	9.46±.48(-1)
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1.	1.40±.44(0)
AG-110M	1.03±.63(0)	NOTE 1	>9.8(-1)	NOTE 1	3.09±1.0(-1)
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	9.43±.58(-1)
SB-125	9.45±2.0(-1)	9.72±2.3(-1)	1.02±.42(0)	1.13±.35(0)	1.36±.44(0)
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	9.90±2.1(-1)
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<3.6(-1)
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.07±.10(0)
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.51±.50(0)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 6.1 (cont'd)

INSTANTANEOUS DF's FOR SPENT FUEL POOL FILTER

SPENT FUEL POOL FILTER DF

DATE	12/ 6	12/12	1/23	2/27
TIME	1204	1146	1053	1127
NUCLIDE	DECONTAMINATION FACTOR			
I-131	1.13±.09(0)	5.73±.18(-1)	>1.1(0)	NOTE 1
I-132	NOTE 1	>7.4(-2)	NOTE 1	NOTE 1
I-134	1.13±.11(0)	6.15±.23(-1)	NOTE 1	3.10±.18(-1)
CS-134	9.86±.22(-1)	7.48±.17(-1)	9.93±.55(-1)	9.79±.51(-1)
CS-136	1.22±.20(0)	4.81±.91(-1)	NOTE 1	NOTE 1
CS-137	9.75±.19(-1)	6.99±.09(-1)	9.82±.42(-1)	9.73±.32(-1)
CS-138	>2.7(0)	NOTE 1	NOTE 1	NOTE 1
CR-51	9.00±.60(-1)	1.63±.02(-1)	2.55±.20(-1)	1.64±.20(0)
MN-54	9.93±.38(-1)	1.01±.02(-1)	1.04±.05(-1)	1.68±.04(0)
FE-59	1.10±.21(0)	7.80±.38(-2)	6.66±2.0(-2)	1.86±.50(0)
CO-57	1.02±.19(0)	1.42±.11(-1)	3.85±.53(-1)	1.61±.26(0)
CO-58	9.94±.15(-1)	2.31±.05(-1)	2.52±.08(-1)	1.37±.03(0)
CO-60	9.94±.39(-1)	1.50±.03(-1)	1.94±.07(-1)	1.65±.05(0)
ZR-95	7.01±2.3(-1)	6.14±.46(-2)	4.71±2.0(-2)	2.05±.44(0)
NB-95	1.25±.14(0)	1.03±.09(-1)	1.62±.10(-1)	1.26±.10(0)
MO-99	<1.2(0)	>3.6(-1)	NOTE 1	NOTE 1
RU-103	2.17±.88(0)	2.18±.47(-1)	>6.8(-1)	NOTE 1
AG-110M	1.31±.21(0)	5.31±.50(-1)	9.43±1.1(-1)	1.07±.13(0)
SB-124	8.79±1.8(-1)	4.34±.30(-1)	9.48±.64(-1)	1.11±.08(0)
SB-125	<1.3(0)	3.34±.47(-1)	1.01±.09(0)	9.99±.70(-1)
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	<1.7(0)	>6.0(-1)	NOTE 1	NOTE 1
LA-140	8.55±1.3(-1)	5.80±.49(-1)	NOTE 1	NOTE 1
CE-141	NOTE 1	2.89±1.2(-1)	>7.9(-1)	>1.2(0)
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 6.2

"BEST VALUE" DF's FOR SPENT FUEL POOL FILTER

Nuclide	"Best Value" Filter DF
^{131}I	1.0
^{134}Cs	1.2
^{136}Cs	1.1
^{137}Cs	0.9
^{51}Cr	1.2
^{54}Mn	2.0
^{59}Fe	1.0
^{57}Co	1.2
^{58}Co	1.6
^{60}Co	2.4
^{95}Zr	1.2
^{95}Nb	1.2
^{99}Mo	1.0
^{103}Ru	1.4
^{110m}Ag	0.9
^{124}Sb	0.9
^{125}Sb	1.1
^{140}La	1.0
^{141}Ce	1.0
^{239}Np	1.5

TABLE 6.3

INSTANTANEOUS DF's FOR SPENT FUEL POOL DEMINERALIZER

SPENT FUEL POOL DEMINERALIZER DF

DATE	9/12	9/21	10/11	11/ 8	11/16
TIME	1345	1057	1355	1527	1200
NUCLIDE	DECONTAMINATION FACTOR				
I-131	NOTE 1	<2.4(0)	NOTE 1	NOTE 1	NOTE 1
I-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-134	NOTE 1	>9.6(-2)	NOTE 1	NOTE 1	NOTE 1
CS-134	9.49±9.0(-1)	7.50±1.5(-1)	1.52±.19(0)	1.21±.14(0)	8.60±.79(-1)
CS-136	NOTE 1	NOTE 1	>6.9(-1)	NOTE 1	NOTE 1
CS-137	9.12±1.1(-1)	9.92±.58(-1)	1.13±.25(0)	1.19±.(8(0)	1.02±.08(0)
CS-138	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	>8.9(-1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	4.34±.21(-1)	9.18±1.4(-1)	2.75±.56(-1)	3.05±.(7(0)	2.21±1.3(-1)
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	4.01±.78(-1)	NOTE 1	6.96±2.8(-1)	1.73±.25(0)	4.59±2.4(-1)
CO-58	2.07±.10(-1)	2.25±.14(0)	8.40±.66(-1)	1.53±.(4(0)	3.25±.31(-1)
CO-60	2.57±.08(-1)	9.91±.66(-1)	2.89±.34(-1)	1.56±.(3(0)	1.64±.15(-1)
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	<1.3(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	<2.1(0)	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	<1.6(0)	NOTE 1	NOTE 1
AG-110M	2.94±1.3(0)	2.66±.55(0)	NOTE 1	<1.6(0)	<3.9(-1)
SB-124	<8.0(-1)	<1.6(0)	NOTE 1	NOTE 1	NOTE 1
SB-125	9.86±2.0(-1)	1.12±.19(0)	1.12±.21(0)	1.17±.53(0)	1.04±.20(0)
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	>1.1(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMTIC OPERATIONS WITH < NUMBERS

TABLE 6.3 (cont'd)

INSTANTANEOUS DF's FOR SPENT FUEL POOL DEMINERALIZER

SPENT FUEL POOL DEMINERALIZER DF

DATE	11/29	12/ 6	12/13	1/23	2/27
TIME	939	1207	1156	1056	1125
NUCLIDE	DECONTAMINATION FACTOR				
I-131	9.08±1.3(1)	1.72±.16(1)	4.25±.13(0)	<9.8(-1)	NOTE 1
I-132	3.84±.71(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-134	8.94±2.6(1)	8.75±1.1(0)	1.12±.07(1)	NOTE 1	2.55±.71(0)
CS-134	2.48±.59(2)	2.61±.75(2)	1.29±.18(2)	3.65±.22(0)	1.08±.05(0)
CS-136	>3.4(1)	>2.6(1)	>7.1(1)	NOTE 1	NOTE 1
CS-137	2.05±.31(2)	3.13±1.6(2)	8.76±.43(1)	2.28±.14(0)	1.10±.04(0)
CS-138	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	2.48±.11(0)	4.17±.17(0)	9.92±.11(0)	4.86±.44(0)	1.62±.27(0)
MN-54	7.88±.28(0)	5.05±.20(0)	3.09±.04(1)	1.91±.11(1)	2.76±.11(0)
FE-59	2.49±.20(0)	3.18±.49(0)	2.15±.07(1)	2.06±.78(1)	1.56±.49(0)
CO-57	8.23±1.4(0)	7.23±1.4(0)	1.75±.15(1)	4.09±.83(0)	1.51±.30(0)
CO-58	1.27±.02(1)	1.07±.02(1)	1.33±.02(1)	4.00±.10(0)	1.67±.03(0)
CO-60	4.69±.17(0)	3.67±.09(0)	1.42±.02(1)	7.91±.20(0)	1.85±.05(0)
ZR-95	2.26±.59(0)	2.39±.71(0)	2.70±.14(1)	1.04±.16(1)	1.24±.60(0)
NB-95	2.87±.20(0)	4.10±.37(0)	2.07±.06(1)	1.16±.15(1)	2.81±.27(0)
MO-99	>9.2(1)	>8.8(0)	NOTE 1	NOTE 1	NOTE 1
RU-103	3.18±.74(0)	>5.5(0)	6.52±1.2(0)	NOTE 1	NOTE 1
AG-110M	2.98±.66(1)	1.14±.32(1)	1.31±.14(1)	7.46±2.1(0)	6.82±2.1(0)
SB-124	>1.5(2)	>1.2(2)	1.51±.10(1)	1.06±.07(0)	1.03±.08(0)
SB-125	8.95±4.0(0)	>7.5(0)	2.28±.56(1)	9.85±.82(-1)	1.13±.07(0)
TE-132	2.13±.30(0)	<4.4(0)	<5.3(0)	NOTE 1	NOTE 1
BA-140	>8.8(0)	>8.0(0)	NOTE 1	NOTE 1	NOTE 1
LA-140	4.40±.43(0)	1.22±.21(1)	8.94±.78(0)	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	9.20±3.8(0)	NOTE 1	NOTE 1
NP-239	>2.2(1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE 6.4

"BEST VALUE" DF's FOR SPENT FUEL POOL DEMINERALIZER

Nuclide	"Best Value" Ion Exchanger DF
^{131}I	2.2(1)
^{134}Cs	6.6(1)
^{136}Cs	>3.3(1)
^{137}Cs	6.1(1)
^{51}Cr	4.6(0)
^{54}Mn	7.1(0)
^{59}Fe	9.9(0)
^{57}Co	4.6(0)
^{58}Co	4.8(0)
^{60}Co	3.6(0)
^{95}Zr	8.9(0)
^{95}Nb	7.0(0)
^{99}Mo	>3.3(1)
^{103}Ru	>3.8(0)
^{110m}Ag	6.2(0)
^{124}Sb	>4.1(1)
^{125}Sb	>4.7(0)
^{140}La	8.5(0)
^{141}Ce	9.2(0)
^{239}Np	>2.2(1)

TABLE 6.5

PLANT TRITIUM ACTIVITY BALANCE

Sampling Period	Item Sampled	Volume (gal)	Average Concentration (μCi/ml)	Tritium Inventory (Ci)
Before Refueling	SFP	605,880	1.03 ± 0.04(-1)	236.2 ± 9.2
	BWST	425,000	8.45 ± 0.28(-2)	135.9 ± 4.5
	Reactor Coolant	***66,198 (cold)	2.2 ± 0.04(-1)	55.1 ± 1.0
	DRCST	22,066	2.2 ± 0.1(-1)	18.4 ± 0.8
	TOTAL ^3H INVENTORY BEFORE REFUELING			450 ± 10 Ci
During Refueling	SFP	605,880	1.03 ± 0.04(-1)	236.2 ± 9.2
	FTC	415,000	9.7 ± 0.4(-2)	152.4 ± 6.3
	**Stagnant Reactor Coolant	54,910	2.2 ± 0.1(-1)	45.7 ± 0.8
	RHR (Reactor Vessel)	30,354	1.43 ± 0.07(-1)	16.4 ± 0.8
	BWST	10,000	8.45 ± 0.28(-2)	3.2 ± 0.1
	RCDT	3,000	2.2 ± 0.1(-1)	2.5 ± 0.1
	TOTAL ^3H INVENTORY DURING REFUELING			460 ± 11 Ci
After Refueling	SFP	605,880	1.07 ± 0.05(-1)	245.4 ± 11.5
	BWST	425,000	1.01 ± 0.05(-1)	162.5 ± 8.0
	Reactor Coolant	***66,198 (cold)	1.33 ± 0.07(-1)	33.3 ± 1.8
	*Displaced Water	22,066	1.33 ± 0.07(-1)	11.1 ± 0.6
	TOTAL ^3H INVENTORY AFTER REFUELING			450 ± 14 Ci

* The displaced water is that fraction of the cold reactor coolant volume displaced into the reactor coolant processing systems during reactor heatup to operating temperatures.

** The stagnant reactor coolant is that fraction of the cold reactor coolant volume that does not get mixed with water from the BWST during refueling and does not get circulated through the RHR system.

*** This is the volume of the reactor coolant when cooled from operating to room temperature.

TABLE 6.6

^3H IN REACTOR COOLANT PROCESSING SYSTEMS

Item Sampled	Date Sampled	Tritium Concentration (μCi/ml)
Reactor Coolant Waste Holdup Tank	10/11/78	2.3 ± 0.1(-1)
BAC Distillate	10/17/78	2.3 ± 0.1(-1)
DRCST	10/13/78	2.1 ± 0.1(-1)
DRCST Demin A Outlet	10/16/78	2.2 ± 0.1(-1)
DRCST Filter Outlet	10/16/78	2.1 ± 0.1(-1)
Makeup Tank Outlet	10/16/78	2.2 ± 0.1(-1)
Flash Tank	1/16/79	2.0 ± 0.1(-1)
Flash Tank	1/18/79	2.1 ± 0.1(-1)
Primary Demin A Outlet	1/18/79	2.1 ± 0.1(-1)
Primary Demin B Outlet	1/18/79	2.2 ± 0.1(-1)

reactor coolant, not mixed with BWST water or circulated through the RHR, is the fraction of the cold reactor coolant volume not contained in the reactor vessel. Its tritium concentration is that of the hot reactor coolant before refueling. A small fraction of reactor coolant was transferred to the reactor coolant drain tank (RCDT) during refueling at the same tritium concentration as the stagnant reactor coolant. Some water was left in the BWST during refueling at the same tritium concentration as before refueling.

After refueling, reactor coolant, SFP, and BWST samples were analyzed for tritium to measure the total change in concentration due to mixing during refueling operations. The water displaced from the reactor coolant due to reactor heatup has the same tritium concentration as the reactor coolant. The total volume included in the plant tritium activity balance is the sum of the BWST, SFP, and cold reactor coolant water volumes.

Samples taken around the reactor coolant processing loop before refueling and analyzed for tritium show no variance from reactor coolant tritium concentration. Samples taken from this loop more than a month after refueling show that the tritium concentration in the reactor coolant and the processing loop is back up to its original concentration. This is primarily due to mixing with water in the reactor coolant processing systems and water in the reactor coolant system that remains stagnant during refueling and the transfer of about 36 Ci to the spent fuel pool and BWST during refueling due to mixing.

7. WASTE GAS PROCESSING AND CONTAINMENT BUILDING VENTILATION SYSTEMS

7.1 Waste Gas Processing System

7.1.1 System Description

The waste gas processing system (WGPS) can collect gas via the waste gas collection header from five different sources: the O_2-N_2 gas analyzer, the boric acid concentrator (BAC), the miscellaneous waste evaporator (MWE), the primary flash tank, and the primary makeup tank. The waste gas collection header is connected to the waste gas surge tank, which in turn feeds the waste gas compressors and the waste gas decay tanks (Figure 7.1). The BAC and MWE are normally valved off from the waste gas header, with the gas going to the radwaste exhaust duct. If it is determined that the gas coming from the BAC or MWE is contributing significantly to the daily plant release, the BAC and MWE off-gases can be valved back to the waste gas header.

The 490 ft waste gas surge tank collects the gas until the high pressure setpoint on the waste gas compressor in service is activated. For waste gas compressor A the high setpoint is 1.3 $\pm$ 0.1 psig and the low setpoint is 0.3 $\pm$ 0.1 psig; for waste gas compressor B the high setpoint is 1.7 $\pm$ 0.1 psig and the low setpoint is 0.7 $\pm$ 0.1 psig. After the high pressure setpoint is reached, the waste gas compressor starts and the gas is pumped to one of the four 450 ft^3 waste gas decay tanks (WGDT's). The gas compressor continues to operate until the pressure in the WGDT is approximately 100 psig or the low setpoint is reached. When the pressure in a WGDT reaches 100 psig, the tank is then isolated and allowed to decay for at least 45 days.

Plant personnel sample the WGDT's prior to release to obtain the concentration of particulates, iodines, noble gases, and tritium. From the analyses a release is calculated. Typically the release flow rate is 3-5 cfm with a recommended maximum rate of 9.5 cfm.

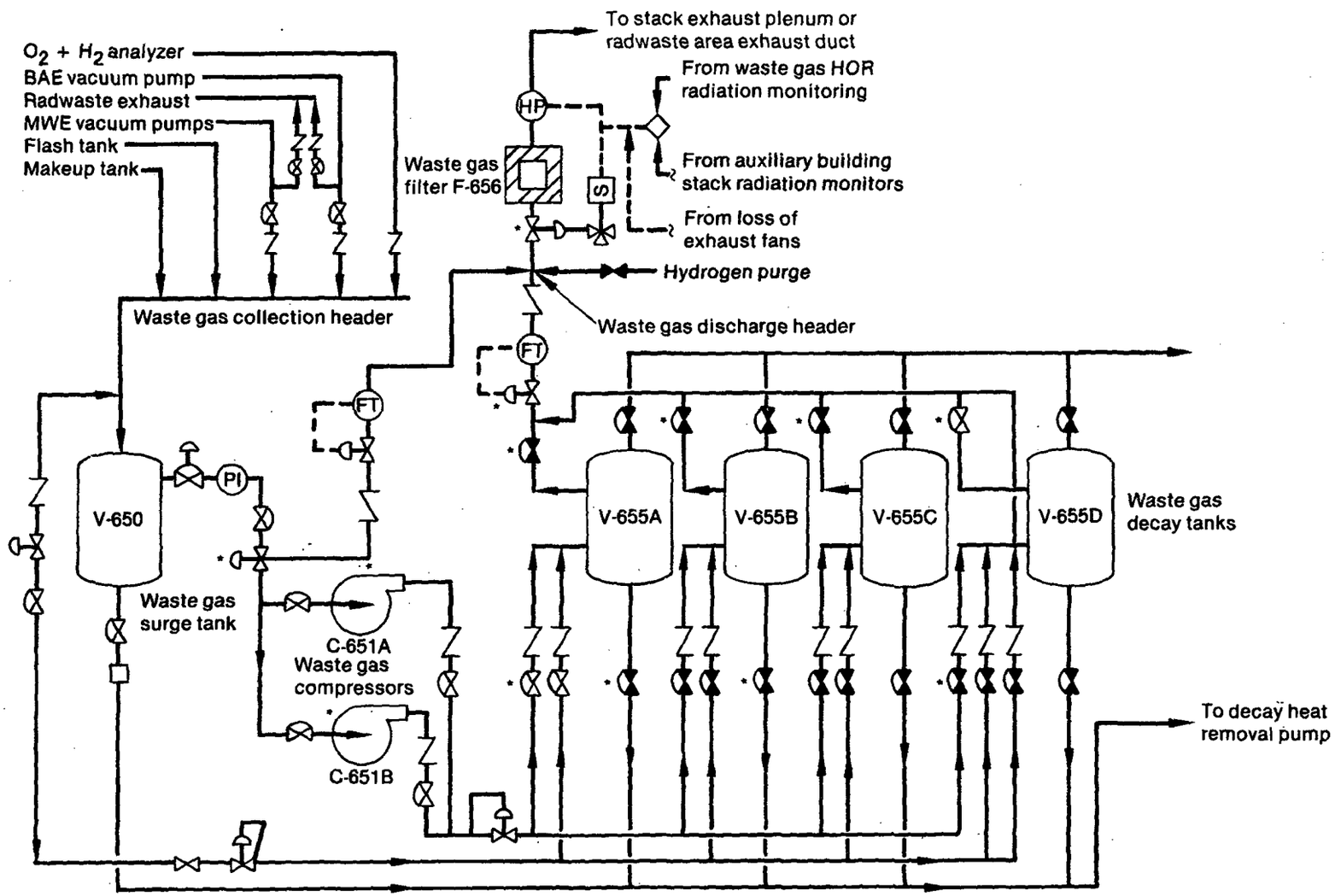
The gas in the WGDT's is released through the waste gas filter (WGF), which is a filter bank composed of: one 24" x 24" x 6" prefilter (Cambridge Aeromold), one 24" x 24" x 11-1/2" HEPA (Cambridge 3MA5), and one 24" x 24" x 26" charcoal bed (Barnebey Cheney BC-727). The gas then goes to the auxiliary building exhaust filters and fans.

7.1.2 Measurement Methods and Data

The types of samples taken from the WGDT's were: particulate-iodine species, ^{14}C and ^{3}H, and noble gases. For a detailed discussion of the analytical methods used and a description of the samples employed refer to references (6,12). Prior to taking the samples, the plant sample lines were purged for at least fifteen minutes. Plant personnel indicated that a fifteen-minute purge was sufficient to completely purge the sample lines.

FIGURE 7.1

DIAGRAM OF WASTE GAS PROCESSING SYSTEM



INEL-A-19 029

* Indicates components whose status is subject to operational changes.

The noble gas samples were collected by filling a 250 cc glass cylinder with sample gas, and then analyzed using the Ge(Li) gamma spectroscopy system in the NRC mobile laboratory. Particulate-iodine species samples were taken by passing approximately 200 liters of sample gas through a particulate-iodine species sampler.(6) The sampler components were then analyzed for gamma-emitting nuclides either in the mobile laboratory or at the INEL. Tritium and ^{14}C samples were collected by using two or three metal gas cylinders hooked in series and having a total volume of 150-225 cm^3. The sample cylinders were flushed with the sample gas for 10 volume changes, filled to the WGDT pressure (80-100 psig) and valved off. These samples were returned to the INEL for analysis.

7.1.3 Results and Discussion

During the measurement period at Rancho Seco, a total of five WGDT samples were taken. All five samples were analyzed for particulates, iodine species, noble gases, and ^{14}C and ^{3}H. The samples were taken between 10/15/78-2/15/79. The samples are of gases which originated before, during, and after refueling.

The WGDT samples taken and the release dates of each tank sampled are shown in Table 7.1. Samples #1-#3, #4, and #5 are of gases that originated before, during, and after refueling, respectively. Table 7.2 presents the concentrations (decay corrected to the time of WGDT release) measured in the WGDT's. From these data, extrapolated annual releases were calculated for particulates, iodine species, noble gases, and ^{14}C and ^{3}H. The following calculation was applied for each radionuclide:

$$R_{WG} = [\Sigma(C_T \times V_T)]/N \times T_Y \times 1.0 \times 10^{-6} \text{ Ci}/\mu\text{Ci}$$

where

R_{WG} = Extrapolated annual release (Ci/year)

C_T = Isotopic concentration in tank ($\mu Ci/cm^3$)

V_T = Gas volume released (cm^3)

N = Number of measurements

T_Y = Tanks released ($year^{-1}$)

In the calculation eleven WGDT releases per year were used, the number released at Rancho Seco in 1978. The gas volumes released were taken from plant data.

Only ^{14}C contributed any significant amount of activity to the plant's annual release, 3.2 percent. The contribution from all other isotopes is negligible (compare Tables 7.2 and 2.4).

TABLE 7.1

WASTE GAS DECAY TANK SAMPLES

Tank	Isolation Date	Sample Date/#	Release Date	Pressure
V655A	9-18-78	10-15-78/1 11-20-78/2	12-6-78	110
V655D	6-2-78	11-3-78/3	11-14-78	90
V655D	12-28-78	2-12-79/4	2-13-79	117
V655A	1-19-79	2-15-79/5	*	128

* Tank not released.

TABLE 7.2

WASTE GAS DECAY TANK ANALYSIS AND EXTRAPOLATED ANNUAL RELEASE

Isotope	Sample #	Concentration, C_T μCi/cc	Volume Released V_T, cc	Total Activity μCi	Avg. Activity μCi	Annual Release,** R_{WG} Ci/year
^{85}Kr	1*	2.1(-3)	1.18(8)	2.5(5)	5.4(5)	5.9(0)
	2	6.2(-4)	1.18(8)	7.3(4)		
	3	4.6(-4)	9.88(7)	4.5(4)		
	4	2.0(-3)	1.24(8)	2.5(5)		
	5	1.3(-2)	1.35(8)	1.8(6)		
^{131m}Xe	1*	8.6(-6)	1.18(8)	1.0(3)	1.4(4)	1.6(-1)
	4	1.14(-4)	1.24(8)	1.4(4)		
^{133}Xe	1*	1.2(-6)	1.18(8)	1.4(2)	3.4(4)	3.7(-1)
	2	5.5(-7)	1.18(8)	6.5(1)		
	3	3.5(-5)	9.88(7)	3.5(3)		
	4	7.8(-4)	1.24(8)	9.7(4)		
^{135}Xe	3	2.9(-6)	9.88(7)	2.9(2)	3.1(2)	3.5(-3)
	4	2.8(-6)	1.24(8)	3.4(2)		
^{3}H	1*	1.7(-6)	1.18(8)	2.0(2)	4.0(2)	4.3(-3)
	2	9.6(-7)	1.18(8)	1.1(2)		
	3	1.6(-6)	9.88(7)	1.6(2)		
	4	4.6(-6)	1.24(8)	5.7(2)		
	5	5.5(-6)	1.35(8)	7.4(2)		
^{14}C	1*	6.5(-4)	1.18(8)	7.6(4)	7.8(4)	8.5(-1)
	2	7.0(-4)	1.18(8)	8.2(4)		
	3	5.5(-4)	9.88(7)	5.4(4)		
	4	3.9(-4)	1.24(8)	4.8(4)		
	5	9.3(-4)	1.35(8)	1.2(5)		
^{134}Cs	1*	1.1(-12)	1.18(8)	1.3(-4)	9.8(-4)	1.1(-8)
	3	6.0(-12)	9.88(7)	5.9(-4)		
	4	1.1(-11)	1.24(8)	1.4(-3)		

TABLE 7.2 (cont'd)

WASTE GAS DECAY TANK ANALYSIS AND EXTRAPOLATED ANNUAL RELEASE

Isotope	Sample #	Concentration, C_T µCi/cc	Volume Released V_T, cc	Total Activity µCi	Avg. Activity µCi	Annual Release,**R_{WG} Ci/year
^{137}Cs	1*	3.8(-12)	1.18(8)	4.5(-4)	1.9(-3)	2.6(-8)
	3	1.4(-11)	9.88(7)	1.4(-3)		
	4	1.9(-11)	1.24(8)	2.4(-3)		
^{58}Co	1*	5.6(-13)	1.18(8)	6.6(-5)	4.6(-3)	5.1(-8)
	4	3.7(-11)	1.24(8)	4.6(-3)		
^{60}Co	1*	1.5(-11)	1.18(8)	1.8(-3)	5.4(-3)	5.9(-8)
	2	4.3(-12)	1.18(8)	5.1(-4)		
	3	4.2(-11)	9.88(7)	4.2(-3)		
	4	1.3(-10)	1.24(8)	1.6(-2)		
	5	5.2(-12)	1.35(8)	7.0(-4)		
^{131}I	1*	6.4(-14)	1.18(8)	7.6(-6)	3.8(-1)	4.2(-6)
	2	5.9(-9)	1.18(8)	7.0(-1)		
	4	5.0(-10)	1.24(8)	6.2(-2)		
^{54}Mn	1*	4.9(-13)	1.18(8)	5.8(-5)	7.6(-4)	8.4(-9)
	4	6.1(-12)	1.24(8)	7.6(-4)		

Note: For sample #5 only values for the long half-life isotopes were used in the Ci/year calculation because the plant release date is unknown, thus not allowing for decay correcting of the short-life isotopes to time of release.

Ci/year is based on an estimated 11 WGDT's released per year.

* Results from this sample not included in average or annual release due to ambiguity concerning which tank actually was sampled.

**No reduction by HEPA and charcoal filters is included.

Iodine species detected in the WGDT's were: I_2, HOI, organic, and particulate. The organic portion was found to be the major iodine species. The following table shows the average percentage and range for the different iodine species.

Species	Average	Range
I_2	22.2%	35-11.2%
HOI	15.4%	24.2-7.3%
Organic	71.4%	92.5-55.5%
Particulate	0.8%	2.3-0.1%

The iodine species distributions for individual samples are shown in Table 7.3. Appendix Tables B.31 and B.32 show the WGDT radionuclide concentrations in each sample. The chemical species of ^{14}C was found to be 90.9% oxidizable (originally nonoxidized) with a range of 95.4-78.5%. The chemical species of ^{3}H was 92.6% oxidizable with a range of 83.3-100%. Individual analyses are shown in Table 7.4.

Tables 7.5 and 7.6 show the Rancho Seco plant release data for the years 1977 and 1978 with release numbers and isotopic release values. These tables were compiled using data obtained from the plant release permits.

7.2 Containment Building Ventilation System

7.2.1 System Description

The Rancho Seco containment building (reactor building) ventilation system is shown schematically in Figure 7.2. The total system consists of the following subsystems:

1. Reactor Building Normal Cooling System
2. Reactor Building Emergency Cooling System
3. Reactor Cavity Supply and Exhaust Systems
4. Lower Reactor Building Circulating Air System
5. Upper Reactor Building Circulating Air System
6. Reactor Building Supply and Exhaust Systems

The lower reactor building circulating air system (A-533-A, B, C, D in Figure 7.2) has four air movers; each has a rated flow of 106,000 cfm. The upper reactor building circulating air system (A-532-A, B, C, D) also has four air movers; each has a rated flow of 25,000 cfm. There are no filters associated with systems A-533 or A-532. The two systems are operational continuously. The reactor cavity supply (A-525-A, B) and

TABLE 7.3

WASTE GAS PROCESSING SYSTEM ^{131}I SPECIES DISTRIBUTION

Tank	Isolation Date	Sample Date	^{131}I Species Fractional Distribution Pf %	I_2 %	HOI %	Org. %	Total (μCi/cm³)
V655A	9-18-78	10-15-78	*	35.0	*	65.0	2.6 ± 0.4(-12)
V655D	6-2-78	11-3-78	*	*	*	*	<6.2(-12)
V655A	9-18-78	11-20-78	0.1	20.3	24.2	55.5	2.56 ± 0.07(-8)
V655D	12-28-78	2-12-79	2.3	11.2	14.8	72.7	4.8 ± 0.3(-10)
V655A	1-19-79	2-15-79	0.2	*	7.3	92.5	4.0 ± 0.2(-10)

*Iodine activity not detected on this sampler component.

TABLE 7.4

WASTE GAS PROCESSING SYSTEM ^{14}C AND ^{3}H SPECIES DISTRIBUTIONS

Tank	Sample Date	Total ^{14}C (μCi/cc)	% Oxidizable	Total ^{3}H (μCi/cm³)	% Oxidizable
V655A	10-15-78	6.5 ± 0.3(-4)	95.2	1.7 ± 0.2(-6)	88.2
V655D	11-3-78	5.5 ± 0.3(-4)	93.7	1.6 ± 0.6(-6)	93.7
V655A	11-20-78	7.0 ± 0.3(-4)	95.4	9.6 ± 0.5(-7)	83.3
V655D	2-12-79	3.9 ± 0.2(-4)	78.5	4.6 ± 0.7(-6)	97.8
V655A	2-15-79	9.3 ± 0.5(-4)	91.6	5.5 ± 1.1(-6)	100

TABLE 7.5

1977 WGDT RELEASES †
(μCi)

Rel #	Volume cc	^{85}Kr	^{131m}Xe	^{133}Xe	^{135}Xe	^{3}H
77-1	1.01(8)	1.4(5)	5.39(2)	1.1(3)		9.88(0)
77-2	9.15(7)	2.58(4)		2.03(3)		1.22(1)
77-3	9.25(7)	4.84(4)	2.91(3)	2.03(3)		9.11(-2)
77-4	1.04(8)	1.51(5)	1.29(3)	2.77(3)		1.49(-1)
77-5	1.11(8)	2.06(5)	1.25(4)	6.06(4)	4.36(2)	3.61(2)
77-6	1.11(8)	1.14(5)		3.23(5)	5.15(4)	1.44(1)
77-7	8.68(7)	3.93(4)	2.54(4)	1.20(5)		7.54(0)
77-8	1.08(8)	1.47(5)	2.23(4)	3.61(4)		6.88(0)
77-9	1.08(8)	1.39(5)	2.48(4)	1.13(5)		
77-10	1.14(8)	9.11(4)	3.18(4)	3.37(3)		1.51(1)
77-11	1.09(8)	4.66(4)	1.08(3)	2.12(2)		
77-12	1.31(8)	2.36(4)	7.76(2)	2.30(2)		1.93(2)
77-13	1.25(8)	3.64(4)		3.11(3)	6.14(1)	7.65(0)
Total Ci/Yr		1.08(0)	1.23(-1)	6.65(-1)	5.20(-2)	6.28(-4)

† Values obtained from plant release permits.

TABLE 7.6

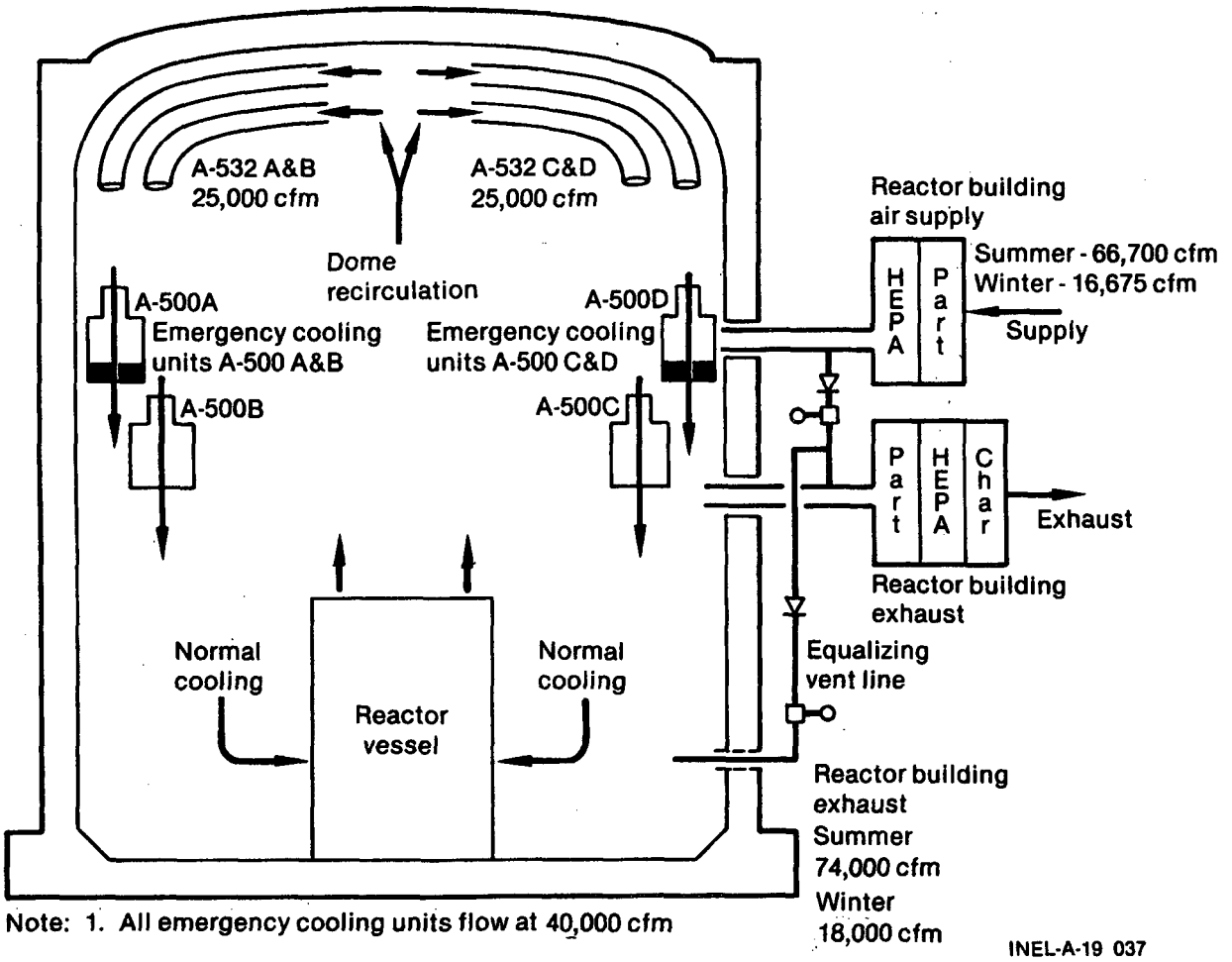
1978 WGDT RELEASES †
(μCi)

Rel #	Volume cc	^{85}Kr	^{131m}Xe	^{133}Xe	^{135}Xe	^{3}H
78-1	*	4.0(5)		1.6(4)		1.85(1)
78-2	*	3.5(5)	2.2(4)	2.4(5)		3.4(1)
78-3	*	3.1(5)	3.7(4)	1.2(5)		2.74(1)
78-4	*	7.8(5)	1.1(5)	2.5(5)	1.3(4)	4.47(1)
78-5	*	9.0(5)	3.8(4)	1.6(4)		3.34(1)
78-6	*	7.4(4)	1.0(4)	8.5(4)	1.6(1)	1.66(1)
78-7	*	1.9(5)	3.9(4)	2.8(5)	3.7(2)	6.73(1)
78-8	*	1.9(5)	6.1(4)	8.3(5)	6.4(2)	2.28(1)
78-9	*	1.8(5)	1.6(4)	5.1(4)		1.45(2)
78-10	*	1.8(4)		4.9(2)		4.16(0)
78-11	*	1.3(5)				1.18(2)
Total Ci/Yr		3.52(0)	3.33(-1)	1.89(0)	1.4(-2)	5.32(-4)

† Values obtained from plant release permits.
* Volumes not available.

FIGURE 7.2

DIAGRAM OF CONTAINMENT BUILDING VENTILATION SYSTEM



Note: 1. All emergency cooling units flow at 40,000 cfm

exhaust (A-531-A, B, C, D) air systems have, respectively, two and four fans. The supply fans are each rated at 28,000 cfm, and the exhaust fans are each rated at 16,000 cfm. The reactor cavity supply and exhaust air systems are operated continuously and regulate air flow around the reactor vessel at 37,000 cfm in the summer and 9250 cfm in the winter. There are six normal cooling units (A-520-A, B, C, D, E, F) in the reactor building, each with a rated flow of 80,000 cfm. Units A-520-A, B, C, D have particulate prefilters, while units A-520-E, F have both prefilters and HEPA filters. Per design, five of the units operate continuously with one in standby; however, during the in-plant measurement program all six units operated continuously. All the above systems are designed to maintain a reactor building temperature of 120°F.

The containment building emergency cooling system (A-500-A, B, C, D) consists of four fans (each 40,000 cfm) and coolers. Two of the units (A-500-C, D) have HEPA filters and two of the units (A-500-A, B) have charcoal filters. The emergency cooling system (ECS) is operated, as needed, to reduce containment building airborne activities; however, operation is limited to times of containment entry or purging and filter testing. At the time of the in-plant measurement program, A-500-A and A-500-B had been operated, respectively, 2900 and 2550 hours (Table 7.7). The exhaust filter (A-536) had been in service at that time, approximately 2700 hours. For a discussion of the decontamination factors, see Section 7.2.3.2.

The containment building supply air system (A-535) has two design flow rates, 66,700 cfm for summer and 16,675 cfm for winter (Table 7.7). The supply air is filtered, in order, by particulate prefilters and HEPA filters. The containment purge exhaust system consists of one single speed fan, rated at 74,000 cfm, and particulate prefilters, HEPA filters and charcoal filters. At the time of the in-plant measurements at Rancho Seco they had been in operation for a total of approximately 2700 hours (Table 7.7).

The containment supply and exhaust air systems are used jointly to purge containment in three operational modes. First, in the vent mode the supply operates at low flow (16,675 cfm) and the exhaust fan is nonoperational. However, a containment exhaust flow of 8000 cfm to the containment stack occurs through the containment vent line. The vent line is only operational in this mode. The second mode of containment purging is the winter mode. In the winter mode the supply fan operates at low flow and the exhaust fan operates at design flow 74,000 cfm. This mode results in a containment exhaust flow of 20,000 cfm. The rest of the air (~54,000) is taken from outside containment air via dampers downstream of the exhaust filters. The third mode of containment purging is the summer mode, where the supply fan is operated at high flow (66,700 cfm) and the exhaust fan operates at 74,000 cfm. The design exhaust flow rate for this mode is 74,000 cfm.

Table 7.8 presents the measured flow rate for each mode of purging. The measurements were performed by helium dilution and/or pitot tube

TABLE 7.7

CONTAINMENT BUILDING FILTER OPERATION

Containment Building Purge Supply System
(A-535)

Fan: Buffalo BL-Aerofoil 980 DIDW w/ variable inlet vanes. Belt driven. Flow rates 66,700 and 16,670 c.f.m.

Filters: Unit has two filter systems in series:

1. 24 each 23-1/2" x 23-1/2" x 2" plus 6 each 23-1/2" x 11-1/2" x 2" frame glass mats (HEPA).
2. 24 each 23-1/2 x 23-1/2 x 36" 535-95 Bag filters and 6 each 23-1/2" x 11-1/2" x 36" 5-34-95 Bag filters (prefilters).

Installation: 8-15-77 for both filters.

Operation: 2680 hrs on 11/3/78

Containment Building Purge Exhaust System
(A-536)

Fan: Buffalo Type BL-Aerofoil size 980 DIDW w/ belt drive. Flow-rate 74,000 c.f.m.

Filters: Exhaust system has three filters; prefilter, HEPA filter and charcoal filter.

1. Prefilter - Cambridge Aeromold, sixteen 24" x 24" x 8-1/2"; arranged 8 wide x 8 high.
2. HEPA filters - sixteen 24" x 24" x 11-1/2"; arranged 8 wide x 8 high.
3. Charcoal filter - Barnebey Cheney - FC 8 wide x 24 high

Installation and Operation:

1. Prefilter and HEPA filters were installed 10/21/74. Based upon breaker hours, they had been in operation for 6882.4 hours on 11/2/78.
2. Charcoal filter installed 8/15/77. Filter in operation 2680 hrs as of 11/3/78.

Containment Building Emergency Cooling System
(A-500-A and A-500-B)

Fan: Joy Manufacturing Co., Axial flow 45° blade setting 25" direct drive. Flow rate - 40,000 c.f.m.

Filter: Charcoal - 42 24" x 24" x 26" filters each unit

Installation: Both filters installed 6/18/74

Operation: Assuming operation based upon breaker hours A-500-A had been in operation 2914.6 hours on 11/2/78 and A-500-B had been in operation 2554.5 hours on 11/2/78.

TABLE 7.8

CONTAINMENT BUILDING DESIGN AND MEASURED EXHAUST FLOW FOR VENTING, WINTER AND SUMMER MODES

Mode	Design* cfm	Measured (cfm)
1. Venting	8000	8000 **
2. Winter	20,000	36,500 †
3. Summer	74,000	78,900 †
		81,000 ††

* From plant specifications.

** Plant measured value.

† Pitot tube measurement.

†† Helium dilution measurement.

techniques (6). The better than 3% agreement between the pitot tube and helium dilution techniques at the exhaust sample point indicates good mixing of exhaust air in the duct. The pitot tube measured flows have been employed in calculations in this report.

7.2.2 Measurement Methods and Data

During the in-plant measurement study at Rancho Seco, samples were taken from the containment building atmosphere; the exhaust purge duct, both before and after the exhaust filters; and the containment building stack. Additionally, samples were taken across the emergency cooling system charcoal filters. These samples, except as noted, were collected using existing plant sampling lines and were analyzed for particulates, radioiodine species, ^{14}C, ^{3}H, and/or noble gases using the methods outlined in reference 6.

Table 7.9 lists the containment building purges that occurred during the in-plant measurements at Rancho Seco. Also included are the exhaust flow rates from the containment and the plant release number for each purge. As indicated, the exhaust flow was changed on two occasions during a purge, i.e., purges 78-12 and 78-14. For these purges appropriate corrections, based on the duration of each flow rate, were applied in the annual release calculations. In some cases the release number was changed without an actual purge stoppage. For example, for releases 78-17 through 78-19 three releases are recorded, but, actually the purge was continuous.

The dates of the particulate-iodine species samples taken from the containment atmosphere and the containment stack are presented in Tables 7.10 and 7.11, respectively. The data are in Appendix Tables B.74-B.75. Particulate-iodine species samples taken across the containment exhaust system and the emergency cooling system (ECS) charcoal filters are taken from Appendix Tables B.76-B.77 and B.78-B.79, respectively. The samples taken across the filters were collected using sampling locations immediately upstream and downstream of the charcoal filters. Dates for these samples are given in Table 7.12. The particulate-iodine species samplers used in this study are detailed in reference 6. Basically, they consist of, in order of flow, HEPA filters, I_2, HOI, and organic iodine adsorption media.

Two different methods were used to collect noble gas samples. The first method uses an evacuated 250 cm^3 glass cylinder (6) while the second employs a cryogenic air sampler (CAS). The CAS's operation is described in more detail in reference 13; but basically the noble gases are concentrated in liquid oxygen, distilled and collected. The CAS was used to collect samples from the containment building exhaust stack and the 250 cc glass gas cylinders were used for noble gas containment atmosphere sampling. Tables 7.13 and 7.14 list the dates and times that the containment building stack and atmosphere samples were taken. The corresponding data are in Appendix Tables B.80-B.81.

TABLE 7.9

CONTAINMENT BUILDING PURGES AND EXHAUST FLOW RATES*

Start		Stop		Exhaust Flow Rate cfm	Plant Purge Release No.
Date	Time	Date	Time		
9/8/78	1611	9/11/78	1250	36,500	78-10
9/15/78	1708	9/16/78	1122	36,500	78-11
10/13/78	1437	10/14/78	2030	8,000	78-12 †
10/14/78	2030	10/15/78	0429	36,500	78-12 †
10/20/78	1502	10/21/78	1421	36,500	78-13
10/27/78	1416	10/29/78	0056	8,000	78-14 †
10/29/78	0056	11/1/78	0900	36,500	78-14/15 †
11/1/78	0900	11/12/78	2330	78,900	78-15/16
11/14/78	1145	12/3/78	1730	78,900	78-17/19
12/7/78	1440	12/14/78	0905	36,500	78-20
12/14/78	0905	12/21/78	0829	78,900	78-21
1/17/79	1155	1/20/79	1630	36,500	79-1
2/23/79	1222	2/25/79	1820	36,500	79-2

* Pitot tube measured flow rates except the 8000 cfm which was measured by the plant staff.

† Denotes containment exhaust flow rate changes during release.

TABLE 7.10

CONTAINMENT BUILDING ATMOSPHERE IODINE SPECIES SAMPLES

	Start Date	Start Time	Stop Date	Stop Time	Sample Before Purge (1)	Purge After Sample (3)	Comments
	9/8/78	1025	9/8/78	1128	78-10	78-10/11	
	10/12/78	1119	10/12/78	1200	78-12	78-12/13	
	10/12/78	1610	10/12/78	1645	78-12	78-12/13	ECS Startup (4)
	10/26/78	1908	10/26/78	2008	78-14	78-14/19	
(7)	11/18/78	1030	11/19/78	0712	78-17/19 (2)	78-17/21	
	1/8/79	1321	1/8/79	1521	79-1	79-1	
	1/17/79	1001	1/17/79	1123	79-1	79-1	
	1/23/79	1409	1/24/79	1445	79-2	79-2	
	1/24/79	1545	1/25/79	0950	79-2	79-2	
	1/25/79	1000	1/26/79	1015	79-2	79-2	
	2/4/79	1314	2/5/79	1407	79-2	79-2	
	2/5/79	1506	2/6/79	0900	79-2	79-2	
	2/6/79	1122	2/6/79	1510	79-2	79-2	ECS Started (5)
	2/6/79	1510	2/6/79	2205	79-2	79-2	
	2/6/79	2205	2/7/79	0903	79-2	79-2	
	2/7/79	0906	2/7/79	1452	79-2	79-2	
	2/7/79	1457	2/8/79	0910	79-2	79-2	
	2/8/79	0913	2/9/79	0850	79-2	79-2	
	2/9/79	0857	2/9/79	1055	79-2	79-2	ECS Stopped (6)
	2/9/79	1055	2/9/79	1558	79-2	79-2	
	2/9/79	1600	2/10/79	0845	79-2	79-2	
	2/10/79	0845	2/11/79	0829	79-2	79-2	
	2/11/79	0834	2/12/79	0836	79-2	79-2	
	2/12/79	0841	2/13/79	0840	79-2	79-2	
	3/6/79	1200	3/7/79	1135	79-3	79-3	

(1) The purge immediately follows the sample.

(2) Sample taken during purge.

(3) Purges after the sample but before the next sample.

(4) Emergency Cooling Systems A-500-A,B started 10/12/79 at 1503 hours; stopped 10/12/79 at ≃ 1903 hours.

(5) Emergency Cooling System A-500-A started 2/6/79 at 1014 hours.

(6) Emergency Cooling System A-500-A stopped 2/9/79 at 0857 hours.

(7) Sample taken inside containment prior to reactor vessel head removal.

TABLE 7.11

CONTAINMENT STACK PARTICULATE-IODINE SPECIES SAMPLES

Sample Interval				
Start		Stop		
Date	Time	Date	Time	Comments
10/27/78	1225	11/9/78	0915	During Purges 78-14/16
11/9/78	0918	11/20/78	1635	During Purges 78-15/19
11/20/78	1645	2/7/78	0905	During Purges 78-17/19
12/7/78	1225	12/21/78	1225	During Purges 78-20/21

TABLE 7.12

CHARCOAL FILTER PARTICULATE-IODINE SPECIES SAMPLES

Sample Interval				
Start		Stop		
Date	Time	Date	Time	Comments
10/30/78	1534	11/2/78	1334*	During Purge 78-14/15 †
11/6/78	0958	11/13/78	1234*	During Purge 78-17/19
1/19/79	0940	1/20/79	1728*	During Purge 79-1 ††
11/2/78	1645	11/9/78	1545**	
11/9/78	1545	11/16/78	0930**	

* Simultaneous samples upstream and downstream of the containment exhaust filters.

** Simultaneous samples upstream and downstream of the ECS charcoal filters.

† Sampler ran 13 hours and 4 minutes after purge 78-15 was stopped.

†† Sampler ran 58 minutes after purge 79-1 was stopped.

TABLE 7.13

CONTAINMENT BUILDING STACK NOBLE GAS SAMPLES

Sample Intervals

Start		Stop		Start		Stop	
Date	Time	Date	Time	Date	Time	Date	Time
10/24/78	1541	10/25/78	0941	11/17/78	1200	11/18/78	0900
10/25/78	1430	10/26/78	0930	11/18/78	1200	11/19/78	0900
10/26/78	1130	10/27/78	0730	11/19/78	1200	11/20/78	0900
10/27/78	1000	10/28/78	0800	11/20/78	1200	11/21/78	0900
10/28/78	1000	10/29/78	0800	11/21/78	0900	11/28/78	0800
10/29/78	1000	10/30/78	0800	11/28/78	1200	11/29/78	0900
10/30/78	1000	10/31/78	0800	11/29/78	1200	11/30/78	0900
10/31/78	1100	11/1/78	0900	11/30/78	1200	12/5/78	1300
11/1/78	1100	11/2/78	0900	12/5/78	1200	12/6/78	0900
11/2/78	1500	11/3/78	0900	12/6/78	1200	12/7/78	0900
11/3/78	1100	11/4/78	0900	12/7/78	1200	12/8/78	0900
11/4/78	1100	11/5/78	0900	12/8/78	1200	12/9/78	0900
11/5/78	1100	11/6/78	0900	12/9/78	1200	12/12/78	0900
11/6/78	1100	11/7/78	0900	12/12/78	1200	12/13/78	0900
11/7/78	1830	11/8/78	0830	12/13/78	1800	12/14/78	0900
11/8/78	1200	11/9/78	0900	12/14/78	1300	12/19/78	0900
11/9/78	1200	11/10/78	0900	12/19/78	1200	12/20/78	0900
11/10/78	1200	11/11/78	0900	12/20/78	1400	12/21/78	0900
11/11/78	1200	11/12/78	0900	1/17/79	1200	1/18/79	0900
11/12/78	1200	11/13/78	0900	1/18/79	1200	1/19/79	0900
11/13/78	1200	11/14/78	0900	1/19/79	1200	1/20/79	0600
11/14/78	1200	11/15/78	0900	1/20/79	1200	1/21/79	0800
11/15/78	1200	11/16/78	0900				
11/16/78	1200	11/17/78	0900				

TABLE 7.14

CONTAINMENT BUILDING ATMOSPHERE NOBLE GAS SAMPLES

Sample Interval	
Date	Time
9/7/78	1402
9/8/78	1130
10/12/78	1127*
10/12/78	1608*
10/26/78	2010
1/9/79	1120
2/9/79	0855†
2/9/79	1610†
2/12/79	0840
2/13/79	0845

* Emergency Cooling System started 10/12/78 at 1503 hours; stopped 10/12/78 at ≃ 1903 hours.

† Emergency Cooling System operational between 2/6/79 (1014 hours) and 2/9/79 (0857 hours).

Tritium and ^{14}C samples of the containment building atmosphere and stack are presented in Table 7.15 (Appendix Tables B.82-B.83). The ^{14}C and ^{3}H sampler and associated analytical techniques are reported fully in reference 12.

7.2.3 Results and Discussion

7.2.3.1 Containment Building Reactor Coolant Leakage Rates, Partition Factors, and Iodine Species

The measured ^{131}I, ^{133}I, and ^{135}I species distributions in the containment building atmosphere are given in Tables 7.16-7.18. With the exception of the 11/18/79 sample, all samples were taken before or after the refueling interval. Table 7.19 presents the average iodine chemical species distributions and ranges for the intervals before and after refueling. As indicated the iodine chemical species are predominantly organic during these time periods. However, in general, it should be observed that the shorter-lived radioiodines ^{133}I and ^{135}I are less organic than ^{131}I. This is consistent with other data (2-4,14,15) which indicates the longer the average life of the radioiodine the more highly converted to the organic species. In other words, the further away in time the radioiodine is from the source (reactor coolant) the more organic it is. Since the ^{131}I exists longer, it has more time to convert. This can be seen from the 11/18/78 and refueling interval samples (Table 7.20). In these samples, the higher elemental percentages indicate radiochemical iodine (I_2) closer, in time, to the reactor coolant source. Since these samples were returned to INEL no short-lived radioiodines were detected, due to radioactive decay. The data presented in Table 7.20 were derived from Appendix Table B.75.

Radionuclide releases from the containment building via the gaseous pathway are a function of reactor coolant concentration, coolant leak rate, partitioning of the radionuclide between coolant and containment atmosphere, losses due to deposition on surfaces, and filtration if any.

An effective leak rate (LR) can be defined which includes the effects of partitioning and deposition. As a first approximation, this leak rate can be defined as follows:

$$LR = LR^* f_p f_d \qquad (1)$$

where:

LR^* = real leak rate of a radionuclide from coolant to containment

f_p = fraction which becomes airborne due to the partitioning of the radionuclide between liquid and vapor states

f_d = fraction of the radionuclide which remains airborne after the deposition-resuspension process.

It remains for future work to determine the real leak rate LR* and losses due to partitioning and deposition. For the purposes of this report it

TABLE 7.15

^{3}H AND ^{14}C CONTAINMENT ATMOSPHERE AND STACK SAMPLES

Containment Atmosphere				Containment Stack			
Sample Interval				Sample Interval			
Start		Stop		Start		Stop	
Date	Time	Date	Time	Date	Time	Date	Time
9/7/78	1405	9/8/78	0835	10/27/78	1225	11/9/78	0915
1/8/79	1321	1/9/79	1120	11/9/78	0918	11/20/78	1735
1/23/79	1404	1/26/79	1015	11/20/78	1810	12/7/78	0905
2/5/79	1506	2/6/79	0900	12/7/78	1225	12/21/78	1221
2/8/79	0910	2/9/79	0855				

TABLE 7.16

CONTAINMENT BUILDING ATMOSPHERE ^{131}I SPECIES

Sample Start Date/Time	^{131}I species fractional distribution (%)				Total ^{131}I ($\mu Ci/cm^3$)
	Particulate	I_2	HOI	Organic	
9/8/78-1025	*	2.39	9.47	88.14	2.09 ± 0.03(-8)
10/12/78-1119	*	3.50	27.27	69.23	1.43 ± 0.04(-9)
10/12/78-1610	*	*	53.33	46.67	1.5 ± 0.1(-10)
10/26/78-1908	*	10.56	65.66	23.79	1.13 ± 0.02(-9)
11/18/78-1030	10.34	47.13	35.06	7.47	1.74 ± 0.05(-10)
1/8/79-1321	0.64	2.90	6.86	89.60	3.21 ± 0.01(-8)
1/17/79-1001	0.81	2.55	10.04	86.59	1.10 ± 0.01(-8)
1/23/79-1409	1.34	3.48	2.73	92.46	5.24 ± 0.01(-8)
1/24/79-1545	3.07	3.07	4.87	88.99	2.59 ± 0.01(-8)
1/25/79-1000	1.42	2.04	3.05	93.49	3.38 ± 0.01(-8)
2/4/79-1314	1.07	1.17	7.18	90.58	1.23 ± 0.01(-8)
2/5/79-1506 **	2.22	6.16	7.14	84.47	3.56 ± 0.01(-9)
2/6/79-1122 †	31.12	8.52	9.24	51.12	2.09 ± 0.02(-9)
2/6/79-1510	31.70	11.06	12.00	45.24	1.61 ± 0.02(-9)
2/6/79-2205	25.69	12.36	11.27	50.67	1.56 ± 0.01(-9)
2/7/79-0906	31.91	10.75	12.82	44.52	1.40 ± 0.02(-9)
2/7/79-1457	30.70	13.33	9.61	46.36	1.29 ± 0.01(-9)
2/8/79-0913	22.54	14.07	12.31	51.08	1.25 ± 0.01(-9)
2/9/79-0857 ††	26.32	8.83	18.54	46.31	1.25 ± 0.02(-9)
2/9/79-1055	23.35	10.25	16.39	50.00	1.34 ± 0.02(-9)
2/9/79-1600	3.52	10.78	10.18	75.53	4.69 ± 0.04(-9)
2/10/79-0845	4.20	6.85	13.77	75.19	3.05 ± 0.02(-9)
2/11/79-0834	2.74	6.36	6.81	84.09	7.39 ± 0.06(-9)
2/12/79-0841	1.67	4.61	9.67	84.05	8.28 ± 0.05(-9)
3/6/79-1200	1.31	2.62	8.15	87.92	5.11 ± 0.01(-8)

* No activity detectable

** Sample validity is questionable due to moisture in sampler.

† Emergency cooling system filter, A-500-A, started 2/6/79 at 1014 hours.

†† Emergency cooling system filter, A-500-A, stopped 2/9/79 at 0857 hours.

TABLE 7.17

CONTAINMENT BUILDING ATMOSPHERE ^{133}I SPECIES

Date/Time	^{133}I species fractional distribution (%)				Total ^{133}I ($\mu Ci/cm^3$)
	Particulate	I_2	HOI	Organic	
9/8/78-1025	*	2.28	11.25	85.47	7.0 ± 0.1(-9)
10/12/78-1119	*	6.72	29.10	64.18	1.3 ± 0.1(-9)
10/12/78-1610	*	*	49.65	50.35	1.4 ± 0.2(-10)
10/26/78-1908	*	9.59	76.03	14.38	6.0 ± 0.2(-10)
11/18/78-1030	*	*	*	*	*
1/8/79-1321	1.22	3.78	9.04	85.97	1.08 ± 0.01(-8)
1/17/79-1001	0.98	1.94	8.28	88.81	1.34 ± 0.01(-8)
1/23/79-1409	2.63	6.16	5.54	85.67	1.12 ± 0.01(-8)
1/24/79-1545	5.14	6.29	10.18	78.40	3.93 ± 0.04(-9)
1/25/79-1000	3.27	4.27	7.24	85.22	7.73 ± 0.04(-9)
2/4/79-1314	2.02	2.43	13.91	81.64	6.54 ± 0.03(-9)
2/5/79-1506 **	2.65	8.19	9.81	79.35	2.04 ± 0.02(-9)
2/6/79-1122 †	24.59	9.24	11.18	55.02	1.34 ± 0.03(-9)
2/6/79-1510	20.92	11.49	13.33	54.25	1.30 ± 0.08(-9)
2/6/79-2205	15.78	13.33	10.81	60.08	1.35 ± 0.02(-9)
2/7/79-0906	22.20	12.03	12.03	53.75	1.08 ± 0.03(-9)
2/7/79-1457	21.82	13.91	9.45	54.82	1.10 ± 0.01(-9)
2/8/79-0913	15.17	14.34	13.76	56.72	1.21 ± 0.01(-9)
2/9/79-0857 ††	15.70	10.99	20.41	52.91	1.27 ± 0.03(-9)
2/9/79-1055	13.82	11.42	18.18	56.59	1.38 ± 0.03(-9)
2/9/79-1600	2.89	11.32	9.71	76.08	5.57 ± 0.05(-9)
2/10/79-0845	3.20	6.32	14.50	75.97	2.44 ± 0.02(-9)
2/11/79-0834	2.70	8.48	7.67	81.13	7.44 ± 0.04(-9)
2/12/79-0841	1.83	5.57	11.39	81.20	8.08 ± 0.06(-9)
3/6/79-1200	*	*	*	*	*

* No detectable activity.

** Sample validity is questionable due to moisture in sampler.

† Emergency cooling system filter, A-500-A, started 2/6/79 at 1014 hours.

†† Emergency cooling system filter, A-500-A, stopped 2/9/79 at 0857 hours.

TABLE 7.18

CONTAINMENT BUILDING ATMOSPHERE ^{135}I SPECIES

Date/Time	^{135}I species fractional distribution (%)				Total ^{135}I ($\mu Ci/cm^3$)
	Particulate	I_2	HOI	Organic	
9/8/78-1025	*	*	*	*	*
10/12/78-1119	*	*	26.83	73.17	8 ± 1(-10)
10/12/78-1610	*	*	*	100.00	7 ± 2(-11)
10/26/78-1908	*	*	*	*	*
11/18/78-1030	*	*	*	*	*
1/8/79-1321	*	22.22	*	77.78	1.8 ± 0.6(-9)
1/17/79-1001	5.10	2.04	22.96	69.89	2.0 ± 0.1(-9)
1/23/79-1409	5.39	14.11	11.62	68.88	2.4 ± 0.1(-9)
1/24/79-1545	6.78	8.47	14.41	70.34	1.2 ± 0.1(-9)
1/25/79-1000	8.37	7.44	15.81	68.37	2.2 ± 0.1(-9)
2/4/79-1314	3.55	6.46	22.61	67.38	2.2 ± 0.1(-9)
2/5/79-1506 **	4.34	11.12	4.45	80.09	4.5 ± 0.3(-10)
2/6/79-1122 †	32.65	12.24	*	55.10	4.9 ± 0.8(-10)
2/6/79-1510	20.00	7.50	*	72.50	4.0 ± 0.4(-10)
2/6/79-2205	18.81	15.36	*	65.83	6.4 ± 0.4(-10)
2/7/79-0906	15.63	*	*	84.38	3.2 ± 0.5(-10)
2/7/79-1457	16.98	11.32	7.55	64.15	5.3 ± 0.4(-10)
2/8/79-0913	13.82	18.43	7.68	60.06	6.5 ± 0.5(-10)
2/9/79-0857 ††	13.75	5.0	22.50	58.75	8.0 ± 0.9(-10)
2/9/79-1055	17.74	17.74	*	64.52	6.2 ± 1.1(-10)
2/9/79-1600	3.15	12.93	11.36	72.56	3.2 ± 0.1(-9)
2/10/79-0845	*	7.65	5.84	86.52	5.0 ± 0.5(-10)
2/11/79-0834	3.87	11.08	9.02	76.03	3.9 ± 0.1(-9)
2/12/79-0841	2.17	6.41	16.20	75.19	3.0 ± 0.1(-9)
3/6/79-1200	*	*	*	*	*

* No activity detectable.

** Sample validity is questionable due to moisture in sampler.

† Emergency cooling system filter, A-500-A, started 2/6/79 at 1014 hours.

†† Emergency cooling system filter, A-500-A, stopped 2/9/79 at 0857 hours.

TABLE 7.19

CONTAINMENT BUILDING ATMOSPHERE IODINE SPECIES AVERAGES ††

Number of Samples	Nuclide	Particulate (%)		I_2 (%)		HOI (%)		Organic (%)		Average Total Iodine ($\mu Ci/cm^3$)
		Avg	Range	Avg	Range	Avg	Range	Avg	Range	
					Before Refueling					
3	^{131}I	*	*	5.5	0-10.56	34.1	9.5-65.7	60.4	23.8-88.1	7.5(-9)
3	^{133}I	*	*	6.2	2.3-9.6	38.8	11.2-76.0	54.7	14.4-85.5	2.8(-9)
2	^{135}I**	*	*	*	*	13.4	0-26.8	86.6	73.2-100	4.4(-10)
					After Refueling †					
9	^{131}I	1.5	0.6-3.0	3.2	1.2-4.6	7.7	2.7-10.0	88.7	84.0-93.5	2.6(-8)
8	^{133}I	2.5	1.0-5.1	4.8	1.9-8.2	9.4	5.5-13.9	83.3	78.4-88.8	8.6(-9)
8	^{135}I	5.1	2.2-8.4	9.8	2.0-22.2	15.4	4.4-23.0	72.2	67.4-80.1	2.3(-9)

* No detectable activity.

** ^{135}I samples prior to refueling show only one sample with any species distribution.

† Only samples taken during steady-state operation are used in calculations. Samples taken during the test of the containment building emergency cooling system and other noted samples are not used.

†† Lower limit of detection values are not included in the calculations.

TABLE 7.20

CONTAINMENT BUILDING EXHAUST STACK IODINE SPECIES**
(During Refueling)

Date Start/Stop	^{131}I species fractional distribution (%)				Total ^{131}I ($\mu Ci/s$)†
	Particulate	I_2	HOI	Organic	
10/27-11/9/78	8.7	55.8	*	35.6	5.2 ± 0.8(-5)
11/9-11/20/78	22.9	*	*	77.1	2.4 ± 0.5(-5)
11/20-12/7/78	8.0	7.4	31.9	52.7	1.9 ± 0.5(-6)
12/7-12/21/78	9.8	26.8	*	63.4	2.5 ± 1.0(-6)

* ND - Activity not detectable

** Samples obtained downstream of charcoal filters.

† Release rates based on 78,900 cfm.

suffices to estimate the effective leak rate from measured concentrations of radionuclides in the containment atmosphere. Equation 2 defines the LR as a fraction of the quantity available for leakage which leaks per unit time.

$$\frac{\left(\frac{C_c \times V_c}{1-e^{-\lambda \Delta t}}\right)}{C_R \times V_R} (100\%) - LR \qquad (2)$$

where

C_c = Concentration of nuclide in containment atmosphere ($\mu Ci/cm^3$)

V_c = Free volume of containment (cm^3) - 5.6(10)

Δt = Time between prior purging and sample time (days)

λ = Radionuclide decay constant (day^{-1})

C_R = Concentration of nuclide in primary coolant ($\mu Ci/cm^3$)

V_R = Volume of primary coolant (cm^3) - 3.3(8)

LR = Percent nuclear inventory in primary coolant leakage to containment atmosphere per day (percent per day)

During refueling equation 2 is not applicable because the containment is being purged continuously. A more applicable equation for ^3H and ^{131}I reactor coolant leakage rates during purge is

$$LR = \frac{C_A \times (DF) \times 1440 \text{ min/day} \times 60 \text{ sec/min}}{C_R \times V_R} \times 100\% \qquad (3)$$

where C_A is the radionuclide release rate ($\mu Ci/s$) from the containment building stack and (DF) is the containment building exhaust filter DF. Decontamination factors of 88 and 1 were used, respectively, for ^{131}I and ^3H. Other terms in equation (3) are the same as defined above for equation (2).

Tables 7.21 and 7.22 present, respectively, the effective leakage rates into the containment building during non-refueling and refueling intervals. Leakage rates during power operations (Table 7.21) were calculated using measured radionuclide concentrations in the containment atmosphere. Leakage rates during refueling (Table 7.22), on the other hand, were calculated using release rates from the containment building stack. These containment building stack release rates were converted to

TABLE 7.21

LEAKAGE RATE TO CONTAINMENT BUILDING DURING POWER OPERATIONS
(% Reactor Coolant Inventory Leakage per Day)[1]

Sample Date	Previous Purge (days)	^{131}I	^{133}I	^{135}I	^{3}H
9/8/78[2]	47.6	2.19(-3)	1.69(-3)	3	4.9(-3)
10/12/78	16.0	1.45(-4)	3.68(-4)	5.43(-4)	
10/12/78[5]	16.2	1.51(-5)	3.85(-5)	4.75(-5)	
10/26/78	5.2	1.33(-4)	1.51(-4)	3	
1/8/79[6]	18.3	3.54(-3)	3.64(-3)	1.85(-3)	5.1(-3)
1/17/79	27.2	2.09(-3)	5.97(-3)	1.90(-3)	
1/23/79	2.9	2.10(-2)	4.36(-3)	2.67(-3)	
1/24/79	4.0	1.78(-2)	1.51(-3)	1.31(-3)	
1/25/79	4.7	1.37(-2)	3.93(-3)	2.45(-3)	3.2(-2)
2/4/79	14.9	2.4(-3)	2.97(-3)	1.99(-3)	
2/5/79	16.0	6.68(-4)	1.01(-3)	4.41(-4)	4.7(-5)[4]
2/12/79	23.7	1.54(-3)	3.22(-3)	2.59(-3)	
3/6/79	8.7	1.69(-2)	3	3	
Avg		6.3(-3)	2.4(-3)	1.6(-3)	1.0(-2)

1. Only samples taken during containment steady-state operations are used, i.e., no purges.
2. Sample taken 4 days after power level change.
3. No detectable activity due to decay before analysis.
4. Sample taken 2/5/79 prior to operation of reactor building emergency cooling system A-500-A. Sample taken 2/9/79 after emergency cooling system operation yielded a leak rate of 5.9(-5).
5. Sample taken during operation of emergency cooling system.
6. Sample taken 2 days after power level change.

TABLE 7.22

LEAKAGE RATE TO CONTAINMENT BUILDING DURING REFUELING
(% Reactor Coolant Inventory Leakage Per Day)

Sample Date	^{131}I	^{3}H
10/27/78 - 11/9/78	7.5(-3)	1.0(-1)
11/9/78 - 11/20/78	9.3(-4)	1.6(-1)
11/20/78 - 12/7/78	6.2(-4)	3.4(-1)
12/7/78 - 12/21/78	4.1(-3)	3.6(-2)
Avg.	3.3(-3)	1.6(-1)

release rates into the containment atmosphere by multiplying them by the containment building exhaust filter DF's. The leakage rates presented in Tables 7.21 and 7.22, therefore, are directly comparable. To calculate these leakage rates, data from Tables 7.16-7.18 and B.82 (power operations) and Tables 7.20 and B.83 (refueling period) were used. Reactor coolant concentrations were obtained from Tables 8.5 and 8.11.

During refueling, reactor coolant is open to the containment atmosphere and one might expect higher ^{3}H release rates. Comparison of Tables 7.21 and 7.22 indicates that, as expected, the ^{3}H leakage rate during refueling was higher (by a factor of 16) than during non-refueling periods.

It is interesting to note that in Table 7.21 the effective release rates for iodine radionuclides with long half lives were greater than that for the short-lived radioiodines. The reason for this is most likely that the shorter-lived radionuclides were reduced more by radioactive decay during the deposition-resuspension process than were the longer-lived radionuclides.

7.2.3.2 HEPA and Charcoal Filter Decontamination Factors

Particulate-iodine species samples were collected directly across the containment emergency cooling system filters (ECS) and the exhaust system charcoal filters. Additionally, containment atmosphere samples were collected before, during, and after the operation of the ECS system.

At the time of the decontamination factor (DF) measurements across the ECS and exhaust charcoal filters, the filters had been in service approximately 2900 and 2700 hours, respectively. Past operation histories of formerly used charcoal filters and of filters in service at the time of the source term measurements are shown in Table 7.23. Based on the operational hours of the filters in service and on efficiency tests carried out with CH_3I in the laboratory (see Figure 8.6), DF's of 37, 42 and 36 might be expected for charcoal filters A-500-A, A-500-B and A-536, respectively. The measured DF's are presented in Tables 7.25 and 7.27 with the corresponding inlet, outlet, and species distributions shown in Tables 7.24 and 7.26. These data are taken from Appendix Tables B.76-B.79. As indicated, the actual average DF for filter A-500-A was 24 for organic ^{131}I. This is considered good agreement. For filter A-536 the average ^{131}I organic iodine DF was 254. The predicted methyl iodide DF of 36 is not considered good agreement. The good agreement between laboratory and field measurements for filter A-500-A and the poor agreement for filter A-536 may be due to relative humidity (RH) conditions. For laboratory tests the RH is held at 95%. The RH during the A-500-A test was more likely to be near 95% than was the RH during the A-536 test because supply air is provided during purging.

Another reason the iodine DF for the emergency cooler A-500-A was lower than the DF for the purge exhaust filter can be related to age. The purge exhaust filter was installed on 8/15/77 and the emergency

TABLE 7.23

CONTAINMENT CHARCOAL FILTER OPERATIONAL HISTORIES

Date	DF	Operational Hours	Eff
Emergency Cooling System			
Filter A-500-B			
10/6/76	63.3	2748.6	98.42
8/11/77	63.3	2837.4	98.42
Filter A-500-A			
10/6/76	56.82	2390.6	98.24
8/11/77	75.19	2477.7	98.67*
Containment Exhaust System			
Filter A-536			
2/10/77	12.64	3300	92.09
8/4/77	12.39	4175	91.93
8/4/77	1000.	0	99.9 *

* In service at time of source term measurement program at Rancho Seco. The A-500-A, A-500-B, and A-536 filters had been in service, respectively, 2900, 2550, and 2680 hours at time of source term measurement program.

TABLE 7.24

CONTAINMENT BUILDING EMERGENCY COOLING FILTER A-500-A

IODINE SPECIES ($\mu Ci/cm^3$)

Nuclide	Particulate	I_2	HOI	Organic	Total Iodine
Filter inlet, sample period: 11/2-11/9/78					
^{131}I	2.58 ± 0.03(-11)	1.58 ± 0.02(-10)	3.79 ± 0.03(-11)	6.49 ± 0.06(-11)	2.87 ± 0.02(-10)
^{133}I	3.89 ± 0.07(-11)	8.4 ± 0.2(-11)	4.2 ± 0.1(-11)	6.3 ± 0.1(-11)	2.28 ± 0.02(-10)
^{135}I	4.1 ± 0.4(-11)	3.8 ± 0.4(-11)	2.0 ± 0.3(-11)	2.4 ± 0.4(-11)	1.23 ± 0.08(-10)
Filter outlet, sample period: 11/2-11/9/78					
^{131}I	1.06 ± 0.01(-11)	5.1 ± 0.1(-12)	1.6 ± 0.3(-13)	2.0 ± 0.6(-12)	1.79 ± 0.06(-11)
^{133}I	2.17 ± 0.05(-11)	4.2 ± 0.3(-12)	<5.4(-13)	9.8 ± 0.1(-13)	>2.7(-11)
^{135}I	2.1 ± 0.3(-11)	<1.1(-12)	<1.5(-12)	<1.6(-12)	>2.5(-11)
Filter inlet, sample period: 11/9-11/16/78					
^{131}I	9.23 ± 0.08(-11)	3.46 ± 0.02(-10)	4.31 ± 0.04(-11)	1.41 ± 0.02(-10)	6.23 ± 0.03(-10)
^{133}I	1.00 ± 0.02(-10)	3.29 ± 0.05(-10)	4.6 ± 0.1(-11)	1.44 ± 0.02(-10)	6.19 ± 0.05(-10)
^{135}I	<1.5(-11)	<2.6(-11)	<1.8(-11)	3 ± 1(-11)	>8.9(-11)
Filter outlet, sample period: 11/9-11/16/78					
^{131}I	1.82 ± 0.03(-11)	1.12 ± 0.03(-11)	1.15 ± 0.07(-12)	8.8 ± 0.2(-12)	3.94 ± 0.04(-11)
^{133}I	2.2 ± 0.1(-11)	1.1 ± 0.1(-11)	1.1 ± 0.4(-12)	8.4 ± 0.5(-12)	4.2 ± 0.1(-11)
^{135}I	<7.6(-10)	<2.3(-11)	<1.6(-11)	<6.8(-12)	>1.1(-9)

TABLE 7.25

CONTAINMENT BUILDING EMERGENCY COOLING SYSTEM A-500-A
FILTER IODINE DECONTAMINATION FACTORS

	Decontamination Factors				
Nuclide	Particulate	I_2	HOI	Organic	Total
Sample Period:	11/2-11/9/78				
^{131}I	2.4	31.0	39.9	32.5	16.0
^{133}I	1.8	20.0	>77.8	64.3	>8.3*
^{135}I	2.0	>34.5	>13.3	>15.0	>4.9
Sample Period:	11/9-11/16/78				
^{131}I	5.1	30.7	37.5	16.1	15.8
^{133}I	4.6	30.3	42.3	17.4	14.7
Average DF's					
^{131}I	3.8	30.9	38.7	24.3	15.9
^{133}I	3.2	25.2	42.3	40.9	14.7
^{135}I	2.0	34.5	13.3	15.0	5.9

* Unless indicated, no values below the limit of detection were used in averaging.

TABLE 7.26

CONTAINMENT BUILDING EXHAUST FILTER

IODINE SPECIES

Nuclide	Filter Inlet Iodine species (%) Particulate	I_2	HOI	Organic	Total release (μCi/s)	Filter Outlet Iodine Species (%) Particulate	I_2	HOI	Organic	Total release (μCi/s)
Sample period: 10/30-11/2/78										
^{131}I	7.70	55.89	11.53	24.66	9.10 ± 0.01(-3)[1]	33.45	27.64	20.36	18.55	1.02 ± 0.05(-4)
^{133}I	6.86	36.76	15.93	40.44	6.1 ± 0.07(-3)[1]	24.87	16.58	35.23	23.32	7 ± 2(-5)
^{135}I	7.77	33.16	25.39	33.68	4.8 ± 0.3(-3)[1]					<7.6(-3)
Sample Period: 11/6-11/13/78										
^{131}I	6.71	46.02	13.10	34.17	7.94 ± 0.04(-3)[2]	ND[3]	51.72	ND	48.28	1.1 ± 0.4(-5)
^{133}I	6.56	35.35	12.90	45.19	1.02 ± 0.06(-2)[2]					<6.2(-5)
Sample period: 1/19-1/21/79										
^{131}I	21.11	25.19	9.34	44.36	7.74 ± 0.07(-3)[4]	33.33	25.64	12.82	28.21	9 ± 2(-5)
^{133}I	24.84	24.84	7.72	42.59	8.3 ± 0.2(-4)[4]	ND	100	ND	ND	2.3 ± 1.6(-5)

1. Inlet duct flow 52,900 c.f.m. based on time weighted average of two duct flows during sample period.

2. Inlet duct flow 78,900 c.f.m. during sample period.

3. ND indicates no detectable activity.

4. The duct flow to the inlet of the filter is 36,500 c.f.m.

TABLE 7.27

CONTAINMENT BUILDING EXHAUST FILTER A-536

IODINE DECONTAMINATION FACTORS

	Decontamination Factors				
Nuclide	Particulate	I_2	HOI	Organic	Total
Sample period: 10/30-11/2/78					
^{131}I	20.5	180.4	50.5	118.6	89.2
^{133}I	23.4	188.5	38.4	147.5	85.0
Sample period: 11/6-11/13/78 [1]					
^{131}I	>275.0	642.3	>832.6	510.9	>555.2
^{133}I	>58.1	>161.7	>98.3	>275.6	>159.6
Sample period: 1/19-1/21/79					
^{131}I	53.51	83.00	61.55	132.88	86.0
^{133}I	>119.2	87.4	>101.9	>56.19	>89.5
Averages [2]:					
^{131}I	74	301.9	56.0	254.1	87.6
^{133}I	23.4	137.7	38.4	147.5	85.0

[1] These data were not used in the average because the samples ran for 13 hours after the purge was secured, and the values are probably not representative of the filter performance.

[2] No lower limit of detection values were used in the averages.

cooling charcoal filter A-500-A was installed 6/18/74. In addition, filter A-500-A does not have a HEPA prefilter. The factors which may cause charcoal filter poisoning have been well documented (16).

The particulate decontamination factors for the containment exhaust filters are shown in Table 7.28. These data were calculated from data in Appendix Tables B.76-B.77. As indicated, the data are limited, but based on the average value observed for the radiocesiums, a value of 50 is the best estimate for the HEPA filter DF. However, it is felt that the DF for the filters represents conservative values and that higher DF's would be observed for higher particulate filter inlet concentrations.

7.2.3.3 Iodine Deposition

In February, 1979, samples were collected before, during, and after the operation of ECS A-500-A. The results are included in Tables 7.16 through 7.18. The reason for making these measurements was to get some insight into the magnitude of reduction of iodine concentration due to deposition on building surfaces. Unfortunately the results of the sample taken just prior to ECS operation are questionable. Therefore, there is no way of knowing for sure the reduction in concentration that occurred as a result of initial ECS operation. However, certain observations are worth noting. Figure 7.3 shows a plot of the various species of ^{131}I measured in containment air. It is assumed that the concentrations measured two days prior to the ECS being put in service are representative of the concentrations just prior to ECS operation. If the loss due to deposition is significant with respect to the loss due to the ECS, the reduction in air concentration would be small when the ECS was put in operation. Note in Figure 7.3 that the concentration of elemental iodine actually increased when the ECS was put in service. The increase may have been the result of $^{131}I_2$ purging from the particulate filter of the species sampler. The ^{131}I collected on the particulate filter increased substantially when the ECS was put in service (see Table 7.16). This may have been due to the fact that the ECS charcoal adsorber has no HEPA filter associated with it. At any rate, the fact that the I_2 concentration was not appreciably affected by the ECS shows that another competing process was dominant. Deposition on building surfaces is such a process.

The conclusion that the competing process is deposition is supported by the fact that the ECS apparently caused a substantial reduction in the concentration of organic iodine. Figure 7.3 shows that the reduction was a factor of 10 or more. Because organic iodine is less reactive than elemental, it does not deposit as readily. Therefore, the ECS is the dominant means of removal. HOI is believed to be less reactive than I_2 but more reactive than organic. Figure 7.3 shows an intermediate removal of HOI which further supports the assumption of deposition as a process for removing a significant quantity of iodine.

7.2.3.4 Radionuclide Annual Release Rates

To calculate the annual releases at Rancho Seco two time periods were used, refueling and non-refueling. The division

TABLE 7.28

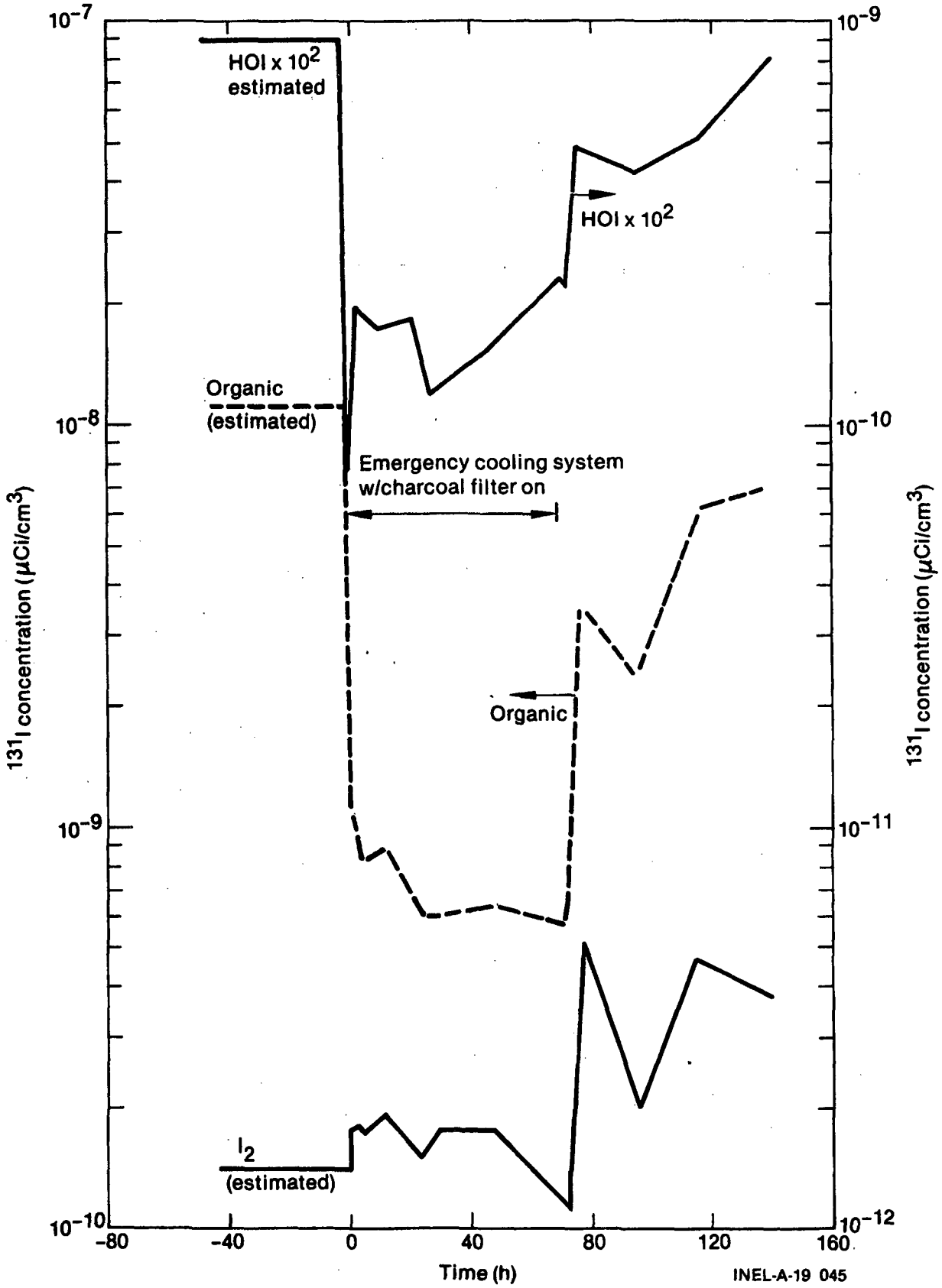
CONTAINMENT BUILDING EXHAUST FILTER
PARTICULATE DECONTAMINATION FACTORS

Nuclide	10/30/78	11/6/78	1/19/79	Avg. DF*
^{134}Cs	>11.0	32.5	50.6	41.6
^{137}Cs	>4.8	>44.0	61.0	61.0

* Less-than values were not included in the average values.

FIGURE 7.3

^{131}I IN CONTAINMENT AIR AT RANCHO SECO DURING ECS MEASUREMENTS



between the two time intervals was based on refueling related containment purges and non-refueling related containment purges during 1978 (Table 7.29).

For the refueling interval, when the containment stack was continuously monitored, the annual release rates and releases for all radionuclides were calculated from the time weighted average release rates (μCi/s). The weighting was performed based on the duration of the sampling interval and the total purge duration (49.3 days). Table 7.30 presents the release rates and releases for the refueling interval. These data were taken from Appendix Tables B.75, B.81, and B.83.

For the non-refueling interval, ^{131}I and ^{3}H releases for each purge were calculated using the following equation:

$$\frac{C_{RB} \times V_{RB} + [C_{RC} \times V_{RC}] \times \frac{L.R.}{100} \times P_d}{DF} = R$$

where

C_{RB} - Gaseous airborne concentration in the reactor building (average) - 2.0(-8) for ^{131}I and 1.4(-6) for ^{3}H (in μCi/cm^3)

V_{RB} - Reactor building free volume - 5.6(10) cm^3.

C_{RC} - Nuclide concentration in reactor coolant (average) - 1.6(-2) for ^{131}I and 2.5(-1) for ^{3}H (in μCi/g).

V_{RC} - Reactor coolant volume - 3.3(8) cm^3.

L.R.- Leak rate to the reactor building - 5.9(-3) for ^{131}I and 1.0(-2) for ^{3}H (in % per day).

P_d - Duration of purge (in days).

DF - Decontamination factor for reactor building filters - 1 for ^{3}H and 88 for ^{131}I.

R - Release for purge (μCi).

The individual purge releases were then summed to obtain a total release for ^{3}H and ^{131}I. The purge durations were taken from Table 7.29. The leakage rates used were the average values from Table 7.21. The decontamination factors were taken from Section 7.2.3.2. The ^{131}I and ^{3}H airborne concentrations are from Appendix Tables B.74 and B.82, respectively.

Table 7.31 lists the ^{131}I and ^{3}H release rates and releases during the non-refueling interval. Also shown in Table 7.31 are the results for

TABLE 7.29

1978 CONTAINMENT BUILDING PURGES AT RANCHO SECO

Start		Stop		
Date	Time	Date	Time	Purge Release No.
1/12/78	0905	1/13/78	1430	78-1
1/27/78	1618	1/29/78	0900	78-2
3/20/78	1111	3/24/78	1510	78-3
3/26/78	1330	3/26/78	2141	78-4
5/4/78	1010	5/6/78	0102	78-5
5/19/78	1605	5/21/78	1220	78-6
6/12/78	1500	6/19/78	1400	78-7
7/7/78	1616	7/8/78	2240	78-8
7/21/78	0833	7/22/78	2242	79-9
9/8/78	1611	9/11/78	1250	78-10
9/15/78	1708	9/16/78	1122	78-11
10/13/78	1437	10/14/78	2030	78-12
10/14/78	2030	10/15/78	0429	78-12 †
10/20/78	1502	10/21/78	1421	78-13
10/27/78	1416	10/29/78	0056*	78-14
10/29/78	0056	11/1/78	0900*	78-14/15 †
11/1/78	0900	11/12/78	2330*	78-15/16
11/14/78	1145	12/3/78	1730*	78-17/19
12/7/78	1440	12/14/78	0905*	78-20
12/14/78	0905	12/21/78	0829*	78-21

* Refueling related purges.

† Represents change in exhaust flow rate only.

TABLE 7.30

CONTAINMENT BUILDING RELEASES** DURING REFUELING

	Radionuclide Releases During Refueling	
Nuclide	Average Release Rate * (μCi/s)	Releases for Refueling Interval (μCi)
^{131}I***	2.0(-5)	1.1(2)
^{134}Cs	2.9(-5)	2.4(1)
^{137}Cs	3.2(-5)	9.8(1)
^{58}Co	2.1(-5)	4.9(1)
^{60}Co	3.6(-6)	6.4(0)
^{3}H	1.2(0)	5.2(6)
^{14}C	2.1(-1)	8.9(5)
^{133}Xe	6.7(2)	2.9(9)
^{131m}Xe	6.1(0)	2.6(7)
^{85}Kr	1.3(0)	5.4(6)

* Time weight averages based on the duration of the sampling intervals and the total purging durations.

** Releases are measured downstream of HEPA and charcoal filtration.

*** Average normalized release rate is 1.0(-3) μCi/sec/μCi/g. The average reactor coolant concentration was 1.9(-2) μCi/g (see Table 8.6).

TABLE 7.31

CONTAINMENT BUILDING RELEASES** DURING NON-REFUELING PERIODS

Nuclide	Average Airborne Concentration ($\mu Ci/cm^3$)	Average Release Rate ($\mu Ci/s$)	Releases Excluding Refueling Interval (μCi)
^{131}I***	2.0(-8)	2.0(-4)	3.1(2)
^{134}Cs	3.0(-10)	3.3(-6)	5.2(0)
^{137}Cs	4.0(-10)	4.4(-6)	6.9(0)
^{58}Co	1.5(-10)	1.4(-7)	2.6(-1)
^{60}Co	6.5(-12)	7.0(-8)	1.1(-1)
^{3}H	1.4(-6)	4.8(-1)	7.6(5)
^{14}C	1.1(-6)	1.2(-2)	1.8(4)
^{133}Xe	4.6(-3)	2.2(3)	3.4(9)
^{131m}Xe	1.7(-4)	8.0(1)	1.2(8)
^{85}Kr	*	---	---

* Not detected due to 0.511 MeV annihilation radiation.

** Releases calculated for ^{131}I assume a DF of 88 for the charcoal adsorber. Releases calculated for particulate radionuclides assume a DF of 50 for the HEPA filter.

*** Annual average normalized release rate in containment purges is 1.0(-3) $\mu Ci/s/\mu Ci/g$. Without the charcoal it was 8.8(-2) $\mu Ci/s/\mu Ci/g$.

other radionuclides. To obtain the values for the other radionuclides the tabulated average airborne radionuclide concentrations (Appendix Tables B.74, B.82 and B.80) were multiplied by the appropriate exhaust flow rate and purge duration. The above equation was not used for the other listed nuclides since the respective leak rates are not known. However, based on the ^{3}H leak rate and the radionuclide reactor coolant concentration, the inleakage of these radionuclides are insignificant compared to the (C_{RB} x V_{RB}) term in the equation. For the values presented in Table 7.31 a DF of 50 (section 7.2.3.2) was used for the particulates (radiocesiums and radiocobalts) and a DF of 1 for ^{14}C, ^{133}Xe, ^{131m}Xe and ^{85}Kr.

Table 7.32 presents the percentages of each radionuclide released during the refueling and non-refueling intervals. The ^{131}I and ^{3}H containment release rates normalized by dividing by the reactor coolant concentration are presented in Table 7.33. These normalized release rates are based on containment stack measurements during refueling, and average release rates (Table 7.31) during non-refueling.

TABLE 7.32

CONTAINMENT BUILDING ANNUAL RELEASES***

(% of Total)

Nuclide	Non-Refueling	Refueling	Total (Ci/y)
^{131}I	74	26	4.2(-4)
^{134}Cs	18	82	3.0(-5)
^{137}Cs	2	98	1.0(-4)
^{58}Co	*	100	4.9(-5)
^{60}Co	2	98	6.5(-6)
^{3}H	3	87	6.0(0)
^{14}C	1	99	0.9(0)
^{133}Xe	54	46	6.3(3)
^{131m}Xe	80	20	1.5(2)
^{85}Kr	**	100 †	5.4(0)†

† Total Ci/y is low since ^{85}Kr releases for non-refueling are not included (see ** below).

* Radionuclide not detected during non-refueling interval.

** Although present, the ^{85}Kr was not detected during non-refueling due to 0.511 MeV annihilation radiation interferences.

*** Releases of ^{131}I and particulate radionuclides measured or calculated downstream of HEPA and charcoal filters.

TABLE 7.33

CONTAINMENT BUILDING NORMALIZED RELEASE RATES***

[(μCi/s)/(μCi/g)]

	^{131}I		^{3}H	
Sample Dates	Avg. R.C. (μCi/g)	Normalized* Release	Avg. R.C. (μCi/g)	Normalized** Release
10/27-11/9/78	1.62(-2)	3.0(-3)	2.5(-1)	4.0
11/9-11/20/78	5.94(-2)	4.0(-4)	2.1(-1)	6.2
11/20-12/7/78	7.0(-3)	2.7(-4)	1.3(-1)	12.9
12/7-12/21/78	1.36(-3)	1.8(-3)	1.3(-1)	1.4
Non-refueling Periods †	1.6(-2)	1.2(-2)	2.0(-1)	2.4

* See Appendix Table B.75 for release rates (μCi/s).

** See Appendix Table B.83 for release rates (μCi/s).

*** Releases of ^{131}I were measured or calculated downstream of a charcoal absorber.

† See Table 7.31 for average release rates (μCi/s).

8. AUXILIARY BUILDING VENTILATION SYSTEM

8.1 System Description and Sampling Methods

Figures 2.1 and 8.1 present, respectively, schematic representations of the systems feeding the auxiliary building stack and the auxiliary building ventilation system at Rancho Seco.

The auxiliary building ventilation system at Rancho Seco is designed to remove heat and potentially contaminated air from the equipment rooms and open areas of the auxiliary building. Air movement is such that potentially contaminated air moves from areas of low contamination to areas of higher contamination and eventually to the exhaust filters for cleanup. As per design, the building exhaust flow rate (42,300 cfm) exceeds the supply air flow rate (32,000 cfm). This results in a slight negative pressure within the auxiliary building and consequently an inleakage of outside air, approximately 10,000 cfm, into the auxiliary building.

Components of the auxiliary building ventilation system and the number of components required for normal operation are listed in Table 8.1. The system basically consists of two supply fans, two exhaust fans, and cleanup filters. The ventilation system is shown schematically in Figure 8.2.

Near the start of the in-plant measurement program at Rancho Seco, plant data indicated that the A and B exhaust HEPA and prefilters had been in operation approximately 24,700 and 15,700 hours, respectively. At this time (10/31/78), dioctylphathale (DOP) testing of the A and B exhaust filters gave, respectively, 99.90 and 99.98 percent efficiencies. Also, on 10/31/77 the A and B charcoal filters had been in service approximately 9000 and 7000 total hours, respectively. Freon testing of the two charcoal filters at that time yielded efficiencies of 99.53% for the A charcoal filter and 99.60% for the B charcoal filter.

The most recent methyl iodide efficiency testing of the charcoal exhaust filters was performed on 8/12/77 and 8/8/77 for the A and B charcoal exhaust filters, respectively. On these dates the methyl iodide removal efficiency for the A charcoal filter was 99.53 percent (DF = 213) and at the time of testing the filter had just been installed new. The B charcoal had a corresponding methyl iodide removal efficiency of 95.35 percent (DF = 21.5) and had been in service approximately 4600 hours. Data on previously changed out charcoal exhaust filters indicated, respectively, methyl iodide removal efficiencies, for two separate charcoal filters, of 65.72 (DF = 2.9) and 89.07 (DF = 9.1) percent for operational hours of approximately 15,800 and 9000. The significance of these efficiencies are discussed in more detail in section 8.3.5.

The auxiliary building ventilation duct sampling locations used in the source term measurement program are shown schematically in Figure 8.1.

FIGURE 8.1

AUXILIARY BUILDING VENTILATION SYSTEM

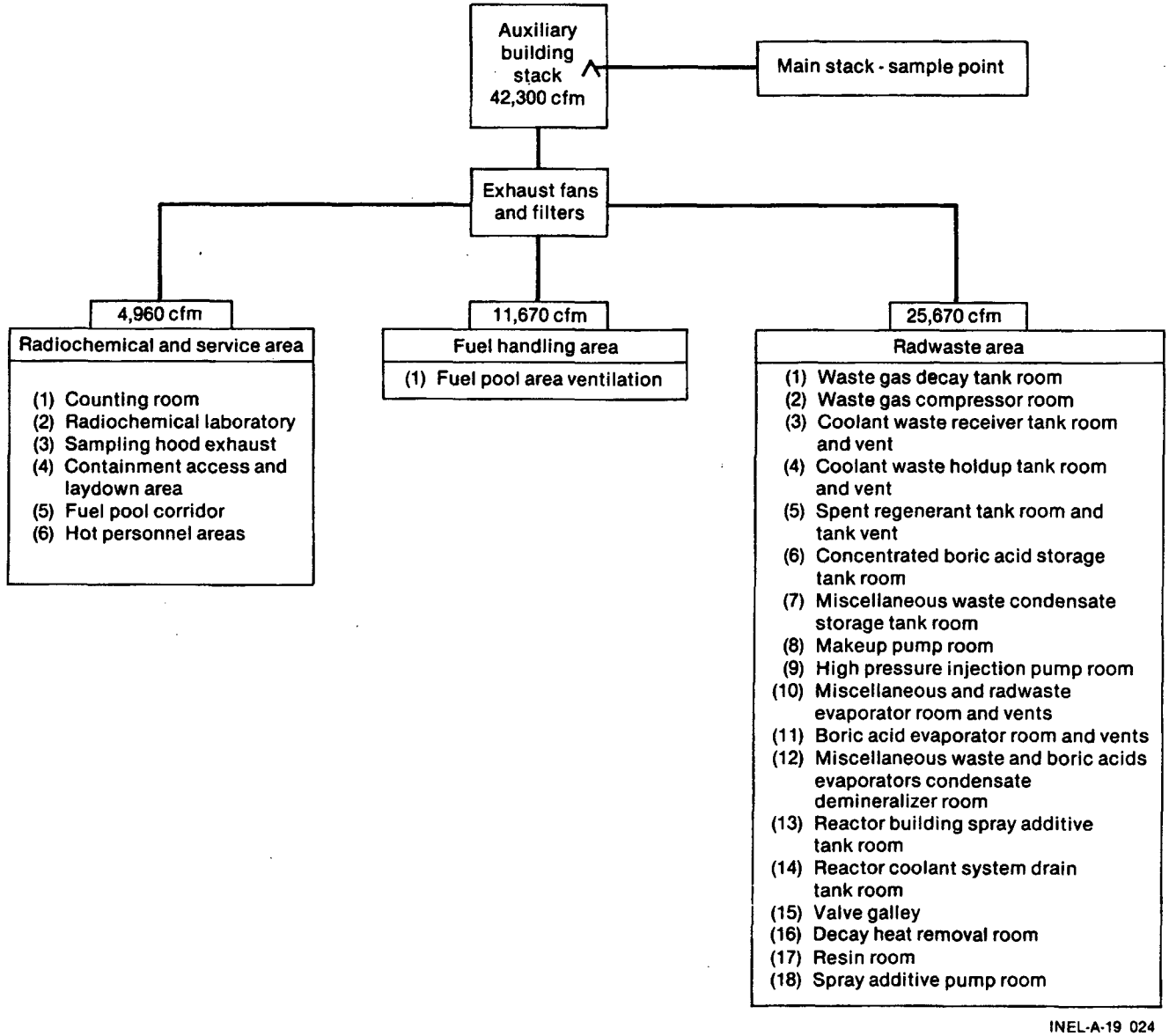


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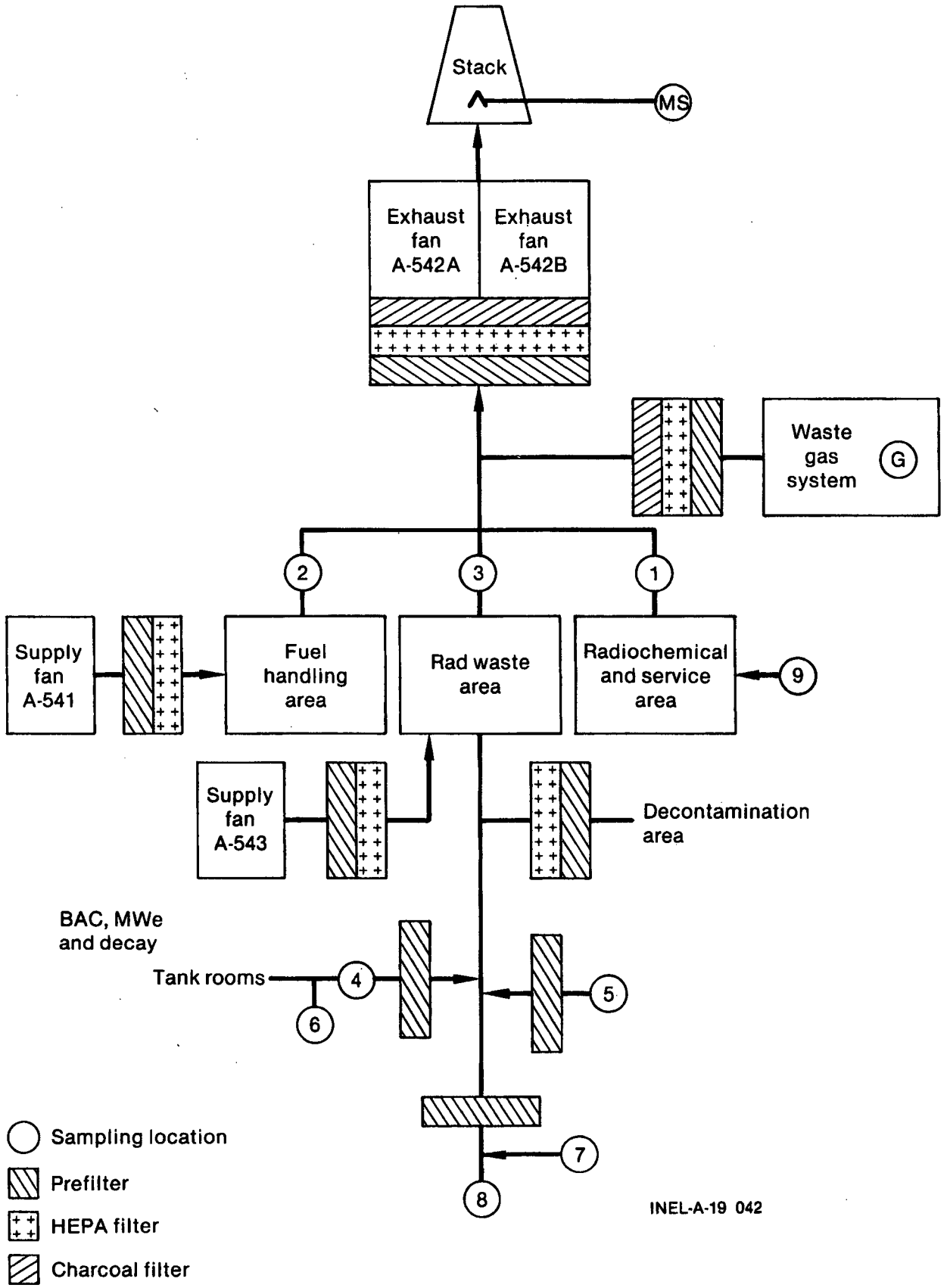
TABLE 8.1

AUXILIARY BUILDING VENTILATION COMPONENTS

System	Equipment	Number	Number for Normal Operation
Auxiliary Building Exhaust Filters	Cambridge Absolute HEPA Filters (T) I-D-1000, w/prefilters (36 per unit)	2	1
Auxiliary Building Exhaust Filters	Barnebey Cheney-FC Charcoal Filters (126 per unit)	2	1
Auxiliary Building Exhaust Fans A-542-A,B	Buffalo BL-Aerofoil 805 DIDW (42,300 cfm rated)	2	1
Radwaste Area Prefilters	Cambridge #43X95 (6 per unit)	3	3
Spent and New Fuel Area Supply Fan A-541	Buffalo type "HV"-182B Horizontal Belt Drive (10,000 cfm rated)	1	1
Spent and New Fuel Area Supply Air Filters	Cambridge Aerosolve Side Flo SF-D95-40-44 w/Filter Gauge	1	1
Radwaste Area Supply Fan A-543	Buffalo Type "HV"-272A (22,000 cfm rated)		
Radwaste Area Supply Filters	Cambridge Aerosolve Side Flo S3P-95 w/Filter Gauges	1	1
Make-up Air to Exhaust hoods (SF-A-6)	Carrier Series 398, Type A, size 060 (3000 cfm rated)	1	1
Hot Sample Hood FH-A-3	Kiwaunee Airistocrat 6Ff. Hood Model 351876X, Stainless Steel (1250 cfm)	1	1
Waste Gas System Exhaust Filters	Cambridge Aeromold - 3 MAS HEPA Filter with prefilter (one each)	1	1
Waste Gas System Exhaust Filters	Barnebey Cheney FC 727 Charcoal Filter	1	1

FIGURE 8.2

AUXILIARY BUILDING VENTILATION SYSTEM COMPONENTS



Specific areas of the auxiliary building which were sampled by each of the sampling locations are listed in Table 8.2 and shown in Figures 8.3-8.5. Also included in Table 8.2 and shown in Figure 8.5 are the locations of the room and area samplers used in the study. It should be noted that flow rates indicated in Table 8.2 and in Figures 8.3-8.5 are design flow rates. The results of actual flow rate measurements for four of the sampling stations are shown in Table 8.3. These measurements were performed by standard pitot tube and helium dilution techniques (6). The pitot tube and helium detection measurements agree within ten percent. This is considered excellent agreement and indicates that valid, representative samples are collected from these sampling locations. The agreement between the plant design flows and both the helium dilution and pitot tube measurement was within five percent. This is also considered excellent agreement and indicates that the ventilation system functions as designed.

For the other sampling locations, pitot tube measurements were not performed due to physical inaccessibility. Consequently, in mass balance determinations (sections 8.3.2 and 8.3.3) design flow rates were used for sampling locations #4-#9 and measured flow rates were used for the main stack and systems #1, #2 and #3.

The types of samples employed at each sampler location and the dates of operation are listed in Table 8.4. All samplers, except the noble gas sampler, are detailed in reference 6. Basically, the particulate iodine (PI) sampler consists of a HEPA filter and different adsorption media to collect the elemental, hypoiodious acid, and organic iodine species. The ^{14}C-^{3}H sampler consists of molecular sieve and silica gel adsorption beds and a Pt-Pd catalytic oxidizer, while the ^{3}H only sampler has a single silica gel adsorption bed. The noble gas sampler is a cryogenic distillation unit (13). The noble gases are concentrated in liquid oxygen and subsequently distilled and collected in a sample container.

8.2 Measurement Data

The measurement data for the auxiliary building are presented in Appendix Tables B.33-B.73. Specifically, the total radioiodine and particulate radionuclide release rate (μCi/s) information for the exhaust stack and sampling systems #1-#9 inclusive are in Appendix Tables B.33-B.42. Corresponding data for the room and area samplers, systems #10T-#13T, are in Tables B.43-B.46.

In Appendix Tables B.51, B.52-B.60 and B.61-B.64 radioiodine chemical species data are presented, respectively, for the exhaust stack, systems #1-#9 and the room/area samplers.

Noble gas release rates (μCi/s) from the auxiliary building stack are presented in Appendix Table B.69. Tritium and tritium species data are presented in Appendix Tables B.70 and B.71. The ^{14}C data are in Table B.72. Table B.73 shows results of selected alpha and beta nuclide analysis.

TABLE 8.2

AUXILIARY BUILDING VENTILATION SAMPLING SYSTEMS

MAIN STACK: 42,300 cfm

(1) System #1
(2) System #2
(3) System #3
(4) Gland seal exhaust
(5) Steam jet air ejector vent
(6) Waste gas decay tank discharges

SYSTEM #1: 4960 cfm

(1) Counting room
(2) Radiochemical laboratory
(3) Sampling hood exhaust
(4) Containment access and laydown area
(5) Fuel pool corridor
(6) Hot personnel areas

SYSTEM #2: 11,670 cfm

(1) Fuel pool area ventilation

SYSTEM #3: 25,670 cfm

(1) Waste gas decay tank room
(2) Waste gas compressor room
(3) Coolant waste receiver tank room and vent
(4) Coolant waste holdup tank room and vent
(5) Spent regenerant tank room and tank vent
(6) Concentrated boric acid storage tank room
(7) Miscellaneous waste condensate storage tank room
(8) Makeup pump room
(9) High pressure injection pump room
(10) Miscellaneous and radwaste evaporator room and vents
(11) Boric acid evaporator room and vents
(12) Miscellaneous waste and boric acid evaporators' condensate demineralizer room (D-676 & D-617)
(13) Reactor building spray additive tank room
(14) Reactor coolant system drain tank room
(15) Valve galley
(16) Decay heat removal room
(17) Resin room
(18) Spray additive pump room
(19) DHR pump room

SYSTEM #4: 7800 cfm

(1) Waste gas decay tank room
(2) Waste gas compressor room
(3) Coolant waste receiver tank room and vent
(4) Coolant waste holdup tank room and vent

TABLE 8.2 (cont'd)

AUXILIARY BUILDING VENTILATION SAMPLING SYSTEMS

SYSTEM #4: 7800 cfm (cont'd)

(5) Spent regenerant tank room and tank vent
(6) Concentrated boric acid storage tank room
(7) Miscellaneous waste and boric acid evaporators' condensate demineralizer room (D-676 & D-617)
(8) Miscellaneous radwaste evaporator room
(9) Boric acid evaporator room

SYSTEM #5: 4150 cfm

(1) High pressure injection pump room
(2) Makeup pump room
(3) Resin room

SYSTEM #6: 5100 cfm

(1) Miscellaneous waste and boric acid evaporators' condensate demineralizer room
(2) Waste gas decay tank room
(3) Waste gas compressor room
(4) Miscellaneous radwaste evaporator room
(5) Boric acid evaporator room

SYSTEM #7: 4250 cfm

(1) Reactor building spray additive tank room
(2) Decay heat removal pump room
(3) Spray additive pump room

SYSTEM #8: 3615 cfm

(1) Reactor coolant drain tank room

SYSTEM #9: 1250 cfm

(1) Hot laboratory primary sample hood

SYSTEM #10T:

(1) Demineralizer room

SYSTEM #11T:

(1) Decay heat removal room (-20)

TABLE 8.2 (cont'd)

AUXILIARY BUILDING VENTILATION SAMPLING SYSTEMS

SYSTEM #12T:

(1) Decay heat removal pump room (-47)

SYSTEM #13T:

(1) Pump corridor outside of tank room (-20)

The letter T following a sampling system denotes room or area sample. These samplers ran at 0.25 cfm.

FIGURE 8.3

RANCHO SECO AUXILIARY BUILDING VENTILATION - TURBINE LEVEL

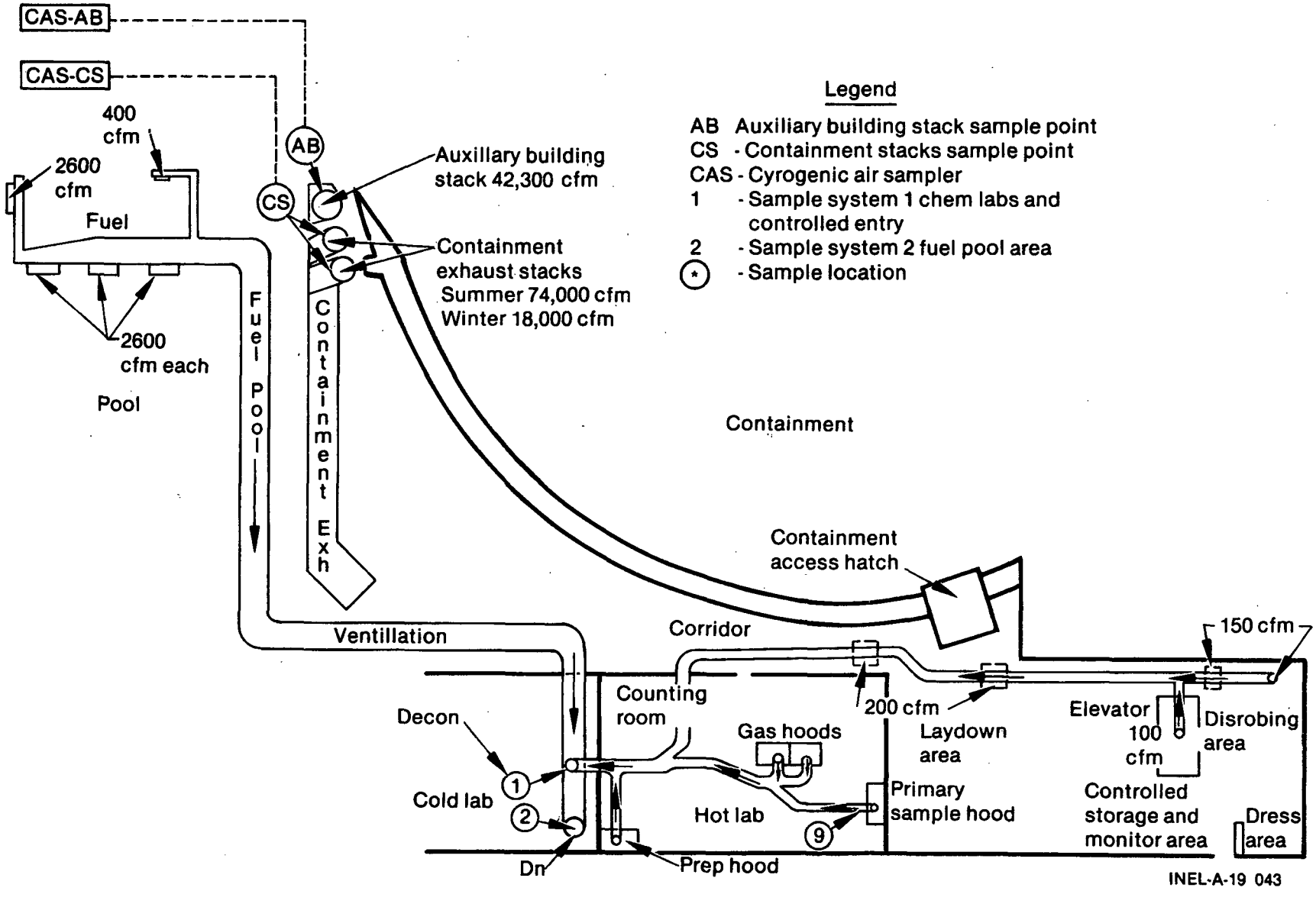


FIGURE 8.4

AUXILIARY BUILDING EXHAUST VENTILATION - MEZZANINE LEVEL

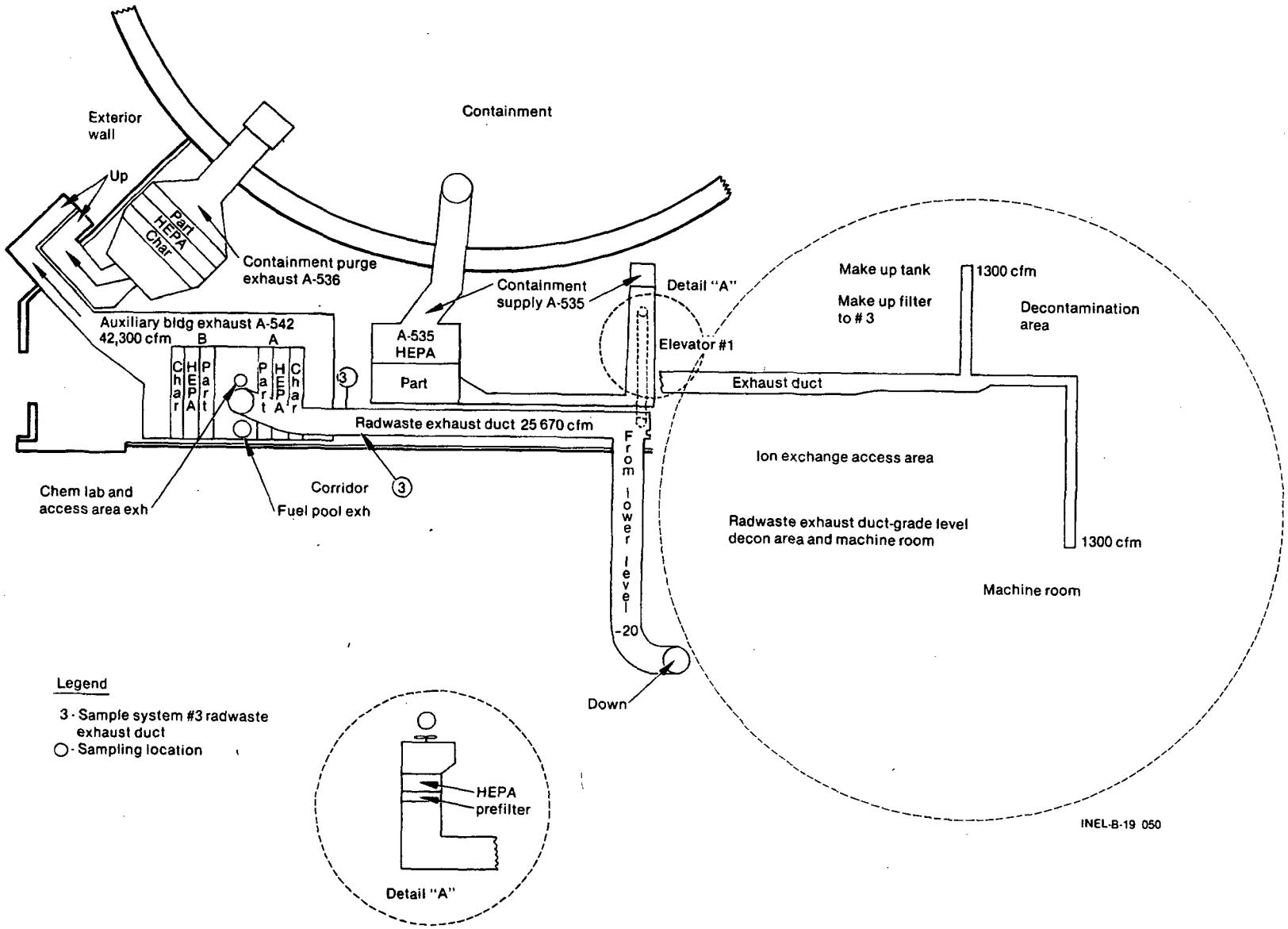


FIGURE 8.5

AUXILIARY BUILDING EXHAUST VENTILATION - (-20) LEVEL

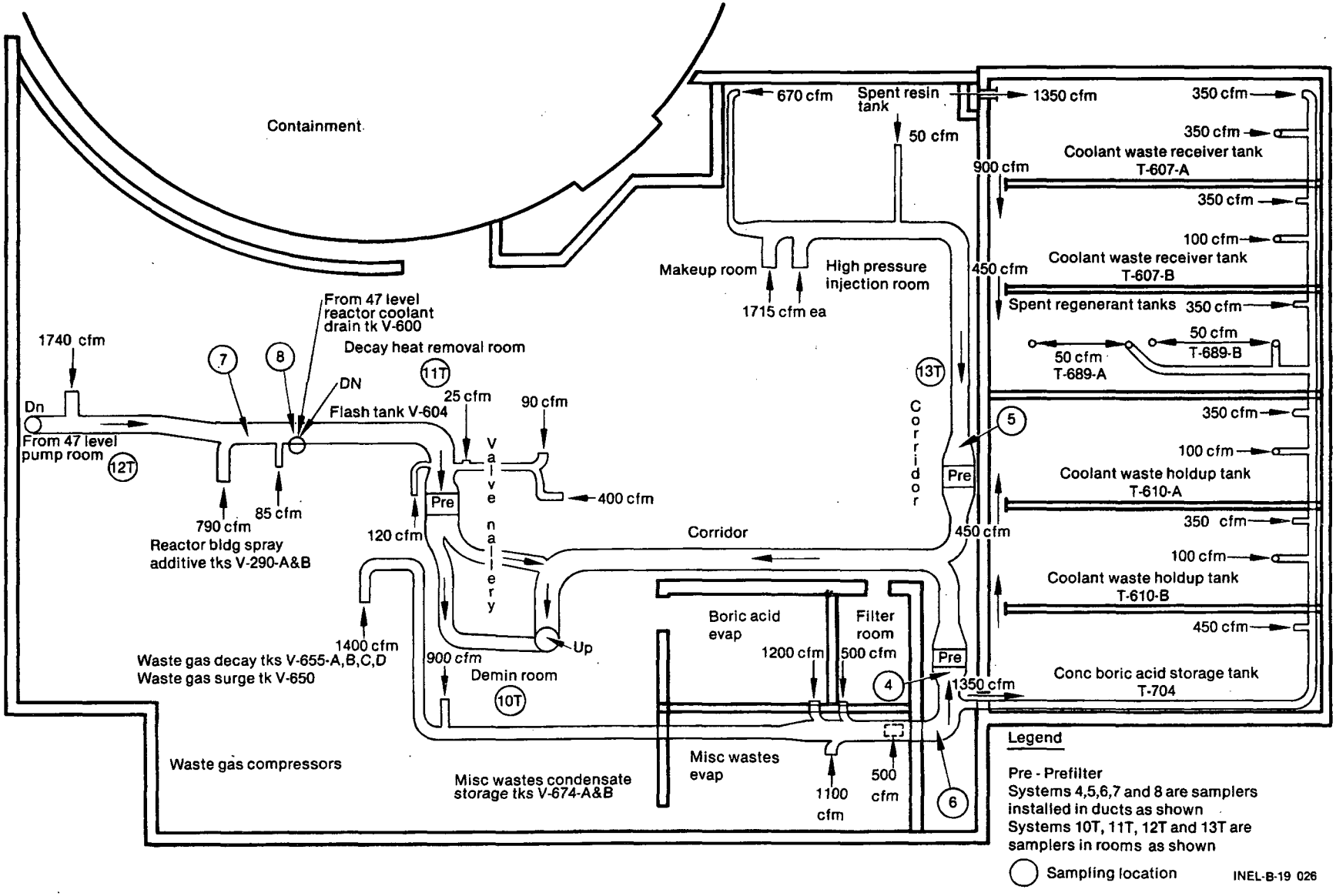


TABLE 8.3

VENTILATION EXHAUST DUCT FLOW MEASUREMENTS

Station	Design Flows	He Dilution Measurement (cfm)	Pitot Tube Measurement (cfm)
Main Stack	42,300	40,400	44,500
Radiochemical & Service Area (#1)	4960	5000	4800
Fuel Handling Area (#2)	11,670	12,000	11,800
Radwaste Area #3	25,670	24,700	24,800

TABLE 8.4

AIR SAMPLER OPERATION AND MEASUREMENT PERIODS

Location	Dates	Sampler Types	Appendix Table #
Main Stack	9/11/78 to 3/13/79	Particulate-Iodine (P-I), ^{14}C-^{3}H	B.33, B.51, B.70, B.72
	10/23/78 to 2/28/79	Noble gas	B.69
System #1	9/14/78 to 3/1/79	PI, ^{3}H Installed (12/21/78)	B.34, B.52, B.70, B.72
#2	9/14/78 to 3/13/79	PI, ^{14}C-^{3}H Installed (10/12/78)	B.35, B.53, B.70, B.72
#3	9/14/78 to 3/13/79	PI, ^{14}C-^{3}H Installed (10/12/78)	B.36, B.54, B.70, B.72
#4	1/8/79 to 3/13/79	PI, ^{3}H Installed (2/4/79)	B.37, B.55, B.71
#5	1/8/79 to 3/1/79	PI, ^{3}H Installed (2/5/79)	B.38, B.56, B.71
#6	1/25/79 to 3/13/79	PI, ^{3}H	B.39, B.57, B.71
#7	1/26/79 to 3/13/79	PI, ^{3}H	B.40, B.58, B.71
#8	1/26/79 to 3/13/79	PI, ^{3}H	B.41, B.59, B.71
#9	2/9/79 to 3/13/79	PI	B.42, B.60
#10T	11/11/78 to 12/21/78	PI	B.43, B.61
#11T	11/28/78 to 12/7/78	PI	B.44, B.62
#12T	12/21/78 to 12/31/78	PI	B.45, B.63
#13T	12/21/78 to 1/18/79	PI	B.46, B.64

Tables B.47-B.50 and B.65-B.68 present total radioiodine and particulate information of coolant waste holdup and receiver tanks' cover gases.

8.3 Results and Discussion

8.3.1 Normalized ^{131}I and ^{3}H Release Rates

A convenient means of comparing the radioactive release rates from different PWR's is to normalize the radionuclide release rates to their respective reactor coolant concentrations (14,17).

The equation used for normalization is:

$$R = \frac{I_G}{I_W}$$

where R, I_G, and I_W are, respectively, the normalized release rate [(μCi/s)/(μCi/g)], the radionuclide gaseous release rate (μCi/s) and the radionuclide concentration in the reactor coolant (μCi/g).

The reactor coolant concentration, I_W, is the average concentration over the sampling period and is used to determine the normalized gaseous release rate. For radioiodines, a phenomenon commonly called iodine spiking (i.e., the reactor coolant radioiodine concentrations become elevated) occurs following a reactor power level transient. To obtain a more accurate normalized release rate these elevated reactor coolant radioiodine concentrations should be included in the normalized release rate calculations. However, in past studies (2,3,14), data were not available for inclusion of the iodine spiking effects. Furthermore, the normalized release rate would be most useful if it could be applied to average coolant concentrations, e.g., those in standard ANSI N237. Consequently, to maintain consistency with past studies and to evaluate the effects of iodine spiking on normalized release rates, normalized release rates are presented by both including and excluding the iodine spiking effect. In the former case, the reactor coolant radioiodine concentrations (Tables 8.5 and 8.7) used for normalization were based on a time weighted average of the reactor coolant concentrations measured during the corresponding gaseous sampling interval. In the latter case (iodine spikes excluded) the reactor coolant radioiodine concentrations used, when possible, were the average baseline concentrations during the corresponding gaseous sampling interval (Tables 8.6 and 8.8). When it was not possible to determine an average baseline ^{131}I reactor coolant concentration, a time weighted ^{131}I reactor coolant concentration was used. This was done for the first three sampling intervals during the refueling outage. Consequently, the time weighted ^{131}I reactor coolant concentrations used could be elevated somewhat due to iodine spiking. However, since the reactor was at zero power for these three sampling intervals, the time weighted averages should approximate true baseline values. It should also be noted the actual refueling outage (zero power)

TABLE 8.5

AUXILIARY BUILDING STACK NORMALIZED ^{131}I RELEASE RATES UPSTREAM OF EXHAUST FILTERS
(Including Spikes)

Sampling Date// Sampling Period	Release** (μCi/s)	Reactor Coolant† (μCi/g)	Normalized Release ($\frac{\mu Ci/s}{\mu Ci/g}$)	Avg.
9/13-9/27 //1	5.9(-4)	1.97(-2)	3.0(-2)	
9/27-10/12 //2	8.9(-5)	1.60(-2)	5.6(-3)	
10/12-10/26 //3	2.8(-4)	6.00(-2)	4.7(-3)	Before Refueling 1.1(-2)
10/26-11/9 //4	7.5(-5)	1.71(-2)	4.4(-3)	
11/9-11/20 //5*	1.7(-2)	5.94(-2)	2.9(-1)	
11/20-12/7 //6*	1.5(-3)	7.00(-3)	2.1(-1)	
12/7-12/21 //7*	3.8(-4)	1.36(-3)	2.8(-1)	During Refueling 2.0(-1)
12/21-1/4 //8*	9.3(-4)	3.32(-2)	2.8(-2)	
1/4-1/18 //9	9.9(-4)	1.21(-2)	8.2(-2)	
1/18-2/1 //10	4.7(-4)	2.96(-2)	1.6(-2)	
2/1-2/15 //11	7.6(-5)	9.30(-3)	8.2(-3)	After Refueling 2.5(-2)
2/15-3/1 //12	1.4(-4)	1.54(-1)	9.1(-4)	
3/1-3/13 //13	1.5(-4)	9.54(-3)	1.6(-2)	
		Avg.	7.5(-2)	

† Time weighted average ^{131}I reactor coolant concentration.

* During Refueling

** Sum of sampling systems #1-#3.

TABLE 8.6

AUXILIARY BUILDING STACK NORMALIZED ^{131}I RELEASE RATES UPSTREAM OF EXHAUST FILTERS
(Excluding Spikes)

Sampling Date// Sampling Period	Release* (μCi/s)	Reactor Coolant† (μCi/g)	Normalized Release $(\frac{\mu Ci/s}{\mu Ci/g})$	Avg.
9/13-9/27 //1	5.9(-4)	1.62(-2)	3.6(-2)	
9/27-10/12 //2	8.9(-5)	1.62(-2)	5.5(-3)	
10/12-10/26 //3	2.8(-4)	1.62(-2)	1.7(-2)	Before Refueling 1.6(-2)
10/26-11/9 //4	7.5(-5)	1.62(-2)	4.6(-3)	
11/9-11/20 //5††	1.7(-2)	5.94(-2)**	2.8(-1)	
11/20-12/7 //6††	1.5(-3)	7.00(-3)**	2.1(-1)	During Refueling 2.2(-1)
12/7-12/21 //7††	3.8(-4)	1.36(-3)**	2.8(-1)	
12/21-1/4 //8††	9.3(-4)	8.83(-3)	1.1(-1)	
1/4-1/18 //9	9.9(-4)	8.83(-3)	1.1(-1)	
1/18-2/1 //10	4.7(-4)	8.83(-3)	5.3(-2)	
2/1-2/15 //11	7.6(-5)	8.83(-3)	8.6(-3)	After Refueling 5.3(-2)
2/15-3/1 //12	1.4(-4)	8.83(-3)	1.6(-2)	
3/1-3/13 //13	1.5(-4)	8.83(-3)	1.7(-2)	
		Avg.	8.8(-2)	
				Annual Average *** 5.6(-2)

† Baseline concentration of ^{131}I in reactor coolant unless noted.

†† During Refueling

* Sum of sampling systems #1-#3.

** Time weighted ^{131}I reactor coolant concentration.

*** Assumes 50 days at 0.22 μCi/s/μCi/g and 315 days at 0.03 μCi/s/μCi/g.

TABLE 8.7

AUXILIARY BUILDING STACK NORMALIZED ^{131}I RELEASE RATES DOWNSTREAM OF EXHAUST FILTERS
(Including Spikes)

Sample Period	Release ** (μCi/s)	Reactor Coolant † (μCi/g)	Normalized Release $(\frac{\mu Ci/s}{\mu Ci/g})$	Avg.
1	3.7(-6)	1.97(-2)	1.9(-4)	
2	2.4(-6)	1.60(-2)	1.5(-4)	Before Refueling
3	4.8(-6)	6.0(-2)	8.0(-5)	1.2(-4)
4	8.7(-7)	1.71(-2)	5.1(-5)	
5	7.7(-5)*	5.94(-2)	1.3(-3)	
6	1.7(-5)*	7.00(-3)	2.4(-3)	During Refueling
7	3.5(-5)*	1.36(-3)	2.6(-2)	7.8(-3)
8	5.5(-5)*	3.32(-2)	1.7(-3)	
9	1.0(-4)	1.21(-2)	8.3(-3)	
10	4.9(-6)	2.96(-2)	1.7(-4)	
11	3.2(-7)	9.30(-3)	3.4(-5)	After Refueling
12	<7.2(-6)	1.54(-1)	<4.7(-5)	2.8(-3)
13	<2.8(-6)	9.54(-3)	<2.9(-4)	
		Avg.	3.7(-3)	

† Time weighted average of ^{131}I reactor coolant concentration.

* During Refueling.

** Release rate in auxiliary building stack.

TABLE 8.8

AUXILIARY BUILDING STACK NORMALIZED ^{131}I RELEASE RATES DOWNSTREAM OF EXHAUST FILTERS

(Excluding Spikes)

Sample Period	Release* (μCi/s)	Reactor Coolant† (μCi/g)	Normalized Release (μCi/s)/(μCi/g)	Avg.
1	3.7(-6)	1.62(-2)	2.3(-4)	
2	2.4(-6)	1.62(-2)	1.5(-4)	Before Refueling 1.8(-4)
3	4.8(-6)	1.62(-2)	3.0(-4)	
4	8.7(-7)	1.62(-2)	5.4(-5)	
5	7.7(-5)††	5.94(-2)**	1.3(-3)	
6	1.7(-5)††	7.00(-3)**	2.4(-3)	
7	3.5(-5)††	1.36(-3)**	2.6(-2)	During Refueling 9.0(-3)
8	5.5(-5)††	8.83(-3)	6.2(-3)	
9	1.0(-4)	8.83(-3)	1.1(-2)	
10	4.9(-6)	8.83(-3)	5.5(-4)	
11	3.2(-7)	8.83(-3)	3.6(-4)	
12	<7.2(-6)	8.83(-3)	<8.1(-4)	After Refueling 4.0(-3)
13	<2.8(-6)	8.83(-3)	<3.1(-4)	
		Avg.	4.4(-3)	

† Baseline concentration of ^{131}I in reactor coolant unless noted.

†† During Refueling

* Release rate in auxiliary building stack.

** Time weighted ^{131}I reactor coolant concentration.

was between 11/14/78 and 12/19/78, but the samples which best reflect the refueling outage are samples 11/9/78 to 1/4/79 inclusive since full power operation was not attained until 12/28/78.

Tables 8.5 and 8.6 present the ^{131}I normalized release rates from the auxiliary building upstream of the exhaust cleanup filter with the reactor coolant iodine spikes included and excluded, respectively. The corresponding ^{131}I normalized release rate data, downstream of the auxiliary building exhaust filters, are presented in Tables 8.7 and 8.8. Also presented in Tables 8.5-8.8 are the average before, during, and after refueling normalized release rates. To determine these averages only positive values were used, i.e., no less thans. The actual ^{131}I release rates (μCi/s) and reactor coolant concentrations (Ci/g) are taken from Appendix Tables B.33-B.36 and B.1-B.2, respectively.

From examination of Tables 8.5-8.8 three phenomena should be noticed: (1) Both the normalized and actual release rates during the refueling interval are consistently higher than during the intervals prior to and following refueling, (2) the inclusion of the ^{131}I reactor coolant spiking concentrations decreases the overall average normalized release rates by approximately 15% only, and (3) the exhaust filters have a significant effect in decreasing the normalized rates (see section 8.3.5 for decontamination factor discussion).

From the first two observations it can be concluded that the inclusion or exclusion of ^{131}I reactor coolant concentrations in the normalized release rate determinations at Rancho Seco did not have a significant effect on the average normalized release rates during refueling and that higher releases from the auxiliary building occur during refueling. In regard to the latter observation, its significance and utility for evaluating effluent treatment systems is not emphasized until the normalized release rates of different PWR's are compared.

The ^{131}I normalized release rates of other PWR's studied in the in-plant measurement program (2,3,4) and of other PWR's studied by other investigators (14) are shown in Table 8.9. The releases presented are the total plant normalized releases without charcoal filtration, from all sources, to the environment and do not include iodine spiking reactor concentrations in the normalization. Of the plants studied in the in-plant measurement program, Rancho Seco is the only plant which had charcoal exhaust filters on all off-gas systems. At Zion and Ft. Calhoun, off-gases from only the fuel handling and cubicle areas passed through charcoal filters prior to discharge to the environment with the majority of the off-gas discharged without treatment. At Turkey Point no charcoal filters were in use. With the exception of Turkey Point, the normalized release rates are quite similar among the plants studied in the In-Plant Source Term Measurement Program.

TABLE 8.9

ANNUAL ^{131}I NORMALIZED RELEASE RATES FROM PWR's
[(μCi/s)/(μCi/g)]

Fort Calhoun[1]	Zion[2]	Turkey Point[3]	Rancho Seco[4]	Others[5]
0.30	0.30	2.9	0.13	0.07
	0.15[6]	1.45[6]		

[1] Data from reference 2. Fort Calhoun is a single unit plant.

[2] Data from reference 3. Zion is a two unit plant.

[3] Data from reference 4. Turkey Point is a two unit plant.

[4] Includes normalized release rate from the containment building (0.07 μCi/s/μCi/g, see Table 7.30) and the auxiliary building stack (0.056 μCi/s/μCi/g, see Table 8.6).

[5] Average of the three PWR's studied in reference 14.

[6] Normalized release rate per reactor unit.

For ^3H the normalized release rates are not subject to reactor power level transients. The ^3H normalized release rates are shown in Table 8.10 and are taken from data in Appendix Tables B.70 and B.2. The average ^3H normalized release rate value is 11.3 [(μCi/s)/(μCi/g)] with a higher value occurring during refueling (18.0 [(μCi/s)/(μCi/g)]. The average value compares with a value of 2.9 [(μCi/s)/(μCi/g)] observed at Turkey Point Station (two units) and an average value of 4.3 [(μCi/s)/(μCi/g)] measured at three other PWR's (14).

8.3.2 Sources of ^{131}I and Annual Releases

Shown in Table 8.11 are the ^{131}I release rates from the auxiliary building (total systems #1-#3) and the percentage contribution of each sampling system contributing to the total auxiliary building release. These data are taken from Appendix Tables B.33-B.42. It should be emphasized that the total of stations #1-#3 are release rates prior to the exhaust cleanup filters. The actual releases from the auxiliary building are those designated main stack. Of course, the differences in the sampling station #1-#3 total and the main stack releases are due to the cleanup of the auxiliary building exhaust filters (Section 8.3.5). It should also be noted that sampling system #4 is not included in Table 8.11. Instead, the contribution from the area designated tank room is included since the tank room is obtained from the difference in systems #4 and #6 (Figure 8.2).

From Table 8.11 it is apparent that systems #1 and #3 are consistently the major contributors to the auxiliary building releases, except during the refueling period. During refueling, the refueling area (system #2) was a significant contributor. The average release rates from the auxiliary building stack before, during and after refueling were, respectively, 2.9(-6), 4.6(-5), and 3.5(-5) μCi/s. Based on these values and the average percent contributions of systems #1, #2, and #3 to the before, during and after refueling intervals, the distribution shown in Table 8.12 is obtained.

Table 8.13 shows the percent contribution of each sampling system located upstream of sampling stations #1 and #3 (Figure 8.2). The information presented in this table is based on mass balance data. From the table it can be concluded that the principal contribution to system #3 releases is the tank room area. This is supported by a chemical iodine species comparison made of system #3 and the tank room area (Table 8.14). This comparison is considered to have excellent agreement and indicates that the tank room is the source of iodine in system #3. It should also be noted that the decontamination area (Figure 8.2) is not a significant contributor of activity.

The tank room area houses seven separate tanks - two coolant waste receiver tanks, two spent regenerant tanks, two coolant water holdup tanks and a concentrated boric acid storage tank (Figure 8.5). With the exception of the concentrated boric acid storage tank, each of the other

TABLE 8.10

AUXILIARY BUILDING ^3H NORMALIZED RELEASE RATES
(Downstream of Filters)

Sample Period	Release µCi/s	Reactor Coolant* (µCi/g)	Normalized Release (µCi/s) / (µCi/g)	Avg.
1	1.65	2.2(-1)	7.5	
2	1.56	2.2(-1)	7.1	Before Refueling 7.8
3	1.76	2.2(-1)	8.0	
4	1.87	2.2(-1)	8.5	
5	NS †	1.3(-1)	NS	
6	2.0 †	1.3(-1)	16.5	
7	2.5 †	1.3(-1)	18.8	During Refueling 18.0
8	2.5 †	1.3(-1)	18.8	
9	2.7	2.6(-1)	10.4	
10	2.3	2.6(-1)	8.8	
11	2.3	2.6(-1)	8.8	
12	NS	2.6(-1)	NS	After Refueling 9.9
13	3.0	2.6(-1)	11.5	
			Avg. 11.3	

* Average ^3H reactor coolant concentration.

† During Refueling

TABLE 8.11

PERCENT CONTRIBUTION OF EACH SYSTEM TO AUXILIARY BUILDING ^{131}I RELEASE

Sample Period	Systems (%) #1	#2	#3	Tank Room**	#5	#6	#7	#8	#9	Total #1-3 Release µCi/s	Main Stack µCi/s
9/13-9/27	17	*	83	†	†	†	†	†	†	5.9(-4)	3.7(-6)
9/27-10/12	19	1	80	†	†	†	†	†	†	8.9(-5)	2.4(-6)
10/12-10/26	24	<1	76	†	†	†	†	†	†	2.8(-4)	4.8(-6)
10/26-11/9	32	*	68	†	†	†	†	†	†	7.5(-5)	8.7(-7)
11/9-11/20 (4)	1	3	96	†	†	†	†	†	†	1.7(-2)	7.7(-5)
11/20-12/7 (4)	1	47	52	†	†	†	†	†	†	1.5(-3)	1.7(-5)
12/7-12/21 (4)	1	13	86	†	†	†	†	†	†	3.8(-4)	3.5(-5)
12/21-1/4 (4)	5	1	94	†	†	†	†	†	†	9.3(-4)	5.5(-5)
1/4-1/18	24	1	75	†	†	†	†	†	†	9.9(-4)	1.0(-4)
1/18-2/1	49	<1	51(1)	47.4(1)	0.5(1)	1.9(1)	0.3(1)	0.9(1)	†	4.7(-4)	4.9(-6)
2/1-2/15	32	1	67(1)	51.7(1)	<0.1(1)	7.7(1)	5.8(1)	1.8(1)	32.0(2)	7.6(-5)	3.2(-7)
2/15-3/1	44	<1	56(1)	26.4(1)	3.7(1)	14.4(1)	9.7(1)	1.8(1)	28.7(2)	1.4(-4)	*
3/1-3/13	24	*	76(1)	59.9(1)	*	1.8(1)	9.5(1)	4.8(1)	14.2(2)	1.5(-4)	*
										Avg.	2.7(-5) (3)

(1) Percentage breakdown of sampling station upstream of sampling station #3. Stations #3-#8, for this period are averages of two one-week samples.

(2) Percentage contribution of Station #9 to Station #1.

(3) Only positive values were used in averaging, i.e., lower limits of detection were not used.

(4) During refueling interval. The average auxiliary building main stack release rates before, during, and after refueling were, respectively, 2.9(-6), 4.6(-5), and 3.5(-5) µCi/sec. No lower limits of detection were used in the average.

* ^{131}I not detected in sample.

** Tank room is difference between sample state #4 and #6.

† Sampler not installed.

TABLE 8.12

PERCENT CONTRIBUTION OF SYSTEMS #1, #2, AND #3
BEFORE, DURING, AND AFTER REFUELING*

Sampling Station	Before Refueling	During Refueling	After Refueling
#1	7.0(-7) (24%)	9.0(-7) (2%)	1.2(-5) (34%)
#2	2.9(-8) (1%)	7.2(-6) (16%)	3.5(-7) (1%)
#3	2.2(-6) (75%)	3.7(-5) (82%)	2.3(-5) (65%)
Total (μCi/s)	2.9(-6)	4.5(-5)	3.5(-5)

* Percentages represent average contribution of each system to the main stack releases.

TABLE 8.13

PERCENT DISTRIBUTIONS OF SAMPLING
System #1 and #3

	Sampling System (%)					
Sampling Date	Tank Room†	#5†	#6†	#7†	#8†	#9††
1/18-2/1	93.0	0.9	3.7	0.6	1.8	*
2/1-2/15	77.1	<0.1	11.5	8.6	2.7	100
2/15-3/1	47.1	6.6	25.7	17.4	3.2	65
3/1-3/13	78.8	**	2.4	12.5	6.3	60

† Component of System #3

†† Component of System #1

* No sampler

** Not detected

TABLE 8.14

IODINE SPECIES COMPARISON BETWEEN TANK ROOM * AND SYSTEM #3

Sample Period	1/25-2/1		2/1-2/8		2/8-2/15		2/15-2/22		2/22-3/1		3/1-3/8		3/8-3/13	
Species	#3	TR	#3	TR	#3	TR	#3	TR	#3	TR	#3	TR	#3	TR
Part. I	0.9	0.3	0	0.4	0	1.5	5.3	11.3	2.2	2.5	2.5	2.5	0	1.8
I_2	5.5	0.5	18.0	13.2	17.5	15.3	12.7	13.3	14.1	13.8	24.3	12.3	18.9	10.8
HOI	4.6	2.0	25.7	22.3	28.2	19.1	16.4	12.7	21.8	32.4	29.8	35.6	21.3	13.4
Organic Iodine	87.4	97.5	55.3	64.5	54.3	64.7	65.7	73.3	62.0	54.4	43.4	50.0	59.8	73.3

* Tank Room is obtained by the difference for each chemical iodine species between systems #4 and #6.

tanks has a cover-gas vent which feeds directly into the building ventilation system. Consequently, any time liquid is added to a tank, the cover-gas in the tank is discharged to the building ventilation. Since it was not possible to monitor these tank vents directly due to physical inaccessibility, an alternate approach was taken to determine which tank was contributing to system #3 releases.

The approach taken was to sample the cover gas and liquids in the tanks if possible. Both cover gas and liquid samples were taken of the reactor coolant receiver and storage tanks; however, only liquid samples could be obtained of the spent regenerant tanks since the system used to collect the gaseous samples (the automatic gas analyzer) is not designed to collect samples from the spent regenerant tanks. For this reason the results of the two gaseous samples collected were inconclusive. However, the results of the liquid samples (Table 8.15) indicate that the spent regenerant tanks (T-689 A & B) were the major source of ^{131}I in the tank room area. In fact, if it is assumed that the ratio of the iodine in the cover gas to the iodine in the liquid in the different tanks are the same (i.e., they have the same partition factors), calculations show that in excess of 90 percent of the iodine in the tank room area comes from the spent regenerant tank. These calculations are based on the airborne concentrations measured in the cover gases (Appendix Tables B.47-B.50) and the design tank vent flow rates.

One of the components contributing a portion of the activity to system #1 is the primary system sampling hood (see Figure 8.1). Based on past studies (2), an iodine species sampler, system #9, was placed on the hood ventilation exhaust. Table 8.13 presents the percent contribution of system #9 to system #1. As indicated, system #9 contributes greater than 60 percent to system #1. A comparison of the chemical iodine species (Table 8.16) confirms that the sampling hood is the most significant source of ^{131}I. Furthermore, the species distribution supports a previous hypothesis (2,3) that sources of iodine closer in time to the reactor coolant have a larger elemental iodine (I_2) fraction.

8.3.3 Sources of Particulates and Average Releases

Average release rates of particulate radionuclides for systems #1, #2 and #3 are shown in Table 8.17. These data are taken from Appendix Tables B.33-B.42. Only the nuclides ^{58}Co, ^{60}Co, ^{134}Cs, and ^{137}Cs are included since other nuclides were seldom detected. As Table 8.17 shows, the average fractional contributions of all particulates indicates system #3 to be the principal contributor. Attempts were made to further isolate the sources of particulates in system #3 by analyzing the results of particulate filter analyses from systems #4 through #8. However, due to the low particulate concentrations observed and the associated large errors, the exact source could not be determined. It should be noted that the particulate releases in systems #1, #2, and #3 are not released to the environment, but to the exhaust system cleanup filters.

TABLE 8.15

^{131}I ANALYSIS OF TANK LIQUIDS (TANK ROOM AREA)

($\mu Ci/cm^3$)

Date	T-607 A&B	Date	T-610 A&B	Date	T-689 - A & B
10/10	<1.0(-6)	9/13	2.3(-7)	9/25	9.5(-4)
1/24	1.4(-5)	10/5	2.6(-7)	9/25	9.3(-4)
1/24	1.3(-5)	10/17	2.5(-7)	10/25	2.6(-5)
2/9	2.0(-6)	10/18	<1.6(-7)	11/14	2.1(-4)
2/28	7.9(-6)	11/2	<1.2(-6)	1/16	5.8(-4)
		11/2	1.9(-7)	1/16	5.4(-4)
		1/16	3.0(-6)	2/2	3.4(-4)
		1/17	<5.2(-6)	2/3	2.2(-4)
		2/6	1.5(-6)	2/3	3.2(-4)
		2/6	1.6(-6)	2/15	1.0(-4)
		2/7	1.0(-6)	2/15	9.7(-5)

Tanks T-607 A & B, T-610 A & B and T-689 A are, respectively, the coolant waste receiver, the coolant waste holdup, and the spent regenerant tanks.

TABLE 8.16

IODINE SPECIES COMPARISON

BETWEEN STATIONS #9 * AND #1

Sample Period	2/1-2/15		2/15-3/1		3/1-3/13	
Species	#1	#9	#1	#9	#1	#9
Particulate Iodine	11.6	2.0	3.0	5.6	6.8	14.1
I_2	58.1	60.0	67.9	70.3	67.5	57.5
HOI	15.5	17.1	19.1	15.9	16.9	18.7
Organic Iodine	13.2	20.9	8.0	8.2	8.8	9.8

* Hot Lab Sample Hood

TABLE 8.17

SAMPLING SYSTEM CONTRIBUTIONS TO THE PARTICULATE RELEASE

	System Average Activity (μCi/s)*				Percent of Activity Contributed (%)		
Nuclide	#1	#2	#3	Total	#1	#2	#3
^{58}Co	1.6(-6)	6.7(-5)	3.8(-4)	4.5(-4)	0.3	15.0	84.7
^{60}Co	2.0(-7)	7.6(-6)	2.3(-5)	3.1(-5)	0.8	24.7	74.5
^{134}Cs	1.4(-7)	9.6(-7)	1.5(-6)	2.6(-6)	5.4	36.9	57.7
^{137}Cs	2.4(-7)	7.4(-7)	2.3(-6)	3.3(-6)	7.3	22.6	70.1
Average - all particulates					3.4	24.8	71.8

* Averages are based on measured data only, no less than values were used.

Average releases of particulate radionuclides from the auxiliary building stack are presented in Table 8.18. The release rates were calculated from data in Appendix Table B.33. It should be noted that the measured average release rates for radiocesiums were higher downstream of the filter than upstream. Possible reasons for this are discussed in Section 8.3.5.

8.3.4 Sources of ^{3}H and ^{14}C and Annual Releases

The individual gaseous ^{3}H and ^{14}C release rates for each sampling period measured in the in-plant measurement program are presented in Appendix Tables B.70-B.72.

The estimated annual releases for ^{3}H and ^{14}C from the auxiliary building were respectively 69 and 2.7 Ci/year. The average ^{3}H and ^{14}C chemical species distribution (Appendix Table B.70 and B.72) indicated that 99.8 and 67.5 percent of the ^{3}H and ^{14}C were present as the oxidized species.

A comparison of the ^{14}C and ^{3}H annual releases from Rancho Seco with other PWR's studied (2,3,4) indicates that releases of ^{3}H from Rancho Seco are significantly higher (Table 8.19). This higher release rate can be explained by the reactor coolant water handling policy at Rancho Seco, where the water is not discharged but is processed and reused. Consequently, long-lived isotopes, not removed in the cleanup systems, continue to concentrate in the waters the longer the plant operates. As a result the ^{3}H release rate increases each year the plant operates. This increase will continue until an equilibrium value is established where the ^{3}H release rate equals the formation rates.

The ^{3}H data for sampling stations #1-#3, the sum of sampling stations #1-#3, and the auxiliary building stack are in Appendix Table B.70. As shown, the auxiliary building stack ^{3}H values consistently exceed the sum of sampling stations #1-#3. One source of this discrepancy may be the sampling location of the #2 ^{3}H-^{14}C sampler, which was different than that used for the iodine species sampler. The sample point in the fuel handling building duct was in the far end of the duct and the air at that point may not have been representative of the fuel handling building air. Therefore, the ^{3}H values reported for the fuel handling area may be significantly low. Other components evaluated which feed the auxiliary building stack downstream of the #1-#3 sampling stations are the waste gas processing system, the steam jet air ejector (SJAE), and the gland seal vent (see Figure 2.3). Since the average ^{3}H released from a WGDT discharge is 3.57(2) μCi (Table 7.2) and the amount of ^{3}H released from the auxiliary building stack during a nominal two week sampling interval is approximately 2.7(6) μCi, approximately 3600 WGDT's would have to be discharged in a two-week period to account for the difference in the observed auxiliary building releases (sum of sampling stations #1-#3) and the main stack releases. In regard to the SJAE and the gland seal vent, it can be shown the ^{3}H concentrations in the secondary system waters must be on the order of 1(-1) μCi/cm^{3} to account for the difference. The measured ^{3}H concentrations were nominally 1(-5) μCi/cm^{3}.

TABLE 8.18

AVERAGE RELEASE RATES OF PARTICULATE RADIONUCLIDES FROM THE AUXILIARY BUILDING**

Nuclide	Average Release Rate (μCi/s)*
^{58}Co	9.3(-7)
^{60}Co	4.8(-6)
^{134}Cs	1.5(-5)
^{137}Cs	2.1(-5)

* Averages are based on positive values only, no less-than values were used.

** Release rates are measured downstream of the HEPA filter.

TABLE 8.19

EXTRAPOLATED ANNUAL ^{14}C AND ^{3}H RELEASES (Ci/y)

	Ft. Calhoun*	Zion**	Turkey Point†	Rancho Seco
		Total Plant		
^{3}H	1.6	30.7	15.8	69
^{14}C	1.2	6.5	7.3	2.7
		Per Unit		
^{3}H	1.6	15.35	7.9	69
^{14}C	1.2	3.25	3.65	2.7

* Data obtained from reference 2.

** Data obtained from reference 3.

† Data obtained from reference 4.

Consequently, the SJAE and gland seal vent do not account for the observed difference and the reason for the difference is unknown. This leaves the #2 sampling location as the most probable cause of the discrepancy.

Table 8.20 presents the percent distributions of ^{3}H for sampling systems #1-#3. As shown the fuel handling area is the major contributor of ^{3}H (average 62%) in the auxiliary building.

Since it was not possible to install a ^{14}C sampler on sampling system #1 the percent contributions within the auxiliary building could not be obtained. The ^{14}C distributions for systems #2 and #3 are shown in Appendix Table B.72. The interesting item to note in Table B.72 is the change in chemical species in system #2 before, during, and after refueling. Before refueling, the predominant ^{14}C species was oxidizable while during and after refueling, the predominent species was oxidized ^{14}C.

8.3.5 Charcoal and HEPA Filter Decontamination Factors

In Section 8.1 the charcoal and HEPA filtering systems in the auxiliary building are described in detail. In addition to the auxiliary building filter bank, consisting of, in order of flow, prefilters, HEPA filters and charcoal filters, there are filters within sampling system #3 (Figure 8.2). To obtain an estimate of the particulate decontamination factor for these prefilters, the data from the sampling systems feeding system #3 were summed and compared to the measured particulate values in system #3 (Table 8.21). As indicated in Table 8.21 the Decontamination Area of the auxiliary building is not included in the total of the different systems feeding system #3 since the Decontamination Area was unmonitored (Figure 8.2). However, as the decontamination area has a prefilter and a HEPA filter on its exhaust, contribution to the particulate concentrations in the duct should be very small. Consequently, it can be concluded that within the uncertainties of the measurements the prefilters do not significantly affect the particulate releases. The data used in Table 8.21 were taken from Appendix Tables B.36-B.41.

Appendix Tables B.33-B.36 present, respectively, the results of particulates measured in the auxiliary stack and systems #1-#3. From these data average DF's of the auxiliary building exhaust filter bank were determined for the radiocesiums and radiocobalts. The DF's were, respectively, 32 and 1.2 for the radiocobalts and the radiocesiums. The reason for the variability is related to the frequency the radionuclides were observed and to the observed radionuclide concentrations. The low DF for the radiocesiums is mainly the result of measuring relatively high ^{137}Cs release rates in the stack downstream of the filter during the outage without measuring correspondingly high rates upstream of the filter. For example, Tables B.33-B.36 show that for the period beginning 12/7 a release rate of ^{137}Cs of 1.3(-4) μCi/sec was measured downstream. The corresponding upstream measurement was 4.7(-6) μCi/sec. This means

TABLE 8.20

^3H FEEDER CONTRIBUTIONS TO THE AUXILIARY BUILDING SUM
(IN PERCENT)

Sample Date	System (Percent of Total) #1*	#2	#3	Feeder Total (μCi/s)
10/12-10/26	†	32	68	1.35
10/26-11/9	†	53	47	0.89
11/9-11/20**	†	59	41	1.00
11/20-12/7**	†	57	43	1.00
12/7-12/21**	†	84	16	1.54
12/21-1/4 **	<1	82	18	1.93
1/4-1/18	<1	70	30	1.99
1/18-2/1	<1	94	6	1.17
2/1-2/15	1	84	15	0.51
2/15-3/1	1	32	67	0.30
3/1-3/13	<1	10	90	1.02

* Oxidized ^3H sampler only on system #1.

** During Refueling

† No sample on system #1.

TABLE 8.21

SYSTEM #3 PREFILTER DECONTAMINATION FACTORS

Off Date	Sta #4 μCi/s	Sta #5 μCi/s	Sta #6 μCi/s	Sta #7 μCi/s	Sta #8 μCi/s	Sta #3 μCi/	DF
^{134}Cs:							
2/1	<3.0(-7)	1.4(-7)	3.9(-8)	<8.3(-8)	<1.3(-7)	<6.7(-7)	>0.21
2/8	1.9(-7)	1.0(-7)	<1.3(-7)	<1.2(-7)	<4.4(-8)	1.9(-7)	1.5
2/15	<1.1(-7)	1.3(-7)	<3.5(-8)	<7.6(-8)	<1.9(-8)	<1.6(-6)	>0.08
2/22	<2.9(-7)	<2.9(-7)	<4.2(-7)	<3.3(-7)	<3.1(-7)	<3.1(-7)	
^{137}Cs:							
2/1	5.1(-7)	3.8(-7)	7.9(-8)	<2.6(-7)	<8.5(-8)	7.9(-7)	1.1
2/8	4.9(-7)	1.7(-7)	<1.6(-7)	<7.7(-8)	<9.3(-8)	4.9(-7)	1.3
2/15	2.0(-7)	1.5(-7)	<1.2(-7)	<1.1(-7)	<8.6(-8)	1.0(-6)	0.35
2/22	3.0(-7)	2.1(-7)	<4.4(-7)	<3.7(-7)	<3.0(-7)	<7.8(-7)	>0.65
^{58}Co:							
2/1	8.4(-6)	4.4(-7)	7.8(-8)	1.6(-7)	2.0(-7)	8.4(-6)	1.5
2/8	3.4(-6)	2.2(-7)	5.5(-7)	<1.6(-7)	<1.0(-7)	3.4(-6)	1.1
2/15	1.7(-6)	8.3(-8)	6.8(-7)	<1.0(-7)	9.8(-8)	5.9(-6)	0.32
2/22	4.8(-6)	<2.9(-7)	1.0(-6)	<5.2(-7)	<2.2(-7)	8.5(-6)	0.56
^{60}Co:							
2/1	1.2(-6)	<2.0(-7)	2.3(-7)	<2.2(-7)	<2.2(-7)	8.3(-7)	1.4
2/8	2.6(-7)	<1.6(-7)	<2.4(-7)	<1.8(-7)	<1.0(-7)	2.6(-7)	1.0
2/15	5.0(-7)	<5.9(-8)	1.1(-7)	<4.8(-8)	<6.3(-8)	2.6(-5)	0.02
2/22	9.9(-7)	<3.6(-7)	<4.4(-7)	<3.1(-7)	<3.3(-7)	9.9(-7)	1.0

that either there was another source upstream of the filter which was not measured by either samplers #1, #2 or #3 or there was a source which was exhausted downstream of the filter. The former explanation is more likely, and it means that the inlet concentrations were really much higher during this period. This, in turn, means that the DF was much higher than indicated.

In Table 8.22 the ^{131}I DF's across the auxiliary building filter bank are tabulated. In Table 8.23 decontamination factors for the different iodine chemical species are presented. Only positive values were used to calculate the average values presented in these tables. Also, as the sum of sampling stations #1-#3 was used in calculating the DF's, the sum of the individual iodine species DF's does not equal the total DF. For example, for organic iodide an actual DF may have been observed but for the other individual species only a lower limit may have been determined. However, in the total DF calculations, all inlet concentrations are summed and divided by the effluent concentration. This results in DF values different from those obtained by adding the individual species DF's, where lower limit values are not included.

In section 8.1 plant data was presented which related the charcoal's methyl iodide DF as a function of operational hours. This data is presented graphically in Figure 8.6. Since the A and B charcoal filters (see Figure 8.1) at Rancho Seco had been in service approximately 9000 and 7000 hours, respectively, at the time of the in-plant measurement program, the predicted methyl iodide DF's for the two charcoal filters are 13 and 9. These values are smaller than the average measured organic iodine species DF of 140. This discrepancy can conceivably be accounted for by the methods of determining the charcoal DF's. In the in-plant measurement program, the DF's are determined by direct measurements across the charcoal filters and measure organic species other than methyl iodide. For the plant data, aliquots of the charcoal are sent to a service laboratory for evaluation. In the service laboratory evaluation a standard procedure (18) is followed to determine a methyl iodide only DF. As a result, a different DF could be obtained by the two methods. It appears from these data that the service laboratory evaluations give conservative DF measurements, i.e., the actual DF's are higher.

8.3.6 Selected Alpha- and Beta-Emitting Radionuclide Data

For general information only an aliquot of an auxiliary building HEPA filter was collected and subjected to transuranic and beta-emitting radionuclide analyses. Table 8.24 presents the results of these analyses. It should be pointed out that the μCi/year release rate values presented are not environmental releases but only the amount of activity that was collected on the total filter (Section 8.1) during a year's time. The μCi/cc value represents the radionuclide concentration that would have to be present in the auxiliary building to collect the observed amounts of radionuclides on the HEPA filter. This assumes a 100% collection efficiency and 1.1(15) cm^3 total flow through the filter bank.

TABLE 8.22

^{131}I DECONTAMINATION FACTORS

Sample Period	Sum (Systems #1, #2, and #3) (μCi/s)	Main Stack (μCi/s)	DF
1	5.9(-4)	3.6(-6)	160
2	8.9(-5)	2.4(-6)	37
3	2.8(-4)	4.8(-6)	58
4	7.5(-5)	8.7(-7)	86
5	1.7(-2)	7.7(-5)	220
6	1.5(-3)	1.7(-5)	88
7	3.8(-4)	3.5(-5)	11
8	9.3(-4)	5.5(-5)	17
9	9.9(-4)	1.0(-4)	10
10	4.7(-4)	4.9(-6)	96
11	7.6(-5)	3.2(-7)	240
12	1.4(-4)	<7.2(-6)	>20
13	1.5(-4)	<2.8(-6)	>55
		Avg.	93

TABLE 8.23

^{131}I SPECIES DECONTAMINATION FACTORS

Sample Period	Particulate Iodine	I_2	HOI	Organic
1	>41	>173	>116	109
2	>6.7	>13	>7.5	21
3	>21	>14	>21	428
4	*	*	*	*
5	>6061	318	1556	581
6	>32	>148	>1536	47
7	>1.3	>5.2	>21	9.1
8	>5.2	>3.8	>7.1	16
9	>5.8	>24	>19	6.9
10	>40	>156	>17	45
11	>9.4	>2.8	>1.9	>4.9
12	>3.4	>23	>12	>49
13	>4.2	>21	>59	>75
	Avg.	318	1556	140

* DF could not be determined for different iodine species.

FIGURE 8.6

RANCHO SECO MAIN STACK CHARCOAL FILTER DF's

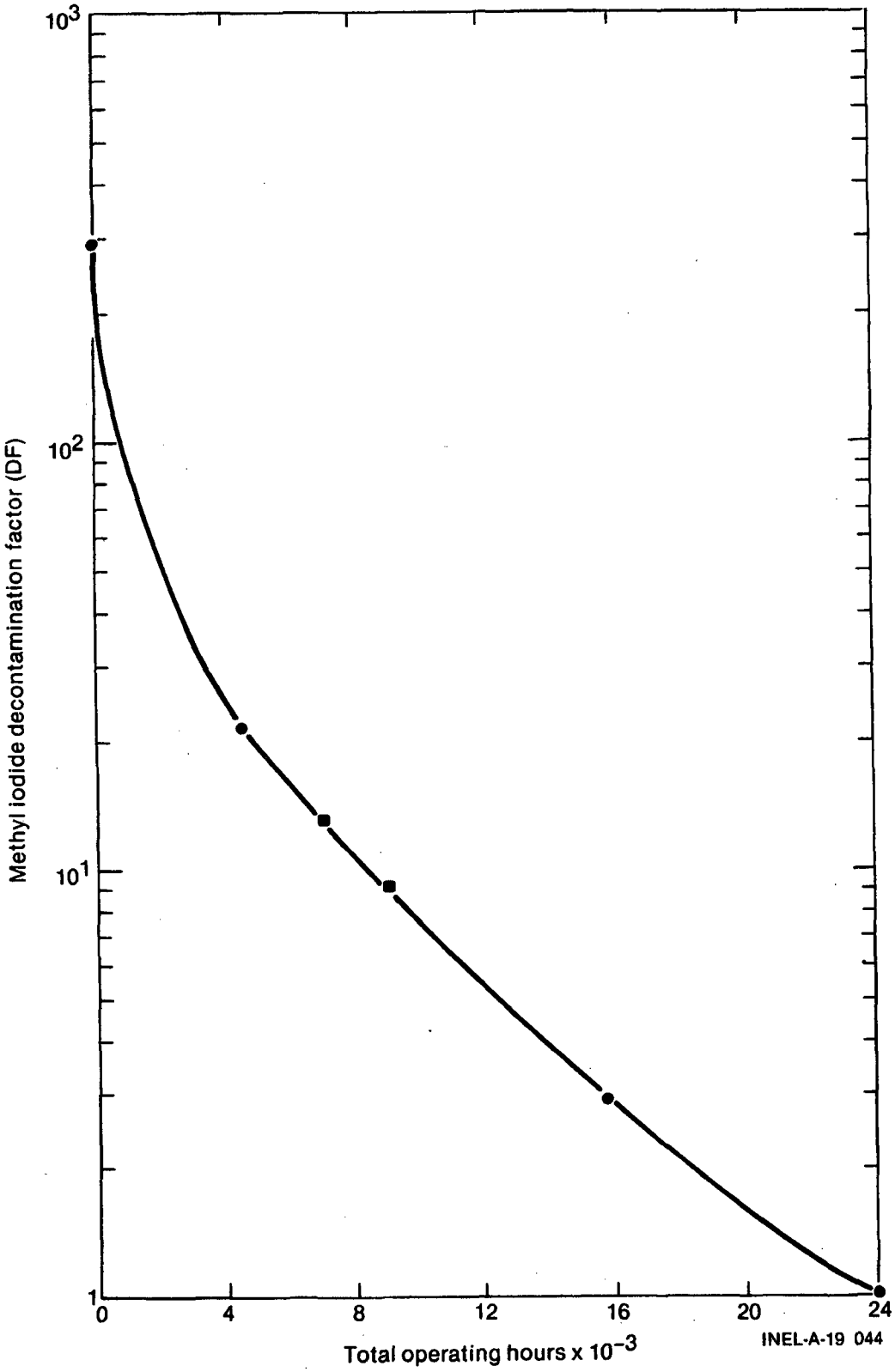


TABLE 8.24

TRANSURANIC AND BETA-EMITTING RADIONUCLIDE ANALYSIS OF AUXILIARY BUILDING HEPA FILTER

Radionuclide	µCi/cc*	µCi/year*
^{55}Fe	3.3(-13)	1.98(2)
^{63}Ni	6.0(-14)	3.6(1)
^{91}Y	2.6(-15)	1.56(0)
^{89}Sr	7.6(-15)	4.6(0)
^{90}Sr	2.1(-16)	1.3(-1)
^{238}Pu	4.0(-18)	2.4(-3)
$^{239,240}Pu$	1.0(-17)	6.0(-3)
^{241}Am	2.8(-17)	1.7(-2)
^{242}Cm	2(-17)	1.2(-2)
^{244}Cm	1.0(-18)	6(-4)

* Numbers are based on observed activities on the filter at the time of sampling; no decay corrections are applied to the decay during collection of activities on the filter, i.e., 4.3 years.

TABLE 8.25

BETA-EMITTING RADIONUCLIDES DOWNSTREAM OF AUXILIARY BUILDING HEPA FILTERS

Off Date	^{55}Fe	^{63}Ni	Release Rate (μCi/s) ^{91}Y	^{89}Sr	^{90}Sr
10/26/78	3.8(-5)	3.5(-5)	1.2(-5)	*	*
12/21/78	4.6(-6)	5.4(-6)	<1.7(-5)	*	*
3/1/79	1.4(-6)	1.5(-5)	2.4(-5)	*	*
11/9/78	*	*	*	<2.5(-5)	<8.9(-8)
12/7/78	*	*	*	<1.4(-5)	1.1(-7)
2/1/79	*	*	*	1.2(-5)	<9.9(-8)

* Analysis not performed on sample.

It is interesting to note that the airborne concentration calculated for $^{239-240}Pu$ is in agreement with the value reported by another research facility (21) for environmental concentration of $^{239-240}Pu$ during the time the filter was in operation. Actual measurements downstream of the HEPA filters are in Table 8.25. These data were derived from analyses of HEPA filter samples. No transuranic analyses were performed on the samples. The analytical procedures used are presented in reference (19). The data is taken from Appendix Table B.73.

8.3.7 Stack Xe and Kr Release Rates

The main stack Xe and Kr releases were monitored using a cryogenic air sampler (CAS). The CAS operated from 10/24/78 to 2/28/79. The CAS selectively concentrates the Xe and Kr from air by using a cryogenic distillation column. The Xe and Kr are then compressed into a 900 cm sample can. Typically the CAS samples stack air for 21 hours, isolates the sample for 1.5 hours, and remains idle for 1.5 hours. Thus, the CAS operates on a 24-hour basis, but it only samples air for 21 of those hours.

Once removed, the sample is analyzed for Xe and Kr isotopes, using a Ge(Li) gamma-ray spectrometer. The samples are then analyzed for total Xe and Kr by gas chromatography to determine the percent recovery of the CAS.

The calculated release rates for the nuclides ^{85}Kr, ^{85m}Kr, ^{88}Kr, ^{131m}Xe, ^{133}Xe, ^{133m}Xe, and ^{135}Xe are reported in Appendix Table B.69. Table 8.26 presents the average release rates and the annual releases for ^{85}Kr, ^{133}Xe and ^{135m}Xe. To convert to annual releases, the average release rates were multiplied by the number of seconds in a year (3.15(7)) and converted to curies. The average release rates during refueling and non-refueling intervals are presented in Table 2.5.

TABLE 8.26

EXTRAPOLATED ANNUAL RELEASE OF SELECTED NOBLE GASES

Nuclide	Average Release Rate (μCi/s)	Annual Release (Ci/yr)
^{85}Kr	2.68(0)	8.42(1)
^{131m}Xe	5.36(0)	1.69(2)
^{133}Xe	1.05(3)	3.32(4)

9. SECONDARY SYSTEM

9.1 Introduction

This section presents the results of samples taken from the secondary system at Rancho Seco. Figure 9.1 is a diagram of the Rancho Seco secondary system showing the principal system components and flow paths.

9.2 System Description

9.2.1 Steam Generators

There are two Babcock & Wilcox once-through steam generators in the secondary system. Each steam generator is rated at 5.9(6) lbs/hr steam flow at 940 psig.

9.2.2 Turbine Train

The turbine train was fabricated by Westinghouse and consists of one high pressure (HP) and two low pressure (LP) turbine units. All the turbines are double flow units with reaction blades at each end. The turbine generating unit is rated at 2788 MWT.

9.2.3 Gland Seal

The turbine gland sealing steam comes from two sources. At less than 15% turbine speed, the gland seal is provided from main steam through a pressure regulating valve. At greater than 15% turbine speed the HP turbine supplies the gland sealing steam.

9.2.4 Moisture Separator Reheaters

There are four tube and shell type reheaters, two for each LP turbine unit. The drains from these reheaters go to the heater drain tanks. There are four heater drain tanks.

9.2.5 Steam Jet Air Ejectors

1. The hogging ejectors used for startups and emergencies.

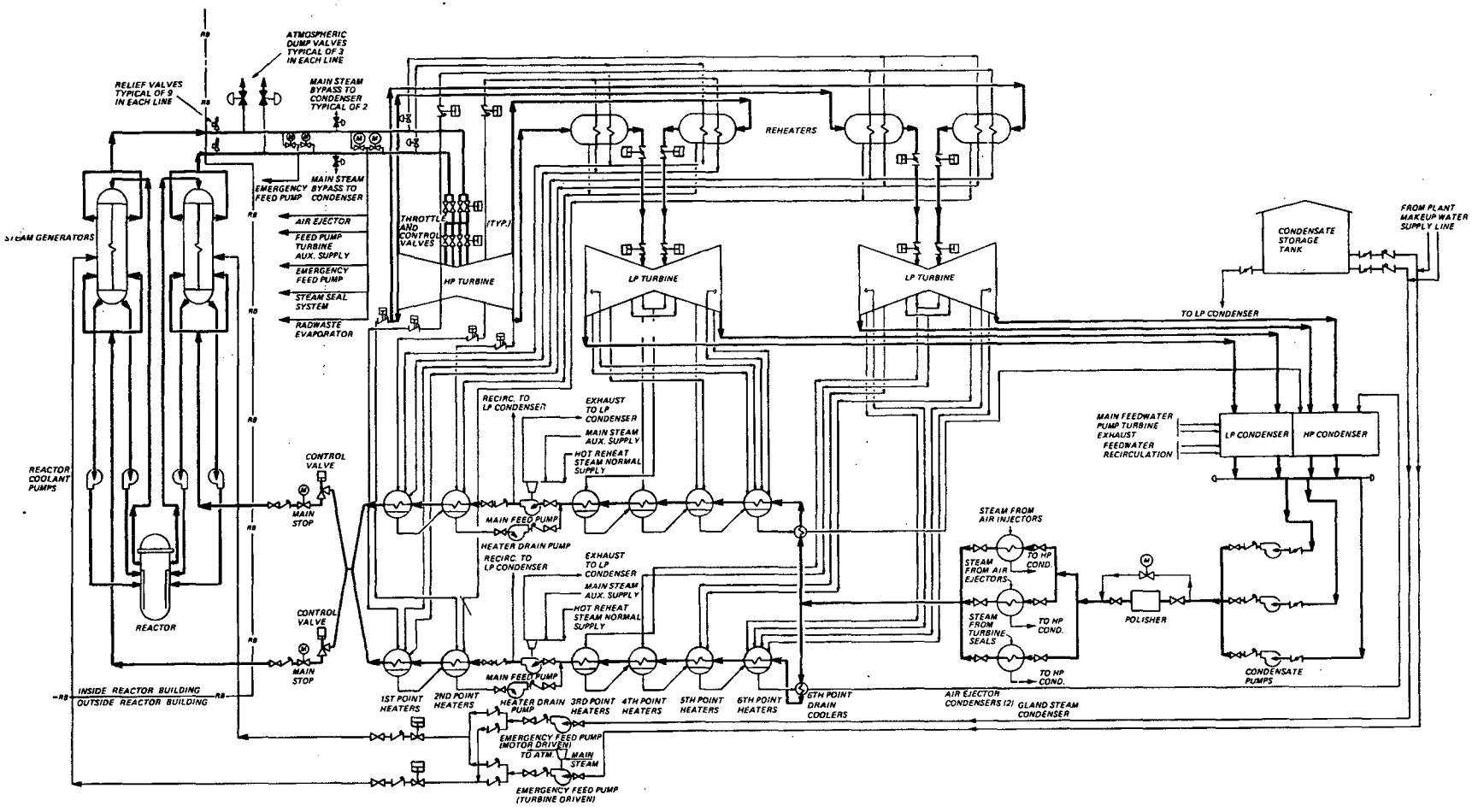
2. The main air ejector consists of two sets of two stage steam jet air ejectors. One set is used while the other remains in standby. The air ejectors are operated with reduced pressure main steam. The vent of the air ejector exhausts to the auxiliary building ventilation exhaust filter plenum.

9.2.6 Main Condenser

The main condenser consists of a low pressure (LP) section and a high pressure (HP) section. The condenser hotwells provide five

FIGURE 9.1

DIAGRAM OF RANCHO SECO SECONDARY SYSTEM



STEAM AND POWER CONVERSION SYSTEM

minutes of condensate storage at full load - about 85000 gallons. Main steam can be dumped directly to the main condenser at the rate of 1.8(6) lbs/hr.

9.2.7 Condensate Storage Tank

The storage tank has a capacity of 450,000 gallons. Demineralized water is supplied to the storage tank through filters and a demineralizer train. The demineralizer train consists of two cation, two anion and two mixed bed demineralizers. The system is designed for the continuous treatment of makeup water at flows ranging from 0-250 gallons per minute.

9.2.8 Condensate Pumps

There are three condensate pumps rated at 8500 gpm each. The condensate system is normally operated with two pumps running and the third pump in standby mode.

9.2.9 Condensate Polishing Demineralizers

There are nine polishing demineralizers. Normally eight demineralizers are in operation and one in standby mode. The system is designed to handle 17,000 gpm of condensate flow.

9.2.10 Feedwater Reheaters

There are two parallel trains of reheaters. Each train can handle 50 percent of full rated flow. There are two high pressure heaters, four low pressure heaters and a drain cooler in each train.

9.2.11 Chemical Addition

Chemicals are added to the feedwater to reduce system corrosion and fouling. Hydrazine is added to suppress oxygen and ammonia is added for pH control.

9.2.12 Feedwater Pumps

There are two turbine driven feedwater pumps. Each pump has a capacity of 14,200 gpm. During normal operation both pumps are running. The pumps take a suction from the low pressure feedwater heater trains and discharge through the high pressure feedwater trains to the steam generators.

9.2.13 Emergency Feedwater Pumps

There are two emergency feedwater pumps, one turbine driven and one motor driven. Each pump has a capacity of 1180 gpm. These pumps can take a suction from the condensate storage tank, the Folsom South Canal pumps or the plant reservoir.

9.2.14 Circulating Water Pumps

There are four circulating water pumps each rated at 111,500 gpm. These pumps take a suction from the cooling canal and discharge through the LP condenser, then the HP condenser to the cooling towers. Water from the cooling towers returns to the cooling canal. Makeup water for the cooling canal is supplied from the Folsom South Canal.

9.2.15 Rated Flows

Table 9.1 contains the rated system flows in lbs/hr and gm/sec.

9.3 Sample Points

During the in-plant measurement program, samples were taken from the steam generator blowdowns and the steam jet air ejectors using the plant sample lines.

9.4 Sample Types and Procedures

Samples obtained at Rancho Seco were obtained using the procedures outlined in reference (6). This included liquid and gaseous samples:

a. Grab Samples - 450 ml of the liquid blowdown stream were collected in a glass bottle containing 9 ml of conc. HCl and counted.

b. Whole Gas Sample - A 250 ml gas bomb was purged (at 0.7 l/min) with the gaseous air ejector sample stream for 10 bomb volumes (about 4 minutes) then sealed. The glass bombs were then counted directly.

9.5 Results

9.5.1 Steam Generator Blowdown

The following steam generator blowdown samples were taken at Rancho Seco:

Date	Time	Unit	Volume (ml)	Comments
9/10/78	0910	A	450	Reactor at 10% power
2/27/79	1534	B	450	Reactor at 7% power

The results for both steam generators showed activity levels at the background level or below the limits of detection.

TABLE 9.1

RATED FLOWS FOR SECONDARY SYSTEM

System	Flow lbs/hr	Flow gm/sec
Main Steam	1.2(7)	1.5(6)
High Pressure Drains	3.5(6)	4.4(5)
Main Condensate	8.5(6)	1.1(6)
Main Feed	1.2(7)	1.5(6)
Steam Jet Air Ejectors	20 cfm	9.5(3)

High Pressure Drains = 28 percent of total flow

Condensate System = 72 percent of total flow

Conversion Factor 1 lb/hr = 0.12623 gm/sec.

9.5.2 Steam Jet Air Ejectors

The following air ejector whole gas sample was taken at Rancho Seco.

Date	Time	Volume	Comments
9/14/74	0953	250 cc	Reactor at 100% power

The results of the sample counting for the air ejector gas sample gave activities at the background level or below the limits of detection. The data are shown in Appendix Table B.77.

9.6 Conclusions

The secondary system was sampled at Rancho Seco to see if a primary-to-secondary leak existed. The results of the samples taken indicate that a measurable primary-to-secondary leak did not exist at Rancho Seco during the in-plant measurement period.

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APPENDIX A. SAMPLE AND DATA HANDLING

A.1 Sample Handling

A.1.1 Sample Volumes and General Sampling Procedures

The general sampling procedures that were followed have been described in the report "Procedures, Source Term Measurement Program" (6). The specific sampling procedures used at Rancho Seco Nuclear Station have been described in the Measurement Plan for Rancho Seco (5).

A.1.2 Sample Validation

Although it is impossible to prove that a given sample is an actual representation of the liquid or gas under study, some confidence can be placed on the quality of the sample by showing how reproducible the results are for replicate samples or for samples from a given system taken under different conditions. Validation of liquid and gaseous samples at Rancho Seco was handled as described below.

A.1.2.1 Liquid Samples

During the initial phase of the measurements at Rancho Seco, each sample point was investigated to determine whether or not a valid sample could be obtained. This was done by first discussing the sample point with plant personnel and determining the sampling procedures they recommend (e.g., recirculation times for tanks). The sample line was then purged for a time at least as long as recommended by plant personnel. Replicate samples were taken under identical conditions over a period of time and the results compared in order to give final verification of the sample validity.

A.1.2.2 Gaseous Samples

Verification of the validity of gaseous samples was determined by two methods. The first involved pitot tube and helium dilution measurements (see sections 2.2 and 2.3 in reference (6)). Ventilation duct flows were calculated based on the results of each of the two types of measurements. The two results agreed (to within $\pm$ 10%), indicating that representative samples had been obtained.

At Rancho Seco it was possible to do an activity balance on the main stack output and all of the sources that contributed to the main stack. The results of the activity balance indicate that representative samples had been obtained.

A.1.3 Validation of Sample Analyses

In order to insure accuracy of analyses, efficiency tables for all systems, both those in the Mobile Laboratory and those at INEL, were established through the use of NBS standards or standards

traceable to NBS. These efficiency tables were obtained under all geometric conditions which the samples were analyzed. During the measurement period at Rancho Seco the efficiencies were checked using standards on a routine basis.

In addition to checks with standards, intercomparisons were made between the Source Term group and the chemistry group at Rancho Seco. Table A.1 shows the results of these comparisons.

A.2 Data Handling

Analysis of each gamma-ray spectrum was performed either in the Mobile Laboratory or at INEL using a program that searches the spectrum for gamma-ray peaks, identifies the radionuclide producing the detected gamma rays, decay corrects activities to the sample collection time, and provides radionuclide concentrations together with counting error estimates. For radionuclides of interest that were not detected, the program determines lower limits of detection.

Uncertainties quoted for radionuclide concentrations in this report are 1σ errors due to counting statistics only. An additional uncertainty of approximately 10% should be added to the quoted errors to account for calibration and volume measurement errors. Indeterminate sampling errors have not been treated, however, the total errors due to sampling, calibration, and volume measurement are estimated to be approximately 20%.

In the determination of radionuclide concentrations in reactor coolant, the sample was gamma counted 3-4 times over a period of 2 weeks in order to obtain data on both long- and short-lived radionuclides. When a radionuclide was detected in more than one spectrum, the quoted concentration for that sample was obtained from the average of the individual results.

In the course of many of the measurements, some of the radionuclides in the standard list are not detected by the peak search routine. When this occurs a detection limit is calculated. The algorithm used for the Rancho Seco detection limit was a forced Gaussian fit of fixed centroid and fixed width where the background and the height of the gaussian were allowed to vary. If the area calculated by this technique was less than 2 times the standard deviation (σ) for the calculation, then the detection limit was quoted as the 2σ value calculated for the fit. If the area calculated by this fit technique was larger than the 2σ error, then it was assumed that the nuclide was present.

In order to use the lower limit of detection (i.e., less-than) values in further calculations, one must be aware of certain problems facing the user. These problems are:

(1) When calculating decontamination factors (DF's) with a less-than in the denominator and a real number as the numerator, the resultant DF will be a greater-than. If the numerator

TABLE A.1

COMPARISON OF RANCHO SECO AND EG&G RESULTS FROM SPLIT SAMPLES

	microcuries/milliliter			
	9/28/78		12/4/78	
Nuclide	RS	EG&G	RS	EG&G
^{133}Xe	4.2 ± 0.6(-5)	4.6 ± 0.5(-5)		
^{99m}Te (^{99}Mo)	1.8 ± 0.2(-5)	1.78 ± 0.03(-5)		
^{135}Xe	7.6 ± 0.3(-5)	1.33 ± 0.02(-4)		
^{131}I	1.66 ± 0.04(-4)	1.46 ± 0.01(-4)		
^{133}I	2.9 ± 0.1(-4)	2.44 ± 0.03(-4)		
^{134}Cs	5.2 ± 0.4(-5)	4.05 ± 0.04(-5)	1.83 ± 0.03(-3)	1.64 ± 0.01(-3)
^{137}Cs	6.2 ± 0.4(-5)	5.04 ± 0.05(-5)	2.06 ± 0.03(-3)	1.97 ± 0.01(-3)
^{58}Co	2.6 ± 0.1(-4)	1.3 ± 0.1(-5)	2.10 ± 0.01(-2)	2.85 ± 0.02(-2)
^{60}Co	2.0 ± 0.2(-5)	4.7 ± 0.2(-6)	1.66 ± 0.03(-3)	1.53 ± 0.02(-3)
^{54}Mn	1.6 ± 0.3(-5)	3.7 ± 0.3(-6)	6.8 ± 0.2(-4)	6.61 ± 0.06(-4)
^{135}I	4.3 ± 0.8(-5)	4.8 ± 0.2(-5)		
^{24}Na	5.6 ± (-5)	4.35 ± 0.08(-5)		
^{51}Cr			5.7 ± 1.5(-4)	9.6 ± 1.3(-4)
^{57}Co			4.4 ± 0.9(-5)	7.8 ± 0.7(-5)
^{110m}Ag			9.6 ± 2.7(-5)	1.6 ± 0.1(-4)

is the less-than with a real number in the denominator, the resultant DF is a less-than. If both the numerator and the denominator are less-thans, then the result is indeterminate and the DF cannot be calculated.

(2) When calculating averages with less-thans as some or all of the data, one can only calculate a minimum (taking the less-than at a value of 0) value that the average is either greater than or equal to and the range that the average will fall. The reporting format is:

Smallest Real Value $\leq$ Average < Largest Value

(3) When calculating averages with greater-thans as some or all of the data, one can only calculate the minimum value for the average, using the greater-thans at value. The reporting format is:

Smallest Real Value $\leq$ Average

(4) When calculating averages with both less-thans and greater-thans as some or all of the data, one can only calculate the minimum value for the average taking the greater-thans at value and the less-thans at 0. The reporting format is:

Smallest Real Value $\leq$ Average

(5) There are a few cases when a very large less-than was computed for a given sample. These large less-thans have been excluded from the calculation of the maximum value for the averages whenever they meet the criteria for outliers as provided by the Dixon Outlier Test (Reference 10). These large less-thans would bias the maximum value for the average at an inordinately high value if they were used.

Average values for some locations have been time weighted. For example, the average ^{131}I concentration in the reactor coolant was time weighted to calculate the normalizing factors used to calculate gaseous releases. The formula used to weight the averages is

$$\overline{X} = \frac{\Sigma x_i w_i}{\Sigma w_i}$$

where

$\overline{X}$ = weighted average

x_i = individual value

w_i = no. of days this value represents

The program used to calculate the weighting factor assumes that a sample value is valid from the time of the last sample to the time of the given sample.

A.3 Fuel Integrity Analysis

A.3.1 Theroretical Basis

References 8 and 20 discuss techniques for evaluation of fuel integrity in operating PWR's and BWR's, respectively, that are similar to the method outlined here. Three mechanisms of fission product release are evaluated: (1) a recoil release from fissioning of tramp uranium deposited on the fuel cladding and the reactor internals, (2) a diffusion release through small defects in the fuel cladding, and (3) an equilibrium release through larger cladding splits or defects.

A recoil release presents fission product activity to the reactor coolant with no time delay, thus the long-lived and short-lived volatile and soluble fission products appear to have the same source term. If a fission source term is calculated by correcting the coolant concentrations for coolant volume, fission yield, clean up through the letdown system and from decay, the long and short lived iodines and fission gases all have the same fission source term. In diffusion type releases, there is a significant time delay in the diffusion process, thus the source term is higher for the longer-lived and more mobile fission species. Spiking of radioiodine reactor coolant activities upon rapid power changes are thought to be the result of pin-hole diffusion leak sites. In equilibrium releases, large breaches in the fuel cladding allow the instantaneous escape of equilibrium mixtures of fission gases and volatile species from voids within the fuel package. All activities are elevated including concentrations of fuel activation nuclides such as ^{239}Np.

The referenced methods require calculation of the apparent fission source giving rise to each nuclide of interest. It can be shown (8) that:

$$\frac{A_i}{y_i \lambda_i} = \frac{\text{fissions}}{\text{sec}} = \text{the apparent fission source term supporting production of the ith nuclide}$$

where

A_i = μCi of nuclide i deposited in the primary/sec.

y_i = fission yield of the ith nuclide

λ_i = decay constant of the ith nuclide (sec^{-1})

A_i can be evaluated from source term measurements as

$$A_i = (C_i)\ (V_p)\ (\lambda_i + \beta_i)$$

where:

C_i = μCi/cc of ith nuclide in reactor coolant.

V_p = reactor coolant volume in cc

β_i = correction for letdown cleanup.

Empirical relationships between the apparent fission source $(\frac{A}{y\lambda})$ and the decay constant (λ) have been determined (8). These relationships quantify the time dependence of the fission product release from recoil, diffusion and equilibrium mechanisms. The relationships are:

$$\frac{A_i}{y_i \lambda_i} = k\lambda^{-b}$$

where:

b = 1 for equilibrium releases

b = 0.5 for diffusion releases

b = 0.0 for recoil releases

k = a constant the value of which changes for the various release modes.

Note that by taking logarithms of the defining equation and rearranging one finds

$$\ln \left(\frac{A_i}{y_i \lambda_i}\right) = \ln k + (-b) \ln \lambda,$$

a linear equation of the general form y = a + bx.

In application, the evaluation technique requires the measurement of reactor coolant concentrations of the iodine isotopes, calculation of $\frac{A_i}{y_i \lambda_i}$ for each isotope, and the calculation of b from a linear least squares fit of $\ln \left(\frac{A_i}{y_i \lambda_i}\right)$ versus $\ln \lambda_i$. For pure recoil releases b=0, for pure diffusion releases b=0.5, and for pure equilibrium releases b=1.0. Seldom are the release modes so clear cut. Usually b values reflect a mixture of release modes. The method is empirical and approximate and its reliability can be improved by analysis of the results from a number of reactor coolant samples.

A.3.2 Calculations for Rancho Seco

Radioiodine and fission gas concentrations in the Rancho Seco reactor coolant have been determined and reported for measurement periods prior to, during, and after refueling (see Appendix Tables B.1 and B.2). Particular sample results have been selected for this study to ensure that the measured concentrations reflect steady-state power operations before and after the refueling outage. Only the radioiodine concentrations measured in these samples will be used in this analysis. Unknown losses of fission gases from the primary system via the letdown loop preclude the use of the measured gas concentrations. Samples selected to reflect fuel conditions prior to refueling include samples obtained at 1401 9/20/78, 1130 9/27/78, 1128 10/4/78, 1140 10/12/78, 1149 10/18/78, 1431 10/24/78, 0940 11/1/78, 0920 11/8/78, and 1145 11/13/78. Samples after refueling include those at 0922 1/11/79, 1408 1/17/78, 1338 2/2/79, 1116 2/8, 0903 2/14/79, 0953 2/21/79, 1408 3/1/79, and 1510 3/6/79. Parameters used in the calculation of $\frac{A}{y\lambda}$ factors are presented in Table A.2 while the apparent fission source values of $\frac{A}{y\lambda}$ for the selected samples are reported in Table A.3.

The $A/y\lambda$ values of Table A.3 and the λ values of Table A.2 were fit to an equation of the form $\ln\left(\frac{A_i}{y_i\ \lambda_i}\right) = \ln k + b \ln \lambda$ using linear least-squares techniques. A separate fit was performed for each sample. Values of the correlation coefficient for the fits varied from about 0.97 to 0.83 indicating good to moderately good fits. The calculated b values were plotted as a histogram. The histogram is presented in Figure A.1. The computed average b both before and after refueling is noted on the plot. The average b value before refueling was found to be -0.41 ± 0.04 after refueling the average shifted to -0.35 ± 0.07. The mechanism for iodine release before refueling appears to be a diffusion-dominated mixture of diffusion and recoil. After refueling, the mechanism is still a diffusion-dominated mixture of diffusion and recoil, but is shifted slightly more toward recoil. This is consistent with the iodine spiking observed during abrupt power changes and with the expected improvement of cladding integrity upon refueling.

A.4 Isotopic Delay Time Calculations

The time it takes for two isotopes, with differing half lives, to move through a process can be calculated from their ratios as they pass through the process.

To begin with, each isotope has a concentration, A_i, and each will decay with a characteristic half life $t_{1/2\ i} = \frac{\ln 2}{\lambda_i}$. The activity at time, t, is $A_i\ e^{\lambda_i t}$. The ratio of activity at time, 0, is $R_o = \frac{A_1}{A_2}$ and

TABLE A.2

PARAMETERS FOR FISSION SOURCE CALCULATIONS

Weight of primary water - 5.07(5) lbs
Letdown Flow - 9.72 lbs/second

Isotope	$\lambda(s^{-1})$	$\lambda+\beta$*	Fractional fission yield (y)
^{131}I	9.98(-7)	2.00(-5)	0.0289
^{132}I	8.37(-5)	1.03(-4)	0.0430
^{133}I	9.26(-6)	2.83(-5)	0.0670
^{134}I	2.20(-4)	2.39(-4)	0.0781
^{135}I	2.91(-5)	4.81(-5)	0.0655

$$* \beta = \frac{\text{(Letdown flow)}}{\text{(Weight of Primary}} = 1.9(-5)\ s^{-1}$$

TABLE A.3

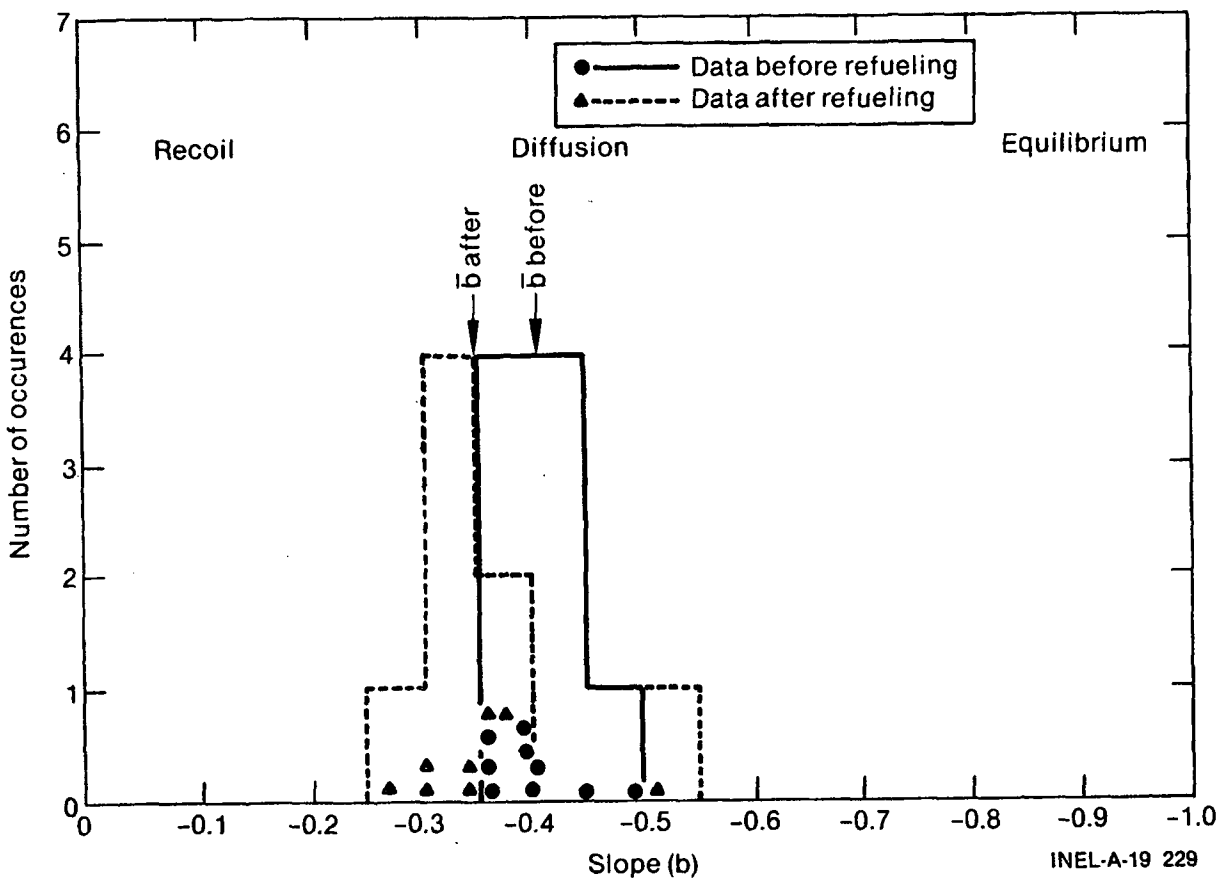
CALCULATED APPARENT FISSION SOURCE ($A/y\lambda$) FOR THE SELECTED REACTOR COOLANT SAMPLES

All values in normalized μCi's

Sample Time	Sample Date	^{131}I	^{132}I	^{133}I	^{134}I	^{135}I
Prior to Refueling:						
1401	9/20/78	1.79(9)	3.12(8)	4.34(8)	4.29(8)	3.39(8)
1130	9/27/78	2.02(9)	3.64(8)	4.69(8)	2.51(8)	3.37(8)
1128	10/4/78	3.28(9)	3.84(8)	5.36(8)	2.58(8)	3.64(8)
1140	10/12/78	2.75(9)	3.92(8)	4.86(8)	2.71(8)	3.68(8)
1149	10/18/78	2.93(9)	3.82(8)	4.89(8)	2.78(8)	3.78(8)
1431	10/24/78	2.89(9)	4.30(8)	5.45(8)	2.84(8)	3.62(8)
0940	11/1/78	2.65(9)	3.98(8)	5.16(8)	2.84(8)	3.75(8)
0920	11/8/78	2.29(9)	3.89(8)	4.51(8)	2.71(8)	3.53(8)
1145	11/13/78	4.01(9)	4.02(8)	5.45(8)	2.36(8)	3.49(8)
After Refueling:						
0922	1/11/79	1.15(9)	2.46(8)	3.49(8)	2.22(8)	2.48(8)
1408	1/17/79	1.47(9)	2.61(8)	3.86(8)	2.10(8)	2.64(8)
1338	2/2/79	1.49(9)	2.66(8)	3.35(8)	2.10(8)	2.74(8)
1116	2/8/79	1.75(9)	2.80(8)	3.86(8)	2.25(8)	2.94(8)
0903	2/14/79	1.55(9)	2.94(8)	3.82(8)	2.27(8)	2.91(8)
0953	2/21/79	1.47(9)	3.22(8)	3.86(8)	2.56(8)	3.03(8)
1408	3/1/79	3.44(9)	2.07(8)	3.56(8)	2.27(8)	3.00(8)
1510	3/6/79	1.18(9)	3.13(8)	4.43(8)	2.69(8)	3.28(8)

FIGURE A.1

OCCURRENCE HISTOGRAM OF CALCULATED b VALUES FROM FUEL INTEGRITY ANALYSIS



the ratio of activity at time, t, is $R_t = \frac{A_1 e^{-\lambda_1 t}}{A_2 e^{-\lambda_2 t}}$. To calculate the time to pass through a process, solve the following equation for t.

$$\frac{R_o}{R_t} = \frac{\frac{A_1}{A_2}}{\frac{A_1}{A_2} e^{(\lambda_2-\lambda_1)t}}$$

$$\frac{R_o}{R_t} = e^{(\lambda_1-\lambda_2)t}$$

$$\ln \frac{R_o}{R_t} = (\lambda_1-\lambda_2)t$$

$$\therefore \quad t = \frac{\ln \frac{R_o}{R_t}}{(\lambda_1-\lambda_2)}$$

One can also solve the equation using the decontamination factor (DF) for each process. This calculation assumes that both isotopes have the same chemical behavior (same DF) for the process being studied and that any difference in DF is from decay during the process.

Then, the measured decontamination factor is $DF_{m_i} = \frac{A_i}{A_i e^{-\lambda_i t}} \times DF_{true}$

and for the two isotopes

$$\frac{DF_{m_1}}{DF_{m_2}} = \frac{\frac{A_1}{A_1 e^{-\lambda_1 t}} \times DF}{\frac{A_2}{A_2 e^{-\lambda_2 t}} \times DF}$$

$$\frac{DF_{m_1}}{DF_{m_2}} = e^{(\lambda_2-\lambda_1)t}$$

and

$$t = \frac{\ln \frac{DF_{m_1}}{DF_{m_2}}}{\lambda_2 - \lambda_1} \qquad \text{(A-1)}$$

These equations must be used with care for time calculations that exceed a few months since the initial ratios should be those of the prior condition. Using instantaneous DF's may give incorrect answers for these long-term calculations.

APPENDIX B

The data obtained during the in-plant measurement studies at Rancho Seco are presented in this Appendix.

TABLE B.1

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, GASES ONLY

REACTOR COOLANT SYSTEM NOBLE GASES

DATE	9/ 7	9/14	9/20	9/27	10/ 4
TIME	1137	1013	1404	1132	1136
NUCLIDE	MICROCURIES/MILLILITER				
AR-41	1.36±.08(-2)	7.00±.20(-3)	3.90±.30(-3)	8.80±.60(-3)	6.00±.40(-3)
KR-85M	5.67±.07(-2)	4.00±1.0(-2)	1.97±.07(-2)	4.80±.10(-2)	5.14±.09(-2)
KR-85	<6.4(-2)	<7.0(-4)	<1.5(-3)	<2.2(-3)	<2.7(-3)
KR-87	7.10±.30(-2)	5.20±.20(-2)	2.19±.09(-2)	5.90±.70(-2)	6.50±.60(-2)
KR-88	1.10±.04(-1)	9.50±.20(-2)	3.57±.08(-2)	9.40±.20(-2)	1.02±.02(-1)
KR-89	<1.3(0)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
XE-131M	7.20±.80(-3)	5.30±.40(-3)	4.40±.30(-3)	<3.7(-4)	8.60±1.2(-3)
XE-133M	2.54±.08(-2)	1.79±.02(-2)	1.29±.02(-2)	2.33±.08(-2)	2.23±.02(-2)
XE-133	9.30±.40(-1)	7.30±.20(-1)	4.52±.02(-1)	7.40±.10(-1)	7.36±.02(-1)
XE-135M	4.70±1.4(-2)	<3.0(-1)	<1.3(0)	<1.3(-1)	<1.1(-1)
XE-135	3.60±.01(-1)	2.70±.10(-1)	1.23±.02(-1)	2.92±.03(-1)	3.28±.07(-1)
XE-137	<2.5(-1)	<2.5(1)	NOTE 1	NOTE 1	<8.5(-1)
XE-138	8.40±.40(-2)	5.10±.80(-2)	<3.4(-2)	8.40±.20(-2)	6.40±.30(-2)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.1 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, GASES ONLY

REACTOR COOLANT SYSTEM NOBLE GASES

DATE	10/12	10/18	10/24	11/ 1	11/ 8
TIME	1137	1152	1435	945	920
NUCLIDE	MICROCURIES/MILLILITER				
AR-41	4.60±.30(-3)	7.70±.40(-3)	6.10±.30(-3)	<3.2(-2)	6.30±.40(-3)
KR-85M	4.80±.10(-2)	7.30±.20(-2)	4.01±.04(-2)	4.78±.04(-2)	4.90±.10(-2)
KR-85	<2.6(-3)	<4.0(-3)	<6.4(-3)	<2.0(-2)	<8.8(-3)
KR-87	6.50±.40(-2)	8.40±.80(-2)	4.70±.10(-2)	6.10±.60(-2)	5.80±.30(-2)
KR-88	1.17±.02(-1)	1.42±.04(-1)	1.00±.02(-1)	1.17±.05(-1)	1.11±.02(-1)
KR-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
XE-131M	6.20±1.6(-3)	<6.4(-4)	<4.8(-4)	<2.8(-4)	<3.6(-4)
XE-133M	1.93±.03(-2)	2.56±.05(-2)	2.48±.03(-2)	1.95±.05(-2)	2.58±.06(-2)
XE-133	6.30±.20(-1)	1.08±.03(0)	8.80±.20(-1)	5.50±.10(-1)	9.00±.30(-1)
XE-135M	<1.6(-1)	<1.3(-1)	<4.6(-1)	NOTE 1	<9.4(0)
XE-135	3.54±.06(-1)	3.99±.04(-1)	3.22±.06(-1)	3.27±.04(-1)	3.30±.10(-1)
XE-137	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
XE-138	6.80±.30(-2)	6.80±.20(-2)	7.10±.80(-2)	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.1 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, GASES ONLY

REACTOR COOLANT SYSTEM NOBLE GASES

DATE	11/13	11/14	11/15	11/15	11/15
TIME	1142	1307	100	706	1403
NUCLIDE	MICROCURIES/MILLILITER				
AR-41	6.00±.50(-3)	1.10±.40(-3)	<3.2(-3)	<2.7(-3)	<1.1(-3)
KR-85M	3.96±.04(-2)	2.10±.03(-2)	4.20±.10(-2)	1.70±.10(-2)	4.30±.40(-3)
KR-85	<6.3(-1)	<2.6(-3)	<2.6(-2)	<3.8(-2)	<9.5(0)
KR-87	3.30±.20(-2)	2.30±.10(-2)	2.10±.10(-2)	1.40±.60(-4)	<8.5(-4)
KR-88	7.20±.10(-2)	4.10±.10(-2)	6.70±.20(-2)	1.57±.06(-2)	2.20±.30(-3)
KR-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<4.3(-1)
XE-131M	<2.2(-2)	<2.6(-4)	<6.4(-3)	<8.0(-4)	<2.7(-2)
XE-133M	3.29±.03(-2)	1.26±.02(-2)	2.90±.30(-2)	2.90±.20(-2)	2.90±.10(-2)
XE-133	1.32±.03(0)	4.90±.20(-1)	1.30±.05(0)	1.36±.05(-1)	1.14±.08(0)
XE-135M	<1.7(0)	<2.0(-1)	<5.2(-1)	<5.4(-1)	<1.3(-1)
XE-135	3.15±.03(-1)	1.56±.01(-1)	3.35±.06(-1)	2.79±.05(-1)	1.72±.06(-1)
XE-137	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<7.6(-2)
XE-138	<1.2(-1)	2.30±.30(-2)	<4.3(-3)	<1.0(-2)	<3.5(-3)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.1 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, GASES ONLY

REACTOR COOLANT SYSTEM NOBLE GASES

DATE	1/ 3	1/11	1/17	2/14	2/21
TIME	856	920	1410	904	955
NUCLIDE	MICROCURIES/MILLILITER				
AR-41	1.70±.10(-2)	2.40±.10(-2)	1.37±.07(-2)	7.60±.50(-3)	8.30±.50(-3)
KR-85M	9.66±.09(-2)	3.60±.05(-2)	3.87±.08(-2)	4.60±.04(-2)	4.73±.05(-2)
KR-85	<5.6(-3)	<3.3(-3)	<6.8(-3)	<2.2(-1)	<3.0(0)
KR-87	6.80±.30(-2)	5.20±.40(-2)	4.10±.40(-2)	4.30±.30(-2)	4.30±.20(-2)
KR-88	1.12±.03(-1)	7.00±.20(-2)	7.30±.10(-2)	7.10±.20(-2)	7.50±.10(-2)
KR-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	2.70±1.1(0)
XE-131M	<3.4(-3)	<8.5(-4)	<9.5(-4)	9.20±1.0(-4)	<2.7(-2)
XE-133M	1.40±.03(-1)	4.07±.04(-2)	3.64±.04(-2)	4.06±.07(-2)	3.97±.04(-2)
XE-133	4.40±.10(0)	1.72±.03(0)	1.47±.04(0)	1.48±.05(0)	1.59±.03(0)
XE-135M	<1.6(0)	<7.3(-1)	<1.8(0)	3.32±.20(-2)	<1.1(-1)
XE-135	1.46±.04(0)	2.70±.06(-1)	2.64±.06(-1)	2.85±.02(-1)	3.09±.03(-1)
XE-137	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<3.6(-1)
XE-138	<4.4(-1)	<1.6(0)	<1.7(-1)	5.70±.40(-2)	5.80±.30(-2)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMITIC OPERATIONS WITH < NUMBERS

TABLE B.2

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

	REACTOR COOLANT				
DATE	9/ 7	9/ 8	9/10	9/10	9/10
TIME	1139	1504	655	755	855
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	6.00±1.0(-3)	7.90±1.8(-3)	NOTE 1	NOTE 1	NOTE 1
I-131	1.67±.07(-2)	1.20±.01(-2)	1.42±.02(-1)	1.88±.03(-1)	2.47±.04(-1)
I-132	4.69±.02(-2)	4.60±.06(-2)	1.32±.02(-1)	1.39±.03(-1)	1.47±.02(-1)
I-133	4.00±.01(-2)	3.61±.02(-2)	2.02±.03(-1)	2.40±.04(-1)	2.84±.06(-1)
I-134	6.43±.04(-2)	6.90±.20(-2)	4.02±.04(-2)	2.37±.04(-2)	1.27±.03(-2)
I-135	5.13±.04(-4)	5.00±.10(-2)	1.36±.02(-1)	1.44±.02(-1)	1.50±.02(-1)
RB-88	1.32±.04(-1)	3.45±.06(-1)	8.07±.23(-2)	8.10±.20(-2)	4.70±.20(-2)
RB-89	<3.6(-2)	<3.3(-3)	NOTE 1	NOTE 1	NOTE 1
CS-134	3.99±.02(-3)	3.65±.03(-3)	8.20±.20(-3)	1.20±.02(-2)	1.62±.02(-2)
CS-136	8.30±.50(-5)	5.60±.20(-5)	1.80±4.5(-3)	3.60±.10(-3)	5.70±.10(-3)
CS-137	4.92±.03(-3)	4.61±.03(-3)	9.50±1.0(-3)	1.40±.04(-2)	1.80±.20(-2)
CS-138	1.20±.02(-1)	1.10±.02(-1)	1.51±.03(-2)	4.30±.30(-3)	NOTE 1
CS-139	4.00±2.0(-2)	5.20±1.4(-2)	NOTE 1	NOTE 1	NOTE 1
NA-24	1.82±.01(-2)	1.69±.03(-2)	1.34±.02(-2)	1.13±.03(-2)	9.40±.30(-3)
CR-51	1.96±.03(-3)	1.77±.03(-3)	NOTE 1	NOTE 1	NOTE 1
MN-54	2.13±.03(-4)	2.06±.04(-4)	NOTE 1	NOTE 1	NOTE 1
MN-56	<2.4(-3)	<3.6(-3)	2.89±.06(-2)	2.70±.10(-2)	2.07±.08(-2)
FE-59	1.39±.06(-4)	1.35±.04(-4)	NOTE 1	NOTE 1	NOTE 1
CO-57	1.60±.20(-5)	1.22±.04(-5)	NOTE 1	NOTE 1	NOTE 1
CO-58	6.47±.03(-3)	6.58±.04(-3)	1.02±.05(-1)	1.10±.06(-1)	1.10±.06(-1)
CO-60	2.25±.03(-4)	2.06±.05(-4)	2.50±.10(-3)	2.60±.10(-3)	2.90±.10(-3)
ZN-65	<5.5(-6)	<1.1(-6)	NOTE 1	NOTE 1	NOTE 1
SR-91	2.90±.90(-4)	<5.6(-4)	NOTE 1	NOTE 1	NOTE 1
Y-91M	<2.4(-4)	<2.5(-4)	NOTE 1	NOTE 1	NOTE 1
Y-93	<9.0(-4)	<5.3(-3)	NOTE 1	NOTE 1	NOTE 1
ZR-95	5.00±.50(-5)	3.60±.30(-5)	NOTE 1	NOTE 1	NOTE 1
NB-95	6.20±.50(-5)	4.20±.30(-5)	NOTE 1	NOTE 1	NOTE 1
MO-99	2.73±.01(-3)	1.99±.02(-3)	1.40±.10(-3)	1.12±.07(-3)	1.22±.08(-3)
RU-103	2.10±.30(-5)	2.10±.40(-5)	NOTE 1	NOTE 1	NOTE 1
RUD-106	<8.2(-5)	<7.7(-5)	NOTE 1	NOTE 1	NOTE 1
AG-110M	<8.7(-6)	<8.7(-6)	NOTE 1	NOTE 1	NOTE 1
SB-124	4.00±2.0(-6)	8.00±2.0(-6)	NOTE 1	NOTE 1	NOTE 1
SB-125	<1.7(-5)	<5.6(-5)	NOTE 1	NOTE 1	NOTE 1
TE-129M	<1.4(-4)	<2.2(-4)	NOTE 1	NOTE 1	NOTE 1
TE-129	<8.2(-2)	<1.0(-1)	NOTE 1	NOTE 1	NOTE 1
TE-131M	<2.4(-4)	<2.3(-4)	NOTE 1	NOTE 1	NOTE 1
TE-131	<1.9(-3)	<2.5(-3)	NOTE 1	NOTE 1	NOTE 1
TE-132	<1.5(-6)	<4.4(-6)	NOTE 1	NOTE 1	NOTE 1
BA-139	6.20±2.8(-3)	2.21±.04(-2)	NOTE 1	NOTE 1	NOTE 1
BA-140	1.35±.10(-4)	1.10±.20(-4)	NOTE 1	NOTE 1	NOTE 1
LA-140	3.00±2.0(-5)	<2.0(-4)	NOTE 1	NOTE 1	NOTE 1
CE-141	<1.9(-5)	<1.1(-5)	NOTE 1	NOTE 1	NOTE 1
CE-143	<3.3(-5)	<1.1(-4)	NOTE 1	NOTE 1	NOTE 1
CE-144	<3.4(-5)	<5.2(-5)	NOTE 1	NOTE 1	NOTE 1
EU-152	<6.2(-5)	<1.9(-5)	NOTE 1	NOTE 1	NOTE 1
EU-154	<5.2(-6)	<4.9(-6)	NOTE 1	NOTE 1	NOTE 1
EU-155	<5.0(-5)	<1.7(-5)	NOTE 1	NOTE 1	NOTE 1
W-187	2.29±.04(-3)	2.10±.40(-3)	8.40±.90(-3)	6.90±.60(-3)	9.90±.70(-3)
NP-239	2.00±.20(-4)	<7.0(-5)	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	9/10	9/10	9/10	9/10	9/10
TIME	955	1100	1155	1300	1401
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	NOTE 1	NOTE 1	6.20±1.2(-2)	4.80±.90(-2)
I-131	3.15±.07(-1)	3.66±.10(-1)	4.03±.11(-1)	4.38±.12(-1)	4.52±.01(-1)
I-132	1.54±.02(-1)	1.47±.02(-1)	1.45±.03(-1)	1.48±.02(-1)	1.46±.02(-1)
I-133	3.30±.05(-1)	3.54±.05(-1)	3.72±.06(-1)	3.87±.06(-1)	3.83±.05(-1)
I-134	6.88±.30(-3)	3.34±.20(-3)	1.62±.21(-3)	7.50±4.7(-4)	2.60±.40(-3)
I-135	1.61±.02(-1)	1.59±.03(-1)	1.52±.02(-1)	1.44±.02(-1)	1.36±.03(-1)
RB-88	4.10±.70(-2)	3.00±.10(-2)	2.60±.10(-2)	1.80±.20(-2)	1.60±.10(-2)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	2.06±.02(-2)	2.36±.05(-2)	2.63±.03(-2)	3.05±.03(-2)	3.37±.03(-2)
CS-136	8.10±.20(-3)	9.50±.10(-3)	1.12±.02(-2)	1.30±.02(-2)	1.34±.02(-2)
CS-137	2.14±.06(-2)	2.29±.09(-2)	2.64±.09(-2)	3.50±.10(-2)	3.70±.09(-2)
CS-138	NOTE 1	NOTE 1	NOTE 1	1.30±.20(-3)	8.60±.40(-3)
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	8.80±.20(-3)	NOTE 1	6.70±.20(-3)	6.10±.20(-3)	5.10±.20(-3)
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-56	1.58±.05(-2)	1.24±.04(-2)	9.40±.60(-3)	5.70±.30(-3)	6.90±.40(-3)
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	1.19±.02(-1)	1.08±.01(-1)	1.09±.02(-1)	9.00±.30(-2)	1.40±.04(-1)
CO-60	2.90±.10(-3)	2.80±.10(-3)	2.90±.10(-3)	2.50±.10(-3)	3.60±.10(-3)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	1.60±.10(-3)	1.48±.09(-3)	1.60±.20(-2)	2.10±.10(-3)	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	5.20±.50(-3)	6.20±.50(-3)	7.30±1.0(-3)	8.70±1.1(-3)	6.00±.60(-3)
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	9/11	9/14	9/20	9/22	9/27
TIME	1453	1012	1401	1438	1130
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<1.7(-3)	9.00±2.0(-3)	7.50±.40(-1)	<1.4(-3)	9.00±2.0(-3)
I-131	9.03±.05(-2)	1.38±.08(-2)	1.10±.09(-2)	9.15±.04(-3)	1.24±.01(-2)
I-132	1.53±.02(-2)	4.51±.09(-2)	4.66±.04(-2)	1.12±.02(-2)	5.43±.04(-2)
I-133	5.91±.05(-2)	4.25±.04(-2)	4.25±.03(-2)	3.44±.01(-2)	4.39±.02(-2)
I-134	4.13±.20(-3)	7.37±.20(-2)	7.64±.11(-2)	5.00±.10(-3)	7.70±.20(-2)
I-135	3.18±.09(-2)	5.60±.10(-2)	5.74±.08(-2)	3.22±.04(-2)	5.70±.10(-2)
RB-88	6.90±.80(-2)	1.26±.08(-1)	6.00±3.0(-2)	3.60±.30(-2)	9.44±.04(-2)
RB-89	<8.9(-4)	<4.0(-2)	<4.9(-2)	<2.5(-3)	<3.8(-2)
CS-134	7.84±.06(-3)	3.04±.02(-3)	3.11±.02(-3)	3.58±.02(-3)	4.39±.02(-3)
CS-136	2.52±.03(-3)	1.02±.05(-4)	1.54±.04(-4)	1.26±.03(-4)	2.74±.09(-4)
CS-137	8.58±.04(-3)	3.60±.03(-3)	3.67±.03(-3)	4.41±.04(-3)	5.20±.04(-3)
CS-138	3.24±.20(-3)	1.17±.02(-1)	1.22±.06(-1)	8.00±.20(-3)	1.07±.01(-1)
CS-139	<1.9(-2)	<5.9(-2)	<5.0(-1)	<2.3(-2)	4.00±1.0(-2)
NA-24	8.10±.20(-3)	1.38±.02(-2)	1.11±.01(-2)	1.04±.01(-2)	1.25±.02(-2)
CR-51	1.00±2.0(-3)	1.63±.04(-3)	3.38±.03(-3)	2.61±.02(-3)	4.33±.09(-3)
MN-54	1.30±.10(-4)	2.22±.06(-4)	3.76±.04(-4)	1.80±.01(-4)	4.54±.06(-4)
MN-56	<4.5(-4)	<2.5(-3)	<2.7(-3)	6.00±2.0(-4)	5.20±.30(-3)
FE-59	4.90±.60(-5)	1.39±.06(-4)	2.45±.06(-4)	1.14±.03(-4)	3.10±.09(-4)
CO-57	<1.1(-5)	1.60±.30(-5)	2.40±.20(-5)	1.16±.06(-5)	3.90±.40(-5)
CO-58	4.38±.03(-3)	8.90±.06(-3)	1.34±.01(-2)	9.18±.05(-3)	1.74±.01(-2)
CO-60	1.77±.07(-4)	2.20±.05(-4)	4.69±.02(-4)	2.55±.03(-4)	4.88±.10(-4)
ZN-65	<1.2(-5)	<8.3(-6)	<6.8(-6)	<2.3(-6)	<1.4(-5)
SR-91	<3.1(-4)	<5.9(-4)	<6.1(-4)	<3.0(-4)	<4.5(-4)
Y-91M	<1.6(-4)	<3.2(-4)	<4.3(-4)	<1.3(-4)	<2.0(-4)
Y-93	<1.3(-3)	<2.6(-3)	<2.6(-3)	3.00±1.0(-3)	<2.8(-3)
ZR-95	2.00±1.0(-5)	3.40±.50(-5)	7.60±.50(-5)	3.70±.20(-5)	9.10±.70(-5)
NB-95	4.00±.70(-5)	8.10±.40(-5)	1.63±.03(-4)	9.00±.10(-5)	1.40±.20(-4)
MO-99	1.90±.04(-3)	2.81±.03(-3)	2.73±.02(-3)	1.80±.01(-3)	1.62±.02(-3)
RU-103	<1.8(-5)	1.70±.40(-5)	3.50±.40(-5)	2.20±.10(-5)	4.90±.70(-5)
RUD-106	<1.3(-4)	<9.3(-5)	<8.5(-5)	<3.5(-5)	<1.6(-4)
AG-110M	<1.9(-5)	<1.3(-5)	<8.6(-6)	1.00±.20(-5)	<2.9(-5)
SB-124	<4.2(-6)	5.00±2.0(-6)	1.20±.20(-5)	6.30±.50(-6)	9.80±.30(-6)
SB-125	<4.6(-5)	<2.9(-5)	<1.9(-5)	<7.2(-6)	<4.6(-5)
TE-129M	<4.1(-4)	<2.2(-4)	<1.7(-4)	<6.0(-5)	<3.7(-4)
TE-129	NOTE 1	<1.0(-1)	NOTE 1	<5.1(-3)	<8.9(-2)
TE-131M	<2.5(-3)	<3.1(-4)	<3.8(-4)	<3.6(-4)	<4.2(-4)
TE-131	<1.4(-3)	<3.6(-3)	<8.5(-3)	1.20±.50(-3)	<4.0(-3)
TE-132	<6.5(-5)	<2.1(-5)	6.00±2.0(-5)	<1.0(-6)	9.00±1.0(-6)
BA-139	<6.1(-3)	<2.3(-2)	<2.8(-2)	<4.3(-3)	1.52±.12(-2)
BA-140	4.50±.60(-4)	1.80±.20(-4)	1.60±.20(-4)	1.12±.08(-4)	2.60±.40(-4)
LA-140	<1.1(-4)	<1.9(-4)	<3.5(-4)	<7.1(-5)	<1.0(-5)
CE-141	<2.6(-5)	<1.3(-5)	<3.0(-5)	7.00±1.0(-6)	3.00±2.0(-5)
CE-143	<2.3(-4)	<2.0(-4)	<2.8(-4)	<5.2(-5)	<7.3(-5)
CE-144	<9.6(-5)	<4.5(-5)	<2.7(-5)	4.10±.60(-5)	<7.2(-5)
EU-152	<4.2(-4)	<3.0(-5)	<7.8(-5)	<5.5(-5)	<1.4(-4)
EU-154	<2.3(-5)	<8.4(-6)	6.00±3.0(-6)	<2.0(-6)	<1.0(-5)
EU-155	<4.9(-5)	<2.3(-4)	3.00±.70(-5)	<1.4(-5)	<3.6(-5)
W-187	<4.1(-4)	<1.4(-3)	2.20±.80(-3)	1.40±.08(-3)	1.30±.10(-3)
NP-239	<3.7(-4)	<1.1(-4)	<1.6(-4)	1.60±.30(-4)	<2.9(-4)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS (FURTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	10/ 4	10/12	10/18	10/24	11/ 1
TIME	1128	1140	1149	1431	940
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	7.80±.16(-3)	NOTE 1	NOTE 1	8.10±3.0(-3)	<2.1(-2)
I-131	2.02±.02(-2)	1.69±.02(-2)	1.80±.01(-2)	1.78±.01(-2)	1.63±.01(-2)
I-132	5.72±.03(-2)	5.65±.09(-2)	5.69±.09(-2)	6.41±.05(-2)	5.93±.05(-2)
I-133	5.01±.02(-2)	4.55±.05(-2)	4.57±.07(-2)	5.10±.03(-2)	4.83±.04(-2)
I-134	7.90±.10(-2)	8.30±.30(-2)	8.50±.30(-2)	8.70±.20(-2)	8.70±.10(-2)
I-135	6.17±.06(-2)	6.23±.07(-2)	6.40±.10(-2)	6.12±.08(-2)	6.35±.07(-2)
RB-86	1.50±.10(-1)	1.60±.20(-1)	1.50±.10(-1)	1.60±.30(-1)	<4.4(-1)
RB-89	<3.0(-2)	<3.7(-2)	<3.5(-2)	<4.8(-2)	<6.6(-2)
CS-134	6.23±.04(-3)	5.64±.03(-3)	4.06±.02(-3)	6.03±.03(-3)	6.12±.06(-3)
CS-136	4.00±.20(-4)	2.84±.09(-4)	2.80±.09(-4)	1.94±.09(-4)	2.24±.09(-4)
CS-137	7.40±.06(-3)	7.04±.06(-3)	6.04±.06(-3)	7.50±.03(-3)	7.16±.03(-3)
CS-138	1.25±.04(-1)	1.16±.04(-2)	1.21±.03(-1)	1.08±.04(-1)	<1.9(-1)
CS-139	8.80±4.1(-2)	<1.4(-2)	4.90±1.2(-2)	<3.1(-1)	<1.7(1)
NA-24	1.27±.02(-2)	1.12±.02(-2)	1.10±.20(-2)	1.21±.03(-2)	1.13±.02(-2)
CR-51	7.98±.08(-3)	7.98±.06(-3)	7.10±.09(-3)	1.38±.01(-2)	1.31±.01(-2)
MN-54	7.64±.01(-4)	7.20±.10(-4)	7.94±.09(-4)	1.51±.02(-3)	1.49±.02(-3)
MN-56	9.10±.40(-3)	7.20±.60(-3)	3.80±1.2(-3)	1.74±.07(-2)	1.50±.08(-2)
FE-59	6.00±.10(-4)	5.40±.08(-4)	6.17±.09(-4)	1.17±.03(-3)	1.19±.03(-3)
CO-57	6.60±.70(-5)	4.40±.40(-5)	8.10±.30(-5)	1.20±.08(-4)	1.00±.07(-4)
CO-58	3.17±.03(-2)	2.97±.03(-2)	3.11±.03(-2)	5.86±.03(-2)	5.27±.03(-2)
CO-60	6.80±.20(-4)	9.70±.10(-4)	9.95±.09(-4)	2.14±.03(-3)	2.05±.02(-3)
ZN-65	<1.5(-5)	8.70±2.5(-5)	<1.5(-5)	<2.9(-5)	<2.2(-5)
SR-91	<4.3(-4)	<2.1(-4)	<2.8(-4)	<5.5(-4)	<3.8(-4)
Y-91M	<3.2(-4)	NOTE 1	NOTE 1	<5.4(-4)	<1.2(-3)
Y-93	<3.5(-3)	<2.4(-4)	<2.8(-4)	<2.9(-3)	<4.4(-4)
ZR-95	2.13±.09(-4)	2.00±.07(-4)	3.00±.10(-4)	7.10±.20(-4)	7.70±.20(-4)
NB-95	3.85±.08(-4)	4.03±.05(-4)	5.30±.10(-4)	1.09±.02(-3)	1.25±.02(-3)
MO-99	1.40±.01(-3)	1.36±.01(-4)	2.92±.05(-3)	1.82±.02(-3)	1.69±.02(-3)
RU-103	6.40±.90(-5)	7.20±.60(-5)	6.10±.90(-5)	1.10±.10(-4)	1.30±.20(-4)
RUD-106	<3.6(-5)	<3.6(-5)	<8.0(-5)	<3.4(-4)	<2.0(-4)
AG-110M	<9.9(-5)	<2.4(-3)	<1.9(-5)	5.50±2.3(-5)	<3.7(-5)
SB-124	2.90±.30(-5)	3.00±.20(-5)	2.90±.40(-5)	6.40±.70(-5)	6.10±.60(-5)
SB-125	<3.0(-5)	<1.6(-5)	<3.2(-5)	<1.0(-4)	<7.1(-5)
TE-129M	<2.8(-5)	<1.8(-5)	<4.0(-5)	<7.6(-4)	<6.6(-5)
TE-129	<1.1(-1)	<1.4(-2)	<1.5(-3)	<8.5(-2)	<6.9(-2)
TE-131M	<5.7(-4)	<2.6(-4)	<2.2(-4)	<5.2(-4)	<2.5(-4)
TE-131	NOTE 1	NOTE 1	NOTE 1	<6.2(-3)	<2.4(-2)
TE-132	NOTE 1	<9.8(-5)	<9.7(-5)	<1.2(-4)	<7.2(-5)
BA-139	1.40±.50(-2)	<4.4(-2)	2.10±.10(-2)	<2.1(-2)	<3.2(-2)
BA-140	1.80±.40(-4)	1.40±.20(-4)	<6.0(-5)	3.00±.60(-4)	2.20±.60(-4)
LA-140	1.20±.20(-4)	3.30±2.1(-4)	<2.8(-4)	<6.0(-5)	<7.2(-5)
CE-141	3.70±.80(-5)	2.00±.40(-5)	<2.2(-6)	<3.9(-5)	<3.7(-5)
CE-143	<1.5(-4)	<6.0(-5)	<8.6(-5)	<1.4(-4)	<1.1(-4)
CE-144	<2.1(-5)	<1.0(-5)	1.90±.60(-4)	3.30±.90(-3)	<1.4(-4)
EU-152	<1.4(-4)	<9.7(-5)	<3.8(-5)	<1.1(-4)	<8.2(-5)
EU-154	<1.2(-5)	<7.2(-6)	<1.1(-5)	<2.4(-5)	<2.1(-5)
EU-155	<5.7(-4)	NOTE 1	<3.5(-5)	<2.7(-4)	<2.4(-4)
W-187	2.70±.20(-3)	2.00±.10(-3)	2.20±.20(-3)	3.90±.30(-3)	3.70±.20(-3)
NP-239	1.20±.07(-3)	3.40±1.9(-4)	2.20±.30(-4)	1.76±.09(-3)	2.10±.20(-3)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	11/ 8	11/13	11/14	11/14	11/14
TIME	920	1145	1308	2155	2257
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	9.70±5.8(-3)	<9.7(-3)	NOTE 1	NOTE 1	NOTE 1
I-131	1.41±.01(-2)	2.47±.01(-2)	2.56±.01(-2)	2.04±.03(-2)	2.52±.04(-2)
I-132	5.60±.06(-2)	6.01±.04(-2)	4.53±.09(-2)	5.32±.07(-2)	5.37±.04(-2)
I-133	4.22±.02(-2)	5.10±.02(-2)	4.21±.04(-2)	4.43±.03(-2)	4.63±.04(-2)
I-134	8.30±.10(-2)	7.22±.09(-2)	6.40±.20(-2)	7.01±.09(-2)	6.67±.06(-2)
I-135	5.98±.07(-2)	5.91±.06(-2)	4.99±.07(-2)	5.81±.08(-2)	5.66±.07(-2)
RB-88	3.00±.70(-1)	<1.0(0)	1.30±.10(-1)	NOTE 1	NOTE 1
RB-89	NOTE 1	<3.2(-2)	<3.0(-2)	NOTE 1	NOTE 1
CS-134	8.81±.09(-3)	7.22±.04(-2)	1.08±.01(-2)	7.98±.11(-3)	7.60±.10(-3)
CS-136	2.22±.07(-4)	2.00±.20(-4)	2.40±.20(-4)	NOTE 1	NOTE 1
CS-137	1.04±.06(-2)	9.04±.03(-3)	1.28±.01(-2)	8.90±.13(-3)	8.60±.30(-3)
CS-138	1.72±.02(-1)	<1.7(-1)	9.80±.30(-2)	NOTE 1	NOTE 1
CS-139	NOTE 1	<4.9(0)	<1.2(-2)	NOTE 1	NOTE 1
NA-24	1.41±.02(-2)	1.15±.01(-2)	1.11±.02(-2)	NOTE 1	NOTE 1
CR-51	1.59±.01(-2)	3.92±.02(-2)	1.32±.01(-2)	NOTE 1	NOTE 1
MN-54	1.64±.01(-3)	4.37±.04(-3)	1.59±.02(-3)	NOTE 1	NOTE 1
MN-56	1.83±.07(-2)	2.91±.06(-2)	4.80±.90(-3)	NOTE 1	NOTE 1
FE-59	1.39±.02(-3)	3.31±.04(-3)	1.14±.03(-3)	NOTE 1	NOTE 1
CO-57	9.80±.50(-5)	3.03±.09(-4)	1.40±.20(-4)	5.60±.90(-4)	NOTE 1
CO-58	6.64±.03(-2)	1.50±.01(-1)	5.16±.04(-2)	6.60±.30(-2)	7.50±.30(-2)
CO-60	2.22±.02(-2)	5.81±.04(-3)	1.98±.02(-3)	2.21±.09(-3)	2.61±.09(-3)
ZN-65	<1.4(-5)	<4.2(-5)	<2.9(-5)	NOTE 1	NOTE 1
SR-91	1.30±.30(-3)	<4.5(-4)	<2.3(-4)	NOTE 1	NOTE 1
Y-91M	<7.1(-4)	<6.4(-4)	NOTE 1	NOTE 1	NOTE 1
Y-93	<2.8(-3)	<3.2(-3)	<2.5(-4)	NOTE 1	NOTE 1
ZR-95	6.90±.10(-4)	1.95±.03(-3)	6.00±.20(-4)	NOTE 1	NOTE 1
NB-95	1.41±.04(-3)	3.25±.03(-3)	1.03±.02(-3)	NOTE 1	NOTE 1
MO-99	1.63±.03(-3)	1.91±.05(-3)	1.62±.02(-3)	NOTE 1	NOTE 1
RU-103	1.46±.09(-4)	4.60±.20(-4)	2.10±.10(-4)	NOTE 1	NOTE 1
RU-106	<2.4(-4)	<5.1(-4)	<4.5(-4)	NOTE 1	NOTE 1
AG-110M	6.30±1.0(-5)	2.20±.40(-4)	7.40±2.3(-5)	NOTE 1	NOTE 1
SB-124	9.21±.06(-5)	2.90±.10(-4)	1.16±.09(-4)	NOTE 1	NOTE 1
SB-125	4.80±2.2(-5)	<3.2(-4)	1.10±.50(-4)	NOTE 1	NOTE 1
TE-129M	<4.0(-4)	<1.4(-3)	<1.0(-3)	NOTE 1	NOTE 1
TE-129	<5.8(-2)	<6.5(-2)	<1.2(-2)	NOTE 1	NOTE 1
TE-131M	<6.4(-4)	<5.1(-4)	<5.2(-4)	NOTE 1	NOTE 1
TE-131	1.50±.70(-2)	<1.5(-2)	NOTE 1	NOTE 1	NOTE 1
TE-132	<6.4(-5)	NOTE 1	3.20±.30(-4)	NOTE 1	NOTE 1
BA-139	<3.2(-2)	<2.8(-2)	<1.4(-2)	NOTE 1	NOTE 1
BA-140	<5.8(-5)	<3.6(-4)	<1.8(-4)	NOTE 1	NOTE 1
LA-140	5.80±1.7(-5)	<1.6(-4)	<1.1(-4)	NOTE 1	NOTE 1
CE-141	8.90±3.3(-5)	2.10±.40(-4)	<5.3(-5)	NOTE 1	NOTE 1
CE-143	<2.6(-4)	<1.7(-4)	<1.3(-4)	NOTE 1	NOTE 1
CE-144	<8.7(-5)	5.00±1.0(-4)	<1.6(-4)	NOTE 1	NOTE 1
PR-152	<1.2(-4)	<1.6(-4)	<1.1(-4)	NOTE 1	NOTE 1
EU-154	<1.2(-5)	<3.3(-5)	<2.1(-5)	NOTE 1	NOTE 1
EU-155	<1.3(-4)	<2.9(-4)	<2.3(-4)	NOTE 1	NOTE 1
W-187	5.20±.30(-3)	4.80±.20(-3)	2.90±.10(-3)	NOTE 1	NOTE 1
NP-239	2.43±.08(-3)	5.20±.09(-3)	1.39±.09(-3)	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OUT DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH MATHEMATICAL OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	11/14	11/15	11/15	11/15	11/15
TIME	2257	100	200	303	403
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	NOTE 1	NOTE 1	<1.3(-3)	NOTE 1
I-131	1.21±.02(-1)	6.41±.05(-1)	2.75±.07(-1)	2.66±.02(-1)	2.60±.07(-1)
I-132	1.11±.01(-1)	1.71±.03(-1)	1.71±.02(-1)	1.40±.01(-1)	1.24±.01(-1)
I-133	1.21±.00(-1)	2.19±.01(-1)	2.41±.02(-2)	2.25±.02(-1)	2.14±.02(-1)
I-134	6.19±.04(-2)	4.61±.05(-2)	2.65±.05(-2)	1.72±.06(-2)	9.30±.37(-3)
I-135	9.60±.10(-2)	1.42±.02(-1)	1.43±.02(-1)	1.23±.01(-1)	1.10±.01(-1)
RB-88	NOTE 1	NOTE 1	NOTE 1	4.50±.30(-2)	NOTE 1
RB-89	NOTE 1	NOTE 1	NOTE 1	<1.0(-3)	NOTE 1
CS-134	1.25±.02(-2)	2.06±.03(-2)	2.39±.03(-2)	2.38±.02(-2)	2.48±.02(-2)
CS-136	2.40±.20(-3)	6.50±.50(-3)	7.80±.30(-3)	6.58±.09(-3)	8.71±.33(-3)
CS-137	1.23±.03(-2)	2.01±.06(-2)	2.31±.06(-2)	2.61±.01(-2)	2.47±.04(-2)
CS-138	NOTE 1	NOTE 1	NOTE 1	<4.1(-3)	NOTE 1
CS-139	NOTE 1	NOTE 1	NOTE 1	<1.5(-2)	NOTE 1
NA-24	NOTE 1	NOTE 1	NOTE 1	7.10±.20(-3)	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	1.29±.01(-1)	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	1.54±.01(-2)	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	2.46±.08(-2)	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	1.08±.02(-2)	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	1.01±.04(-3)	NOTE 1
CO-58	9.50±.40(-2)	1.50±.06(-1)	1.80±.07(-1)	5.34±.05(-1)	4.90±.10(-1)
CO-60	3.48±.09(-3)	5.33±.13(-3)	6.20±.10(-3)	2.01±.01(-2)	1.84±.02(-2)
ZN-65	NOTE 1	NOTE 1	NOTE 1	<8.2(-5)	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	5.00±2.0(-4)	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	<3.7(-4)	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	<6.7(-3)	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	5.47±.06(-3)	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	9.80±.02(-3)	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	1.16±.01(-2)	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	1.54±.04(-2)	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	<1.2(-3)	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	6.90±.60(-4)	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	9.60±.30(-4)	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	5.20±.90(-4)	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	3.00±1.0(-3)	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	<5.5(-3)	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	<3.0(-3)	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	<4.1(-2)	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	<4.9(-3)	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	9.10±1.9(-4)	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	<1.2(-4)	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	2.60±.90(-4)	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	<5.8(-4)	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	<4.2(-4)	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	<3.2(-3)	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	<6.4(-5)	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	<1.8(-3)	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	6.80±.40(-3)	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	8.30±.30(-3)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	11/15	11/15	11/15	11/15	11/15
TIME	503	601	703	800	905
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	NOTE 1	NOTE 1	1.80±.60(-3)	NOTE 1
I-131	2.57±.04(-1)	2.69±.04(-1)	3.08±.04(-1)	2.06±.03(-1)	3.14±.04(-1)
I-132	1.11±.01(-1)	1.03±.04(-1)	1.05±.05(-1)	9.44±.04(-2)	8.04±.04(-2)
I-133	2.04±.01(-1)	2.03±.01(-1)	2.21±.03(-1)	2.10±.01(-1)	2.08±.03(-1)
I-134	5.10±.20(-3)	3.53±.24(-3)	4.40±1.2(-3)	7.30±2.6(-4)	5.10±2.3(-4)
I-135	9.60±.10(-2)	8.90±.10(-2)	9.10±.10(-2)	8.05±.09(-2)	7.26±.09(-2)
RB-88	NOTE 1	NOTE 1	NOTE 1	1.50±.30(-2)	NOTE 1
RB-89	NOTE 1	NOTE 1	NOTE 1	<2.2(-3)	NOTE 1
CS-134	2.51±.02(-2)	2.84±.02(-2)	3.39±.02(-2)	3.35±.01(-2)	3.45±.05(-2)
CS-136	9.10±.40(-3)	9.39±.40(-3)	1.08±.02(-2)	1.09±.02(-2)	1.18±.06(-2)
CS-137	2.52±.04(-2)	2.69±.07(-2)	3.11±.05(-2)	3.27±.02(-2)	3.37±.04(-2)
CS-138	NOTE 1	<2.8(-4)	<5.7(-4)	<2.8(-4)	<2.2(-4)
CS-139	NOTE 1	NOTE 1	NOTE 1	<3.4(-2)	NOTE 1
NA-24	NOTE 1	NOTE 1	NOTE 1	3.89±.09(-3)	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	7.57±.06(-2)	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	9.40±.10(-3)	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	4.90±.20(-3)	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	7.36±.07(-3)	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	7.80±.40(-4)	NOTE 1
CO-58	3.73±.02(-1)	3.86±.09(-1)	3.69±.08(-1)	3.06±.03(-1)	6.40±.10(-1)
CO-60	1.39±.02(-2)	1.49±.03(-2)	1.44±.02(-2)	1.23±.01(-2)	3.05±.04(-2)
ZN-65	NOTE 1	NOTE 1	NOTE 1	<9.8(-5)	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	1.60±.30(-3)	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	5.00±2.0(-4)	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	1.40±.60(-2)	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	4.11±.06(-3)	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	6.60±.10(-3)	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	1.57±.01(-2)	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	8.70±.30(-4)	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	<3.0(-4)	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	2.70±.60(-4)	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	5.10±.20(-4)	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	<1.7(-4)	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	<1.2(-4)	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	<3.9(-3)	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	<1.4(-3)	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	<2.7(-3)	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	8.50±.80(-4)	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	<1.7(-3)	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	2.70±.20(-3)	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	7.60±.30(-4)	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	1.70±.60(-4)	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	<2.8(-4)	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	<1.1(-3)	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	<2.6(-3)	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	<4.1(-5)	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	<4.0(-3)	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	4.40±.20(-3)	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	5.70±.20(-3)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	11/15	11/15	11/15	11/15	11/15
TIME	958	1100	1200	1300	1400
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-131	2.96±.06(-1)	2.91±.07(-1)	2.99±.07(-1)	2.80±.06(-1)	2.78±.06(-1)
I-132	6.33±.07(-2)	6.89±.04(-2)	6.90±.10(-2)	5.90±.10(-2)	5.40±.09(-2)
I-133	1.91±.03(-1)	1.84±.02(-1)	1.86±.03(-1)	1.69±.02(-1)	1.62±.02(-1)
I-134	2.60±1.1(-3)	1.00±.10(-3)	<2.4(-4)	<3.0(-4)	NOTE 1
I-135	6.31±.07(-2)	5.70±.10(-2)	5.20±.10(-2)	4.38±.07(-2)	3.94±.07(-2)
RB-88	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	3.29±.04(-2)	3.37±.02(-2)	3.32±.03(-2)	3.42±.02(-2)	3.45±.04(-2)
CS-136	1.17±.02(-2)	1.12±.02(-2)	1.13±.02(-2)	1.09±.02(-2)	1.08±.02(-2)
CS-137	3.33±.03(-2)	3.13±.02(-2)	3.44±.06(-2)	3.35±.04(-2)	3.40±.03(-2)
CS-138	<5.3(-4)	<2.3(-4)	<1.4(-4)	NOTE 1	NOTE 1
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	2.22±.00(0)	1.82±.04(-1)	1.75±.06(-1)	1.35±.04(-1)	1.32±.04(-1)
CO-60	7.90±.10(-2)	8.50±.20(-3)	8.50±.10(-3)	6.48±.09(-3)	6.65±.16(-3)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	11/15	11/15	11/16	11/20	11/28
TIME	1506	1600	1510	805	1532
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	NOTE 1	<2.3(-4)	<3.4(-4)	<7.0(-5)
I-131	2.89±.06(-1)	2.81±.06(-1)	2.01±.02(-1)	1.64±.04(-2)	4.85±.06(-4)
I-132	4.99±.07(-2)	4.99±.40(-2)	8.10±.20(-3)	5.70±.08(-3)	7.90±.80(-5)
I-133	1.63±.02(-1)	1.54±.02(-1)	5.11±.03(-2)	3.00±.20(-4)	<1.1(-5)
I-134	NOTE 1	NOTE 1	<2.5(-4)	<2.7(-4)	4.50±.20(-4)
I-135	3.65±.07(-2)	3.24±.05(-2)	1.91±.02(-3)	<3.1(-5)	<1.2(-5)
RB-88	NOTE 1	NOTE 1	<2.2(-4)	<1.8(-3)	<3.7(-4)
RB-89	NOTE 1	NOTE 1	<5.8(-4)	<6.6(-3)	<1.6(-3)
CS-134	3.70±.03(-2)	3.75±.05(-2)	3.09±.03(-2)	7.90±.10(-3)	1.08±.01(-3)
CS-136	1.15±.03(-2)	1.14±.03(-2)	9.04±.09(-3)	8.90±.10(-4)	5.60±.30(-5)
CS-137	3.65±.04(-2)	3.65±.05(-2)	3.07±.02(-2)	9.13±.09(-3)	1.32±.01(-3)
CS-138	NOTE 1	NOTE 1	<8.5(-4)	<4.8(-4)	<1.5(-4)
CS-139	NOTE 1	NOTE 1	<4.1(-3)	NOTE 1	NOTE 1
NA-24	NOTE 1	NOTE 1	2.90±.60(-4)	<1.1(-6)	<9.4(-7)
CR-51	NOTE 1	NOTE 1	1.90±.60(-3)	4.10±.10(-3)	1.98±.04(-3)
MN-54	NOTE 1	NOTE 1	2.46±.02(-2)	2.42±.02(-3)	3.60±.05(-3)
MN-56	NOTE 1	NOTE 1	<8.2(-5)	<2.0(-5)	<4.9(-6)
FE-59	NOTE 1	NOTE 1	2.51±.06(-3)	2.70±.10(-4)	1.15±.05(-4)
CO-57	NOTE 1	NOTE 1	4.90±.20(-4)	3.40±.10(-4)	4.40±.20(-5)
CO-58	1.20±.04(-1)	1.18±.05(-1)	2.13±.02(-1)	1.62±.03(-1)	2.26±.02(-2)
CO-60	6.00±.09(-3)	6.00±.10(-3)	2.09±.02(-2)	4.91±.05(-3)	6.10±.10(-4)
ZN-65	NOTE 1	NOTE 1	<8.1(-5)	<2.1(-5)	7.80±3.8(-6)
SR-92	NOTE 1	NOTE 1	<4.2(-4)	<4.7(-5)	<1.3(-5)
Y-91M	NOTE 1	NOTE 1	<4.3(-4)	<2.4(-4)	<6.1(-5)
Y-93	NOTE 1	NOTE 1	<2.5(-3)	<3.4(-4)	<9.0(-5)
ZR-95	NOTE 1	NOTE 1	2.90±.40(-4)	1.10±.10(-4)	5.30±.80(-5)
NB-95	NOTE 1	NOTE 1	4.30±.30(-4)	1.64±.10(-4)	1.11±.07(-4)
MO-99	NOTE 1	NOTE 1	4.90±.10(-3)	1.26±.03(-2)	1.25±.02(-4)
RU-103	NOTE 1	NOTE 1	8.90±3.9(-5)	8.80±1.6(-5)	4.60±.60(-5)
RUD-106	NOTE 1	NOTE 1	<8.4(-4)	<5.1(-4)	<9.6(-5)
AG-110M	NOTE 1	NOTE 1	<1.3(-4)	<3.4(-5)	8.10±.60(-5)
SB-124	NOTE 1	NOTE 1	1.40±.20(-4)	6.00±.10(-4)	1.24±.07(-4)
SB-125	NOTE 1	NOTE 1	<3.0(-4)	4.70±.40(-4)	7.40±1.3(-5)
TE-129M	NOTE 1	NOTE 1	<1.8(-3)	6.80±3.2(-4)	<3.1(-4)
TE-129	NOTE 1	NOTE 1	<3.2(-3)	<1.5(-3)	<5.8(-4)
TE-131M	NOTE 1	NOTE 1	<6.2(-4)	<6.2(-5)	<2.1(-5)
TE-131	NOTE 1	NOTE 1	<1.9(-3)	<5.9(-3)	<1.4(-3)
TE-132	NOTE 1	NOTE 1	<1.0(-4)	4.80±.40(-4)	3.40±.30(-5)
BA-139	NOTE 1	NOTE 1	<8.6(-4)	<7.0(-4)	<5.5(-5)
BA-140	NOTE 1	NOTE 1	7.80±.20(-3)	6.60±.60(-4)	6.40±1.9(-5)
LA-140	NOTE 1	NOTE 1	3.50±.50(-4)	8.50±.40(-5)	2.80±.20(-5)
CE-141	NOTE 1	NOTE 1	<2.1(-4)	<1.2(-3)	<2.1(-5)
CE-143	NOTE 1	NOTE 1	<3.3(-4)	<5.1(-5)	<1.2(-5)
CE-144	NOTE 1	NOTE 1	<5.2(-4)	<2.2(-4)	<2.9(-5)
EU-152	NOTE 1	NOTE 1	<4.7(-3)	<6.8(-4)	<4.1(-5)
EU-154	NOTE 1	NOTE 1	<6.9(-5)	<1.9(-5)	<6.5(-6)
EU-155	NOTE 1	NOTE 1	<2.2(-3)	<2.8(-3)	<8.4(-5)
W-187	NOTE 1	NOTE 1	<1.3(-3)	<1.2(-4)	<4.7(-5)
NP-239	NOTE 1	NOTE 1	<4.3(-4)	1.10±.30(-3)	1.61±.07(-4)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	11/29	12/ 4	12/ 6	12/13	12/18
TIME	1030	2300	1230	1214	1530
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<4.5(-5)	NOTE 1	<5.7(-4)	<2.3(-3)	<1.6(-4)
I-131	4.20±.20(-4)	NOTE 1	2.89±.06(-4)	4.34±.05(-4)	6.00±.04(-3)
I-132	1.30±.10(-4)	NOTE 1	<2.2(-5)	<3.2(-5)	<1.4(-4)
I-133	<1.4(-5)	NOTE 1	<1.0(-5)	<1.2(-5)	<6.2(-5)
I-134	<8.3(-5)	NOTE 1	2.29±.10(-3)	4.50±.90(-3)	<3.6(-4)
I-135	<1.1(-5)	NOTE 1	<9.6(-6)	<1.8(-5)	<7.2(-5)
RB-88	<1.2(-4)	NOTE 1	NOTE 1	NOTE 1	<2.6(-4)
RB-89	<3.4(-4)	NOTE 1	NOTE 1	NOTE 1	<6.0(-4)
CS-134	1.11±.02(-3)	1.64±.01(-3)	9.90±.20(-4)	1.54±.02(-3)	1.48±.04(-2)
CS-136	4.40±.40(-5)	1.80±.20(-4)	4.70±.50(-5)	8.50±.30(-5)	7.00±.30(-4)
CS-137	1.44±.03(-3)	1.97±.01(-3)	1.17±.01(-3)	1.95±.03(-3)	1.71±.01(-2)
CS-138	<3.1(-5)	NOTE 1	<3.8(-4)	<8.1(-4)	<6.3(-5)
CS-139	<1.2(-2)	NOTE 1	NOTE 1	NOTE 1	<1.3(-2)
NA-24	<1.8(-6)	NOTE 1	<1.1(-6)	<6.1(-7)	<1.8(-6)
CR-51	1.71±.05(-3)	9.60±1.3(-4)	1.36±.04(-3)	3.53±.04(-3)	6.04±.09(-2)
MN-54	2.38±.06(-4)	6.61±.06(-4)	3.21±.04(-4)	1.32±.02(-3)	3.11±.04(-2)
MN-56	<6.0(-6)	NOTE 1	<5.5(-6)	<1.9(-5)	<3.2(-5)
FE-59	1.00±.10(-4)	7.50±1.0(-5)	7.50±.60(-5)	3.76±.06(-4)	1.05±.01(-2)
CO-57	4.00±.40(-5)	7.80±.70(-5)	3.00±.40(-5)	1.00±.02(-4)	9.44±.20(-4)
CO-58	1.95±.03(-2)	2.85±.03(-2)	1.65±.01(-2)	4.74±.06(-2)	3.59±.06(-1)
CO-60	5.10±.10(-4)	1.53±.02(-3)	7.21±.08(-4)	3.00±.04(-3)	2.82±.02(-2)
ZN-65	<9.7(-6)	<1.2(-5)	<6.4(-6)	1.60±.40(-5)	1.50±.30(-4)
SR-91	<1.5(-5)	NOTE 1	<1.3(-5)	<2.3(-5)	<9.3(-5)
Y-91M	<4.4(-5)	NOTE 1	<2.1(-4)	<4.1(-4)	<1.4(-4)
Y-93	<1.1(-4)	NOTE 1	<1.2(-4)	<1.4(-4)	<6.4(-4)
ZR-95	4.70±1.1(-5)	<2.1(-5)	3.50±.50(-5)	2.17±.05(-4)	8.90±.10(-3)
NB-95	8.70±.70(-5)	<5.1(-5)	8.40±.50(-5)	4.32±.09(-4)	1.50±.02(-2)
MO-99	1.27±.03(-4)	NOTE 1	1.50±.40(-5)	6.70±2.4(-6)	<9.6(-5)
RU-103	1.50±.70(-5)	<2.0(-5)	<7.9(-6)	5.00±.40(-5)	5.20±.30(-4)
RUD-106	<1.5(-4)	<1.4(-4)	<7.5(-5)	<1.3(-4)	<1.1(-3)
AG-110M	7.90±.90(-5)	1.60±.10(-4)	1.12±.08(-4)	2.01±.07(-4)	5.20±.60(-4)
SB-124	1.03±.06(-4)	1.70±.07(-4)	8.00±.40(-5)	1.84±.05(-4)	4.60±.20(-4)
SB-125	<3.8(-5)	1.70±.10(-4)	<1.6(-4)	2.20±.07(-4)	3.40±3.8(-4)
TE-129M	<2.8(-4)	<5.0(-4)	<2.3(-4)	<2.3(-4)	<1.3(-3)
TE-129	<5.1(-4)	NOTE 1	<8.8(-4)	<1.2(-3)	<1.3(-3)
TE-131M	<2.2(-5)	NOTE 1	<1.5(-5)	<3.5(-5)	<1.3(-4)
TE-131	<5.1(-4)	NOTE 1	<2.0(-2)	<2.9(-2)	<1.2(-3)
TE-132	<2.4(-5)	<5.9(-3)	<1.1(-5)	<6.4(-6)	<4.0(-5)
BA-139	<3.9(-4)	NOTE 1	<1.7(-3)	<1.6(-4)	<2.7(-4)
BA-140	<6.1(-5)	<3.5(-4)	8.50±1.6(-5)	1.40±.20(-4)	3.90±1.6(-4)
LA-140	<3.3(-5)	NOTE 1	2.90±.20(-5)	1.50±.20(-5)	<6.0(-5)
CE-141	<4.5(-5)	<2.0(-5)	<8.1(-6)	2.40±.20(-5)	3.90±.30(-4)
CE-143	<1.6(-5)	NOTE 1	<1.2(-5)	<1.5(-5)	<8.4(-5)
CE-144	<4.0(-5)	<6.5(-5)	<3.6(-5)	5.40±1.8(-5)	6.90±2.5(-4)
EU-152	<3.1(-5)	<3.8(-5)	<4.6(-5)	<8.5(-5)	<5.4(-4)
EU-154	<7.8(-6)	<5.5(-6)	<5.5(-6)	<8.9(-6)	<4.6(-5)
EU-155	<4.4(-5)	<1.8(-4)	<2.2(-5)	<1.5(-5)	<1.4(-4)
W-187	<6.1(-5)	NOTE 1	<5.7(-5)	<7.0(-5)	<5.0(-4)
NP-239	1.50±.10(-4)	NOTE 1	1.80±.70(-5)	<1.5(-5)	<1.4(-4)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	12/19	1/3	1/11	1/17	1/20
TIME	943	854	922	1408	605
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<3.8(-4)	4.20±1.0(-3)	<4.4(-2)	<1.3(-2)	6.90±1.5(-3)
I-131	8.52±.03(-3)	1.84±.02(-1)	7.08±.09(-3)	9.10±.10(-3)	9.70±.20(-3)
I-132	<8.1(-5)	7.20±.30(-2)	3.65±.08(-2)	3.90±.07(-2)	4.02±.06(-2)
I-133	NOTE 1	2.91±.04(-1)	3.26±.04(-2)	3.61±.04(-2)	3.49±.02(-2)
I-134	<5.3(-4)	3.11±.04(-2)	6.80±.10(-2)	6.40±.20(-2)	6.11±.05(-2)
I-135	<6.8(-5)	9.04±.05(-2)	4.21±.05(-2)	4.45±.07(-2)	4.52±.08(-2)
RB-88	<1.8(-3)	1.20±.10(-1)	1.20±.20(-1)	1.50±.50(-1)	9.70±.90(-2)
RB-89	NOTE 1	<3.0(-2)	<6.0(-2)	<1.0(-1)	NOTE 1
CS-134	2.04±.05(-2)	9.78±.09(-3)	9.67±.08(-3)	7.59±.03(-3)	1.10±.03(-2)
CS-136	1.52±.03(-3)	3.07±.04(-3)	1.13±.04(-4)	5.60±.40(-5)	NOTE 1
CS-137	3.33±.03(-2)	1.30±.01(-2)	1.07±.01(-2)	9.14±.07(-3)	1.26±.02(-2)
CS-138	<1.7(-4)	1.18±.02(-1)	1.10±.20(-1)	<1.2(-1)	7.87±.13(-2)
CS-139	<7.6(-1)	<3.6(-2)	<4.0(-1)	<6.8(-0)	6.80±2.2(-2)
NA-24	<1.3(-6)	2.70±.08(-3)	8.95±.07(-3)	8.70±.20(-3)	NOTE 1
CR-51	3.82±.04(-2)	2.00±.20(-3)	<1.1(-4)	<8.2(-5)	NOTE 1
MN-54	1.18±.02(-2)	7.00±.10(-4)	9.60±.30(-5)	9.40±.30(-5)	NOTE 1
MN-56	<2.8(-5)	<1.6(-3)	<2.0(-3)	<2.8(-3)	NOTE 1
FE-59	4.90±.08(-3)	2.20±.10(-4)	<7.2(-6)	9.30±2.9(-6)	NOTE 1
CO-57	5.20±.20(-4)	<3.4(-5)	<6.4(-6)	<3.6(-6)	1.20±.60(-4)
CO-58	2.06±.03(-1)	1.03±.02(-2)	8.47±.07(-4)	5.57±.09(-4)	1.40±.40(-3)
CO-60	1.41±.02(-2)	7.39±.09(-4)	8.90±.20(-5)	6.60±.30(-5)	<1.8(-4)
ZN-65	1.00±.30(-4)	<1.9(-6)	<8.0(-6)	<5.0(-6)	NOTE 1
SR-91	<6.2(-5)	8.20±2.4(-4)	5.60±1.3(-4)	1.00±.20(-3)	NOTE 1
Y-91M	<3.4(-4)	4.20±2.0(-4)	<6.4(-4)	<7.0(-3)	NOTE 1
Y-93	<4.5(-4)	<1.0(-2)	<2.1(-3)	<1.8(-3)	NOTE 1
ZR-95	3.56±.06(-3)	2.40±.10(-4)	7.70±5.2(-6)	<6.2(-6)	NOTE 1
NB-95	6.35±.08(-3)	3.00±.30(-4)	1.30±.50(-5)	<3.6(-6)	NOTE 1
MO-99	<3.8(-5)	1.08±.02(-2)	2.19±.06(-3)	1.53±.05(-3)	NOTE 1
RU-103	6.90±.30(-4)	3.30±1.2(-5)	<1.1(-5)	<7.4(-6)	NOTE 1
RUD-106	<5.8(-4)	<5.1(-4)	<1.6(-4)	<6.6(-5)	NOTE 1
AG-110M	1.09±.03(-3)	4.80±1.6(-5)	<1.0(-5)	<1.0(-5)	NOTE 1
SB-124	5.30±.10(-4)	3.20±.40(-5)	<2.7(-6)	<1.6(-6)	NOTE 1
SB-125	4.60±.40(-4)	<1.1(-5)	<3.2(-5)	<1.9(-5)	NOTE 1
TE-129M	<8.2(-4)	<7.1(-4)	<2.0(-4)	<1.7(-4)	NOTE 1
TE-129	<1.6(-2)	<7.6(-2)	1.80±.70(-2)	<8.8(-2)	NOTE 1
TE-131M	<9.0(-5)	<1.8(-3)	<1.9(-4)	<3.5(-4)	NOTE 1
TE-131	<7.5(-3)	<2.8(-3)	3.50±1.7(-3)	<3.0(-2)	NOTE 1
TE-132	<3.0(-5)	<8.5(-6)	<1.6(-6)	<1.4(-5)	NOTE 1
BA-139	<8.0(-4)	<2.1(-2)	<1.6(-2)	<3.0(-2)	NOTE 1
BA-140	4.40±.80(-4)	<3.8(-4)	1.50±.30(-4)	4.10±.20(-4)	NOTE 1
LA-140	6.30±.70(-5)	3.30±.20(-4)	<4.0(-5)	<4.3(-5)	NOTE 1
CE-141	2.20±.40(-4)	<1.4(-4)	<1.6(-5)	<1.2(-5)	NOTE 1
CE-143	<8.4(-5)	<2.7(-4)	<6.4(-5)	<2.0(-4)	NOTE 1
CE-144	7.70±.90(-4)	<2.6(-4)	<1.6(-4)	<2.9(-5)	NOTE 1
EU-152	<4.0(-5)	<1.1(-4)	<4.0(-5)	<2.8(-5)	NOTE 1
EU-154	<3.0(-5)	<1.6(-5)	<8.5(-6)	<5.6(-6)	NOTE 1
EU-155	<1.0(-4)	<2.7(-4)	<3.3(-5)	<2.6(-5)	NOTE 1
W-187	<8.3(-4)	7.30±2.2(-4)	3.82±.08(-3)	2.00±.10(-3)	NOTE 1
NP-239	<7.0(-5)	<9.6(-4)	<9.8(-5)	<1.0(-4)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OUT DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	1/20	1/20	1/20	1/20	1/20
TIME	751	930	1208	1404	1505
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	4.60±1.2(-3)	<1.0(-2)	<1.4(-3)	<7.0(-4)	NOTE 1
I-131	3.35±.07(-2)	4.63±.05(-2)	1.00±.10(-1)	1.00±.01(-1)	9.90±.10(-2)
I-132	7.12±.04(-2)	5.33±.05(-2)	8.00±.10(-2)	6.81±.08(-2)	6.04±.03(-2)
I-133	8.19±.04(-2)	9.29±.06(-2)	1.44±.01(-1)	1.33±.01(-1)	1.27±.01(-1)
I-134	6.06±.07(-2)	1.78±.06(-2)	5.20±.20(-3)	1.00±.10(-3)	NOTE 1
I-135	7.46±.07(-2)	7.00±.10(-2)	7.80±.10(-2)	6.20±.20(-2)	5.44±.10(-2)
RB-88	9.50±.60(-2)	<2.2(-1)	3.30±.50(-2)	1.75±.09(-2)	1.70±.10(-2)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.10±.02(-2)	1.08±.02(-2)	1.30±.02(-2)	1.33±.03(-2)	1.29±.02(-2)
CS-136	1.90±.70(-4)	NOTE 1	NOTE 1	NOTE 1	1.99±.09(-3)
CS-137	1.21±.03(-2)	1.22±.04(-2)	1.43±.02(-2)	1.44±.05(-2)	1.41±.03(-2)
CS-138	5.60±.20(-2)	5.90±1.1(-3)	<3.6(-4)	<2.4(-4)	NOTE 1
CS-139	NOTE 1	NOTE 1	<4.0(-2)	<4.6(-3)	NOTE 1
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	<8.6(-5)	<8.6(-5)	<1.4(-5)	<1.0(-4)	NOTE 1
CO-58	1.40±.60(-3)	9.60±3.4(-4)	2.00±.70(-3)	<9.2(-3)	2.39±.09(-3)
CO-60	1.20±.40(-4)	<1.0(-4)	1.00±.50(-4)	<9.5(-5)	NOTE 1
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-133M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER FACTORS ASSOCIATED WITH MATHEMATICAL OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	1/20	1/20	1/20	1/21	1/26
TIME	1630	1904	2310	1205	1352
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	<8.6(-3)	1.10±.30(-2)	NOTE 1	5.70±2.3(-3)
I-131	6.72±.07(-1)	5.60±.10(-1)	3.62±.07(-1)	1.73±.07(-1)	8.90±.06(-3)
I-132	1.80±.01(-1)	1.12±.03(-1)	6.70±.20(-2)	1.59±.04(-2)	4.07±.05(-2)
I-133	6.87±.08(-1)	5.50±.10(-1)	3.21±.06(-1)	1.24±.03(-1)	3.28±.06(-2)
I-134	1.40±.20(-3)	1.30±.07(-2)	5.20±.10(-2)	3.80±.30(-3)	6.84±.09(-2)
I-135	2.17±.02(-1)	1.49±.02(-1)	8.60±.10(-2)	3.80±.10(-2)	4.90±.10(-2)
RB-88	1.80±.20(-2)	5.10±.30(-2)	<1.2(-2)	1.30±.20(-1)	1.30±.10(-1)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<3.4(-2)
CS-134	1.44±.03(-2)	1.40±.05(-2)	1.18±.05(-2)	9.30±.30(-3)	1.34±.01(-2)
CS-136	NOTE 1	5.40±.30(-3)	3.40±.40(-3)	1.55±.09(-3)	3.19±.07(-4)
CS-137	1.80±.10(-2)	1.95±.05(-2)	1.48±.04(-2)	1.25±.03(-2)	1.68±.01(-2)
CS-138	5.60±.50(-3)	4.70±.30(-2)	1.50±.02(-1)	<1.9(-3)	9.20±.20(-2)
CS-139	<1.6(-3)	2.30±.80(-2)	4.60±2.3(-2)	<4.0(-1)	<5.2(-2)
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.57±.04(-2)
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	2.90±.30(-4)
MN-54	NOTE 1	NOTE 1	NOTE 1	NOTE 1	4.91±.05(-4)
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<1.9(-3)
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.00±.05(-4)
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	8.00±1.5(-6)
CO-58	5.20±.20(-3)	3.60±1.5(-3)	2.10±1.0(-3)	2.20±.10(-3)	4.12±.02(-3)
CO-60	<1.6(-4)	<2.8(-4)	<4.4(-4)	<1.6(-4)	4.49±.05(-4)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<6.3(-6)
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<8.1(-4)
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<4.0(-4)
Y-92	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<4.6(-3)
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	4.80±.30(-5)
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.16±.03(-4)
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.29±.05(-3)
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<7.0(-6)
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<5.4(-5)
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.20±.50(-5)
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	4.00±1.1(-6)
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<1.6(-5)
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<1.4(-4)
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<2.2(-2)
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<2.6(-4)
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<3.6(-3)
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<4.3(-6)
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<2.1(-2)
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	1.50±.20(-4)
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<1.0(-4)
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<8.0(-6)
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<9.1(-5)
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<3.4(-5)
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<1.1(-4)
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<5.1(-6)
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	<6.0(-5)
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1	2.30±.50(-3)
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	9.20±4.1(-4)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ANALYTICAL OPERATIONS WITH < NUMBERS

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE	2/ 2	2/ 8	2/14	2/21	3/ 1
TYPE	1338	1116	903	953	1408
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	5.50±2.5(-3)	8.00±2.5(-3)	6.20±1.9(-3)	6.80±1.3(-3)	4.90±2.6(-3)
I-131	9.17±.05(-3)	1.07±.01(-2)	9.50±.07(-3)	9.03±.08(-3)	2.13±.02(-2)
I-132	3.97±.04(-2)	4.16±.08(-2)	4.40±.07(-2)	4.80±.05(-2)	3.09±.05(-2)
I-133	3.12±.03(-2)	3.60±.03(-2)	3.57±.03(-2)	3.62±.02(-2)	3.33±.03(-2)
I-134	6.40±.20(-2)	6.90±.10(-2)	6.93±.07(-2)	7.80±.20(-2)	7.00±.10(-2)
I-135	4.65±.06(-2)	5.00±.09(-2)	4.95±.07(-2)	5.15±.05(-2)	5.10±.10(-2)
RB-88	1.10±.20(-1)	8.90±1.0(-2)	8.70±.70(-2)	1.04±.07(-1)	1.21±.09(-1)
RB-89	<7.0(-2)	<2.8(-2)	<3.1(-2)	<3.4(-2)	<3.4(-2)
CS-134	1.09±.01(-2)	1.02±.01(-2)	9.10±.10(-3)	9.00±.08(-3)	5.79±.06(-3)
CS-136	2.30±.10(-4)	2.17±.07(-4)	1.50±.10(-4)	9.40±.40(-5)	3.54±.07(-4)
CS-137	1.33±.01(-2)	1.20±.01(-2)	1.13±.02(-2)	1.09±.01(-2)	7.38±.08(-3)
CS-138	9.00±.40(-2)	8.00±.30(-2)	7.90±.20(-2)	9.50±.30(-2)	9.00±.10(-2)
CS-139	<3.4(-1)	<8.0(-2)	4.30±1.6(-2)	3.70±1.6(-2)	<6.7(-2)
NA-24	1.38±.03(-2)	1.21±.03(-2)	1.08±.02(-2)	1.19±.02(-2)	6.50±.30(-3)
CR-51	<1.2(-3)	<6.8(-5)	<2.7(-4)	<6.0(-5)	<9.0(-5)
MN-54	7.00±.30(-5)	6.00±.20(-5)	6.90±.60(-5)	6.30±.20(-5)	8.00±.30(-5)
MN-56	<4.7(-3)	<2.9(-3)	<3.2(-3)	<3.0(-3)	<2.8(-3)
FE-59	1.60±.70(-5)	1.50±.30(-5)	<2.8(-5)	1.30±.30(-5)	<8.0(-6)
CO-57	<8.3(-6)	<4.2(-6)	<1.9(-5)	<3.8(-6)	<7.0(-6)
CO-58	5.92±.09(-4)	5.00±.10(-4)	5.10±.20(-4)	5.76±.06(-4)	6.12±.07(-4)
CO-60	7.60±.40(-5)	5.50±.40(-5)	7.40±.80(-5)	6.80±.40(-5)	7.60±.40(-5)
ZN-65	<1.2(-5)	<6.2(-6)	<3.4(-5)	<5.4(-6)	<8.0(-6)
SR-91	<5.6(-4)	9.50±4.5(-4)	4.70±2.3(-4)	1.10±.30(-3)	<9.6(-4)
Y-91M	<4.6(-4)	<6.0(-4)	<3.9(-4)	<3.7(-4)	<4.8(-4)
Y-93	<2.3(-3)	<2.7(-3)	<2.9(-3)	<2.1(-3)	<3.8(-3)
ZR-95	<1.4(-5)	<1.0(-5)	<2.4(-5)	<6.8(-6)	<1.4(-5)
NB-95	<9.2(-6)	<6.2(-6)	<1.8(-5)	<4.1(-6)	<1.5(-5)
MO-99	7.50±.20(-4)	6.90±.40(-4)	6.90±.10(-4)	7.30±.40(-4)	3.40±.06(-3)
RU-103	<1.9(-5)	<8.8(-6)	<2.2(-5)	<9.6(-6)	<1.0(-5)
RUD-106	<1.5(-4)	<7.2(-5)	<4.8(-4)	<8.4(-5)	<8.1(-5)
AG-110M	6.60±1.1(-5)	<9.1(-6)	<4.2(-5)	<8.7(-6)	<1.4(-5)
SB-124	<4.0(-6)	<1.8(-6)	<2.1(-5)	<1.5(-6)	<2.2(-6)
SB-125	<4.8(-5)	<4.4(-5)	<7.2(-5)	<2.2(-5)	<3.6(-5)
TE-129M	<3.0(-4)	<1.5(-4)	<4.1(-4)	<1.3(-4)	<1.7(-4)
TE-129	<5.6(-2)	<7.4(-2)	<8.6(-2)	<6.9(-2)	<1.1(-1)
TE-131M	<3.8(-4)	<5.6(-4)	<2.8(-4)	<3.8(-4)	<3.0(-4)
TE-131	<4.9(-3)	<3.4(-3)	<3.3(-3)	<2.0(-3)	<5.9(-3)
TE-132	<3.2(-5)	<1.7(-5)	<3.0(-5)	<1.6(-5)	<1.1(-5)
BA-139	<1.9(-2)	<6.4(-2)	1.30±.20(-2)	1.30±.20(-2)	<2.6(-2)
BA-140	2.90±.40(-4)	2.60±.20(-4)	3.10±.40(-4)	4.10±.30(-4)	4.50±.20(-4)
LA-140	<1.5(-4)	<8.2(-5)	<6.0(-5)	<5.0(-5)	<2.8(-4)
CE-141	<2.0(-5)	<1.2(-4)	<3.6(-5)	<8.1(-6)	<2.6(-4)
CE-143	<3.4(-4)	<9.6(-6)	<4.7(-4)	<2.0(-4)	<1.9(-4)
CE-144	<6.4(-5)	<3.4(-3)	1.00±.40(-3)	<3.1(-5)	<6.4(-5)
EU-152	<1.1(-4)	<7.4(-5)	<7.0(-5)	<4.9(-5)	<1.2(-4)
EU-154	<1.3(-5)	<6.7(-6)	<3.8(-5)	<6.0(-6)	<8.0(-6)
EU-155	<1.2(-4)	<1.8(-5)	<1.7(-3)	<5.3(-4)	<8.1(-3)
W-187	1.60±.30(-3)	1.30±.30(-3)	7.80±1.5(-4)	1.60±.10(-3)	<3.0(-3)
NP-239	<1.5(-4)	<9.9(-5)	<1.1(-4)	<9.2(-5)	<2.6(-4)

TABLE B.2 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT, ALL RADIONUCLIDES EXCEPT GASES

REACTOR COOLANT

DATE 3/ 6
TIME 1510

NUCLIDE	MICROCURIES/MILLILITER
BR-84	7.10±1.0(-3)
I-131	7.24±.07(-3)
I-132	4.64±.06(-2)
I-133	4.15±.02(-2)
I-134	8.20±.20(-2)
I-135	5.55±.05(-2)
RB-88	1.02±.04(-1)
RB-89	<3.4(-2)
CS-134	8.94±.08(-3)
CS-136	1.00±.10(-4)
CS-137	1.14±.01(-2)
CS-138	1.01±.01(-1)
CS-139	6.10±.60(-2)
NA-24	1.22±.01(-2)
CR-51	<7.2(-5)
MN-54	8.60±.80(-5)
MN-56	<4.2(-3)
FE-59	<1.8(-5)
CO-57	<5.5(-6)
CO-58	4.41±.05(-4)
CO-60	6.00±.30(-5)
ZN-65	<1.1(-5)
SR-91	7.80±1.3(-4)
Y-91M	<2.1(-4)
Y-93	<1.9(-3)
ZR-95	<1.1(-5)
NB-95	<1.1(-5)
MO-99	1.27±.02(-3)
RU-103	<8.6(-6)
RUD-106	<2.3(-4)
AG-110M	<1.8(-5)
SB-124	<6.7(-6)
SB-125	<4.7(-5)
TE-129M	<1.8(-4)
TE-129	<9.0(-2)
TE-131M	<2.7(-4)
TE-131	<2.0(-3)
TE-132	<7.3(-6)
BA-139	1.17±.06(-2)
BA-140	1.30±.80(-4)
LA-140	<1.6(-4)
CE-141	<6.0(-5)
CE-143	<3.8(-5)
CE-144	<1.6(-3)
EU-152	<3.4(-5)
EU-154	<1.1(-5)
EU-155	<5.2(-5)
W-187	1.50±.20(-3)
NP-239	<1.0(-4)

TABLE B.2A

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT - ALPHA AND BETA ANALYSIS RESULTS

DATE	10/4	10/12	10/24	11/8	11/13
TIME	1123	1142	1431	920	1145
NUCLIDE			MICROCURIES/MILLILITER		
H-3	2.2 ± 0.1(-1)	2.5 ± 0.1(-1)	2.3 ± 0.1(-1)	2.2 ± 0.1(-1)	2.0 ± 0.1(-1)
C-14	*	1.6 ± 0.2(-5)	*	*	*
P-32	*	2.1 ± 0.1(-4)	*	*	*
FE-55	*	5.70 ± 0.05(-3)	*	*	*
NI-63	*	1.31 ± 0.02(-4)	*	*	*
SR-89	*	3.9 ± 0.1(-5)	*	*	*
SR-90	*	4.6 ± 0.3(-6)	*	*	*
Y-91	*	1.56 ± 0.06(-5)	*	*	*
PU-238	4.6 ± 0.4(-8)	*	8.1 ± 0.4(-8)	1.35 ± 0.08(-7)	3.4 ± 0.1(-7)
PU-239,240	3.3 ± 0.7(-8)	*	4.9 ± 0.4(-8)	9.6 ± 0.7(-8)	2.5 ± 0.1(-7)
AM-241	7 ± 8(-9)	*	1.7 ± 0.3(-8)	2.8 ± 0.4(-8)	4.5 ± 0.4(-8)
CM-242	5.3 ± 0.4(-7)	*	1.02 ± 0.06(-6)	1.65 ± 0.08(-6)	4.2 ± 0.2(-6)
CM-244	1.0 ± 0.3(-8)	*	2.3 ± 0.1(-8)	3.9 ± 0.4(-8)	8.2 ± 0.5(-8)

* ANALYSIS NOT PERFORMED

TABLE B.2A (cont'd)

RADIONUCLIDE CONCENTRATIONS IN REACTOR COOLANT - ALPHA AND BETA ANALYSIS RESULTS

DATE	11/14	11/15	12/19
TIME	1310	303	945
NUCLIDE		MICROCURIES/MILLILITER	
H-3	2.2 ± 0.1(-1)	2.0 ± 0.1(-1)	1.33 ± 0.07(-1)
C-14	3.3 ± 0.3(-5)	*	1.5 ± 0.2(-4)
P-32	*	*	5.8 ± 0.1(-4)
FE-55	1.089 ± 0.006(-2)	*	5.561 ± 0.006(-2)
NI-63	2.502 ± 0.009(-3)	*	1.042 ± 0.001(-2)
SR-89	3.99 ± 0.09(-5)	*	6.72 ± 0.03(-4)
SR-90	2.5 ± 0.1(-6)	*	6.77 ± 0.05(-5)
Y-91	3.9 ± 0.4(-5)	*	2.2 ± 0.1(-4)
PU-238	1.6 ± 0.1(-8)	5.0 ± 0.3(-7)	5.4 ± 0.3(-7)
PU-239,240	2.6 ± 0.3(-8)	3.8 ± 0.3(-7)	3.6 ± 0.2(-7)
AM-241	6 ± 2(-9)	5.7 ± 0.5(-8)	6.4 ± 0.4(-8)
CM-242	2.5 ± 0.2(-7)	6.6 ± 0.3(-6)	6.7 ± 0.3(-6)
CM-244	7.7 ± 0.9(-9)	1.39 ± 0.09(-7)	1.57 ± 0.09(-7)

* ANALYSIS NOT PERFORMED

TABLE B.3

RADIONUCLIDE CONCENTRATIONS IN LETDOWN FILTER OUTLET

RCS LETDOWN FILTER OUT

DATE	9/ 7	9/11	9/22	10/ 4	10/24
TIME	1142	1456	1440	1145	1429
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	7.20±1.3(-3)	6.00±2.2(-3)	9.00±1.7(-3)	<5.5(-3)	<1.1(-2)
I-131	1.70±.01(-2)	6.52±.02(-2)	8.80±.05(-3)	2.19±.01(-2)	1.72±.01(-2)
I-132	4.80±.05(-2)	4.05±.05(-2)	4.29±.04(-2)	6.01±.07(-2)	6.10±.07(-2)
I-133	4.28±.05(-2)	5.40±.04(-2)	3.71±.04(-2)	5.32±.02(-2)	4.91±.02(-2)
I-134	6.58±.06(-2)	5.55±.07(-2)	6.04±.08(-2)	7.60±.10(-2)	7.80±.10(-2)
I-135	5.29±.06(-2)	4.80±.10(-2)	5.33±.05(-2)	6.33±.06(-2)	5.99±.06(-2)
RB-88	1.60±.10(-1)	1.30±.10(-1)	1.50±.10(-1)	2.60±.20(-1)	1.50±.70(-1)
RB-89	<3.2(-2)	<2.0(-2)	<2.0(-2)	<1.9(-2)	<2.2(-2)
CS-134	4.22±.02(-3)	6.00±.03(-3)	3.27±.02(-3)	7.06±.04(-3)	6.49±.07(-3)
CS-136	1.36±.07(-4)	1.79±.02(-3)	1.28±.02(-4)	5.40±.10(-4)	1.70±2.8(-4)
CS-137	4.96±.04(-3)	6.82±.04(-3)	4.26±.03(-3)	8.14±.05(-3)	7.75±.08(-3)
CS-138	1.26±.04(-1)	9.90±.20(-2)	1.05±.03(-1)	1.29±.09(-1)	9.30±1.4(-2)
CS-139	<8.7(-2)	<5.7(-2)	<2.5(-1)	<8.1(-1)	NOTE 1
NA-24	1.71±.01(-2)	8.50±.30(-3)	1.26±.02(-2)	1.44±.02(-2)	1.12±.02(-2)
CR-51	2.20±.60(-4)	2.00±.80(-4)	8.60±.10(-4)	2.23±.08(-3)	5.90±.20(-3)
MN-54	7.10±.40(-5)	1.02±.04(-4)	1.32±.01(-4)	3.30±.30(-4)	<4.0(-4)
MN-56	<2.4(-3)	<2.5(-3)	<1.8(-3)	<2.0(-3)	6.60±.60(-3)
FE-59	2.10±.50(-5)	2.30±.50(-5)	7.60±.20(-5)	2.20±.20(-4)	7.80±.80(-4)
CO-57	<8.0(-6)	<7.8(-6)	7.60±.60(-6)	1.80±.60(-5)	1.60±.50(-4)
CO-58	1.41±.02(-3)	1.97±.02(-3)	4.28±.04(-3)	9.80±.07(-3)	2.79±.02(-2)
CO-60	9.10±.50(-5)	8.60±.30(-5)	1.40±.01(-4)	2.93±.08(-4)	1.05±.03(-3)
ZN-65	<8.4(-6)	<6.7(-6)	<1.9(-6)	<2.3(-5)	<6.2(-5)
SR-91	<2.8(-4)	<1.1(-3)	<4.0(-4)	<4.0(-4)	<3.9(-4)
Y-91M	<2.0(-4)	<4.1(-4)	<3.1(-4)	<3.5(-4)	<8.0(-4)
Y-93	<1.6(-3)	<3.6(-3)	<2.1(-3)	<2.5(-3)	<1.6(-3)
ZR-95	<1.1(-5)	<9.4(-6)	1.90±.10(-5)	6.81±1.0(-5)	3.30±.30(-4)
NB-95	<2.0(-5)	<2.5(-5)	4.60±.10(-5)	8.60±.90(-5)	5.50±.60(-4)
MO-99	2.84±.02(-3)	4.95±.05(-3)	1.71±.01(-3)	1.35±.01(-3)	1.49±.02(-3)
RU-103	<1.3(-5)	<1.5(-5)	6.90±1.1(-6)	3.20±.90(-5)	4.70±2.2(-5)
RUD-106	<1.1(-4)	<7.2(-5)	<2.5(-5)	<3.7(-4)	<9.0(-4)
AG-110M	<1.5(-5)	1.40±.50(-5)	<3.4(-6)	<7.1(-5)	<7.9(-5)
SB-124	<3.8(-6)	<1.9(-6)	3.80±.50(-6)	2.20±.90(-5)	<5.5(-5)
SB-125	<4.7(-5)	<2.5(-5)	<1.1(-5)	<4.8(-5)	<1.1(-4)
TE-129M	<2.1(-4)	2.30±.90(-4)	<6.8(-5)	<5.6(-4)	<1.1(-3)
TE-129	<7.6(-2)	<7.3(-2)	<4.2(-2)	<8.1(-2)	<6.2(-2)
TE-131M	<3.7(-4)	<1.5(-3)	<2.6(-4)	<5.7(-4)	<6.5(-4)
TE-131	2.40±1.2(-3)	<3.2(-3)	<5.0(-3)	<6.7(-3)	<1.1(-2)
TE-132	<2.7(-5)	<4.0(-5)	1.20±.30(-5)	<1.6(-5)	<2.0(-4)
BA-139	<2.4(-2)	<1.9(-2)	<1.8(-2)	<2.9(-2)	<2.4(-2)
BA-140	1.60±.30(-4)	2.50±.30(-4)	1.04±.07(-4)	8.10±3.7(-5)	<1.7(-4)
LA-140	<4.6(-5)	<3.5(-4)	<1.3(-4)	<5.0(-5)	<9.2(-5)
CE-141	<7.1(-5)	1.50±.70(-5)	<2.3(-6)	2.60±1.2(-5)	<6.0(-5)
CE-143	<2.5(-4)	<7.2(-4)	<2.1(-4)	<1.0(-4)	<1.2(-4)
CE-144	<6.6(-5)	<5.9(-5)	<1.1(-5)	4.60±.70(-4)	<7.6(-4)
EU-152	<9.4(-5)	<7.4(-4)	<1.4(-5)	<3.4(-4)	<1.7(-4)
EU-154	<6.1(-6)	<5.8(-6)	<2.0(-6)	<2.0(-5)	<5.8(-5)
EU-155	<1.2(-4)	<2.7(-5)	<7.9(-6)	<3.5(-4)	<4.7(-4)
W-187	2.04±.09(-3)	<1.0(-3)	1.90±.40(-3)	1.30±.09(-3)	2.60±.10(-3)
NP-239	<1.3(-4)	<2.8(-4)	<4.6(-5)	1.40±.50(-4)	6.20±.70(-4)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.3 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN LETDOWN FILTER OUTLET

AOC LETDOWN FILTER OUT

DATE	11/ 1	11/13	11/15	11/15	1/ 3
TIME	942	1156	310	802	1306
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<2.4(-3)	<1.4(-2)	<2.9(-3)	<1.7(-3)	<7.2(-3)
I-131	1.56±.02(-2)	2.47±.02(-2)	2.38±.03(-1)	2.58±.03(-1)	1.32±.00(-1)
I-132	4.43±.06(-2)	5.69±.09(-2)	1.25±.09(-1)	3.33±.04(-2)	5.22±.06(-2)
I-133	3.97±.03(-2)	4.88±.05(-2)	2.00±.02(-1)	1.96±.01(-1)	1.92±.01(-1)
I-134	5.40±.70(-2)	6.86±.09(-2)	1.44±.06(-2)	<5.7(-4)	4.60±.10(-2)
I-135	5.01±.06(-2)	5.70±.10(-2)	1.04±.01(-1)	7.16±.09(-2)	6.70±.07(-2)
RB-88	NOTE 1	<2.4(-1)	<3.0(-2)	1.50±.30(-2)	2.10±.30(-1)
RB-89	NOTE 1	<1.2(-1)	<7.8(-3)	<1.7(-3)	<6.0(-3)
CS-134	6.03±.07(-3)	7.55±.06(-3)	2.13±.02(-2)	2.38±.02(-2)	8.30±.10(-3)
CS-136	2.00±.30(-4)	2.20±.20(-4)	7.26±.06(-3)	6.18±.06(-3)	2.10±.05(-3)
CS-137	7.22±.06(-3)	9.04±.04(-3)	2.29±.02(-2)	2.59±.02(-2)	1.11±.01(-2)
CS-138	<2.9(-1)	1.43±.02(-1)	<3.0(-3)	<1.4(-3)	<1.3(-1)
CS-139	NOTE 1	NOTE 1	NOTE 1	<2.8(-2)	<3.0(-1)
NA-24	8.60±.10(-3)	1.17±.02(-2)	6.10±.09(-3)	5.75±.14(-3)	3.75±.07(-3)
CR-51	6.60±.20(-3)	3.74±.03(-2)	7.16±.05(-2)	5.95±.03(-2)	<5.2(-4)
MN-54	1.00±.10(-3)	4.22±.02(-3)	8.64±.09(-3)	6.39±.06(-3)	2.80±.10(-4)
MN-56	6.90±.80(-3)	2.74±.08(-2)	1.30±.04(-2)	2.90±.50(-3)	<1.1(-3)
FE-59	7.60±.60(-4)	3.15±.04(-3)	6.08±.06(-3)	4.62±.07(-3)	3.30±.90(-5)
CO-57	1.60±.30(-4)	3.50±.20(-4)	9.00±.10(-4)	5.14±.24(-4)	<2.9(-5)
CO-58	2.71±.04(-2)	1.53±.02(-1)	2.95±.03(-1)	2.44±.02(-1)	2.13±.05(-3)
CO-60	1.02±.02(-3)	5.64±.04(-3)	1.14±.01(-2)	9.27±.07(-3)	1.67±.07(-4)
ZN-65	<8.1(-5)	4.00±1.0(-5)	<7.4(-5)	<5.9(-5)	<1.8(-5)
SR-91	<4.1(-4)	<3.9(-4)	<4.6(-4)	6.00±3.0(-4)	1.20±.20(-3)
Y-91M	<1.4(-2)	<7.5(-4)	<6.9(-4)	<5.4(-4)	<6.2(-4)
Y-93	<4.1(-4)	<2.0(-3)	1.70±.70(-2)	5.10±.00(-3)	4.90±1.8(-3)
ZR-95	2.20±.60(-4)	1.64±.03(-3)	2.63±.05(-3)	2.05±.04(-3)	<3.0(-5)
NB-95	<1.0(-4)	2.92±.03(-3)	5.24±.07(-3)	4.06±.07(-3)	<3.1(-5)
MO-99	1.31±.04(-3)	2.00±.07(-3)	9.00±.10(-3)	6.69±.05(-3)	7.00±.10(-3)
RU-103	<1.8(-4)	4.90±.30(-4)	9.30±.40(-4)	7.00±.30(-4)	<2.3(-5)
RUD-106	<2.0(-4)	<3.2(-4)	<1.4(-3)	<6.2(-4)	<4.2(-4)
AG-110M	<1.4(-4)	2.30±.20(-4)	4.20±.80(-4)	2.40±.50(-4)	<2.8(-5)
SB-124	7.30±3.2(-5)	2.80±.09(-4)	5.00±.20(-4)	3.80±.20(-4)	6.40±3.0(-6)
SB-125	<9.6(-5)	1.10±.40(-4)	<2.3(-4)	2.70±1.2(-4)	<1.1(-4)
TE-129M	<8.5(-5)	<7.8(-4)	<2.1(-3)	<2.1(-3)	<4.8(-4)
TE-129	3.80±.00(-2)	<5.3(-2)	<5.7(-3)	<4.6(-3)	<2.6(-2)
TE-131M	<3.2(-4)	<7.7(-4)	<2.4(-3)	<2.1(-3)	<1.2(-3)
TE-131	NOTE 1	<4.1(-2)	<7.7(-3)	<3.6(-3)	<7.6(-2)
TE-132	<1.5(-2)	NOTE 1	NOTE 1	NOTE 1	<6.0(-6)
BA-139	<5.9(-2)	<2.7(-2)	<5.0(-3)	<2.5(-3)	<9.7(-3)
BA-140	<1.2(-4)	1.80±.80(-4)	5.60±2.4(-4)	6.80±1.5(-4)	3.40±.60(-3)
LA-140	<2.0(-4)	<1.3(-4)	1.20±.60(-4)	2.30±1.2(-4)	<1.8(-4)
CE-141	<1.2(-4)	1.60±.20(-4)	<3.4(-4)	<1.2(-4)	<8.7(-5)
CE-143	<1.7(-4)	1.10±.40(-3)	<5.3(-4)	<2.6(-4)	<2.0(-4)
CE-144	<1.6(-4)	1.60±.50(-4)	<4.0(-4)	<4.9(-4)	<2.4(-4)
EU-152	<1.0(-4)	<7.0(-5)	<3.2(-3)	<1.1(-4)	<6.0(-4)
EU-154	<6.0(-5)	<2.6(-5)	<6.0(-5)	7.60±3.6(-5)	<1.6(-5)
EU-155	<8.0(-4)	<6.5(-4)	<8.1(-4)	<7.6(-4)	<2.9(-4)
W-187	1.40±.10(-3)	4.40±.30(-3)	4.20±.60(-3)	3.40±.50(-3)	5.00±2.3(-4)
NP-239	3.60±.50(-4)	4.10±.20(-3)	4.20±.50(-3)	3.80±.20(-3)	<4.0(-4)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.3 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN LETDOWN FILTER OUTLET

RCS LETDOWN FILTER OUT

DATE	1/11	1/17	1/20	1/20	1/20
TIME	958	1412	705	858	1117
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<4.4(-2)	2.20±.80(-2)	<2.0(-3)	<2.1(-3)	<2.0(-3)
I-131	7.67±.09(-3)	6.90±.06(-3)	9.30±.30(-3)	9.60±.10(-3)	7.11±.07(-2)
I-132	3.11±.08(-2)	3.71±.07(-2)	2.84±.04(-2)	1.91±.03(-2)	4.56±.06(-2)
I-133	3.05±.05(-2)	2.55±.03(-2)	3.35±.02(-2)	3.29±.03(-2)	1.13±.01(-1)
I-134	5.10±.10(-2)	4.90±.80(-2)	2.67±.04(-2)	8.70±.20(-3)	5.60±.20(-3)
I-135	3.77±.07(-2)	4.20±.10(-2)	3.89±.08(-2)	3.00±.20(-2)	7.00±.10(-2)
RB-88	1.00±.20(-1)	1.70±1.0(-1)	5.70±.70(-2)	5.50±2.3(-2)	4.20±.60(-2)
RB-89	<3.8(-2)	<2.0(-1)	NOTE 1	NOTE 1	NOTE 1
CS-134	8.80±.20(-3)	6.84±.07(-3)	1.07±.02(-2)	1.07±.02(-2)	1.13±.01(-2)
CS-136	8.50±.70(-5)	9.10±.30(-5)	<1.7(-4)	1.30±.60(-4)	5.40±.60(-4)
CS-137	1.04±.01(-2)	7.49±.08(-3)	1.25±.02(-2)	1.29±.01(-2)	1.27±.03(-2)
CS-138	<9.6(-2)	<1.0(-1)	NOTE 1	NOTE 1	NOTE 1
CS-139	<4.0(-1)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	7.90±.20(-3)	6.90±.10(-3)	NOTE 1	NOTE 1	NOTE 1
CR-51	<1.8(-4)	1.40±.50(-4)	NOTE 1	NOTE 1	NOTE 1
MN-54	8.20±.50(-5)	2.32±.05(-4)	NOTE 1	NOTE 1	NOTE 1
MN-56	<2.4(-3)	<2.2(-3)	NOTE 1	NOTE 1	NOTE 1
FE-59	<2.4(-5)	5.00±.30(-5)	NOTE 1	NOTE 1	NOTE 1
CO-57	<4.4(-5)	<3.5(-6)	NOTE 1	NOTE 1	NOTE 1
CO-58	4.90±.10(-4)	1.64±.02(-3)	1.10±.40(-3)	2.80±.30(-3)	1.46±.40(-3)
CO-60	5.80±.20(-5)	2.00±.04(-4)	<1.4(-4)	<1.0(-4)	<7.0(-5)
ZN-65	<1.2(-5)	8.50±3.1(-6)	NOTE 1	NOTE 1	NOTE 1
SR-91	7.90±3.5(-4)	<6.8(-4)	NOTE 1	NOTE 1	NOTE 1
Y-91M	<6.8(-4)	<7.3(-3)	NOTE 1	NOTE 1	NOTE 1
Y-93	<2.2(-3)	<3.6(-3)	NOTE 1	NOTE 1	NOTE 1
ZR-95	<2.0(-5)	5.40±.50(-5)	NOTE 1	NOTE 1	NOTE 1
NB-95	<1.2(-5)	9.10±.40(-5)	NOTE 1	NOTE 1	NOTE 1
MO-99	2.23±.03(-3)	6.72±.20(-4)	NOTE 1	NOTE 1	NOTE 1
RU-103	<2.8(-5)	2.20±.70(-5)	NOTE 1	NOTE 1	NOTE 1
RU-106	<2.4(-4)	<8.0(-5)	NOTE 1	NOTE 1	NOTE 1
AG-110M	<1.8(-5)	1.00±.50(-5)	NOTE 1	NOTE 1	NOTE 1
SB-124	<6.2(-6)	5.00±1.2(-6)	NOTE 1	NOTE 1	NOTE 1
SB-125	<9.1(-5)	<2.6(-5)	NOTE 1	NOTE 1	NOTE 1
TE-129M	<3.2(-4)	<1.4(-4)	NOTE 1	NOTE 1	NOTE 1
TE-129	<6.1(-2)	<6.3(-2)	NOTE 1	NOTE 1	NOTE 1
TE-131M	<3.2(-4)	<2.4(-4)	NOTE 1	NOTE 1	NOTE 1
TE-131	<8.7(-3)	<2.4(-2)	NOTE 1	NOTE 1	NOTE 1
TE-132	<1.2(-4)	<1.8(-4)	NOTE 1	NOTE 1	NOTE 1
BA-139	<1.2(-2)	<2.6(-2)	NOTE 1	NOTE 1	NOTE 1
BA-140	<1.8(-4)	3.50±.20(-4)	NOTE 1	NOTE 1	NOTE 1
LA-140	<1.0(-4)	<6.2(-5)	NOTE 1	NOTE 1	NOTE 1
CE-141	<4.7(-4)	<9.4(-6)	NOTE 1	NOTE 1	NOTE 1
CE-143	<1.5(-5)	<4.0(-4)	NOTE 1	NOTE 1	NOTE 1
CE-144	<1.0(-4)	<3.0(-4)	NOTE 1	NOTE 1	NOTE 1
EU-152	<8.6(-5)	<4.1(-5)	NOTE 1	NOTE 1	NOTE 1
EU-154	<1.3(-5)	<5.4(-6)	NOTE 1	NOTE 1	NOTE 1
EU-155	<1.8(-4)	<6.8(-4)	NOTE 1	NOTE 1	NOTE 1
W-187	3.50±.20(-2)	9.10±1.1(-4)	NOTE 1	NOTE 1	NOTE 1
NP-239	<1.9(-4)	<1.0(-4)	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.3 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN LETDOWN FILTER OUTLET

RCS LETDOWN FILTER OUT

DATE	1/20	1/20	1/20	1/20	1/21
TIME	1321	1509	1740	2111	100
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<8.0(-4)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-131	1.00±.01(-1)	1.02±.01(-1)	6.19±.07(-1)	4.40±.08(-1)	3.00±.05(-1)
I-132	6.83±.06(-2)	6.07±.05(-2)	1.41±.02(-1)	9.20±.20(-2)	5.30±.10(-2)
I-133	1.38±.01(-1)	1.30±.01(-1)	6.65±.05(-1)	4.10±.07(-1)	2.56±.04(-1)
I-134	2.00±.10(-3)	4.10±2.8(-4)	4.00±.40(-3)	3.60±.09(-2)	5.20±.10(-2)
I-135	6.90±.10(-2)	5.60±.10(-2)	1.90±.03(-1)	1.07±.02(-1)	6.70±.20(-2)
RB-88	1.98±.11(-2)	1.26±.32(-2)	2.60±.30(-2)	9.80±.50(-3)	1.55±.08(-1)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.30±.02(-2)	1.32±.02(-2)	1.40±.03(-2)	1.16±.03(-2)	1.13±.04(-2)
CS-136	2.00±.10(-3)	1.90±.10(-3)	6.50±.20(-3)	4.90±.60(-3)	3.20±.20(-3)
CS-137	1.44±.05(-2)	1.45±.04(-2)	1.93±.09(-2)	1.58±.03(-2)	1.37±.05(-2)
CS-138	NOTE 1	NOTE 1	1.70±.10(-2)	1.11±.04(-1)	8.90±.20(-2)
CS-139	NOTE 1	NOTE 1	NOTE 1	2.70±1.1(-2)	1.80±1.5(-2)
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-52	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	2.20±.10(-3)	3.60±.10(-2)	3.80±.20(-3)	3.10±.30(-3)	2.10±2.9(-3)
CO-60	<9.0(-5)	3.66±.09(-3)	<2.7(-4)	<4.6(-4)	<3.6(-4)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS ON MICRO PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.3 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN LETDOWN FILTER OUTLET

PCS LETDOWN FILTER OUT

DATE	1/26	2/ 2	2/ 8	2/14	2/21
TIME	1400	1337	1112	907	946
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	5.20±1.4(-3)	<5.0(-3)	1.00±.30(-2)	<5.7(-3)	6.30±1.9(-3)
I-131	9.10±.10(-3)	8.92±.05(-3)	1.10±.01(-2)	9.73±.01(-3)	8.35±.06(-3)
I-132	3.89±.03(-2)	3.73±.08(-2)	4.13±.05(-2)	4.43±.06(-2)	4.22±.06(-2)
I-133	3.43±.02(-2)	3.21±.08(-2)	3.58±.02(-2)	3.61±.02(-2)	3.44±.05(-2)
I-134	6.31±.05(-2)	5.14±.07(-2)	6.60±.10(-2)	6.88±.09(-2)	6.54±.07(-2)
I-135	4.49±.08(-2)	4.27±.04(-2)	4.78±.08(-2)	5.00±.10(-2)	4.74±.05(-2)
RB-88	1.22±.08(-1)	1.08±.04(-1)	9.60±1.8(-2)	1.00±.10(-1)	1.40±.10(-1)
RB-89	<3.4(-2)	<1.3(-4)	<2.8(-2)	<3.1(-2)	<2.8(-2)
CS-134	1.36±.03(-2)	1.09±.01(-2)	1.02±.01(-2)	9.17±.08(-3)	8.72±.07(-3)
CS-136	5.80±1.2(-4)	2.20±.10(-4)	1.93±.03(-4)	1.50±.10(-4)	9.10±.30(-5)
CS-137	1.57±.03(-2)	1.33±.01(-2)	1.25±.01(-2)	1.17±.01(-2)	1.03±.01(-2)
CS-138	9.30±.90(-2)	<8.3(-2)	8.60±.80(-2)	8.40±.30(-2)	7.90±.70(-2)
CS-139	<1.0(-1)	NOTE 1	<2.7(-1)	<1.5(-1)	<2.1(-1)
NA-24	1.50±.03(-2)	1.31±.02(-2)	1.22±.03(-2)	1.12±.02(-2)	1.11±.01(-2)
CR-51	NOTE 1	<1.4(-4)	<6.2(-5)	<1.9(-4)	<4.1(-5)
MN-54	NOTE 1	6.30±.40(-5)	5.50±.20(-5)	8.90±4.4(-5)	5.10±.20(-5)
MN-56	<1.4(-3)	<1.6(-3)	<1.9(-3)	<2.2(-3)	<1.9(-3)
FE-59	NOTE 1	<1.0(-5)	8.90±2.3(-5)	2.20±1.1(-5)	7.50±2.4(-6)
CO-57	NOTE 1	<8.2(-6)	<2.8(-6)	<1.2(-5)	<3.5(-6)
CO-58	<4.6(-3)	4.75±.09(-4)	4.44±.03(-4)	5.00±.10(-4)	4.45±.04(-4)
CO-60	NOTE 1	4.80±.40(-5)	5.20±.10(-5)	6.10±.60(-5)	5.50±.20(-5)
ZN-65	NOTE 1	<1.1(-5)	6.60±2.6(-5)	<3.0(-5)	<4.4(-6)
SR-91	4.20±1.7(-4)	5.00±1.4(-4)	<6.0(-4)	<1.0(-3)	6.40±1.6(-4)
Y-91M	<4.2(-4)	9.00±2.4(-4)	<4.8(-4)	<4.8(-4)	<5.2(-4)
Y-93	<1.4(-3)	<3.0(-3)	3.70±1.7(-3)	<5.6(-3)	<1.4(-3)
ZR-95	<1.8(-4)	1.70±.70(-5)	<5.3(-6)	<1.9(-5)	<8.1(-6)
NB-95	NOTE 1	<8.8(-6)	<3.4(-6)	<2.0(-5)	<3.0(-6)
MO-99	NOTE 1	8.10±1.4(-4)	6.50±.30(-4)	7.50±.10(-4)	6.80±.50(-4)
RU-103	NOTE 1	<1.8(-5)	<6.3(-6)	<2.1(-5)	<5.5(-6)
RUD-106	NOTE 1	<1.1(-4)	<5.3(-5)	<3.2(-4)	<4.2(-5)
AG-110M	NOTE 1	<2.1(-5)	<6.9(-6)	<3.8(-5)	<6.6(-6)
SB-124	NOTE 1	<3.6(-6)	<1.5(-6)	<1.5(-5)	<1.4(-6)
SB-125	NOTE 1	<5.4(-5)	<1.4(-5)	<6.0(-5)	<2.2(-5)
TE-129M	NOTE 1	<2.8(-4)	<1.1(-4)	<3.5(-4)	<1.1(-4)
TE-129	<2.6(-2)	<3.0(-2)	<6.1(-2)	<7.2(-2)	<5.9(-2)
TE-131M	<8.0(-3)	<7.0(-3)	<1.6(-4)	<3.0(-4)	<3.2(-4)
TE-131	<2.4(-3)	<6.2(-3)	<5.2(-3)	<5.0(-3)	<4.4(-3)
TE-132	<3.1(-4)	<9.3(-6)	<3.9(-5)	<2.2(-5)	<1.9(-5)
BA-139	<1.9(-2)	<1.4(-2)	<2.1(-2)	<2.0(-2)	<1.9(-2)
BA-140	NOTE 1	3.20±.50(-4)	2.60±.10(-4)	4.20±.40(-4)	3.40±.10(-4)
LA-140	NOTE 1	<9.0(-5)	1.10±.30(-5)	<1.1(-4)	<6.1(-5)
CE-141	NOTE 1	<1.8(-5)	<1.0(-5)	<2.5(-5)	<1.8(-5)
CE-143	NOTE 1	<2.4(-4)	<1.3(-4)	<6.7(-5)	<1.1(-4)
CE-144	NOTE 1	<8.0(-5)	<3.0(-5)	<5.2(-4)	<2.9(-5)
EU-152	NOTE 1	<1.1(-4)	<8.0(-5)	<1.1(-4)	<4.0(-5)
EU-154	NOTE 1	<1.0(-5)	<5.0(-6)	<2.0(-5)	<4.7(-6)
EU-155	NOTE 1	<1.4(-4)	<3.2(-5)	<5.2(-5)	<3.8(-5)
W-187	2.60±.20(-3)	1.30±.20(-3)	1.90±.30(-3)	8.10±2.2(-4)	9.50±1.2(-4)
NP-239	<4.0(-4)	<3.6(-4)	<1.6(-4)	<8.2(-5)	<1.8(-4)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.4

RADIONUCLIDE CONCENTRATIONS IN PURIFICATION DEMINERALIZER OUTLET

LETDOWN DEMIN OUT

DATE TIME	9/7 1145	9/11 1459	9/20 1409	9/22 1434	10/4 1148
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<5.8(-3)	<2.2(-3)	<6.3(-3)	<4.2(-4)	<2.7(-3)
I-131	1.35±.02(-4)	5.20±.20(-4)	<2.4(-4)	8.10±.20(-5)	1.67±.03(-4)
I-132	6.00±.70(-4)	4.00±.80(-4)	4.30±.30(-4)	6.00±2.4(-5)	5.80±.50(-4)
I-133	3.50±.10(-4)	5.30±.40(-4)	3.00±.10(-4)	1.09±7.0(-4)	3.70±.10(-4)
I-134	5.60±1.0(-4)	3.60±1.9(-4)	6.40±1.1(-4)	5.50±2.1(-5)	6.00±.90(-4)
I-135	4.50±.40(-4)	3.90±1.7(-4)	3.20±.70(-4)	<4.0(-5)	4.10±.80(-4)
RB-86	<6.5(0)	1.30±.30(-1)	4.20±1.0(-1)	1.40±.30(-1)	1.00±.30(-1)
RB-89	<1.2(-2)	<1.3(-3)	<2.3(-2)	<4.7(-4)	<3.0(-3)
CS-134	3.81±.05(-3)	2.26±.02(-3)	3.44±.03(-3)	3.36±.03(-3)	6.64±.05(-3)
CS-136	2.08±.09(-5)	2.60±.40(-5)	8.20±1.8(-5)	7.70±.10(-5)	5.01±.04(-4)
CS-137	4.52±.08(-3)	2.71±.03(-3)	4.23±.03(-3)	4.28±.03(-3)	7.97±.07(-3)
CS-138	<3.3(-2)	2.10±.30(-2)	<3.0(-2)	<3.3(-3)	<2.9(-2)
CS-139	NOTE 1	<5.9(-2)	NOTE 1	NOTE 1	<3.0(-1)
NA-24	1.63±.06(-4)	8.20±2.2(-5)	8.10±.80(-5)	2.60±.30(-5)	1.34±.06(-4)
CR-51	<3.3(-5)	<7.0(-5)	<2.6(-4)	2.50±.60(-5)	8.10±1.5(-5)
MN-54	1.40±.60(-6)	8.20±1.7(-6)	<1.7(-4)	1.30±.30(-6)	7.00±1.1(-6)
MN-56	<2.6(-4)	<6.9(-4)	<3.3(-4)	<5.2(-5)	<3.9(-4)
FE-59	<1.9(-6)	<6.6(-6)	<5.6(-5)	5.40±2.5(-6)	<2.8(-6)
CO-57	<2.6(-6)	<3.8(-6)	1.90±.10(-4)	<7.0(-7)	<5.9(-6)
CO-58	5.30±.20(-5)	6.90±.40(-5)	4.70±.10(-4)	4.41±.09(-5)	2.32±.03(-4)
CO-60	2.00±.30(-6)	<3.2(-6)	<3.7(-5)	2.20±.30(-6)	6.90±.50(-6)
ZN-65	<1.9(-6)	<6.4(-6)	<6.7(-5)	<1.4(-6)	<2.6(-6)
SR-91	<3.7(-5)	<2.3(-4)	<1.1(-4)	<2.5(-5)	<6.8(-5)
Y-91M	<1.2(-4)	<1.2(-4)	<2.0(-4)	<2.2(-5)	<1.3(-4)
Y-93	<6.1(-4)	<1.1(-3)	<4.4(-4)	<9.2(-5)	<6.5(-4)
ZR-95	<3.1(-6)	<6.9(-6)	5.70±2.3(-5)	<2.0(-6)	<4.1(-6)
NB-95	<1.8(-6)	<1.1(-5)	<2.5(-5)	<2.0(-6)	<4.7(-6)
MO-99	1.30±.40(-5)	<4.5(-5)	<4.5(-5)	2.10±.90(-5)	1.30±.50(-5)
RU-103	<3.7(-6)	<7.7(-6)	<3.7(-5)	<2.4(-6)	<6.1(-6)
RUD-106	<3.1(-5)	<6.0(-5)	<2.8(-4)	<1.3(-5)	<6.2(-6)
AG-110M	<2.8(-6)	<7.1(-6)	<8.5(-5)	<2.2(-6)	<5.7(-5)
SB-124	<5.8(-7)	<4.0(-6)	<1.6(-4)	1.40±.30(-6)	1.90±.40(-6)
SB-125	<1.1(-5)	<2.2(-5)	<8.4(-5)	<4.5(-6)	<1.1(-5)
TE-129M	<6.2(-5)	<1.7(-4)	<8.2(-4)	<2.0(-5)	<4.6(-6)
TE-129	<1.1(-2)	<2.1(-2)	<2.1(-3)	<1.2(-3)	<1.3(-2)
TE-131M	<2.4(-5)	<5.6(-4)	<1.4(-4)	<3.4(-5)	<2.9(-5)
TE-131	<5.0(-3)	<9.8(-4)	<6.7(-3)	<4.3(-4)	<2.0(-3)
TE-132	<6.6(-6)	<2.4(-5)	<4.2(-5)	<7.9(-7)	<7.4(-6)
BA-139	<1.9(-2)	<1.5(-2)	<1.7(-2)	<9.9(-4)	<1.6(-2)
BA-140	<1.6(-5)	<3.7(-5)	<1.1(-4)	<9.0(-6)	<1.2(-5)
LA-140	<2.5(-6)	<6.2(-5)	<5.2(-5)	<3.1(-6)	<1.3(-6)
CE-141	<1.1(-5)	<9.4(-6)	<8.1(-5)	<1.6(-6)	<5.1(-6)
CE-143	<1.5(-5)	<1.0(-4)	<5.3(-5)	<1.1(-5)	<1.8(-5)
CE-144	<2.1(-5)	<3.2(-5)	<3.5(-4)	<6.0(-6)	<4.0(-6)
EU-152	<9.4(-6)	<2.1(-5)	<8.1(-5)	<3.6(-5)	<4.6(-6)
EU-154	<1.2(-6)	<4.1(-6)	<1.1(-4)	<1.2(-6)	<1.2(-6)
EU-155	<6.1(-5)	<2.0(-5)	<1.9(-4)	<3.2(-6)	<1.0(-3)
W-187	<1.1(-4)	<2.9(-4)	<1.2(-4)	<6.4(-5)	<2.1(-4)
NP-239	<5.4(-5)	<1.9(-4)	<1.7(-4)	3.70±1.5(-5)	<3.0(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH QUANTIFYING OPERATIONS WITH < NUMBERS

TABLE B.4 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN PURIFICATION DEMINERALIZER OUTLET

LETDOWN DEMIN OUT

DATE	10/24	11/ 1	11/13	11/15	11/15
TIME	1426	950	1151	308	805
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<3.5(-3)	<2.5(-3)	<7.6(-3)	<8.1(-3)	<7.2(-4)
I-131	1.66±.06(-4)	1.43±.09(-4)	1.27±.05(-4)	2.04±.02(-3)	1.93±.04(-3)
I-132	7.10±.40(-4)	6.70±.50(-4)	5.40±.80(-4)	1.03±.06(-3)	3.00±.20(-4)
I-133	4.90±.20(-4)	3.90±.20(-4)	2.00±.10(-4)	1.74±.05(-3)	1.45±.04(-3)
I-134	3.20±1.5(-4)	7.40±.90(-4)	<2.8(-4)	<3.4(-4)	<6.5(-5)
I-135	5.00±.70(-4)	4.70±.70(-4)	3.20±.40(-4)	1.00±.10(-3)	5.00±.50(-4)
RB-88	1.80±1.1(-1)	1.30±.30(-1)	<1.8(-1)	2.60±.10(0)	1.00±.50(-2)
RB-89	<7.2(-3)	<2.4(-3)	<1.7(-2)	<3.0(-2)	<8.0(-4)
CS-134	7.32±.09(-3)	6.50±.10(-3)	7.85±.07(-3)	8.00±.07(-3)	8.20±.10(-3)
CS-136	1.75±.03(-4)	2.03±.08(-4)	1.43±.02(-4)	1.63±.03(-4)	1.95±.04(-4)
CS-137	8.84±.07(-3)	7.68±.09(-3)	9.29±.08(-3)	9.40±.09(-3)	9.70±.20(-3)
CS-138	<4.2(-2)	<2.7(-2)	<2.9(-2)	<1.2(-3)	<1.1(-4)
CS-139	NOTE 1	<2.1(-1)	NOTE 1	NOTE 1	<6.8(-2)
NA-24	1.35±.07(-4)	8.70±.90(-5)	1.40±.10(-4)	1.00±.10(-4)	8.40±.90(-5)
CR-51	1.50±.30(-4)	1.80±.80(-4)	3.70±.30(-4)	1.24±.03(-3)	5.20±.10(-4)
MN-54	1.01±.09(-5)	<1.9(-5)	4.90±.20(-5)	1.32±.02(-4)	3.10±.30(-5)
MN-56	<4.5(-3)	<3.3(-4)	<3.7(-4)	<3.8(-4)	<1.1(-4)
FE-59	7.10±1.7(-6)	<7.6(-6)	3.00±.20(-5)	9.90±.30(-5)	2.40±.30(-5)
CO-57	<2.4(-6)	<1.7(-5)	<7.0(-6)	7.60±2.0(-6)	<7.5(-5)
CO-58	3.97±.04(-4)	4.30±.20(-4)	1.41±.01(-3)	6.11±.07(-3)	2.14±.03(-3)
CO-60	1.51±.06(-5)	1.50±.30(-5)	6.20±.10(-5)	2.00±.03(-4)	7.70±.20(-5)
ZN-65	<2.9(-6)	<8.5(-6)	<4.9(-6)	<5.8(-6)	<5.2(-6)
SR-91	<6.6(-5)	<9.2(-5)	<5.8(-5)	<1.4(-4)	<4.8(-5)
Y-91M	<1.3(-4)	<1.5(-4)	<2.2(-4)	<2.9(-4)	<7.2(-5)
Y-92	<4.8(-4)	<5.9(-4)	<6.0(-4)	<6.8(-4)	<4.8(-4)
ZR-95	<4.4(-6)	<1.3(-5)	1.20±.30(-5)	4.70±.40(-5)	<1.0(-5)
NB-95	<7.5(-6)	<8.2(-6)	2.50±.20(-5)	1.00±.08(-4)	<3.2(-5)
MO-99	<2.5(-5)	2.10±1.0(-5)	<1.5(-5)	8.60±.60(-5)	8.30±1.5(-5)
RU-103	<5.6(-6)	<1.4(-5)	<1.1(-5)	1.30±.30(-5)	1.50±.50(-5)
RUD-106	<3.4(-5)	<1.1(-4)	<6.5(-5)	<5.9(-5)	<7.9(-5)
AG-110M	<4.8(-6)	<1.5(-5)	<7.2(-6)	1.20±.40(-5)	<8.2(-6)
SB-124	2.90±.60(-6)	<5.2(-6)	2.40±.80(-6)	8.50±1.1(-6)	2.20±.80(-6)
SB-125	<1.8(-5)	<6.5(-5)	<2.8(-5)	<1.6(-5)	<3.5(-5)
TE-129M	<9.2(-5)	<2.7(-4)	<1.7(-4)	<1.2(-4)	<1.7(-4)
TE-129	<8.0(-3)	<1.1(-2)	<8.7(-3)	3.00±1.0(-3)	<7.4(-4)
TE-131M	<4.1(-5)	<5.0(-5)	<3.3(-5)	<6.6(-5)	<5.6(-5)
TE-131	<3.5(-3)	<3.7(-3)	<5.8(-3)	<9.6(-3)	<1.0(-3)
TE-132	<2.7(-5)	<2.1(-5)	<1.4(-5)	2.60±.80(-6)	<2.8(-5)
BA-139	<1.1(-2)	<1.7(-2)	<1.9(-2)	<7.0(-3)	<1.2(-3)
BA-140	<3.3(-5)	<6.6(-5)	<3.6(-5)	<3.2(-5)	<5.1(-5)
LA-140	<1.0(-5)	<5.1(-6)	<2.7(-6)	<6.0(-5)	<2.3(-6)
CE-141	<5.5(-6)	<2.9(-5)	<9.5(-6)	1.20±.40(-5)	<2.5(-5)
CE-143	<4.0(-5)	<3.5(-5)	<3.1(-5)	<4.1(-5)	<4.0(-5)
CE-144	<2.3(-5)	<1.4(-4)	<4.0(-5)	<2.0(-5)	<6.3(-5)
EU-152	<4.9(-5)	<1.3(-4)	<7.0(-5)	<8.7(-5)	<1.1(-4)
EU-154	<1.9(-6)	<9.6(-6)	<3.0(-6)	<3.9(-6)	<5.6(-6)
EU-155	<6.6(-5)	<7.0(-5)	<2.0(-5)	<1.8(-5)	<3.7(-5)
W-187	<1.9(-4)	<2.3(-4)	<2.4(-4)	<1.7(-4)	<2.4(-4)
NP-239	<1.0(-4)	<8.5(-5)	<1.1(-4)	<6.8(-5)	<6.7(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.4 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN PURIFICATION DEMINERALIZER OUTLET

LETDOWN DEMIN OUT

DATE	11/29	1/ 3	1/11	1/17	1/20
TIME	945	1308	958	1414	614
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	<3.2(-3)	<2.0(-3)	<1.3(-2)	NOTE 1
I-131	4.40±.30(-5)	1.11±.01(-3)	8.10±1.0(-5)	6.70±.60(-5)	1.10±.30(-4)
I-132	3.70±.90(-5)	3.30±.80(-4)	1.60±.50(-4)	4.40±1.0(-4)	<3.3(-5)
I-133	<1.4(-5)	1.76±.04(-3)	1.40±.20(-4)	2.20±.30(-4)	3.60±2.0(-5)
I-134	8.10±1.5(-4)	3.80±1.2(-4)	3.20±.80(-4)	<6.6(-4)	<2.5(-5)
I-135	<4.1(-6)	3.70±1.4(-4)	2.90±.60(-4)	<8.7(-4)	<3.4(-5)
RB-88	NOTE 1	7.40±1.3(-2)	4.60±2.1(-2)	5.20±1.4(-1)	<8.2(-4)
RB-89	NOTE 1	<2.4(-3)	<3.0(-3)	<6.2(-2)	NOTE 1
CS-134	1.54±.03(-3)	4.83±.06(-3)	1.26±.02(-2)	6.30±.08(-3)	8.30±.10(-3)
CS-136	1.90±.40(-5)	7.40±.50(-5)	1.01±.05(-4)	6.90±.20(-5)	7.70±1.6(-5)
CS-137	7.03±.02(-3)	5.68±.07(-3)	1.47±.02(-2)	7.88±.08(-3)	9.90±.20(-3)
CS-138	NOTE 1	2.30±.80(-2)	<2.2(-2)	<3.1(-2)	NOTE 1
CS-139	NOTE 1	<1.2(-1)	<1.9(-1)	NOTE 1	NOTE 1
NA-24	<1.2(-6)	<1.6(-5)	4.70±.80(-5)	1.10±.30(-4)	NOTE 1
CR-51	1.05±.03(-3)	3.10±.60(-4)	<1.8(-4)	<1.6(-5)	NOTE 1
MN-54	3.45±.03(-4)	1.08±.06(-3)	9.80±3.6(-6)	1.50±.30(-5)	NOTE 1
MN-56	<4.0(-6)	<6.0(-4)	<2.8(-4)	<8.0(-4)	NOTE 1
FE-59	1.40±.04(-4)	2.60±.40(-5)	<8.9(-6)	<6.4(-6)	NOTE 1
CO-57	1.60±.10(-5)	<2.1(-5)	<1.2(-5)	8.30±3.7(-6)	NOTE 1
CO-58	6.22±.07(-3)	2.03±.05(-3)	8.30±.40(-5)	9.50±.30(-5)	1.60±.30(-4)
CO-60	4.68±.06(-4)	1.52±.05(-4)	8.60±1.9(-6)	1.14±.09(-5)	<1.2(-5)
ZN-65	<4.4(-6)	<8.4(-6)	<9.5(-6)	<6.3(-6)	NOTE 1
SR-91	<7.8(-6)	<1.4(-4)	<1.0(-4)	<3.1(-4)	NOTE 1
Y-91M	NOTE 1	<1.4(-4)	<1.0(-4)	<2.0(-3)	NOTE 1
Y-93	<9.4(-6)	<1.5(-3)	<4.8(-4)	<1.6(-3)	NOTE 1
ZR-95	8.40±.30(-5)	1.80±.80(-3)	<1.4(-5)	<1.0(-5)	NOTE 1
NB-95	1.43±.02(-4)	2.90±.40(-5)	<8.1(-6)	6.50±2.9(-6)	NOTE 1
MO-99	<4.1(-6)	<8.6(-5)	<3.7(-5)	<1.4(-5)	NOTE 1
RU-103	1.70±.40(-5)	<2.0(-5)	<1.8(-5)	<1.1(-5)	NOTE 1
RUD-106	<3.8(-5)	<1.2(-4)	<1.5(-5)	<1.8(-5)	NOTE 1
AG-110M	<5.6(-4)	<2.0(-3)	<1.6(-5)	<1.0(-5)	NOTE 1
SB-124	1.10±.10(-5)	3.10±.40(-5)	1.50±.30(-5)	4.80±1.3(-6)	NOTE 1
SB-125	<7.0(-6)	6.10±2.7(-5)	<5.2(-5)	<1.8(-5)	NOTE 1
TE-129M	<6.2(-6)	<3.8(-4)	<2.8(-4)	2.20±.80(-4)	NOTE 1
TE-129	<2.5(-4)	<1.2(-2)	<1.1(-3)	<1.2(-2)	NOTE 1
TE-131M	<5.4(-6)	<8.8(-5)	<4.8(-5)	<6.8(-5)	NOTE 1
TE-131	NOTE 1	<1.8(-3)	<1.5(-3)	<1.4(-2)	NOTE 1
TE-132	1.40±.20(-5)	<2.2(-6)	<1.7(-6)	<1.2(-6)	NOTE 1
BA-139	<8.1(-6)	<1.7(-2)	<8.3(-3)	<1.1(-2)	NOTE 1
BA-140	<1.1(-6)	<5.7(-5)	<7.3(-5)	<2.2(-5)	NOTE 1
LA-140	8.30±.70(-6)	<8.2(-6)	<3.0(-6)	<3.6(-6)	NOTE 1
CE-141	1.70±.20(-5)	3.80±1.9(-5)	<3.0(-5)	1.70±.80(-5)	NOTE 1
CE-143	<1.1(-5)	<8.2(-5)	<4.0(-5)	<1.4(-4)	NOTE 1
CE-144	3.50±.70(-5)	<1.3(-4)	<1.1(-4)	<9.0(-6)	NOTE 1
EU-152	<6.2(-6)	<5.4(-5)	<8.0(-5)	<2.2(-5)	NOTE 1
EU-154	<2.7(-6)	<8.0(-6)	<6.5(-6)	<3.0(-6)	NOTE 1
EU-155	NOTE 1	<1.8(-3)	<7.4(-5)	<1.1(-4)	NOTE 1
W-187	<1.4(-5)	<1.9(-4)	<3.1(-4)	<5.3(-4)	NOTE 1
NP-239	<4.1(-6)	<6.2(-4)	<1.6(-4)	<6.1(-5)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.4 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN PURIFICATION DEMINERALIZER OUTLET

LETDOWN DEMIN OUT

DATE	1/20	1/20	1/20	1/20	1/20
TIME	708	758	859	935	1117
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-131	9.90±1.7(-5)	<9.2(-5)	<1.4(-4)	7.40±.40(-4)	7.90±.30(-4)
I-132	<2.8(-5)	6.40±3.1(-5)	2.30±.50(-4)	8.60±1.0(-4)	5.80±.60(-4)
I-133	2.70±1.4(-5)	1.30±.20(-4)	3.90±.30(-4)	1.04±.05(-3)	1.11±.03(-3)
I-134	<5.1(-5)	<2.2(-4)	<1.5(-4)	3.60±1.8(-4)	<1.2(-4)
I-135	<2.7(-5)	<6.5(-4)	3.20±1.0(-4)	7.10±1.3(-4)	5.00±1.3(-4)
RB-88	<6.5(-3)	<1.8(-1)	<2.8(-1)	9.20±4.1(-1)	4.00±1.1(-2)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	8.49±.08(-3)	9.23±.09(-3)	1.01±.02(-2)	1.01±.01(-2)	1.00±.01(-2)
CS-136	7.80±1.1(-5)	7.80±2.0(-5)	1.20±.30(-4)	1.50±.30(-4)	2.20±.60(-4)
CS-137	9.64±.08(-3)	1.09±.01(-2)	1.21±.02(-2)	1.21±.01(-2)	1.18±.01(-2)
CS-138	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	1.10±.10(-4)	<3.2(-5)	<3.3(-5)	<4.6(-5)	<3.6(-5)
CO-60	<2.8(-5)	<3.6(-5)	<4.4(-5)	<5.4(-5)	<2.0(-5)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.4 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN PURIFICATION DEMINERALIZER OUTLET

LETDOWN DEMIN OUT

DATE	1/20	1/20	1/20	1/20	1/20
TIME	1215	1320	1406	1510	1734
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-131	9.20±.30(-4)	6.90±.30(-4)	6.90±.30(-4)	6.90±.30(-4)	4.26±.05(-3)
I-132	6.80±.40(-4)	5.70±.40(-4)	5.20±.40(-4)	4.10±.60(-4)	1.04±.06(-3)
I-133	1.35±.05(-3)	1.31±.05(-3)	1.29±.05(-3)	9.60±.50(-4)	4.60±.10(-3)
I-134	8.50±4.1(-5)	<5.8(-5)	<5.8(-5)	<8.4(-5)	<8.6(-5)
I-135	7.30±1.2(-4)	6.50±2.9(-4)	6.90±.80(-4)	1.90±.60(-4)	1.29±.10(-3)
RB-86	2.20±.50(-2)	7.10±1.5(-3)	1.60±1.2(-3)	<2.0(-2)	1.60±.40(-2)
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.00±.01(-2)	9.90±.10(-3)	1.02±.01(-2)	9.80±.10(-3)	9.27±.08(-3)
CS-136	5.00±2.5(-5)	1.40±.20(-4)	2.00±.50(-4)	2.00±.20(-4)	2.20±.20(-4)
CS-137	1.24±.01(-2)	1.21±.01(-2)	1.23±.01(-2)	1.16±.09(-2)	1.11±.02(-2)
CS-138	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	<4.4(-5)	<3.0(-5)	<4.2(-5)	2.90±.10(-3)	<1.1(-4)
CO-60	<4.1(-5)	<3.2(-5)	<2.2(-5)	2.30±.20(-4)	<3.0(-5)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.4 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN PURIFICATION DEMINERALIZER OUTLET

LETDOWN LEAK OUT

DATE	1/20	1/20	1/20	1/21	1/21
TIME	1904	2109	2320	101	1214
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
I-131	3.96±.06(-3)	2.39±.09(-3)	2.16±.08(-3)	1.84±.08(-3)	1.39±.09(-3)
I-132	1.10±.10(-3)	6.80±.90(-4)	4.90±2.8(-4)	5.30±1.8(-4)	<1.0(-4)
I-133	<8.4(-3)	2.60±.10(-3)	3.00±.20(-3)	<4.0(-3)	9.30±.40(-4)
I-134	<5.3(-4)	3.90±1.2(-4)	2.70±1.2(-4)	<2.0(-4)	2.00±1.1(-4)
I-135	9.10±1.2(-4)	<3.3(-4)	4.70±1.9(-4)	<3.6(-4)	<2.1(-4)
RB-88	1.70±.30(-2)	<4.3(-2)	4.80±.10(-1)	6.20±1.3(-2)	NOTE 1
RB-89	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	5.00±.20(-3)	8.70±.20(-3)	8.80±.30(-3)	8.30±.30(-3)	8.40±.09(-3)
CS-136	3.20±.50(-4)	<1.0(-4)	1.20±.60(-4)	9.50±5.5(-5)	1.60±.50(-4)
CS-137	9.60±.20(-3)	1.04±.03(-2)	1.04±.03(-2)	9.60±.40(-3)	1.02±.01(-2)
CS-138	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NA-24	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CR-51	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-54	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MN-56	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
FE-59	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-57	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CO-58	4.70±1.5(-3)	<3.2(-4)	<2.8(-4)	<2.4(-4)	<1.1(-4)
CO-60	<8.1(-5)	<9.0(-5)	<1.2(-4)	<1.2(-4)	<5.6(-5)
ZN-65	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SR-91	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-91M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
Y-93	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
ZR-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NB-95	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
MO-99	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RU-103	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
RUD-106	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
AG-110M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-124	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
SB-125	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-129	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131M	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-131	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
TE-132	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-139	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
BA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
LA-140	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-141	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-143	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CE-144	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-152	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-154	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
EU-155	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
NP-239	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.4 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN PURIFICATION DEMINERALIZER OUTLET

LEYDOKN DEMIN OUT

DATE	1/26	2/ 2	2/ 8	2/14	2/21
TIME	1405	1335	1113	905	942
NUCLIDE	MICROCURIES/MILLILITER				
BR-84	<3.0(-3)	<1.2(-2)	<9.0(-3)	<1.6(-3)	NOTE 1
I-131	<5.0(-4)	9.60±.60(-5)	6.70±.90(-5)	7.90±.70(-5)	5.40±1.2(-5)
I-132	3.10±1.8(-4)	3.70±.30(-4)	2.50±.40(-4)	4.80±.40(-4)	4.11±.07(-4)
I-133	<1.0(-3)	2.50±.20(-4)	3.40±.20(-4)	3.20±.30(-4)	2.30±.10(-4)
I-134	3.90±1.1(-4)	4.20±1.4(-4)	<6.0(-4)	4.00±.60(-4)	<1.2(-3)
I-135	<2.7(-4)	3.30±.80(-4)	4.40±.70(-4)	1.60±.80(-4)	1.00±.40(-4)
RB-88	4.00±.20(-1)	NOTE 1	<5.0(-1)	2.60±1.3(-2)	NOTE 1
RB-89	<3.0(-3)	NOTE 1	NOTE 1	<1.1(-3)	NOTE 1
CS-134	1.46±.01(-2)	1.99±.01(-2)	9.30±.20(-3)	8.90±.20(-3)	8.82±.06(-3)
CS-136	2.90±.70(-4)	2.70±.04(-4)	1.82±.05(-4)	1.18±.06(-4)	8.00±.80(-5)
CS-137	1.80±.02(-2)	1.32±.01(-2)	1.24±.01(-2)	1.14±.02(-2)	1.17±.02(-2)
CS-138	1.30±.50(-2)	<2.1(-2)	<2.5(-2)	<2.2(-2)	<4.3(-2)
CS-139	NOTE 1	NOTE 1	NOTE 1	<5.6(-2)	NOTE 1
NA-24	<6.0(-4)	2.30±.10(-4)	1.56±.09(-4)	1.36±.09(-4)	1.08±.08(-4)
CR-51	NOTE 1	<4.4(-5)	<6.4(-5)	<8.4(-5)	<4.6(-5)
MN-54	NOTE 1	3.80±1.1(-6)	1.80±.30(-5)	<4.2(-6)	2.20±.40(-5)
MN-56	<5.0(-4)	<2.1(-4)	<4.2(-4)	<2.6(-4)	<1.8(-4)
FE-59	NOTE 1	<2.8(-6)	<3.4(-6)	<4.4(-6)	<2.0(-5)
CO-57	NOTE 1	<2.4(-6)	<5.6(-6)	<1.1(-5)	<4.4(-5)
CO-58	NOTE 1	1.90±.20(-5)	<1.4(-6)	1.20±.30(-5)	2.60±.60(-5)
CO-60	NOTE 1	2.30±.30(-6)	1.00±.50(-6)	<2.3(-6)	<5.0(-6)
ZN-65	NOTE 1	<5.2(-6)	<3.8(-6)	<6.2(-6)	<1.2(-5)
SR-91	<2.2(-4)	<6.6(-5)	<1.0(-5)	<1.2(-4)	<7.0(-5)
Y-91M	<1.4(-4)	<2.6(-4)	<2.8(-4)	<1.0(-4)	NOTE 1
Y-93	<1.0(-3)	<7.4(-4)	<4.8(-4)	<1.2(-3)	<5.0(-5)
ZR-95	<8.0(-5)	<6.7(-6)	<5.4(-6)	<1.2(-5)	<1.8(-5)
NB-95	<5.2(-5)	<3.2(-6)	<3.2(-6)	<4.5(-6)	<9.7(-6)
MO-99	<6.8(-5)	5.50±3.0(-5)	<2.2(-5)	<3.2(-5)	<3.0(-5)
RU-103	NOTE 1	<8.6(-6)	<5.6(-6)	<1.1(-5)	<2.2(-5)
RUD-106	NOTE 1	<6.1(-5)	<4.6(-5)	<8.8(-5)	<5.1(-5)
AG-110M	NOTE 1	<7.6(-6)	<5.8(-6)	<7.6(-6)	<2.0(-5)
SB-124	NOTE 1	6.00±3.0(-7)	<1.2(-6)	<1.3(-6)	<7.4(-6)
SB-125	NOTE 1	<3.0(-5)	<1.6(-5)	<4.0(-5)	<4.8(-5)
TE-129M	NOTE 1	<1.4(-4)	<1.6(-4)	<2.3(-4)	<3.4(-5)
TE-129	<5.6(-3)	<5.3(-3)	<6.2(-3)	<1.7(-2)	<6.5(-4)
TE-131M	<2.5(-4)	<1.4(-4)	<4.7(-5)	<5.0(-5)	<6.2(-5)
TE-131	<2.1(-3)	<2.0(-2)	<1.1(-2)	<1.1(-3)	NOTE 1
TE-132	<6.6(-5)	<3.6(-5)	<2.6(-5)	<3.4(-5)	<1.2(-5)
BA-139	1.30±.00(-2)	<9.3(-3)	<1.3(-2)	<4.9(-2)	<3.6(-3)
BA-140	NOTE 1	<4.6(-5)	<2.6(-5)	<5.1(-5)	<3.4(-5)
LA-140	<9.2(-5)	<3.2(-5)	<4.1(-6)	<5.6(-6)	<6.2(-6)
CE-141	NOTE 1	<6.0(-6)	<3.8(-5)	<4.1(-5)	<4.1(-5)
CE-143	<6.7(-5)	<4.4(-5)	<5.6(-5)	<7.6(-5)	<4.8(-5)
CE-144	NOTE 1	<3.4(-5)	<4.0(-5)	<7.3(-5)	<5.0(-5)
EU-152	NOTE 1	<7.0(-5)	<5.0(-6)	<7.2(-5)	<5.0(-5)
EU-154	NOTE 1	<2.8(-6)	<3.4(-6)	<4.0(-6)	<1.2(-5)
EU-155	NOTE 1	<1.8(-5)	<6.6(-5)	<6.7(-5)	<1.8(-5)
W-187	<2.1(-4)	<2.6(-4)	<1.4(-4)	<1.1(-4)	<5.5(-5)
NP-239	<2.5(-4)	<1.4(-4)	<1.0(-4)	<1.2(-4)	<6.4(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS
AT OTHER PROBLEMS ASSOCIATED WITH RADIOCHEMISTRY OPERATIONS WITH < NUMBERS

TABLE B.5

RADIONUCLIDE CONCENTRATIONS IN MAKEUP FILTER OUTLET

MAKEUP FILTER

DATE	12/29	1/ 3	1/11	1/17	2/21
TIME	1	1310	1002	1416	948
NUCLIDE		MICROCURIES/MILLILITER			
BR-84	NOTE 1	<1.4(-3)	<3.6(-3)	<4.2(-3)	<2.6(-3)
I-131	NOTE 1	1.49±.01(-3)	4.00±1.3(-5)	8.20±.40(-5)	4.30±.50(-5)
I-132	NOTE 1	2.60±.70(-4)	1.60±.70(-4)	3.20±.30(-4)	2.20±1.4(-4)
I-133	NOTE 1	2.06±.05(-3)	1.80±.30(-4)	3.10±.10(-4)	2.00±.20(-4)
I-134	NOTE 1	3.10±1.7(-4)	<2.8(-4)	3.00±1.0(-4)	2.20±.50(-4)
I-135	NOTE 1	5.00±1.6(-4)	<2.4(-4)	3.00±.60(-4)	1.80±.80(-4)
RB-88	NOTE 1	1.60±.50(-1)	1.00±.20(-1)	1.80±.60(-1)	6.60±.90(-2)
RB-89	NOTE 1	<3.2(-2)	<5.4(-3)	<1.4(-2)	NOTE 1
CS-134	NOTE 1	5.23±.04(-3)	1.22±.03(-2)	7.70±.06(-3)	7.60±.06(-3)
CS-136	NOTE 1	4.80±.40(-5)	9.70±.50(-5)	6.40±.20(-5)	6.60±.30(-5)
CS-137	NOTE 1	6.12±.06(-3)	1.41±.03(-2)	9.30±.10(-3)	9.33±.06(-3)
CS-138	NOTE 1	<2.6(-2)	<1.7(-2)	<1.6(-2)	<1.9(-2)
CS-139	NOTE 1	NOTE 1	<5.2(-1)	NOTE 1	NOTE 1
NA-24	NOTE 1	<3.6(-5)	3.10±1.0(-5)	8.20±.80(-5)	7.30±1.1(-5)
CR-51	NOTE 1	<5.4(-5)	<1.4(-4)	<3.4(-5)	<5.0(-5)
MN-54	NOTE 1	1.80±.20(-5)	1.70±.30(-5)	9.20±1.0(-6)	8.50±.20(-5)
MN-56	NOTE 1	<4.8(-4)	<4.5(-4)	<3.4(-4)	<2.6(-4)
FE-59	NOTE 1	<6.9(-6)	<1.1(-5)	<3.0(-6)	6.00±2.3(-6)
CO-57	NOTE 1	<3.4(-6)	<3.6(-5)	<2.9(-6)	<3.0(-6)
CO-58	NOTE 1	2.54±.04(-4)	1.22±.04(-4)	1.40±.04(-4)	4.47±.05(-4)
CO-60	NOTE 1	2.10±.10(-5)	1.80±.20(-5)	1.30±.07(-5)	9.10±.20(-5)
ZN-65	NOTE 1	<5.4(-6)	<1.4(-5)	<5.1(-6)	<4.4(-6)
SR-91	NOTE 1	<1.6(-4)	<2.0(-4)	<8.1(-5)	<1.4(-4)
Y-91M	NOTE 1	<2.4(-4)	<4.3(-4)	<1.6(-4)	<8.8(-5)
Y-93	NOTE 1	<2.4(-4)	<1.3(-3)	<4.0(-4)	<5.2(-4)
ZR-95	NOTE 1	<6.1(-6)	<2.2(-5)	1.20±.60(-5)	1.70±.30(-5)
NB-95	NOTE 1	<3.8(-6)	<1.1(-5)	<2.5(-6)	1.80±.20(-5)
MO-99	NOTE 1	1.03±.05(-4)	<2.6(-5)	<1.6(-5)	<1.3(-5)
RU-103	NOTE 1	<7.6(-6)	<2.4(-5)	<6.2(-6)	<8.6(-6)
RUD-106	NOTE 1	<5.4(-5)	<1.6(-4)	<3.4(-5)	<4.8(-5)
AG-110M	NOTE 1	<7.8(-6)	<1.8(-5)	<5.6(-6)	<6.8(-6)
SB-124	NOTE 1	2.80±.30(-5)	1.00±.30(-5)	4.20±.90(-6)	<1.3(-6)
SB-125	NOTE 1	3.30±1.2(-5)	<8.0(-5)	<1.2(-5)	<1.8(-5)
TE-129M	NOTE 1	<1.3(-4)	<3.4(-4)	9.00±4.5(-5)	<1.8(-4)
TE-129	NOTE 1	<3.2(-3)	<8.7(-3)	<5.2(-3)	<7.7(-3)
TE-131M	NOTE 1	<9.5(-5)	<5.6(-5)	<3.7(-5)	<8.0(-5)
TE-131	NOTE 1	<5.7(-3)	<4.3(-3)	<4.5(-3)	<1.6(-3)
TE-132	NOTE 1	<1.2(-4)	<7.4(-4)	4.90±2.0(-6)	<1.4(-5)
BA-139	NOTE 1	<5.4(-3)	<4.7(-3)	<7.3(-3)	<6.8(-3)
BA-140	NOTE 1	<3.6(-5)	<1.0(-4)	<2.4(-5)	<3.7(-5)
LA-140	NOTE 1	<3.7(-5)	<4.0(-6)	<1.1(-5)	<6.0(-6)
CE-141	NOTE 1	<1.3(-5)	<3.0(-5)	<6.9(-6)	<6.3(-6)
CE-143	NOTE 1	<7.0(-5)	<6.0(-5)	<4.4(-5)	<5.4(-5)
CE-144	NOTE 1	<2.8(-5)	<1.1(-4)	<1.6(-5)	<3.4(-5)
EU-152	NOTE 1	<4.9(-5)	<6.2(-5)	<2.8(-5)	<1.8(-5)
EU-154	NOTE 1	<4.6(-6)	<8.0(-6)	<3.1(-6)	<3.6(-6)
EU-155	NOTE 1	<1.5(-5)	<6.0(-5)	<7.4(-5)	<1.3(-6)
W-187	NOTE 1	<2.6(-4)	<3.1(-4)	<2.5(-4)	<1.6(-4)
NP-239	NOTE 1	<5.0(-5)	<1.2(-4)	<6.9(-5)	<7.0(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.6

RADIONUCLIDE CONCENTRATIONS IN MAKEUP TANK

MAKEUP TANK

DATE	9/11	11/12	1/17	2/21
TIME	1631	1300	1417	951
NUCLIDE	MICROCURIES/MILLILITER			
BR-84	<4.6(-4)	<2.0(-3)	<9.6(-3)	<2.8(-3)
I-131	3.75±.02(-4)	1.93±.04(-4)	3.00±.20(-5)	5.00±.40(-5)
I-132	1.85±.30(-4)	4.07±.30(-4)	2.00±.60(-4)	2.40±.40(-4)
I-133	<6.1(-4)	3.30±.07(-4)	1.30±.20(-4)	2.10±.20(-4)
I-134	2.00±.30(-4)	2.20±.60(-4)	<6.0(-4)	1.90±.80(-4)
I-135	3.10±.50(-4)	4.00±.40(-4)	<2.7(-4)	2.90±.90(-4)
RB-88	1.12±.04(-1)	<5.4(-2)	<2.8(-1)	1.50±.10(-1)
RB-89	<1.7(-4)	<4.6(-3)	<8.1(-2)	<4.0(-3)
CS-134	1.24±.02(-3)	7.00±.07(-3)	3.20±.04(-3)	7.21±.06(-3)
CS-136	1.86±.06(-5)	1.22±.03(-4)	3.00±.10(-5)	6.00±.30(-5)
CS-137	1.65±.03(-3)	8.15±.08(-3)	3.86±.05(-3)	9.29±.09(-3)
CS-138	<8.7(-3)	<1.2(-2)	<1.1(-2)	<1.1(-2)
CS-139	<5.1(-3)	NOTE 1	NOTE 1	NOTE 1
NA-24	5.00±.90(-5)	1.44±.07(-4)	<1.6(-5)	7.40±.70(-5)
CR-51	<3.7(-6)	8.00±3.0(-5)	<5.2(-6)	<5.2(-5)
MN-54	2.00±.30(-6)	9.70±.10(-6)	1.22±.06(-5)	5.00±.20(-5)
MN-56	<1.4(-4)	4.00±1.0(-3)	<3.8(-4)	<2.7(-4)
FE-59	<9.2(-7)	7.40±1.7(-6)	3.20±1.3(-6)	1.40±.30(-5)
CO-57	<1.8(-6)	<3.6(-6)	<2.6(-6)	<2.8(-6)
CO-58	1.20±.05(-3)	3.22±.03(-4)	1.17±.02(-4)	3.85±.04(-4)
CO-60	3.30±.30(-6)	1.46±.08(-5)	1.34±.06(-5)	6.10±.20(-5)
ZN-65	<7.0(-7)	<4.8(-6)	<2.3(-6)	<5.0(-6)
SR-91	<7.2(-5)	<4.4(-5)	<1.7(-4)	<8.0(-5)
Y-91M	<4.2(-5)	<8.5(-5)	<2.0(-3)	<1.4(-4)
Y-93	<3.3(-4)	<7.5(-4)	<1.1(-3)	<4.6(-4)
ZR-95	<1.2(-6)	<5.3(-6)	5.40±1.6(-6)	8.30±3.4(-6)
NB-95	<1.4(-6)	5.00±2.0(-6)	1.04±.08(-5)	1.30±.20(-5)
MO-99	<3.2(-5)	<1.4(-5)	<5.4(-6)	<1.2(-5)
RU-103	<2.4(-6)	<8.9(-6)	<6.3(-6)	1.10±.50(-5)
RU-106	<2.0(-6)	<6.4(-5)	<5.3(-6)	<6.4(-5)
AG-110M	<6.4(-5)	<4.7(-6)	<5.4(-6)	<1.0(-5)
SB-124	6.90±1.7(-7)	<7.4(-7)	2.60±.50(-6)	<1.2(-6)
SB-125	<3.1(-6)	<1.9(-5)	<6.0(-6)	<3.1(-5)
TE-129M	<1.6(-6)	<9.9(-5)	<3.6(-6)	<1.2(-4)
TE-129	<4.6(-3)	<3.7(-3)	<5.2(-3)	<3.9(-3)
TE-131M	<1.0(-4)	<3.9(-5)	<2.7(-5)	<4.1(-5)
TE-131	<4.7(-4)	<2.4(-3)	<1.8(-2)	<2.8(-3)
TE-132	<1.0(-5)	<1.7(-5)	<1.0(-5)	<1.3(-5)
BA-139	<2.9(-3)	<5.3(-3)	<4.0(-4)	<4.9(-3)
BA-140	7.70±3.5(-6)	<4.0(-5)	<7.8(-6)	<3.8(-5)
LA-140	<4.1(-5)	<2.3(-6)	<1.9(-6)	<2.2(-6)
CE-141	<2.8(-6)	<8.3(-6)	<3.2(-6)	<6.0(-6)
CE-143	<4.1(-5)	<2.4(-5)	<2.6(-5)	2.90±1.1(-5)
CE-144	<2.1(-6)	<2.8(-5)	<2.6(-6)	<2.2(-5)
EU-152	<6.5(-5)	<5.6(-5)	<8.1(-6)	<3.2(-5)
EU-154	<3.8(-7)	<2.6(-6)	<1.2(-6)	<3.6(-6)
EU-155	<1.6(-4)	<5.1(-5)	<1.5(-5)	<1.2(-5)
W-187	<8.3(-5)	<1.7(-4)	<2.9(-4)	<2.1(-4)
NP-239	<2.8(-5)	<8.0(-5)	<2.6(-5)	<5.2(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OUT DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.7

RADIONUCLIDE CONCENTRATIONS IN BORATED STORAGE TANK

Isotope	Nov. 14, 1978 (μCi/ml)	Dec. 13, 1978 (μCi/ml)
^{84}Br	<4.70(-6)	-
^{131}I	<2.80(-7)	1.47 ± 0.02(-4)
^{132}I	<5.20(-6)	-
^{133}I	<3.20(-7)	-
^{134}I	<4.6(-6)	<1.40(-4)
^{135}I	9.10 ± 3.4(-7)	-
^{88}Rb	<1.20(-5)	-
^{89}Rb	<2.10(-5)	-
^{134}Cs	3.02 ± 0.06(-5)	8.31 ± 0.11(-4)
^{136}Cs	<3.9(-7)	3.40 ± 0.10(-5)
^{137}Cs	4.05 ± 0.06(-5)	1.03 ± 0.01(-3)
^{138}Cs	<6.80(-7)	-
^{139}Cs	<9.00(-4)	-
^{24}Na	<1.80(-7)	-
^{51}Cr	<2.20(-6)	2.08 ± 0.02(-3)
^{54}Mn	1.07 ± 0.04(-5)	4.42 ± 0.03(-4)
^{56}Mn	<6.10(-7)	-
^{59}Fe	<7.00(-7)	1.40 ± 0.04(-4)
^{57}Co	5.01 ± 0.81(-7)	5.60 ± 0.50(-5)
^{58}Co	1.44 ± 0.04(-5)	1.73 ± 0.02(-2)
^{60}Co	4.09 ± 0.10(-5)	9.29 ± 0.10(-4)
^{65}Zn	<6.51(-7)	1.60 ± 0.20(-5)
^{91}Sr	<1.00(-6)	-
^{91m}Y	<1.50(-6)	-
^{93}Y	<3.11(-6)	-
^{95}Zr	<5.10(-7)	7.21 ± 0.21(-5)
^{95}Nb	<4.60(-7)	1.76 ± 0.09(-4)
^{99}Mo	<1.90(-7)	-
^{103}Ru	<3.20(-7)	1.90 ± 0.20(-5)
^{106}RuD	<2.90(-6)	-
^{110m}Ag	3.20 ± 0.50(-6)	1.72 ± 0.03(-4)
^{124}Sb	<1.90(-7)	7.20 ± 0.20(-5)
^{125}Sb	<1.00(-6)	6.00 ± 0.50(-5)
^{129m}Te	<8.20(-6)	-
^{129}Te	<8.60(-6)	-
^{131m}Te	<1.40(-6)	-
^{131}Te	<1.70(-5)	-
^{132}Te	<2.00(-7)	-
^{139}Ba	<1.30(-6)	-
^{140}Ba	<1.20(-6)	-
^{140}La	<9.10(-8)	4.24 ± 0.08(-5)
^{141}Ce	<2.80(-7)	1.40 ± 0.30(-5)
^{143}Ce	<5.10(-7)	-
^{144}Ce	<1.30(-6)	-
^{152}Eu	<8.10(-7)	-
^{154}Eu	<4.70(-7)	-
^{155}Eu	<5.00(-7)	-
^{187}W	<1.20(-6)	-
^{239}Np	<5.90(-7)	-

TABLE B.7A

RADIONUCLIDE CONCENTRATIONS IN BORATED STORAGE TANK - BETA ANALYSIS RESULTS

DATE	10/13	11/14	12/13
TIME	1416	1320	1205
NUCLIDE			MICROCURIES/MILLILITER
H-3	8.3 ± 0.4(-2)	8.6 ± 0.4(-2)	1.01 ± 0.05(-1)
C-14	5.5 ± 0.5(-6)	5.3 ± 0.5(-6)	7 ± 1(-6)
P-32	4 ± 2(-7)	*	*
FE-55	1.40 ± 0.01(-4)	1.60 ± 0.01(-4)	1.984 ± 0.005(-3)
NI-63	2.35 ± 0.02(-5)	2.74 ± 0.02(-5)	1.794 ± 0.002(-3)
SR-89	<2(-8)	2.3 ± 0.3(-7)	8.12 ± 0.05(-5)
SR-90	1.4 ± 0.1(-7)	1.13 ± 0.05(-7)	1.10 ± 0.01(-5)
Y-91	3.4 ± 0.2(-7)	3.8 ± 0.3(-7)	3 ± 7(-5)

* ANALYSIS NOT PERFORMED

TABLE B.8

RADIONUCLIDE CONCENTRATIONS IN FEED TO COOLANT RADWASTE SYSTEM PRIMARY DEMINERALIZER A

CRWS PRIMARY DEMIN A FEED

DATE	10/ 5	1/16	1/16	1/16	1/18
TIME	940	1040	1058	1130	1105
NUCLIDE	MICROCURIES/MILLILITER				
I-131	1.14±.02(-4)	5.90±.10(-4)	5.90±.10(-4)	5.70±.10(-4)	4.50±.10(-4)
I-132	2.30±.10(-4)	<4.0(-5)	<4.0(-5)	NOTE 1	NOTE 1
I-133	2.60±.10(-4)	4.50±.10(-4)	4.40±.10(-4)	4.30±.20(-4)	4.90±.10(-4)
I-134	2.97±.02(-3)	<1.0(-3)	<1.2(-3)	NOTE 1	NOTE 1
I-135	3.00±.20(-4)	1.20±.10(-4)	1.20±.10(-4)	1.60±1.2(-4)	2.00±1.0(-3)
CS-134	3.90±.02(-3)	3.92±.06(-3)	3.80±.10(-3)	3.90±.10(-3)	3.90±.05(-3)
CS-136	2.70±.02(-4)	3.30±.30(-5)	3.40±.20(-5)	3.10±.30(-5)	2.80±.30(-5)
CS-137	4.45±.02(-3)	4.60±.10(-3)	4.50±.20(-3)	4.50±.10(-3)	4.56±.08(-3)
NA-24	4.60±.40(-5)	7.70±.40(-5)	7.40±.50(-5)	7.40±.80(-5)	7.50±.80(-5)
CR-51	2.90±1.1(-5)	<2.0(-4)	<6.0(-5)	<6.0(-5)	<6.0(-5)
MN-54	3.60±.40(-6)	4.50±.30(-5)	3.70±.20(-5)	5.60±.20(-5)	1.18±.05(-4)
FE-59	<1.0(-6)	1.40±.20(-5)	8.40±2.5(-6)	1.40±.20(-5)	1.80±.30(-5)
CO-57	5.00±1.0(-5)	<4.0(-5)	<8.0(-6)	<6.0(-6)	<8.0(-6)
CO-58	4.20±.10(-5)	3.70±.10(-4)	3.30±.10(-4)	5.37±.06(-4)	9.01±.09(-4)
CO-60	8.10±.30(-6)	5.60±.30(-5)	4.50±.20(-5)	7.60±.30(-5)	1.41±.05(-4)
ZN-65	<2.0(-6)	<6.0(-6)	<4.0(-6)	<6.0(-7)	<6.0(-6)
ZR-95	<3.0(-6)	<8.0(-6)	<6.0(-6)	<8.0(-6)	1.00±.50(-5)
NB-95	1.30±.50(-5)	5.30±2.6(-6)	9.10±5.8(-6)	1.50±.20(-5)	2.80±.20(-5)
MO-99	5.60±2.4(-6)	5.70±1.3(-5)	2.20±.70(-5)	2.80±.60(-5)	2.20±.70(-5)
RU-103	<3.0(-6)	<1.0(-5)	<6.0(-5)	<6.0(-6)	<1.0(-5)
RU-106	1.30±.60(-4)	<1.0(-4)	<6.0(-5)	<6.0(-5)	<6.0(-5)
AG-110M	<2.0(-6)	<1.0(-5)	<6.0(-6)	<6.0(-6)	1.10±.40(-5)
SB-124	1.00±.30(-6)	2.30±1.4(-6)	5.60±1.4(-6)	<2.0(-6)	2.70±1.3(-6)
SB-125	<9.0(-6)	<4.0(-5)	<2.0(-6)	<2.0(-5)	<2.0(-5)
BA-140	<1.0(-5)	<4.0(-4)	<2.0(-5)	<2.0(-5)	<1.4(-4)
LA-140	2.50±.60(-6)	1.60±.20(-5)	1.60±.10(-5)	2.50±.20(-5)	2.00±.20(-5)
CE-141	<3.0(-6)	<8.0(-5)	<2.0(-5)	<2.0(-5)	<2.0(-5)
CE-144	<1.0(-5)	<2.0(-4)	<8.0(-5)	<6.0(-5)	<6.0(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.8 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN FEED TO COOLANT RADWASTE SYSTEM PRIMARY DEMINERALIZER A

CRWS PRIMARY DEMIN A FEED

DATE	2/ 9	2/28
TIME	1349	903
NUCLIDE	MICROCURIES/MILLILITER	
I-131	4.66±.06(-4)	9.40±.20(-3)
I-132	3.90±.90(-5)	<1.4(-5)
I-133	5.80±.90(-5)	1.11±.04(-3)
I-134	<4.0(-5)	<4.0(-5)
I-135	2.50±.30(-4)	<1.0(-5)
CS-134	3.73±.06(-3)	2.67±.06(-3)
CS-136	7.00±.20(-5)	2.00±.02(-4)
CS-137	4.65±.07(-3)	2.39±.02(-3)
NA-24	1.40±.09(-4)	8.60±2.0(-6)
CR-51	<4.0(-5)	<4.0(-5)
MN-54	3.10±.20(-5)	7.80±.40(-6)
FE-59	5.90±1.1(-6)	<1.0(-6)
CO-57	<4.0(-7)	<2.0(-6)
CO-58	2.85±.03(-4)	8.79±.08(-5)
CO-60	5.20±.10(-5)	1.60±.04(-5)
ZN-65	<2.0(-6)	<1.4(-6)
ZR-95	5.80±1.7(-6)	1.60±.90(-6)
NB-95	1.20±.10(-5)	<1.0(-6)
MO-99	2.20±1.2(-4)	8.40±1.6(-5)
RU-103	<4.0(-6)	<2.0(-6)
RUD-106	<4.0(-5)	<1.4(-5)
AG-110M	<4.0(-6)	<1.4(-6)
SB-124	5.40±3.3(-7)	4.20±2.8(-7)
SB-125	<1.4(-5)	<8.0(-6)
BA-140	<1.6(-5)	<1.0(-5)
LA-140	3.70±.30(-5)	3.70±.10(-6)
CE-141	1.30±1.0(-5)	<6.0(-5)
CE-144	2.80±1.3(-5)	<1.4(-5)

TABLE B.8A

RADIONUCLIDE CONCENTRATIONS IN FEED TO COOLANT RADWASTE SYSTEM PRIMARY DEMINERALIZER A - ALPHA AND BETA ANALYSIS RESULTS

DATE	1/18
TIME	1109

NUCLIDE	MICROCURIES/MILLILITER
H-3	2.1 ± 0.1(-1)
C-14	5.7 ± 0.6(-5)
P-32	4.1 ± 0.3(-6)
FE-55	7.8 ± 0.1(-5)
NI-63	9.810 ± 0.002(-4)
SR-89	1.2 ± 0.2(-7)
SR-90	<3(-8)
Y-91	4.8 ± 0.7(-7)
PU-238	<6(-10)
PU-239,240	9 ± 1(-9)
AM-241	3 ± 2(-10)
CM-242	5.0 ± 0.4(-9)
CM-244	1.1 ± 0.6(-10)

TABLE B.9

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM COOLANT RADWASTE SYSTEM PRIMARY DEMINERALIZER A

CRWS PRIMARY DEMIN A EFFLUENT

DATE	10/ 5	1/16	1/16	1/16	1/18
TIME	940	1018	1102	1132	1108
NUCLIDE	MICROCURIES/MILLILITER				
I-131	1.70±.30(-6)	<1.0(-5)	<2.0(-6)	<1.0(-5)	<4.0(-6)
I-132	<8.0(-6)	<4.0(-5)	NOTE 1	NOTE 1	NOTE 1
I-133	<3.6(-6)	<6.0(-6)	<6.0(-6)	<2.0(-5)	<8.0(-6)
I-134	<2.0(-5)	<1.2(-3)	NOTE 1	NOTE 1	NOTE 1
I-135	<2.0(-5)	<8.0(-6)	<4.0(-5)	<1.2(-4)	<2.0(-5)
CS-134	4.13±.04(-4)	3.00±.10(-4)	3.70±.20(-4)	4.60±1.5(-4)	5.60±.20(-4)
CS-136	<3.0(-7)	<4.0(-5)	<2.0(-6)	<8.0(-5)	<2.0(-6)
CS-137	1.02±.01(-3)	6.70±.20(-4)	8.60±.60(-4)	1.01±.04(-3)	1.30±.05(-3)
NA-24	<1.0(-6)	<2.0(-6)	<4.0(-6)	<1.2(-5)	<4.0(-6)
CR-51	6.50±2.7(-6)	<2.0(-4)	<2.0(-5)	<1.0(-4)	<4.0(-5)
MN-54	3.20±.10(-6)	2.20±.10(-5)	1.00±.10(-5)	4.30±.30(-5)	1.14±.09(-5)
FE-59	4.70±2.1(-7)	6.00±1.9(-6)	2.00±1.1(-6)	7.90±3.9(-6)	4.50±1.3(-6)
CO-57	1.30±.60(-5)	<4.0(-5)	<8.0(-6)	<2.0(-5)	<6.0(-6)
CO-58	1.35±.06(-5)	3.90±.10(-4)	2.40±.10(-4)	6.80±.20(-4)	2.45±.05(-4)
CO-60	8.50±.20(-6)	3.90±.30(-5)	2.50±.20(-5)	9.80±.50(-5)	2.70±.20(-5)
ZN-65	<5.0(-7)	<6.0(-6)	<2.0(-6)	<8.0(-6)	1.40±1.0(-6)
ZR-95	<6.0(-7)	<6.0(-6)	2.20±1.2(-6)	<1.0(-5)	<4.0(-6)
NB-95	<3.0(-7)	4.70±1.4(-6)	7.00±1.1(-6)	1.60±.20(-5)	9.50±.90(-6)
MO-99	<3.0(-6)	<4.0(-5)	<4.0(-5)	<4.0(-5)	<1.6(-5)
RU-103	<8.0(-7)	<6.0(-6)	<2.0(-6)	<8.0(-6)	<4.0(-6)
RUD-106	7.20±2.6(-6)	<4.0(-5)	<2.0(-5)	<6.0(-5)	<2.0(-5)
AG-110M	<8.0(-7)	<6.0(-6)	<2.0(-6)	<1.4(-5)	<4.0(-6)
SB-124	<2.0(-7)	<2.0(-6)	<1.2(-6)	<4.0(-6)	<1.2(-6)
SB-125	6.30±.70(-6)	<1.4(-5)	<8.0(-6)	<4.0(-5)	9.80±5.1(-6)
BA-140	<3.0(-6)	<1.6(-5)	<2.0(-6)	<4.0(-5)	<1.2(-5)
LA-140	<4.0(-7)	3.80±1.1(-6)	6.40±1.1(-6)	<4.0(-6)	5.40±1.0(-6)
CE-141	<2.0(-6)	<8.0(-5)	<6.0(-5)	1.60±.30(-4)	1.50±.90(-5)
CE-144	<4.0(-6)	<1.6(-4)	<6.0(-5)	<2.0(-5)	<6.0(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.9 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM COOLANT RADWASTE SYSTEM PRIMARY DEMINERALIZER A

CRVS PRIMARY DEMIN A EFFLUENT

DATE	2/ 9	2/28
TIME	1354	908
NUCLIDE	MICROCURIES/MILLILITER	
I-131	1.20±1.1(-6)	1.30±.20(-5)
I-132	<1.2(-5)	<1.2(-5)
I-133	<8.0(-6)	<8.0(-6)
I-134	<2.0(-5)	<6.0(-5)
I-135	<2.0(-5)	1.10±.80(-5)
CS-134	6.60±.10(-4)	7.70±.10(-4)
CS-136	<1.8(-6)	<4.0(-6)
CS-137	1.51±.01(-3)	1.64±.04(-3)
NA-24	<2.0(-6)	<2.0(-6)
CR-51	1.60±.70(-5)	1.50±1.0(-5)
MN-54	3.34±.09(-5)	1.13±.06(-5)
FE-59	3.40±.70(-6)	<1.0(-6)
CO-57	1.80±.70(-6)	1.30±.70(-5)
CO-58	3.25±.05(-4)	1.69±.03(-4)
CO-60	6.50±.10(-5)	3.20±.10(-5)
ZN-65	<1.2(-6)	<1.0(-6)
ZR-95	8.40±1.2(-6)	2.00±.80(-6)
NB-95	1.20±.05(-5)	5.30±.60(-6)
MO-99	1.10±.80(-5)	<2.0(-5)
RU-103	<1.4(-6)	<2.0(-6)
RUD-106	<1.2(-5)	<1.4(-5)
AG-110M	<1.8(-6)	1.60±1.3(-6)
SB-124	1.60±.30(-6)	2.70±.40(-6)
SB-125	5.90±2.1(-6)	6.70±2.4(-6)
BA-140	<6.0(-6)	<8.0(-6)
LA-140	5.30±.90(-6)	1.10±.20(-5)
CE-141	<4.0(-6)	2.50±1.3(-5)
CE-144	1.30±.60(-5)	<4.0(-5)

TABLE B.9A

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM COOLANT RADWASTE SYSTEM PRIMARY DEMINERALIZER A - ALPHA AND BETA ANALYSIS RESULTS

DATE	1/18
TIME	1110

NUCLIDE	MICROCURIES/MILLILITER
H-3	2.2 ± 0.1(-1)
C-14	4.3 ± 0.4(-5)
P-32	1.6 ± 0.2(-6)
FE-55	6.5 ± 0.1(-5)
NI-63	1.32 ± 0.02(-5)
SR-89	2 ± 1(-8)
SR-90	<1(-8)
Y-91	4.1 ± 0.4(-7)
PU-238	1.0 ± 0.9(-10)
PU-239,240	3.2 ± 0.3(-9)
AM-241	7 ± 2(-10)
CM-242	2.6 ± 0.2(-9)
CM-244	6 ± 5(-11)

TABLE B.10

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM COOLANT RADWASTE SYSTEM PRIMARY DEMINERALIZER B

CRWS PRIMARY DEMIN B EFFLUENT

DATE	10/ 5	1/16	1/16	1/16	1/18
TIME	940	1019	1103	1134	1109
NUCLIDE	MICROCURIES/MILLILITER				
I-131	1.30±.20(-6)	2.40±.70(-6)	2.20±.40(-6)	2.00±.80(-6)	3.40±.50(-6)
I-132	<8.0(-6)	<6.0(-6)	NOTE 1	NOTE 1	NOTE 1
I-133	<3.0(-6)	1.80±.80(-6)	<4.0(-6)	<6.0(-6)	<4.0(-6)
I-134	<2.0(-5)	<1.6(-4)	NOTE 1	NOTE 1	NOTE 1
I-135	<2.0(-5)	<4.0(-6)	<1.2(-4)	<1.8(-4)	<2.0(-5)
CS-134	5.20±.20(-6)	2.70±.20(-5)	2.70±.05(-5)	2.90±.10(-5)	3.05±.04(-5)
CS-136	<4.0(-7)	<2.0(-7)	<8.0(-7)	<1.0(-6)	<4.0(-7)
CS-137	1.42±.03(-5)	7.90±.30(-5)	8.20±.20(-5)	8.50±.20(-5)	9.60±.20(-5)
NA-24	<3.0(-6)	<6.0(-7)	<4.0(-6)	<6.0(-6)	<4.0(-6)
CR-51	4.30±.90(-6)	3.40±.90(-5)	1.70±.20(-5)	1.70±.40(-5)	1.10±.20(-5)
MN-54	3.10±.10(-5)	1.70±.10(-5)	4.50±.20(-6)	7.30±.60(-6)	3.70±.10(-6)
FE-59	<7.0(-7)	5.00±.80(-6)	1.80±.20(-6)	1.30±.80(-6)	1.60±.20(-6)
CO-57	2.37±.04(-5)	<1.2(-5)	<4.0(-6)	<4.0(-6)	<6.0(-7)
CO-58	2.68±.04(-5)	3.50±.20(-4)	1.25±.02(-4)	1.79±.07(-4)	3.80±.20(-5)
CO-60	6.01±.07(-5)	3.70±.10(-5)	1.08±.03(-5)	1.60±.10(-5)	9.70±.20(-6)
ZN-65	8.00±3.0(-7)	<1.2(-6)	<4.0(-7)	7.70±5.6(-7)	1.80±.70(-6)
ZR-95	<4.0(-7)	6.10±2.3(-6)	1.60±.20(-6)	3.40±.70(-6)	1.10±.70(-6)
NB-95	7.00±1.3(-7)	9.40±.60(-6)	3.80±.20(-6)	4.40±.50(-6)	3.00±.20(-6)
MO-99	<3.0(-6)	<2.0(-6)	<4.0(-5)	<4.0(-5)	<1.4(-5)
RU-103	<3.0(-7)	<1.2(-6)	<4.0(-7)	<8.0(-6)	<4.0(-7)
RUD-106	<2.0(-6)	<1.2(-5)	<2.0(-6)	<8.0(-6)	<2.0(-6)
AG-110M	<9.0(-7)	<2.0(-6)	1.30±.20(-6)	<1.4(-6)	1.10±.30(-6)
SB-124	<1.0(-7)	<6.0(-7)	2.60±.90(-7)	<6.0(-7)	<1.6(-7)
SB-125	7.70±.40(-6)	3.90±1.8(-6)	5.00±.50(-6)	4.00±1.4(-6)	8.10±.40(-6)
BA-140	<1.0(-6)	<4.0(-6)	<2.0(-6)	<4.0(-6)	<2.0(-6)
LA-140	<4.0(-7)	4.70±.70(-6)	3.50±.70(-6)	5.00±1.0(-6)	2.20±.70(-6)
CE-141	<1.0(-6)	<4.0(-5)	<4.0(-5)	<2.0(-5)	<4.0(-6)
CE-144	<4.0(-6)	<4.0(-5)	<4.0(-6)	<4.0(-5)	<4.0(-6)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.10 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM COOLANT RADWASTE SYSTEM PRIMARY DEMINERALIZER B

CRWS PRIMARY DEMIN B EFFLUENT

DATE	2/ 9	2/26
TIME	1400	904
NUCLIDE	MICROCURIES/MILLILITER	
I-131	1.40±.40(-6)	6.90±1.1(-6)
I-132	<8.0(-6)	2.80±1.7(-5)
I-133	<4.0(-6)	<6.0(-6)
I-134	<4.0(-5)	<8.0(-4)
I-135	<2.0(-5)	<2.0(-5)
CS-134	8.90±.20(-5)	5.60±.10(-5)
CS-136	<8.0(-7)	<6.0(-6)
CS-137	2.50±.03(-4)	1.74±.04(-4)
NA-24	<2.0(-6)	<2.0(-6)
CR-51	1.40±.40(-5)	3.40±.50(-5)
MN-54	3.17±.08(-5)	1.20±.03(-4)
FE-59	4.00±.50(-6)	7.40±.40(-6)
CO-57	2.70±1.4(-5)	<8.0(-6)
CO-58	2.51±.05(-4)	7.40±.07(-4)
CO-60	7.30±.10(-5)	3.10±.07(-4)
ZN-65	<1.0(-6)	<2.0(-6)
ZR-95	3.60±.50(-6)	1.00±.10(-5)
NB-95	8.20±.50(-6)	2.20±.10(-5)
MO-99	<6.0(-6)	<1.4(-5)
RU-103	9.50±6.5(-7)	1.70±.90(-6)
RUD-106	<6.0(-6)	<1.2(-5)
AG-110M	<1.6(-6)	<4.0(-6)
SB-124	3.90±2.0(-7)	4.90±2.3(-7)
SB-125	1.03±.09(-5)	6.60±1.6(-6)
BA-140	<4.0(-6)	<6.0(-6)
LA-140	4.90±.70(-6)	9.40±1.9(-6)
CE-141	<4.0(-6)	5.60±3.0(-5)
CE-144	<1.2(-5)	<2.0(-5)

TABLE B.11

RADIONUCLIDE CONCENTRATIONS IN FEED TO COOLANT RADWASTE SYSTEM SECONDARY DEMINERALIZER A

CRWS SECONDARY DEMIN A FEED

DATE	10/10	1/24	1/24	2/ 9	2/28
TIME	1539	1059	1157	1410	1018
NUCLIDE	MICROCURIE/MILLILITER				
I-131	<1.0(-6)	1.40±.10(-5)	1.30±.10(-5)	2.00±.30(-6)	7.90±.30(-6)
I-132	<8.0(-7)	NOTE 1	NOTE 1	<6.0(-6)	<1.2(-5)
I-133	<5.0(-7)	4.60±3.6(-6)	2.20±2.0(-6)	1.20±.50(-5)	2.50±1.3(-6)
I-134	<4.0(-6)	NOTE 1	NOTE 1	<2.0(-5)	<2.0(-4)
I-135	<1.0(-6)	<6.0(-5)	<1.8(-5)	<1.2(-5)	<6.0(-6)
CS-134	7.50±.40(-6)	7.00±.20(-5)	6.30±.20(-5)	7.80±.07(-5)	7.95±.06(-5)
CS-136	<7.0(-7)	<4.0(-6)	<1.2(-6)	<6.0(-7)	<2.0(-6)
CS-137	1.95±.06(-5)	2.04±.05(-4)	1.82±.04(-4)	2.35±.02(-4)	2.53±.02(-4)
NA-24	<2.0(-6)	<2.0(-6)	<2.0(-6)	<2.0(-6)	<1.4(-6)
CR-51	6.00±2.1(-6)	8.90±.90(-5)	6.30±.70(-5)	1.70±.30(-5)	1.60±1.4(-5)
MN-54	5.80±.30(-6)	9.10±.30(-5)	3.60±.10(-5)	1.10±.03(-5)	3.15±.03(-5)
FE-59	<1.0(-6)	2.30±.20(-5)	9.30±1.1(-6)	2.60±.40(-6)	4.10±.20(-6)
CO-57	<3.0(-6)	4.50±1.5(-6)	3.50±1.1(-6)	<6.0(-7)	1.40±.10(-6)
CO-58	2.08±.08(-5)	1.51±.03(-3)	7.50±.10(-4)	2.60±.02(-4)	3.70±.02(-4)
CO-60	7.90±.40(-6)	1.54±.03(-4)	6.90±.20(-5)	2.97±.05(-5)	6.06±.06(-5)
ZN-65	<1.0(-6)	<2.0(-6)	<4.0(-5)	<4.0(-7)	<4.0(-7)
ZR-95	<1.0(-6)	1.80±.20(-5)	9.40±1.3(-6)	3.90±.40(-6)	5.00±.20(-6)
NB-95	5.50±4.3(-7)	4.00±.20(-5)	1.90±.10(-5)	6.20±.30(-6)	1.05±.03(-5)
MO-99	<3.0(-6)	<6.0(-6)	<4.0(-6)	<4.0(-6)	<8.0(-7)
RU-103	<1.0(-6)	1.90±1.3(-6)	1.80±1.0(-6)	6.30±2.4(-7)	<4.0(-7)
RUD-106	<1.0(-6)	<2.0(-5)	<2.0(-5)	<4.0(-6)	<2.0(-6)
AG-110M	<6.0(-6)	1.50±1.2(-6)	1.80±1.6(-6)	7.90±4.0(-7)	1.10±.40(-6)
SB-124	<1.0(-6)	<8.0(-7)	7.30±5.4(-7)	3.30±1.2(-7)	3.60±.70(-7)
SB-125	8.90±.70(-6)	1.20±.40(-5)	8.70±2.4(-6)	1.00±.10(-5)	1.10±.05(-5)
BA-140	<1.0(-6)	<1.0(-5)	<8.0(-6)	<2.0(-6)	<2.0(-6)
LA-140	<1.0(-6)	4.80±.80(-6)	6.00±.70(-6)	2.50±.40(-6)	1.22±.09(-5)
CE-141	<3.0(-6)	7.70±4.2(-6)	3.90±3.2(-6)	1.80±.90(-6)	5.00±3.9(-6)
CE-144	<3.0(-6)	<4.0(-5)	<1.8(-5)	5.30±3.9(-5)	<2.0(-6)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.12

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM COOLANT RADWASTE SYSTEM SECONDARY DEMINERALIZER A

CRWS SECONDARY DEMIN A EFFLUENT

DATE	10/10	1/24	1/24	2/ 9	2/28
TIME	1532	1105	1203	1416	1023
NUCLIDE	MICROCURIE/MILLILITER				
I-131	2.70±.30(-7)	9.10±.30(-6)	8.50±.30(-6)	7.20±2.7(-7)	5.90±.40(-6)
I-132	<1.0(-5)	<8.0(-6)	NOTE 1	<6.0(-4)	<1.0(-5)
I-133	4.30±.40(-7)	1.00±.60(-6)	<6.0(-5)	<4.0(-6)	9.60±8.3(-7)
I-134	NOTE 1	<8.0(-4)	NOTE 1	NOTE 1	<4.0(-4)
I-135	<5.0(-7)	<2.0(-6)	NOTE 1	<1.4(-5)	<4.0(-6)
CS-134	2.80±.40(-7)	2.10±.20(-6)	1.32±.20(-6)	2.40±.30(-6)	2.90±.30(-6)
CS-136	<2.0(-7)	<4.0(-7)	<8.0(-7)	<4.0(-7)	<1.4(-6)
CS-137	1.20±.20(-7)	5.90±.30(-6)	5.50±.30(-6)	8.30±.30(-6)	1.10±.04(-5)
NA-24	<1.0(-7)	<1.4(-7)	NOTE 1	<1.4(-6)	<1.2(-6)
CR-51	1.50±.30(-6)	4.10±.20(-5)	2.90±.20(-5)	1.50±.20(-5)	1.20±.50(-6)
MN-54	3.50±.10(-6)	2.29±.04(-5)	9.40±.30(-6)	1.70±.01(-4)	1.29±.04(-5)
FE-59	<2.0(-7)	5.20±.30(-6)	3.10±.30(-6)	1.20±.30(-6)	9.80±4.3(-7)
CO-57	3.30±.70(-7)	7.30±3.3(-7)	5.90±2.2(-7)	<6.0(-7)	<8.0(-7)
CO-58	9.10±.20(-6)	9.90±.20(-4)	2.96±.07(-4)	1.73±.01(-4)	2.55±.02(-4)
CO-60	1.08±.02(-5)	6.74±.07(-5)	3.16±.04(-5)	2.11±.06(-5)	4.02±.08(-5)
ZN-65	<1.0(-7)	7.40±3.7(-7)	<4.0(-7)	<6.0(-7)	<8.0(-7)
ZR-95	<2.0(-7)	7.50±.30(-6)	3.30±.30(-6)	1.60±.30(-6)	2.50±.40(-6)
NB-95	3.20±.60(-7)	1.31±.03(-5)	6.20±.20(-6)	3.70±.30(-6)	6.10±.40(-6)
MO-99	<8.0(-7)	<8.0(-6)	<4.0(-6)	<2.0(-6)	<2.0(-6)
RU-103	<1.0(-7)	1.10±.20(-6)	5.90±2.0(-7)	4.70±2.6(-7)	8.80±4.3(-7)
RU-106	<1.0(-7)	<4.0(-6)	<4.0(-6)	<6.0(-6)	<6.0(-6)
AG-110M	2.10±.40(-7)	3.00±.40(-6)	2.70±.40(-6)	1.50±.50(-6)	1.92±.06(-6)
SB-124	<6.0(-8)	6.60±1.1(-7)	7.50±1.2(-7)	6.30±2.1(-7)	9.20±6.7(-7)
SB-125	<1.0(-7)	7.30±.60(-6)	6.50±.50(-6)	9.10±.70(-6)	9.50±.80(-6)
BA-140	<1.0(-7)	<2.0(-6)	<2.0(-6)	<2.0(-6)	<4.0(-6)
LA-140	1.60±.30(-7)	5.00±.30(-6)	4.60±.90(-6)	4.00±.60(-6)	1.30±.10(-5)
CE-141	<5.0(-7)	<4.0(-6)	<2.0(-6)	<1.4(-6)	<2.0(-6)
CE-144	<4.0(-7)	<6.0(-6)	<4.0(-6)	<6.0(-6)	<6.0(-6)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.13

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM COOLANT RADWASTE SYSTEM SECONDARY DEMINERALIZER B

CRWS SECONDARY DEMIN B EFFLUENT

DATE	10/10	1/24	1/24	2/ 9	2/28
TIME	1535	1104	1202	1420	1025
NUCLIDE	MICROCURIE/MILLILITER				
I-131	2.30±.40(-7)	8.00±.20(-6)	6.70±.20(-6)	1.10±.20(-6)	5.60±.20(-6)
I-132	<4.0(-7)	<1.0(-5)	<4.0(-5)	<6.0(-4)	<4.0(-6)
I-133	3.80±.40(-7)	<6.0(-7)	7.00±4.0(-5)	<2.0(-6)	<1.6(-6)
I-134	<1.0(-6)	NOTE 1	NOTE 1	NOTE 1	<2.0(-5)
I-135	<2.0(-7)	<2.0(-6)	<2.0(-6)	<2.0(-5)	<4.0(-6)
CS-134	1.70±.60(-7)	<4.0(-7)	<2.0(-7)	2.70±1.4(-7)	<1.6(-7)
CS-136	<2.0(-7)	<6.0(-7)	<6.0(-7)	<4.0(-7)	<1.4(-6)
CS-137	<2.0(-7)	<8.0(-7)	<6.0(-7)	2.20±1.5(-7)	<1.4(-6)
NA-24	<1.0(-7)	<1.2(-7)	<1.4(-7)	<1.6(-6)	<1.2(-6)
CR-51	1.60±.30(-6)	2.90±.10(-5)	2.68±.09(-5)	7.30±1.2(-6)	6.90±.80(-6)
MN-54	3.55±.06(-6)	1.05±.02(-5)	1.30±.02(-5)	4.20±.20(-6)	5.00±.10(-6)
FE-59	<2.0(-7)	2.50±.20(-6)	3.40±.20(-6)	7.80±1.4(-7)	5.70±1.3(-7)
CO-57	<6.0(-7)	<6.0(-7)	5.40±1.6(-7)	<4.0(-7)	<6.0(-7)
CO-58	8.60±.30(-6)	3.15±.07(-4)	3.18±.06(-4)	1.54±.01(-4)	1.52±.02(-4)
CO-60	8.40±.20(-6)	3.91±.03(-5)	4.37±.04(-5)	1.85±.04(-5)	2.00±.05(-5)
ZN-65	<2.0(-7)	<4.0(-7)	<4.0(-7)	<4.0(-7)	3.00±1.5(-7)
ZR-95	<1.0(-7)	3.10±.20(-6)	3.20±.20(-6)	9.20±2.9(-7)	1.40±.20(-6)
NB-95	2.10±.60(-7)	6.30±.20(-6)	6.30±.10(-6)	2.50±.20(-6)	3.30±.10(-6)
MO-99	<7.0(-7)	<6.0(-6)	<4.0(-6)	<1.2(-6)	<2.0(-6)
RU-103	<2.0(-7)	5.60±1.3(-7)	9.70±1.3(-7)	1.40±1.4(-7)	3.30±1.4(-7)
RUD-106	<2.0(-7)	<2.0(-6)	<2.0(-6)	<4.0(-6)	1.80±.80(-6)
AG-110M	NOTE 1	2.80±.30(-6)	1.40±.30(-6)	1.60±.40(-6)	7.00±.20(-6)
SB-124	<1.0(-7)	1.40±.50(-7)	2.40±.60(-7)	<1.2(-7)	8.90±4.1(-8)
SB-125	<2.0(-7)	8.70±5.3(-7)	6.80±5.0(-7)	<8.0(-7)	<4.0(-7)
BA-140	<2.0(-7)	<1.6(-6)	<1.6(-6)	<1.2(-6)	<6.0(-6)
LA-140	<2.0(-7)	4.40±.20(-6)	5.30±.30(-6)	4.00±.40(-6)	1.25±.07(-5)
CE-141	<1.0(-7)	<4.0(-6)	<2.0(-6)	<8.0(-7)	<4.0(-6)
CE-144	NOTE 1	NOTE 1	NOTE 1	<4.0(-6)	<2.0(-6)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.14

RADIONUCLIDE CONCENTRATIONS IN FEED TO BORIC ACID EVAPORATOR

BORIC ACID EVAPORATOR FEED

DATE	9/13	10/ 5	10/17	10/18	11/ 2
TIME	1355	1146	1051	1119	1048
NUCLIDE	MICROCURIE/MILLILITER				
I-131	2.30±.20(-7)	2.60±.30(-7)	2.50±.20(-7)	<1.6(-7)	<1.2(-6)
CS-134	<1.0(-7)	<1.2(-7)	9.30±2.0(-9)	<8.4(-8)	<1.4(-6)
CS-137	<1.6(-7)	1.80±1.1(-7)	<4.6(-8)	<1.3(-7)	<1.5(-6)
CR-51	1.20±.30(-6)	6.70±.40(-6)	9.80±.60(-6)	9.70±.40(-6)	1.20±.10(-4)
MN-54	5.00±.30(-6)	5.20±.10(-6)	1.90±.10(-6)	2.76±.06(-6)	1.17±.08(-5)
FE-59	2.20±1.0(-7)	<2.1(-7)	2.60±1.6(-7)	<2.6(-7)	3.60±1.0(-6)
CO-57	2.90±.30(-7)	2.70±.40(-7)	1.49±.03(-7)	1.60±.20(-7)	<1.9(-6)
CO-58	1.05±.04(-5)	2.12±.04(-5)	2.32±.03(-5)	2.37±.02(-5)	5.61±.05(-4)
CO-60	2.02±.09(-5)	2.42±.02(-5)	8.60±.20(-6)	1.01±.02(-5)	3.80±.16(-5)
ZN-65	<2.0(-7)	<2.1(-7)	5.10±1.8(-8)	<1.4(-7)	<2.6(-6)
ZR-95	<1.5(-7)	<1.6(-7)	1.30±.20(-7)	<1.4(-7)	2.30±1.0(-6)
NB-95	<1.2(-7)	2.50±.30(-7)	7.70±1.5(-7)	3.90±.50(-7)	4.00±3.0(-6)
MO-99	1.30±.20(-7)	<6.6(-8)	4.13±.09(-7)	<9.8(-7)	<1.2(-6)
RU-103	9.70±3.9(-8)	1.70±1.6(-7)	2.12±.07(-7)	1.70±.40(-7)	<1.8(-6)
AG-110M	5.70±.10(-7)	8.00±.40(-7)	4.09±.09(-7)	4.30±1.2(-7)	<2.6(-6)
SB-124	<4.8(-8)	6.60±3.2(-8)	<1.2(-8)	<5.4(-8)	<9.4(-7)
SB-125	<1.8(-7)	2.40±1.1(-7)	<4.1(-8)	<1.9(-7)	<3.7(-6)
BA-140	<3.0(-7)	<3.5(-7)	<1.0(-8)	<2.7(-7)	<6.0(-6)
LA-140	9.30±3.5(-8)	<5.1(-8)	3.30±.40(-8)	<2.1(-7)	<4.5(-7)
CE-141	<8.9(-8)	<9.5(-8)	6.00±.50(-8)	<1.5(-7)	<2.2(-6)
CE-144	<3.3(-7)	<4.0(-7)	<2.6(-8)	<4.1(-7)	<1.1(-5)
NP-239	<1.6(-7)	<2.6(-7)	<1.2(-7)	<1.1(-6)	<4.9(-6)

TABLE B.14 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN FEED TO BORIC ACID EVAPORATOR

BORIC ACID EVAPORATOR FEED

DATE	11/ 2	1/16	1/17	2/ 6	2/ 6
TIME	1529	1715	1000	1431	2242
NUCLIDE	MICROCURIE/MILLILITER				
I-131	1.90±.90(-7)	3.00±.70(-6)	<5.2(-6)	1.50±.20(-6)	1.60±.30(-6)
CS-134	1.17±.80(-7)	<2.4(-6)	<6.6(-6)	<3.9(-7)	<6.9(-7)
CS-137	<7.1(-7)	<2.3(-5)	<1.9(-5)	<1.0(-6)	<1.2(-6)
CR-51	1.01±.01(-4)	5.80±.20(-4)	4.30±.30(-4)	5.40±.20(-5)	4.60±.20(-5)
MN-54	8.14±.08(-6)	1.07±.02(-4)	7.70±.20(-5)	2.08±.05(-5)	1.63±.04(-5)
FE-59	2.90±.30(-6)	5.00±.30(-5)	2.70±.30(-5)	4.60±.30(-6)	2.70±.30(-6)
CO-57	1.08±.05(-6)	3.00±.20(-5)	3.60±.50(-5)	2.70±.20(-6)	2.20±.20(-6)
CO-58	4.78±.02(-4)	5.00±.10(-3)	3.33±.06(-3)	7.27±.04(-4)	6.15±.06(-4)
CO-60	3.30±.02(-5)	4.43±.08(-4)	2.96±.07(-4)	8.22±.08(-5)	7.00±.10(-5)
ZN-65	<2.2(-7)	1.80±1.1(-6)	5.20±3.3(-6)	3.50±2.6(-7)	<6.1(-7)
ZR-95	1.88±.12(-6)	3.36±.09(-5)	2.70±.40(-5)	5.70±.50(-6)	5.20±.50(-6)
NB-95	4.89±.15(-6)	7.70±.20(-5)	5.30±.20(-5)	1.12±.03(-5)	1.01±.04(-5)
MO-99	3.80±1.3(-7)	<1.4(-6)	<3.2(-6)	<1.8(-7)	<3.3(-7)
RU-103	1.58±.12(-6)	4.00±.30(-5)	6.60±4.0(-6)	8.50±2.0(-7)	1.20±.30(-6)
AG-110M	2.41±.09(-6)	5.40±.20(-5)	3.20±.30(-5)	3.70±.20(-6)	3.10±.30(-6)
SB-124	2.80±.80(-7)	2.80±.30(-6)	1.30±.80(-6)	2.60±1.1(-7)	3.10±1.1(-7)
SB-125	<3.9(-7)	5.00±2.0(-6)	1.00±.80(-5)	<1.2(-6)	<1.2(-6)
BA-140	<7.9(-7)	<7.0(-6)	<2.6(-5)	<1.5(-6)	<2.0(-6)
LA-140	<2.0(-7)	1.30±.10(-6)	2.00±.60(-6)	7.00±.90(-7)	2.80±1.2(-7)
CE-141	2.40±.80(-7)	3.90±1.2(-6)	<5.6(-6)	<4.6(-7)	<4.5(-7)
CE-144	<6.3(-7)	1.90±.50(-5)	<3.2(-5)	<2.0(-6)	2.70±1.0(-6)
NP-239	<1.0(-6)	<4.4(-6)	<1.2(-5)	<7.4(-7)	1.70±.70(-6)

TABLE B.14 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN FEED TO BORIC ACID EVAPORATOR

BORIC ACID EVAPORATOR FEED

DATE 2/ 7
TIME 957

NUCLIDE	MICROCURIE/MILLILITER
I-131	1.00±.40(-6)
CS-134	<7.4(-7)
CS-137	<1.7(-6)
CR-51	9.00±.30(-5)
MN-54	5.81±.06(-5)
FE-59	6.30±.90(-6)
CO-57	6.20±.50(-6)
CO-58	1.38±.01(-3)
CO-60	1.75±.02(-4)
ZN-65	<1.4(-6)
ZR-95	1.47±.09(-5)
NB-95	2.91±.05(-5)
MO-99	<6.3(-7)
RU-103	1.10±.50(-6)
AG-110M	4.60±.60(-6)
SB-124	7.00±2.0(-7)
SB-125	<1.8(-6)
BA-140	<3.2(-6)
LA-140	2.30±1.6(-7)
CE-141	6.40±3.8(-7)
CE-144	4.20±2.2(-6)
NP-239	<2.3(-6)

TABLE B.14A

RADIONUCLIDE CONCENTRATIONS IN FEED TO BORIC ACID EVAPORATOR - BETA ANALYSIS RESULTS

DATE	10/17
TIME	1051

NUCLIDE	MICROCURIES/MILLILITER
H-3	2.3 ± 0.1(-1)
C-14	3.0 ± 0.3(-5)
P-32	<3(-7)
FE-55	2.46 ± 0.05(-5)
NI-63	5.65 ± 0.08(-6)
SR-89	3.46 ± 0.08(-6)
SR-90	3 ± 2(-8)
Y-91	2.4 ± 0.6(-8)

TABLE B.15

RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR BOTTOMS

BORIC ACID EVAPORATOR BOTTOMS

DATE	9/13	9/13	9/14	10/ 5	10/17
TIME	1124	1545	1000	1346	1020
NUCLIDE	MICROCURIE/MILLILITER				
I-131	1.10±.70(-6)	1.53±.07(-6)	5.20±.10(-6)	5.30±.20(-6)	1.23±.04(-5)
CS-134	1.30±.30(-6)	2.40±.10(-6)	9.20±.20(-6)	<6.6(-7)	2.43±.04(-5)
CS-137	2.10±.20(-6)	3.10±.10(-6)	1.34±.02(-5)	<6.5(-6)	3.22±.07(-5)
CR-51	2.30±1.1(-6)	8.00±.50(-6)	2.61±.08(-5)	1.10±.02(-4)	2.81±.03(-4)
MN-54	4.59±.05(-5)	4.67±.04(-5)	6.25±.07(-5)	1.92±.03(-4)	2.92±.03(-4)
FE-59	<9.8(-7)	2.00±1.4(-6)	3.80±.30(-6)	7.90±.70(-6)	1.08±.08(-5)
CO-57	1.90±.10(-6)	2.07±.04(-6)	3.62±.06(-6)	6.70±.30(-6)	1.48±.03(-5)
CO-58	7.06±.06(-5)	9.42±.04(-5)	1.83±.01(-4)	5.19±.04(-4)	1.18±.01(-3)
CO-60	1.67±.02(-4)	2.03±.02(-4)	2.95±.03(-4)	8.60±.20(-4)	1.39±.01(-3)
ZN-65	<9.3(-7)	6.00±2.5(-7)	<7.0(-7)	4.00±.70(-6)	7.10±1.0(-6)
ZR-95	<9.4(-7)	4.60±1.2(-7)	1.40±1.0(-6)	3.00±.60(-6)	6.00±.60(-6)
NB-95	<6.9(-7)	9.70±4.1(-7)	<2.1(-6)	1.01±.08(-5)	2.10±.20(-5)
MO-99	4.90±4.3(-7)	1.03±.04(-6)	2.50±.20(-6)	5.70±3.2(-7)	5.50±.20(-6)
RU-103	<3.3(-7)	3.90±1.0(-7)	1.00±.10(-6)	2.00±.30(-6)	5.60±.30(-6)
AG-110M	4.10±.50(-6)	6.00±.20(-6)	1.67±.04(-5)	1.96±.04(-5)	3.15±.08(-5)
SB-124	<4.8(-7)	1.70±.50(-7)	4.50±.70(-7)	<3.3(-7)	2.00±.20(-6)
SB-125	<1.0(-6)	7.40±1.9(-7)	2.40±.30(-6)	4.10±.70(-6)	7.20±.80(-6)
BA-140	<1.5(-6)	8.70±3.0(-7)	9.50±3.9(-7)	<2.3(-6)	<1.5(-6)
LA-140	<2.1(-7)	8.50±.60(-7)	2.39±.08(-6)	4.70±.50(-7)	1.10±.10(-6)
CE-141	<2.9(-7)	3.20±.70(-7)	5.30±1.9(-7)	1.60±.30(-6)	1.90±.20(-6)
CE-144	<1.9(-6)	<9.4(-7)	2.10±1.9(-6)	<4.4(-6)	<1.9(-6)
NP-239	<6.1(-7)	6.60±2.2(-7)	1.50±.70(-6)	<1.3(-6)	<9.4(-7)

TABLE B.15 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR BOTTOMS

BORIC ACID EVAPORATOR BOTTOMS

DATE	10/18	11/ 2	11/ 2	1/16	1/17
TIME	1102	1043	1534	1655	950
NUCLIDE	MICROCURIE/MILLILITER				
I-131	1.48±.05(-5)	<9.2(-6)	7.10±2.4(-6)	1.40±.80(-5)	7.20±3.6(-6)
CS-134	2.54±.05(-5)	<1.3(-5)	8.05±7.1(-6)	<2.3(-5)	3.70±3.3(-6)
CS-137	3.29±.05(-5)	<2.3(-5)	<2.6(-5)	<5.4(-5)	<3.8(-5)
CR-51	4.52±.04(-4)	2.51±.06(-3)	2.54±.02(-3)	1.40±.10(-3)	1.02±.05(-3)
MN-54	2.15±.01(-4)	2.19±.07(-4)	1.82±.01(-4)	2.98±.07(-4)	2.07±.04(-4)
FE-59	1.52±.09(-5)	6.40±.80(-5)	5.70±.20(-5)	1.20±.50(-4)	8.60±.50(-5)
CO-57	1.16±.02(-5)	2.99±.26(-5)	2.03±.12(-5)	7.90±.80(-5)	2.80±.10(-5)
CO-58	1.52±.02(-3)	1.06±.01(-2)	1.07±.01(-2)	1.12±.01(-2)	9.60±.10(-3)
CO-60	1.22±.02(-3)	9.40±.20(-4)	8.60±.10(-4)	1.14±.02(-3)	7.90±.10(-4)
ZN-65	4.40±1.7(-5)	<1.4(-5)	<2.1(-6)	2.00±1.1(-5)	<8.1(-6)
ZR-95	8.70±.80(-6)	3.50±1.1(-5)	4.20±.20(-5)	9.90±.90(-5)	7.50±.70(-5)
NB-95	2.50±.20(-5)	1.06±.10(-4)	1.07±.02(-4)	1.83±.07(-4)	1.67±.07(-4)
MO-99	1.24±.08(-5)	5.20±2.5(-6)	<6.2(-6)	<1.0(-5)	2.00±1.6(-6)
RU-103	9.40±.50(-6)	3.70±.60(-5)	4.77±.16(-5)	3.70±1.4(-5)	2.60±.40(-5)
AG-110M	3.95±.06(-5)	5.90±.60(-5)	5.90±.10(-5)	1.09±.08(-4)	1.05±.06(-4)
SB-124	2.20±.30(-6)	<4.9(-6)	6.50±.60(-6)	<5.1(-6)	5.40±1.5(-6)
SB-125	8.80±1.2(-6)	<2.9(-5)	<7.1(-6)	<5.6(-5)	8.00±6.8(-6)
BA-140	<3.2(-6)	<6.1(-5)	<1.4(-5)	<7.8(-5)	<2.8(-5)
LA-140	1.20±.20(-6)	<2.3(-6)	5.40±1.5(-6)	<3.6(-6)	7.30±1.7(-6)
CE-141	3.10±.60(-6)	1.90±.40(-5)	1.30±.30(-5)	<1.6(-5)	1.50±.40(-5)
CE-144	<1.8(-6)	<4.6(-5)	2.57±.58(-5)	6.30±4.1(-5)	2.90±1.0(-5)
NP-239	7.50±3.4(-6)	3.00±.90(-5)	<2.1(-5)	<3.4(-5)	<1.3(-5)

TABLE B.15 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR BOTTOMS

BORIC ACID EVAPORATOR BOTTOMS

DATE	2/ 6	2/ 6	2/ 6	2/ 6	2/ 7
TIME	940	1422	1603	2233	946
NUCLIDE	MICROCURIE/MILLILITER				
I-131	2.04±.09(-5)	3.40±.40(-5)	2.10±.20(-5)	2.20±.10(-5)	1.60±.30(-5)
CS-134	1.46±.09(-5)	2.30±.30(-5)	1.30±.20(-5)	8.70±2.8(-6)	1.70±1.4(-6)
CS-137	2.40±.09(-5)	1.30±.50(-5)	2.60±.20(-5)	9.50±5.3(-6)	6.20±3.6(-6)
CR-51	5.55±.07(-4)	8.20±.30(-4)	7.60±.10(-4)	6.10±.10(-4)	5.39±.09(-4)
MN-54	2.43±.02(-4)	4.00±.10(-4)	3.83±.04(-4)	2.84±.03(-4)	2.30±.03(-4)
FE-59	5.90±.20(-5)	1.00±.05(-4)	8.30±.30(-5)	6.20±.20(-5)	4.90±.20(-5)
CO-57	2.93±.08(-5)	4.20±.20(-5)	4.30±.20(-5)	3.50±.20(-5)	3.00±.20(-5)
CO-58	7.90±.03(-3)	1.17±.01(-2)	1.12±.01(-2)	9.42±.08(-3)	8.28±.06(-3)
CO-60	9.80±.07(-4)	1.53±.02(-3)	1.43±.03(-3)	1.12±.02(-3)	9.30±.20(-4)
ZN-65	4.60±1.2(-6)	9.10±5.0(-6)	6.50±2.4(-6)	<4.4(-6)	2.40±1.6(-6)
ZR-95	6.70±.20(-5)	9.70±.80(-5)	9.50±.40(-5)	7.70±.30(-5)	7.60±.20(-5)
NB-95	1.30±.02(-4)	1.97±.06(-4)	1.88±.08(-4)	1.55±.05(-4)	1.45±.02(-4)
MO-99	8.10±6.3(-7)	<4.4(-6)	<1.5(-6)	<1.3(-6)	6.10±5.9(-7)
RU-103	1.50±.10(-5)	2.30±.50(-5)	1.60±.20(-5)	1.30±.10(-5)	1.50±.10(-5)
AG-110M	5.94±.09(-5)	8.30±.50(-5)	7.50±.20(-5)	6.50±.20(-5)	5.40±.20(-5)
SB-124	7.00±.70(-6)	6.80±1.5(-6)	7.30±.70(-6)	5.90±.60(-6)	4.00±.50(-6)
SB-125	6.50±2.7(-6)	<1.8(-5)	1.40±.40(-5)	<6.8(-6)	<9.1(-6)
BA-140	<9.6(-6)	1.70±1.5(-5)	<1.4(-5)	<2.0(-5)	<1.0(-5)
LA-140	5.20±.40(-6)	6.10±1.1(-6)	4.40±.50(-6)	6.40±.50(-6)	6.00±.70(-6)
CE-141	5.40±1.4(-6)	<1.2(-5)	4.10±2.3(-6)	3.60±2.6(-6)	4.60±1.0(-6)
CE-144	3.60±.50(-5)	<4.8(-5)	2.50±1.4(-5)	4.70±1.1(-5)	3.90±.80(-5)
NP-239	<3.9(-6)	<2.2(-5)	<5.8(-6)	5.20±2.7(-6)	<5.4(-6)

TABLE B.15A

RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR BOTTOMS - BETA ANALYSIS RESULTS

DATE	10/17
TIME	1020

NUCLIDE	MICROCURIES/MILLILITER
H-3	2.4 ± 0.1(-1)
C-14	1.4 ± 0.1(-4)
P-32	1.9 ± 0.3(-6)
FE-55	3.89 ± 0.03(-3)
NI-63	9.49 ± 0.03(-4)
SR-89	3.0 ± 0.4(-7)
SR-90	1.4 ± 0.1(-7)
Y-91	2.00 ± 0.05(-6)

TABLE B.16

RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR DISTILLATE

BORIC ACID EVAPORATOR DISTILLATE

DATE	9/13	9/13	9/13	9/14	10/ 5
TIME	1119	1349	1540	955	1347
NUCLIDE	MICROCURIE/MILLILITER				
I-131	<3.2(-8)	<3.5(-8)	<3.0(-8)	<5.9(-8)	<2.3(-8)
CS-134	<4.4(-8)	<4.6(-8)	<4.2(-8)	<1.8(-7)	<4.6(-8)
CS-137	<7.5(-8)	<6.8(-8)	<6.8(-8)	<1.3(-7)	<5.4(-8)
CR-51	<2.4(-7)	<2.5(-7)	<2.5(-7)	<5.5(-7)	<1.6(-7)
MN-54	<5.6(-8)	<4.4(-8)	<4.4(-8)	<7.3(-8)	3.50±1.7(-8)
FE-59	<4.7(-8)	<6.4(-8)	<5.3(-8)	<1.2(-7)	<3.5(-8)
CO-57	<3.0(-8)	<2.7(-8)	<2.9(-8)	<5.6(-8)	<2.0(-8)
CO-58	<4.3(-8)	5.00±1.9(-8)	<3.6(-8)	<1.4(-7)	4.70±1.5(-8)
CO-60	<1.2(-7)	1.20±.60(-7)	<1.3(-7)	<1.2(-7)	1.30±.40(-7)
ZN-65	<8.2(-8)	<1.0(-7)	<6.7(-8)	<1.5(-7)	<4.0(-8)
ZR-95	<5.6(-8)	<8.0(-8)	<4.8(-8)	<1.1(-7)	<3.1(-8)
NB-95	<3.5(-8)	<3.9(-8)	<4.4(-8)	<6.6(-8)	<1.8(-8)
MO-99	<3.8(-8)	<3.0(-8)	<2.5(-8)	<4.8(-8)	<2.4(-8)
RU-103	<4.4(-8)	<3.6(-8)	<3.3(-8)	<5.8(-8)	<2.1(-8)
AG-110M	<4.3(-8)	6.90±2.4(-8)	<4.5(-8)	1.20±.50(-7)	<2.5(-8)
SB-124	<5.1(-8)	<5.9(-8)	<6.4(-8)	<1.1(-7)	<2.9(-8)
SB-125	<6.9(-8)	<9.8(-8)	<9.1(-8)	<1.6(-7)	<5.2(-8)
BA-140	1.20±.50(-7)	<1.0(-7)	<1.1(-7)	<2.2(-7)	<7.4(-8)
LA-140	<5.8(-8)	<5.5(-8)	<4.7(-8)	<5.4(-8)	<2.0(-8)
CE-141	<4.5(-8)	<4.8(-8)	<4.6(-8)	<9.1(-8)	<3.8(-8)
CE-144	<2.1(-7)	<2.1(-7)	<2.2(-7)	<6.1(-7)	<1.7(-7)
NP-239	<1.4(-7)	<1.7(-7)	<1.1(-7)	<2.5(-7)	1.30±.60(-7)

TABLE B.16 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR DISTILLATE

BORIC ACID EVAPORATOR DISTILLATE

DATE	10/17	10/18	11/ 2	11/ 2	1/16
TIME	1029	1057	1045	1537	1700
NUCLIDE	MICROCURIE/MILLILITER				
I-131	6.00±.90(-9)	8.40±.80(-9)	<4.7(-8)	<8.6(-8)	5.90±1.6(-8)
CS-134	2.00±.10(-8)	1.40±.10(-8)	7.65±4.6(-8)	<8.9(-8)	3.30±2.8(-8)
CS-137	4.70±.20(-8)	2.50±.10(-8)	<7.7(-8)	<9.8(-8)	<1.2(-7)
CR-51	2.70±.60(-8)	5.20±.60(-8)	<3.7(-7)	<5.1(-7)	<2.3(-7)
MN-54	1.22±.08(-7)	9.60±1.9(-8)	2.45±.49(-7)	<7.2(-8)	3.60±1.8(-8)
FE-59	<4.5(-9)	<4.5(-9)	<1.0(-7)	<1.5(-7)	<7.1(-8)
CO-57	2.70±.30(-9)	2.60±1.0(-9)	<7.7(-8)	7.40±2.3(-8)	1.70±1.3(-8)
CO-58	1.40±.20(-7)	1.70±.30(-7)	5.05±.62(-7)	6.52±1.2(-7)	7.10±.40(-7)
CO-60	2.40±.30(-7)	1.15±.04(-7)	1.96±.70(-7)	9.02±5.5(-8)	2.20±.50(-7)
ZN-65	<1.8(-9)	<3.1(-9)	<2.2(-7)	<1.8(-7)	<8.7(-8)
ZR-95	<3.1(-9)	<4.6(-9)	1.00±.50(-7)	<1.4(-7)	4.30±2.5(-8)
NB-95	<2.6(-9)	<4.2(-9)	<5.2(-8)	<5.3(-8)	<3.6(-8)
MO-99	1.30±.40(-9)	1.50±.50(-9)	<4.4(-8)	<2.0(-7)	<4.8(-8)
RU-103	<2.3(-9)	<3.1(-9)	<5.1(-8)	<5.3(-8)	<3.4(-8)
AG-110M	1.20±.10(-8)	5.00±4.8(-9)	<9.4(-8)	<7.1(-8)	3.60±2.2(-8)
SB-124	<2.3(-9)	<2.9(-9)	<7.6(-8)	<7.9(-8)	<4.6(-8)
SB-125	<2.7(-9)	<3.6(-9)	<1.1(-7)	<1.7(-7)	<7.8(-8)
BA-140	<1.1(-9)	<6.2(-9)	<1.6(-7)	<2.4(-7)	<8.4(-8)
LA-140	<2.4(-9)	<1.8(-8)	<7.6(-8)	<3.2(-7)	<2.1(-8)
CE-141	<1.5(-9)	<2.0(-9)	<6.4(-8)	<8.7(-8)	<4.4(-8)
CE-144	<1.5(-9)	<2.1(-9)	<3.4(-7)	<3.7(-7)	<2.0(-7)
NP-239	<2.1(-9)	<8.0(-9)	<2.1(-7)	<8.1(-7)	<1.1(-7)

TABLE B.16 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR DISTILLATE

BORIC ACID EVAPORATOR DISTILLATE

DATE	1/17	2/ 6	2/ 6	2/ 7
TIME	955	1419	2229	940
NUCLIDE	MICROCURIE/MILLILITER			
I-131	4.80±.80(-8)	4.40±2.8(-8)	<1.5(-8)	2.10±1.6(-8)
CS-134	<2.0(-8)	<8.3(-8)	<2.0(-8)	<5.8(-8)
CS-137	<2.3(-8)	9.10±2.9(-8)	<2.7(-8)	<3.8(-7)
CR-51	1.70±1.1(-7)	<2.6(-7)	6.00±4.1(-8)	2.30±1.3(-7)
MN-54	2.10±1.1(-8)	<4.9(-8)	1.90±.90(-8)	<3.4(-8)
FE-59	<3.2(-8)	5.50±3.5(-8)	<2.1(-8)	7.40±4.6(-8)
CO-57	<1.2(-8)	<3.4(-8)	<8.0(-9)	<3.4(-8)
CO-58	6.20±.20(-7)	4.20±.30(-7)	1.40±.20(-7)	1.90±.60(-7)
CO-60	6.65±1.8(-8)	4.30±4.1(-8)	2.00±1.6(-8)	<9.8(-8)
ZN-65	<2.7(-8)	<9.0(-8)	<2.1(-8)	<1.1(-7)
ZR-95	<3.0(-8)	2.90±2.8(-8)	<1.8(-8)	<5.3(-8)
NB-95	<1.7(-8)	<3.3(-8)	<1.1(-8)	<5.4(-8)
MO-99	2.30±1.2(-8)	<7.8(-8)	<1.2(-8)	2.70±1.8(-8)
RU-103	<1.3(-8)	<3.1(-8)	<1.0(-8)	<4.2(-8)
AG-110M	1.50±1.1(-8)	3.70±2.3(-8)	<1.8(-8)	<4.6(-8)
SB-124	<2.0(-8)	<5.0(-8)	<2.6(-8)	<5.4(-8)
SB-125	<2.6(-8)	<9.4(-8)	3.40±1.3(-8)	<9.6(-8)
BA-140	<5.8(-8)	<1.2(-7)	<5.3(-8)	8.60±5.8(-8)
LA-140	<4.1(-8)	<1.5(-7)	<3.3(-8)	<8.8(-8)
CE-141	2.20±1.9(-8)	<8.6(-8)	<1.5(-8)	<5.8(-8)
CE-144	<1.3(-7)	3.20±1.3(-7)	<1.2(-7)	<3.6(-7)
NP-239	<1.0(-7)	<2.8(-7)	<5.8(-8)	1.40±.80(-7)

TABLE B.16A

RADIONUCLIDE CONCENTRATIONS IN BORIC ACID EVAPORATOR DISTILLATE - BETA ANALYSIS RESULTS

DATE	10/17
TIME	1029

NUCLIDE	MICROCURIES/MILLILITER
H-3	2.3 ± 0.1(-1)
C-14	1.6 ± 0.2(-5)
P-32	<2(-7)
FE-55	8.9 ± 0.8(-7)
NI-63	2.8 ± 0.2(-7)
SR-89	<5(-8)
SR-90	4 ± 2(-8)
Y-91	<5(-9)

TABLE B.17

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM BORIC ACID EVAPORATOR CONDENSATE DEMINERALIZER

BAE CONDENSATE DEMINERALIZER OUTLET

DATE	9/13	9/13	9/14	10/ 5	10/17
TIME	1131	1551	1005	1352	1043
NUCLIDE	MICROCURIE/MILLILITER				
I-131	<4.6(-8)	<5.0(-8)	<4.0(-8)	<2.6(-8)	<3.5(-8)
CS-134	1.66±.07(-6)	1.29±.06(-6)	1.08±.07(-6)	8.30±.40(-7)	7.10±.30(-7)
CS-137	2.03±.07(-6)	1.71±.08(-6)	1.41±.06(-6)	1.12±.04(-6)	9.70±.30(-7)
CR-51	<3.1(-7)	<3.2(0)	<3.1(-7)	<1.9(-7)	<4.6(-8)
MN-54	<4.8(-8)	<5.4(-8)	<5.2(-8)	3.70±1.5(-8)	3.80±3.4(-8)
FE-59	<6.4(-8)	<6.5(-8)	<7.0(-8)	<4.7(-8)	<5.9(-8)
CO-57	<4.1(-8)	<2.9(-8)	<3.5(-8)	<2.2(-8)	<2.1(-8)
CO-58	1.30±.30(-7)	2.10±1.9(-8)	4.60±2.4(-8)	<4.8(-8)	<5.0(-8)
CO-60	2.40±.70(-7)	6.70±6.0(-8)	1.70±.70(-7)	5.30±3.1(-8)	9.40±2.6(-8)
ZN-65	<8.2(-8)	<6.5(-8)	<6.2(-8)	<6.2(-8)	<8.5(-8)
ZR-95	<6.7(-8)	<8.9(-8)	<6.2(-8)	<6.4(-8)	<5.7(-8)
NB-95	<3.2(-8)	<3.4(-8)	<4.6(-8)	<2.6(-8)	<2.9(-8)
MO-99	<3.1(-8)	<2.9(-8)	<2.6(-8)	<5.7(-8)	<5.0(-8)
RU-103	<4.4(-8)	<4.0(-8)	<3.7(-8)	<3.0(-8)	<2.6(-8)
AG-110M	<5.7(-8)	<4.1(-8)	<4.9(-8)	<3.5(-8)	<7.9(-8)
SB-124	<5.6(-8)	<4.8(-8)	<5.9(-8)	<4.8(-8)	<4.8(-8)
SB-125	<1.5(-7)	<1.1(-7)	<1.2(-7)	<7.1(-8)	<7.1(-8)
BA-140	<1.6(-7)	<1.4(-7)	<1.3(-7)	<9.4(-8)	<7.4(-8)
LA-140	<8.7(-8)	<3.9(-8)	<3.5(-8)	<4.4(-8)	<9.4(-8)
CE-141	<6.8(-8)	<4.9(-8)	<5.6(-8)	<5.2(-8)	<4.0(-8)
CE-144	<2.6(-7)	<2.3(-7)	<2.0(-7)	<1.6(-7)	<4.3(-8)
NP-239	<1.3(-7)	<1.2(-7)	<1.1(-7)	<1.2(-7)	<6.2(-8)

TABLE B.17 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM BORIC ACID EVAPORATOR CONDENSATE DEMINERALIZER

BAE CONDENSATE DEMINERALIZER OUTLET

DATE	10/18	11/ 2
TIME	1113	1538
NUCLIDE	MICROCURIE/MILLILITER	
I-131	<3.6(-8)	<1.2(-7)
CS-134	5.98±.51(-7)	5.87±.51(-7)
CS-137	8.60±.70(-7)	9.98±.85(-7)
CR-51	<2.3(-7)	<6.0(-7)
MN-54	4.70±2.2(-8)	8.74±4.1(-8)
FE-59	<5.2(-8)	<1.4(-7)
CO-57	<2.4(-8)	<4.8(-8)
CO-58	<5.3(-8)	4.25±.47(-7)
CO-60	<9.0(-8)	3.18±.72(-7)
ZN-65	<7.8(-8)	<1.6(-7)
ZR-95	<4.5(-8)	<1.1(-7)
NB-95	<3.3(-8)	<6.5(-8)
MO-99	<5.4(-8)	<1.9(-7)
RU-103	<2.7(-8)	<6.7(-8)
AG-110M	<6.8(-8)	<7.8(-8)
SB-124	<5.3(-8)	<1.1(-7)
SB-125	<8.1(-8)	<1.6(-7)
BA-140	<1.1(-7)	<3.0(-7)
LA-140	<1.3(-7)	<1.3(-6)
CE-141	<4.2(-8)	<1.1(-7)
CE-144	<1.5(-7)	<4.0(-7)
NP-239	<2.9(-7)	<1.1(-6)

TABLE B.17A

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM BORIC ACID EVAPORATOR CONDENSATE DEMINERALIZER - BETA ANALYSIS RESULTS

DATE	10/17
TIME	1043

NUCLIDE	MICROCURIES/MILLILITER
H-3	8.9 ± 0.4(-3)
C-14	6.6 ± 0.7(-6)
P-32	<2(-7)
FE-55	5.7 ± 0.5(-7)
NI-63	1.71 ± 0.01(-7)
SR-89	<4(-8)
SR-90	6 ± 2(-8)
Y-91	<5(-8)

TABLE B.18

RADIONUCLIDE CONCENTRATIONS IN DEMINERALIZED REACTOR COOLANT SYSTEM

DEMIN R. C. STORAGE TANK

DATE	10/16	1/31
TIME	1534	1347
NUCLIDE	MICROCURIE/MILLILITER	
I-131	<2.6(-8)	<2.0(-8)
CS-134	1.26±.04(-6)	5.00±.30(-7)
CS-137	2.07±.06(-6)	7.90±.40(-7)
CR-51	<3.4(-8)	<1.5(-7)
MN-54	4.30±.70(-8)	<2.3(-8)
FE-59	<2.8(-8)	<3.5(-8)
CO-57	<1.9(-8)	<1.7(-8)
CO-58	5.40±2.1(-8)	2.80±.30(-7)
CO-60	4.10±2.0(-8)	4.10±3.9(-8)
ZN-65	<5.8(-8)	<6.0(-8)
ZR-95	2.60±.90(-8)	<3.4(-8)
NB-95	<2.8(-8)	<2.0(-8)
MO-99	<2.1(-8)	1.40±.80(-8)
RU-103	1.60±.60(-8)	<2.2(-8)
AG-110M	<6.7(-7)	<2.8(-8)
SB-124	<2.5(-8)	<2.8(-8)
SB-125	<3.0(-8)	<5.4(-8)
BA-140	<2.7(-8)	<8.2(-8)
LA-140	<2.7(-8)	<1.4(-8)
CE-141	<1.9(-8)	<2.8(-8)
CE-144	<2.0(-8)	<1.9(-7)
NP-239	<2.1(-8)	<6.1(-8)

TABLE B.18 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN DEMINERALIZED REACTOR COOLANT SYSTEM

EAST DEMINERALIZER EFFLUENT

DATE	10/16	1/31
TIME	1521	1336
NUCLIDE	MICROCURIE/MILLILITER	
I-131	<3.1(-8)	<1.9(-8)
CS-134	<5.8(-8)	2.10±.30(-7)
CS-137	<9.2(-8)	3.30±.40(-7)
CR-51	<2.4(-7)	1.60±.90(-7)
MN-54	<4.2(-8)	<2.7(-8)
FE-59	<4.7(-8)	<4.0(-8)
CO-57	<1.8(-8)	<1.6(-8)
CO-58	7.00±2.6(-8)	1.60±.30(-7)
CO-60	<7.8(-8)	<7.7(-8)
ZN-65	<7.1(-8)	<1.6(-8)
ZR-95	7.70±3.7(-8)	<4.3(-8)
NB-95	<2.9(-8)	<1.8(-8)
MO-99	<4.1(-8)	<1.6(-8)
RU-103	<4.0(-8)	<1.9(-8)
AG-110M	<8.5(-8)	<2.8(-8)
SB-124	<4.7(-8)	<2.9(-8)
SB-125	<8.6(-8)	<5.1(-8)
BA-140	<8.7(-8)	<7.0(-8)
LA-140	<7.8(-8)	<1.9(-8)
CE-141	<3.7(-8)	<2.8(-8)
CE-144	<1.3(-7)	1.40±.70(-7)
NP-239	<2.5(-7)	<6.8(-8)

TABLE B.18 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN DEMINERALIZED REACTOR COOLANT SYSTEM

DRCST DEMIN FILTER EFFLUENT

DATE	10/16	1/31
TIME	1520	1338
NUCLIDE	MICROCURIE/MILLILITER	
I-131	<3.7(-8)	<1.9(-8)
CS-134	<5.8(-8)	1.40±.20(-7)
CS-137	<7.2(-8)	2.40±.30(-7)
CR-51	<1.8(-7)	<1.4(-7)
MN-54	<3.1(-8)	<1.9(-8)
FE-59	<4.4(-8)	<3.9(-8)
CO-57	<1.7(-8)	<2.1(-8)
CO-58	<5.0(-8)	<8.2(-8)
CO-60	7.10±2.8(-8)	<8.0(-8)
ZN-65	<9.3(-8)	<4.7(-8)
ZR-95	<5.5(-8)	<3.4(-8)
NB-95	<3.1(-8)	<2.5(-8)
MO-99	<4.0(-8)	<2.3(-8)
RU-103	<2.8(-8)	<1.8(-8)
AG-110M	<8.4(-8)	<2.4(-8)
SB-124	<4.2(-8)	<2.8(-8)
SB-125	<5.7(-8)	<4.7(-8)
BA-140	<1.1(-7)	<7.3(-8)
LA-140	<8.0(-8)	<2.0(-8)
CE-141	<3.4(-8)	<2.7(-8)
CE-144	<1.9(-7)	<2.0(-7)
NP-239	<1.8(-7)	<7.2(-8)

TABLE B.19

RADIONUCLIDE CONCENTRATIONS IN FEED TO MISCELLANEOUS WASTE EVAPORATOR

MISC. WASTE EVAPORATOR FEED

DATE	9/25	9/25	10/25	11/14	1/16
TIME	1003	1420	1515	1427	1403
NUCLIDE	MICROCURIES/MILLILITER				
I-131	9.54±.06(-4)	9.33±.03(-4)	2.60±.70(-5)	2.12±.03(-4)	5.77±.08(-4)
I-132	<3.8(-6)	<4.3(-6)	<7.5(-6)	6.70±.30(-5)	<2.6(-5)
CS-134	4.62±.04(-4)	4.41±.18(-4)	6.50±.50(-5)	3.17±.05(-4)	5.90±.10(-4)
CS-136	6.25±.02(-4)	5.69±.17(-5)	7.60±2.4(-6)	7.80±2.7(-6)	1.80±.10(-5)
CS-137	5.51±.02(-4)	5.40±.03(-4)	9.70±.40(-5)	4.11±.04(-4)	7.51±.05(-4)
CR-51	3.46±.02(-3)	3.56±.03(-3)	1.28±.03(-3)	3.30±.03(-3)	1.15±.01(-3)
MN-54	6.34±.06(-4)	6.40±.03(-4)	2.25±.05(-4)	8.80±.10(-4)	3.46±.02(-4)
FE-59	2.28±.04(-4)	2.49±.03(-4)	7.30±.50(-5)	2.49±.08(-4)	1.10±.03(-4)
CO-57	2.71±.13(-5)	3.96±.28(-5)	1.50±.20(-5)	5.80±.20(-5)	3.70±.30(-5)
CO-58	1.78±.02(-2)	1.77±.01(-2)	6.87±.03(-3)	2.52±.02(-2)	1.35±.02(-2)
CO-60	9.51±.07(-4)	9.60±.10(-4)	4.60±.10(-4)	1.60±.02(-3)	8.90±.10(-4)
ZN-65	5.10±1.9(-6)	4.30±.00(-6)	<7.5(-6)	1.00±.40(-4)	6.10±1.8(-6)
ZR-95	9.74±.22(-5)	1.00±.03(-4)	4.80±.90(-5)	1.32±.05(-4)	6.20±.20(-5)
NB-95	2.20±.03(-4)	2.19±.02(-4)	8.20±.40(-5)	2.90±.09(-4)	1.43±.08(-4)
MO-99	5.90±.20(-5)	5.90±.20(-5)	<2.6(-6)	2.30±.30(-5)	9.10±5.4(-6)
RU-103	5.80±.20(-5)	4.60±.20(-5)	2.10±.40(-5)	6.70±.30(-5)	2.50±.30(-5)
AG-110M	7.60±.20(-5)	6.80±.40(-5)	5.30±.70(-5)	1.02±.06(-4)	6.20±.40(-5)
SB-124	5.21±.09(-5)	5.00±.10(-5)	1.00±.20(-5)	1.26±.04(-4)	6.40±.20(-5)
SB-125	5.40±.40(-5)	5.10±.50(-5)	2.90±.90(-5)	9.60±.80(-5)	1.10±.05(-4)
BA-140	2.10±.50(-5)	3.30±.70(-5)	<3.9(-5)	<3.3(-5)	8.30±7.4(-6)
LA-140	1.76±.06(-5)	1.36±.06(-4)	<1.3(-6)	1.20±.10(-5)	2.60±.10(-5)
CE-141	1.03±.14(-5)	1.50±.20(-5)	6.40±2.4(-6)	3.10±.70(-5)	6.10±.20(-6)
CE-143	<3.9(-6)	<5.5(-6)	<8.6(-6)	<8.9(-6)	<1.3(-5)
CE-144	<1.7(-5)	3.50±.90(-5)	<2.9(-5)	1.40±.20(-3)	<1.5(-5)
NP-239	<5.0(-6)	<1.0(-5)	<1.0(-5)	2.90±.90(-5)	<1.0(-5)

TABLE B.19 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN FEED TO MISCELLANEOUS WASTE EVAPORATOR

MISC. WASTE EVAPORATOR FEED

DATE	1/16	2/ 2	2/ 3	2/ 3	2/15
TIME	1718	1415	1239	1458	847
NUCLIDE	MICROCURIES/MILLILITER				
I-131	5.44±.05(-4)	3.35±.02(-4)	3.23±.03(-4)	3.15±.03(-4)	1.00±.04(-4)
I-133	2.00±1.1(-5)	1.30±.70(-5)	<1.0(-5)	4.30±2.8(-6)	8.20±2.5(-6)
CS-134	5.90±.90(-4)	7.30±.10(-4)	7.21±.10(-4)	7.20±.10(-4)	4.64±.12(-4)
CS-136	2.70±.40(-5)	1.10±.10(-5)	7.10±3.0(-6)	1.20±.20(-5)	4.30±1.6(-6)
CS-137	7.90±1.0(-4)	9.99±.09(-4)	1.02±.01(-3)	1.00±.02(-3)	5.99±.14(-4)
CR-51	1.21±.04(-3)	1.29±.02(-3)	1.21±.02(-3)	1.19±.02(-3)	2.10±.20(-4)
MN-54	3.40±.05(-4)	1.72±.01(-3)	1.59±.02(-3)	1.48±.02(-3)	2.40±.20(-4)
FE-59	1.40±.11(-4)	2.61±.07(-4)	2.36±.06(-4)	2.31±.09(-4)	3.40±.40(-5)
CO-57	1.30±.10(-4)	8.50±.20(-5)	8.10±.10(-5)	8.01±.10(-5)	1.70±.20(-5)
CO-58	7.10±1.6(-3)	2.17±.02(-2)	2.10±.03(-2)	2.02±.03(-2)	4.10±.30(-3)
CO-60	8.90±.20(-4)	2.92±.02(-3)	2.71±.03(-3)	2.60±.03(-3)	5.50±.30(-4)
ZN-65	1.10±.50(-5)	1.10±.30(-5)	1.40±.50(-5)	7.30±3.6(-6)	<6.0(-6)
ZR-95	5.80±3.8(-5)	1.69±.04(-4)	1.61±.06(-4)	1.50±.04(-4)	2.40±.30(-5)
NB-95	1.41±.05(-4)	3.67±.09(-4)	3.40±.09(-4)	3.20±.10(-4)	5.10±.40(-5)
MO-99	1.50±.40(-5)	<5.8(-6)	<3.0(-6)	<3.2(-6)	2.00±.40(-6)
RU-103	9.20±8.7(-6)	2.40±.20(-5)	2.50±.30(-5)	2.70±.30(-5)	4.50±.80(-6)
AG-110M	1.50±.10(-4)	1.23±.04(-4)	1.11±.07(-4)	1.11±.05(-4)	3.10±.60(-5)
SB-124	6.30±.30(-5)	6.30±.20(-5)	6.30±.20(-5)	5.90±.20(-5)	1.80±.20(-5)
SB-125	1.15±.09(-4)	1.20±.07(-4)	1.27±.08(-4)	1.07±.05(-4)	5.30±.90(-5)
BA-140	<4.2(-5)	1.50±.80(-5)	<2.8(-5)	<1.8(-5)	6.40±1.1(-6)
LA-140	1.70±1.0(-5)	9.70±.90(-6)	4.20±.80(-6)	3.70±.70(-6)	3.10±1.9(-6)
CE-141	<1.2(-5)	<5.4(-6)	6.30±2.0(-6)	<6.0(-6)	5.20±4.1(-6)
CE-143	<6.0(-5)	<7.5(-6)	<7.1(-6)	<6.0(-6)	9.10±4.1(-6)
CE-144	<4.2(-5)	1.10±1.2(-4)	8.80±6.9(-5)	3.90±1.4(-5)	<1.0(-5)
NP-239	<3.0(-5)	<8.0(-6)	<8.0(-6)	<6.0(-6)	<9.0(-6)

TABLE B.19 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN FEED TO MISCELLANEOUS WASTE EVAPORATOR

MISC. WASTE EVAPORATOR FEED

DATE 2/15
TIME 1410

NUCLIDE	MICROCURIES/MILLILITER
I-131	9.70±.03(-5)
I-133	6.30±3.7(-6)
CS-134	4.42±.03(-4)
CS-136	3.90±.70(-6)
CS-137	5.83±.12(-4)
CR-51	2.30±.20(-4)
MN-54	2.49±.11(-4)
FE-59	3.73±.06(-5)
CO-57	1.84±.13(-5)
CO-58	4.19±.10(-3)
CO-60	5.60±.10(-4)
ZN-65	4.40±1.0(-6)
ZR-95	2.45±.10(-5)
NB-95	5.50±.40(-5)
MO-99	<1.1(-6)
RU-103	4.80±1.0(-6)
AG-110M	3.50±.30(-5)
SB-124	1.69±.02(-5)
SB-125	4.30±.40(-5)
BA-140	5.80±4.1(-6)
LA-140	1.80±.40(-6)
CE-141	3.70±1.4(-6)
CE-143	1.00±.60(-5)
CE-144	2.40±2.2(-5)
NP-239	<6.0(-6)

TABLE B.19A

RADIONUCLIDE CONCENTRATIONS IN FEED TO MISCELLANEOUS WASTE EVAPORATOR - BETA ANALYSIS RESULTS

DATE	10/25
TIME	1515

NUCLIDE	MICROCURIES/MILLILITER
H-3	4.0 ± 0.2(0)
C-14	4.3 ± 0.4(-6)
P-32	3 ± 2(-6)
FE-55	1.32 ± 0.01(-3)
NI-63	3.69 ± 0.03(-4)
SR-89	2.7 ± 0.8(-6)
SR-90	2 ± 1(-6)
Y-91	5.2 ± 0.2(-6)

TABLE B.20

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS WASTE EVAPORATOR BOTTOMS

MISC. WASTE EVAPORATOR BOTTOMS

DATE	9/25	9/25	10/25	11/14	1/16
TIME	1005	1430	1510	1412	1400
NUCLIDE	MICROCURIES/MILLILITER				
I-131	9.00±.20(-3)	1.19±.01(-2)	1.60±.09(-3)	5.80±.40(-3)	1.58±.08(-3)
I-133	<3.3(-5)	<6.4(-5)	<1.2(-4)	1.40±.70(-4)	<1.7(-5)
CS-134	9.20±.20(-3)	9.88±.08(-3)	6.00±.10(-3)	9.50±.90(-3)	1.70±.04(-3)
CS-136	6.40±.20(-4)	8.30±.10(-4)	1.40±.40(-4)	1.30±.20(-4)	5.80±.05(-5)
CS-137	1.19±.03(-2)	1.28±.01(-2)	7.35±.10(-3)	1.23±.08(-2)	2.29±.02(-3)
CR-51	3.90±.30(-3)	4.50±.10(-3)	5.77±.06(-2)	3.80±.30(-2)	1.21±.06(-3)
MN-54	2.71±.09(-3)	2.72±.03(-3)	5.30±.10(-3)	6.80±.70(-3)	7.30±.10(-4)
FE-59	2.20±.20(-4)	2.70±.20(-4)	1.66±.07(-3)	1.70±.20(-3)	1.99±.10(-4)
CO-57	1.80±.03(-4)	1.90±.08(-4)	3.60±1.0(-4)	8.00±.40(-4)	6.30±.30(-5)
CO-58	6.30±.20(-2)	6.98±.06(-2)	2.71±.03(-1)	4.00±.30(-1)	2.61±.03(-2)
CO-60	4.90±.30(-3)	4.91±.08(-3)	1.56±.02(-2)	2.20±.20(-2)	1.77±.02(-3)
ZN-65	1.60±.70(-5)	<2.5(-5)	<1.0(-4)	1.10±.50(-4)	1.20±.50(-5)
ZR-95	7.50±.80(-5)	7.60±1.2(-5)	1.16±.04(-3)	1.10±.30(-4)	8.50±.60(-5)
NB-95	2.30±.10(-4)	2.80±.10(-4)	3.30±.20(-3)	2.80±.70(-3)	1.80±.10(-4)
MO-99	2.79±.02(-4)	5.10±.10(-4)	<5.0(-5)	3.10±.20(-4)	2.80±.30(-5)
RU-103	1.61±.06(-4)	1.90±.20(-4)	1.32±.06(-3)	1.17±.06(-3)	4.30±.50(-5)
AG-110M	4.70±.20(-4)	5.20±.20(-4)	4.30±.10(-3)	3.50±.30(-3)	1.20±.10(-4)
SB-124	8.30±.20(-4)	9.20±.30(-4)	1.20±.10(-3)	3.60±.40(-3)	2.05±.05(-4)
SB-125	1.32±.01(-3)	1.34±.04(-3)	1.40±.20(-3)	3.60±.10(-3)	3.53±.09(-4)
BA-140	1.40±.50(-4)	<9.2(-5)	<4.2(-4)	<3.1(-4)	<3.3(-5)
LA-140	7.60±.50(-5)	1.36±.06(-4)	5.40±1.4(-5)	2.80±.20(-4)	4.10±.30(-5)
CE-141	3.10±.40(-5)	<5.2(-5)	6.50±.60(-4)	4.00±1.3(-4)	5.70±3.9(-6)
CE-143	<3.4(-5)	<5.0(-5)	<1.5(-4)	<1.0(-4)	2.20±.80(-5)
CE-144	<6.1(-5)	<9.0(-5)	1.30±.30(-3)	1.30±.10(-3)	6.30±1.3(-5)
NP-239	<2.3(-5)	<7.0(-5)	2.40±1.0(-4)	<1.0(-4)	<1.3(-5)

TABLE B.20 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS WASTE EVAPORATOR BOTTOMS

MISC. WASTE EVAPORATOR BOTTOMS

DATE	1/16	2/ 3	2/ 3	2/ 3	2/ 3
TIME	1732	844	1231	1454	1857
NUCLIDE	MICROCURIES/MILLILITER				
I-131	2.68±.05(-3)	6.49±.02(-4)	1.09±.01(-3)	1.90±.01(-3)	1.90±.01(-3)
I-133	<1.0(-5)	<3.0(-6)	6.60±3.4(-6)	1.60±.50(-5)	9.10±4.6(-6)
CS-134	3.80±.30(-3)	1.55±.02(-3)	2.50±.04(-3)	4.41±.07(-3)	4.49±.07(-3)
CS-136	1.60±.10(-4)	3.30±.20(-5)	4.70±.40(-5)	5.50±.50(-5)	8.30±.40(-5)
CS-137	4.00±.10(-3)	2.03±.02(-3)	3.47±.04(-3)	6.12±.06(-3)	6.17±.07(-3)
CR-51	2.50±.20(-3)	2.20±.20(-4)	1.04±.02(-3)	2.05±.03(-3)	1.95±.03(-3)
MN-54	1.04±.02(-3)	1.49±.02(-4)	1.22±.01(-3)	2.38±.02(-3)	1.78±.02(-3)
FE-59	4.40±.40(-4)	3.50±.10(-5)	2.04±.07(-4)	3.85±.12(-4)	3.15±.08(-4)
CO-57	2.80±.30(-4)	2.20±.06(-5)	8.40±.10(-5)	1.62±.04(-4)	1.43±.03(-4)
CO-58	4.26±.08(-2)	7.60±.10(-3)	2.47±.03(-2)	4.76±.05(-2)	4.36±.05(-2)
CO-60	2.90±.06(-3)	4.83±.05(-4)	2.65±.04(-3)	5.20±.06(-3)	4.25±.05(-3)
ZN-65	3.50±2.9(-5)	2.30±1.2(-6)	9.90±4.1(-6)	1.90±.60(-5)	2.90±.60(-5)
ZR-95	<1.3(-4)	9.50±6.9(-6)	1.04±.04(-4)	2.22±.06(-4)	1.83±.06(-4)
NB-95	2.20±.10(-4)	3.40±.40(-5)	2.50±.10(-4)	5.10±.20(-4)	4.30±.20(-4)
MO-99	5.30±1.5(-5)	4.80±.50(-6)	8.10±2.2(-6)	1.30±.20(-5)	1.00±.30(-5)
RU-103	<8.2(-5)	1.10±.10(-5)	3.90±.60(-5)	6.10±.40(-5)	4.80±.40(-5)
AG-110M	2.50±.60(-4)	5.10±.20(-5)	1.35±.10(-4)	2.67±.09(-4)	2.52±.09(-4)
SB-124	3.30±.20(-4)	1.49±.02(-4)	2.23±.04(-4)	3.74±.06(-4)	3.53±.07(-4)
SB-125	8.30±1.0(-4)	3.40±.09(-4)	4.81±.09(-4)	7.43±.20(-4)	7.40±.10(-4)
BA-140	<2.1(-4)	<8.0(-6)	1.50±1.2(-5)	<3.2(-5)	<4.1(-5)
LA-140	7.30±.80(-5)	1.66±.05(-5)	3.00±.10(-5)	5.10±.30(-5)	5.00±.20(-5)
CE-141	<5.5(-5)	<2.8(-6)	4.60±2.8(-6)	1.16±.26(-5)	5.50±3.0(-6)
CE-143	<2.4(-4)	<3.3(-6)	<8.1(-6)	<1.1(-5)	<1.2(-5)
CE-144	<2.0(-4)	<1.1(-5)	3.20±1.9(-5)	2.10±1.5(-4)	<8.5(-5)
NP-239	<1.2(-4)	<6.0(-6)	<1.0(-5)	<1.5(-5)	<4.8(-5)

TABLE B.20 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS WASTE EVAPORATOR BOTTOMS

MISC. WASTE EVAPORATOR BOTTOMS

DATE	2/15	2/15	2/15
TIME	902	1122	1411
NUCLIDE	MICROCURIES/MILLILITER		
I-131	7.60±.50(-4)	1.07±.04(-3)	1.22±.05(-3)
I-133	<5.4(-5)	<2.4(-5)	1.40±.60(-5)
CS-134	3.80±.20(-3)	5.24±.11(-3)	5.96±.08(-3)
CS-136	3.60±.80(-5)	6.10±1.2(-5)	6.20±.30(-5)
CS-137	5.10±.20(-3)	7.20±.30(-3)	8.20±.30(-3)
CR-51	1.40±.20(-3)	1.60±.10(-3)	1.80±.20(-3)
MN-54	2.12±.04(-3)	2.60±.20(-3)	2.30±.20(-3)
FE-59	2.70±.30(-4)	3.80±.40(-4)	3.70±.30(-4)
CO-57	1.40±.10(-4)	1.68±.09(-4)	1.60±.10(-4)
CO-58	3.22±.08(-2)	3.93±.18(-2)	4.10±.20(-2)
CO-60	5.00±.20(-3)	6.24±.21(-3)	5.60±.20(-3)
ZN-65	3.00±.90(-5)	3.50±.40(-5)	2.70±.30(-5)
ZR-95	1.80±.10(-4)	2.06±.06(-4)	2.10±.10(-4)
NB-95	3.90±.40(-4)	4.80±.30(-4)	4.80±.40(-4)
MO-99	7.50±3.4(-6)	<1.0(-5)	<1.1(-5)
RU-103	6.50±1.9(-5)	4.80±.60(-5)	5.80±.90(-5)
AG-110M	2.60±.30(-4)	3.10±.30(-4)	3.43±.06(-4)
SB-124	1.60±.10(-4)	2.05±.04(-4)	2.34±.06(-4)
SB-125	5.10±2.1(-4)	4.83±.12(-4)	5.70±.50(-4)
BA-140	6.50±3.5(-5)	8.30±1.8(-5)	5.30±3.5(-5)
LA-140	2.80±.80(-5)	5.90±.40(-5)	5.60±.40(-5)
CE-141	1.10±.90(-5)	1.50±.50(-5)	1.60±.60(-5)
CE-143	<6.0(-5)	5.70±1.3(-5)	1.70±1.2(-5)
CE-144	2.10±.30(-4)	9.60±6.5(-5)	1.60±.70(-4)
NP-239	<3.2(-5)	<2.2(-5)	<2.2(-5)

TABLE B.20A

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS WASTE EVAPORATOR BOTTOMS - BETA ANALYSIS RESULTS

DATE	10/25
TIME	1510

NUCLIDE	MICROCURIES/MILLILITER
H-3	8.3 ± 0.4(-3)
C-14	1.3 ± 0.1(-5)
P-32	1.95 ± 0.05(-5)
FE-55	2.02 ± 0.02(-3)
NI-63	6.00 ± 0.03(-5)
SR-89	4.2 ± 0.1(-6)
SR-90	8.2 ± 0.4(-7)
Y-91	2.03 ± 0.02(-5)

TABLE B.21

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS WASTE EVAPORATOR DISTILLATE

MISC. WASTE EVAPORATOR DISTILLATE

DATE	9/25	9/25	10/25	11/14	1/16
TIME	1028	1434	1458	1415	1358
NUCLIDE	MICROCURIES/MILLILITER				
I-131	3.12±.08(-6)	3.30±.05(-6)	5.20±1.9(-6)	1.70±.40(-7)	7.10±.30(-7)
I-133	<2.7(-8)	<3.3(-8)	<4.5(-8)	<1.1(-7)	<6.0(-8)
CS-134	<6.7(-8)	7.70±1.5(-8)	7.60±4.2(-8)	2.40±.20(-7)	3.00±.10(-6)
CS-136	<3.0(-8)	<4.0(-8)	<4.2(-8)	<4.0(-8)	1.20±.30(-7)
CS-137	5.50±2.2(-8)	4.60±2.6(-8)	8.50±2.8(-8)	3.60±.50(-7)	3.90±.10(-6)
CR-51	<2.0(-7)	<3.0(-7)	<4.0(-7)	<4.0(-7)	<3.2(-7)
MN-54	3.90±1.2(-8)	<3.0(-8)	<5.0(-8)	3.60±.50(-7)	2.60±2.1(-8)
FE-59	<4.0(-8)	<5.0(-8)	<5.0(-8)	<1.0(-7)	<5.0(-8)
CO-57	<3.0(-8)	<2.0(-8)	<2.0(-8)	<4.0(-8)	<3.0(-8)
CO-58	1.20±.10(-7)	1.10±.20(-7)	2.40±.30(-7)	1.34±.14(-6)	6.10±.50(-7)
CO-60	<6.0(-8)	<1.4(-7)	<7.0(-8)	1.15±.15(-6)	1.40±.60(-7)
ZN-65	<8.0(-8)	<6.0(-8)	<6.0(-8)	<8.0(-8)	<8.0(-8)
ZR-95	<4.0(-8)	<4.0(-8)	<5.0(-8)	6.60±3.2(-8)	3.30±3.3(-8)
NB-95	<2.0(-8)	<2.0(-8)	<4.0(-8)	<4.0(-8)	<5.0(-8)
MO-99	<2.0(-8)	<2.0(-8)	<2.0(-8)	<4.0(-8)	<3.0(-8)
RU-103	<2.0(-8)	<2.0(-8)	<3.0(-8)	<5.0(-8)	<4.0(-8)
AG-110M	<6.0(-8)	<8.0(-8)	<9.0(-8)	<1.0(-7)	1.80±.50(-7)
SB-124	<4.0(-8)	<5.0(-8)	<5.0(-8)	<4.0(-8)	<4.0(-8)
SB-125	<6.0(-8)	<1.0(-7)	<7.0(-8)	<1.0(-7)	<2.0(-7)
BA-140	<7.0(-8)	<1.0(-7)	<8.0(-8)	<1.0(-7)	<1.5(-7)
LA-140	<2.0(-8)	<5.0(-8)	<3.0(-8)	<4.0(-8)	4.20±1.9(-8)
CE-141	<3.0(-8)	<4.0(-8)	<4.0(-8)	<6.0(-8)	<5.0(-8)
CE-143	<4.0(-8)	<6.0(-7)	<7.0(-8)	<1.0(-7)	<8.0(-8)
CE-144	<2.0(-7)	<2.0(-7)	<2.0(-7)	<2.0(-7)	<2.0(-7)
NP-239	<7.0(-8)	<1.0(-7)	1.30±.50(-7)	<2.0(-7)	<1.3(-7)

TABLE B.21 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS WASTE EVAPORATOR DISTILLATE

MISC. WASTE EVAPORATOR DISTILLATE

DATE	1/16	2/ 3	2/ 3	2/15	2/15
TIME	1738	1226	1450	900	1120
NUCLIDE	MICROCURIES/MILLILITER				
I-131	6.30±.30(-7)	7.10±.30(-7)	1.02±.03(-6)	4.55±.(7(-7)	4.90±.60(-7)
I-133	<6.0(-8)	2.00±2.0(-8)	5.00±1.9(-8)	2.30±2.3(-8)	<6.0(-8)
CS-134	1.60±.10(-6)	1.60±.20(-7)	<3.0(-8)	1.40±.40(-7)	2.25±.07(-7)
CS-136	1.20±.20(-7)	<3.0(-8)	<4.0(-8)	<3.0(-8)	<3.0(-8)
CS-137	2.20±.10(-6)	1.60±.30(-7)	4.00±2.0(-8)	1.70±.10(-7)	3.15±.07(-7)
CR-51	3.50±2.2(-7)	3.10±1.1(-7)	2.60±.90(-7)	1.90±.80(-7)	1.50±.90(-7)
MN-54	2.20±.40(-7)	2.20±.30(-7)	8.30±3.1(-8)	4.70±2.1(-8)	3.20±.50(-7)
FE-59	<6.0(-8)	5.90±2.4(-8)	<4.0(-7)	2.70±1.9(-8)	4.50±.60(-8)
CO-57	<3.0(-8)	<2.0(-8)	1.40±.80(-7)	1.10±.70(-8)	<2.0(-8)
CO-58	.10±.10(-6)	4.01±.08(-6)	2.11±.07(-6)	6.60±.30(-7)	1.70±.40(-6)
CO-60	4.40±.50(-7)	4.50±.30(-7)	2.80±.30(-7)	1.30±.40(-7)	9.20±.90(-7)
ZN-65	<6.0(-8)	<5.0(-8)	<6.0(-8)	<4.0(-8)	<5.0(-8)
ZR-95	3.40±3.1(-8)	<5.0(-8)	<4.0(-8)	<3.0(-8)	<5.0(-8)
NB-95	<5.0(-8)	1.20±.20(-7)	<3.0(-8)	<2.0(-8)	<3.0(-8)
MO-99	<4.0(-8)	<2.0(-8)	<2.0(-8)	<3.0(-8)	<2.0(-8)
RU-103	2.40±2.0(-8)	<3.0(-8)	<2.0(-8)	<2.0(-8)	<2.0(-8)
AG-110M	<1.1(-7)	<7.0(-8)	<6.0(-8)	<8.0(-8)	6.60±5.1(-8)
SB-124	<5.0(-8)	<2.0(-8)	<3.0(-8)	<2.0(-8)	<5.0(-8)
SB-125	<1.0(-7)	<7.0(-8)	<6.0(-8)	<5.0(-8)	<6.0(-8)
BA-140	<2.0(-7)	<1.0(-7)	<8.0(-8)	<8.0(-8)	<1.0(-7)
LA-140	<3.0(-8)	<2.0(-8)	<2.0(-8)	<3.0(-8)	<2.0(-8)
CE-141	<7.0(-8)	<3.0(-8)	<5.0(-8)	4.40±2.3(-8)	<4.0(-8)
CE-143	<1.0(-7)	<6.0(-8)	<5.0(-8)	<6.0(-8)	<1.0(-7)
CE-144	<2.0(-7)	<1.0(-7)	<1.0(-7)	<2.0(-7)	<2.0(-7)
NP-239	<1.0(-7)	<1.0(-7)	<7.0(-7)	<4.0(-5)	<1.0(-7)

TABLE B.21 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS WASTE EVAPORATOR DISTILLATE

MISC. WASTE EVAPORATOR DISTILLATE

DATE 2/15
TIME 1410

NUCLIDE	MICROCURIES/MILLILITER
I-131	5.00±.40(-7)
I-133	<3.0(-8)
CS-134	<5.0(-8)
CS-136	1.60±1.3(-8)
CS-137	3.50±.70(-8)
CR-51	<2.0(-7)
MN-54	<2.0(-8)
FE-59	<5.0(-8)
CO-57	1.30±1.1(-8)
CO-58	1.70±.50(-7)
CO-60	<6.0(-8)
ZN-65	<7.0(-8)
ZR-95	<3.0(-8)
NB-95	<2.0(-8)
MO-99	<2.0(-8)
RU-103	<3.0(-8)
AG-110M	<5.0(-8)
SB-124	<3.0(-8)
SB-125	<4.0(-8)
BA-140	<6.0(-8)
LA-140	<3.0(-8)
CE-141	<3.0(-8)
CE-143	<1.0(-7)
CE-144	<1.0(-7)
NP-239	<1.0(-7)

TABLE B.21A

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS WASTE EVAPORATOR DISTILLATE - BETA ANALYSIS RESULTS

DATE	10/25
TIME	1458

NUCLIDE	MICROCURIES/MILLILITER
H-3	1.49 ± 0.07(-1)
C-14	6.1 ± 0.1(-7)
P-32	<1(-7)
FE-55	6.1 ± 0.5(-7)
NI-63	2.0 ± 0.1(-7)
SR-89	6 ± 4(-8)
SR-90	<2(-8)
Y-91	<5(-9)

TABLE B.22

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM MISCELLANEOUS WASTE EVAPORATOR CONDENSATE DEMINERALIZER A

MWE CONDENSATE DEMIN-A OUT

DATE	9/25	9/25	10/25	11/14	2/15
TIME	1015	1444	1446	1421	912
NUCLIDE	MICROCURIES/MILLILITER				
I-131	4.70±1.1(-8)	7.00±1.0(-8)	<2.0(-8)	<4.0(-8)	3.80±1.3(-8)
I-133	<3.0(-8)	<4.0(-8)	<5.0(-8)	<8.0(-8)	<1.0(-7)
CS-134	<2.0(-8)	<2.0(-8)	<4.0(-8)	1.30±1.0(-7)	1.50±.30(-6)
CS-136	<3.0(-8)	<3.0(-8)	<3.0(-8)	<3.0(-8)	6.40±5.0(-8)
CS-137	<6.0(-8)	<4.0(-8)	<6.0(-8)	1.00±.40(-7)	1.90±.40(-6)
CR-51	<3.0(-7)	<2.0(-7)	2.20±1.1(-7)	4.60±2.0(-7)	6.10±3.8(-7)
MN-54	<2.0(-8)	4.90±1.0(-8)	<3.0(-8)	4.10±3.7(-8)	7.00±5.0(-8)
FE-59	<5.0(-8)	<6.0(-8)	<6.0(-8)	<6.0(-8)	<3.0(-8)
CO-57	<2.0(-8)	<2.0(-8)	<3.0(-8)	<3.0(-8)	<2.0(-8)
CO-58	<3.0(-8)	5.90±1.0(-8)	3.40±1.7(-8)	8.60±.60(-7)	2.00±.70(-7)
CO-60	<7.7(-8)	<7.0(-8)	<7.0(-8)	1.60±.40(-7)	2.20±1.9(-7)
ZN-65	<7.0(-8)	<7.0(-8)	<7.0(-8)	<6.0(-8)	<4.0(-8)
ZR-95	<4.0(-8)	<4.0(-8)	<6.0(-8)	1.30±.60(-7)	<3.0(-8)
NB-95	<2.0(-8)	<2.0(-8)	<4.0(-8)	<4.0(-8)	<2.0(-8)
MO-99	<2.0(-8)	<1.0(-8)	<2.0(-8)	<4.0(-8)	<4.0(-8)
RU-103	<2.0(-8)	<2.0(-8)	<3.0(-8)	<3.0(-8)	<3.0(-8)
AG-110M	<8.0(-8)	<7.0(-8)	<1.0(-7)	<1.0(-7)	<3.0(-7)
SB-124	<4.0(-8)	<3.0(-8)	<4.0(-8)	<5.0(-8)	5.40±3.3(-8)
SB-125	<6.0(-8)	<6.0(-8)	<1.0(-7)	<9.0(-8)	<7.0(-8)
BA-140	<7.0(-8)	<7.0(-8)	<9.0(-8)	<1.0(-7)	<1.0(-7)
LA-140	<2.0(-8)	<3.0(-8)	<3.0(-8)	<4.0(-8)	<4.0(-8)
CE-141	<3.0(-8)	<2.0(-8)	<4.0(-8)	<6.0(-8)	<3.0(-8)
CE-143	<6.0(-8)	<1.0(-7)	<1.0(-7)	<1.0(-7)	<2.0(-7)
CE-144	<1.0(-7)	<1.0(-7)	<2.0(-7)	<2.0(-7)	<2.0(-7)
NP-239	<7.0(-8)	<7.0(-8)	<1.0(-7)	<2.0(-7)	<4.0(-7)

TABLE B.22 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM MISCELLANEOUS WASTE EVAPORATOR CONDENSATE DEMINERALIZER A

MWE CONDENSATE DEMIN-A OUT

DATE 2/15
TIME 1414

NUCLIDE	MICROCURIES/MILLILITER
I-131	1.30±.20(-6)
I-133	<4.0(-8)
CS-134	<3.0(-8)
CS-136	<3.0(-8)
CS-137	<4.0(-8)
CR-51	1.10±1.0(-7)
MN-54	1.90±1.3(-8)
FE-59	<3.0(-8)
CO-57	<1.0(-8)
CO-58	<4.0(-8)
CO-60	<4.0(-8)
ZN-65	<6.0(-8)
ZR-95	<3.0(-8)
NB-95	<2.0(-8)
MO-99	<2.0(-8)
RU-103	<2.0(-8)
AG-110M	<5.0(-8)
SB-124	<3.0(-8)
SB-125	<4.0(-8)
BA-140	<1.0(-7)
LA-140	<3.0(-8)
CE-141	<3.0(-8)
CE-143	<5.0(-8)
CE-144	<2.0(-7)
NP-239	<1.0(-7)

TABLE B.22A

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM MISCELLANEOUS WASTE EVAPORATOR CONDENSATE DEMINERALIZER A - BETA ANALYSIS RESULTS

DATE	10/25
TIME	1446

NUCLIDE	MICROCURIES/MILLILITER
H-3	1.51 ± 0.07(-1)
C-14	4.9 ± 0.5(-7)
P-32	<3(-7)
FE-55	1.03 ± 0.08(-6)
NI-63	1.7 ± 0.1(-7)
SR-89	<2(-8)
SR-90	5 ± 1(-8)
Y-91	<5(-9)

TABLE B.23

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM MISCELLANEOUS WASTE EVAPORATOR CONDENSATE DEMINERALIZER B

MWE CONDENSATE DEMIN-B OUT

DATE	9/25	9/25	10/25	11/14	2/15
TIME	1015	1445	1447	1419	915
NUCLIDE	MICROCURIES/MILLILITER				
I-131	<2.0(-8)	7.70±1.8(-8)	<3.0(-8)	<3.0(-8)	<2.0(-8)
I-133	<2.0(-6)	<1.0(-7)	<5.0(-8)	<7.0(-8)	<4.0(-8)
CS-134	<3.0(-8)	5.00±2.0(-8)	4.70±1.7(-8)	8.00±1.2(-8)	1.06±.05(-6)
CS-136	<3.0(-8)	<4.0(-8)	<4.0(-8)	<3.0(-8)	2.60±1.8(-8)
CS-137	<4.0(-8)	6.50±2.2(-8)	2.60±2.0(-8)	1.10±.60(-7)	1.50±.10(-6)
CR-51	<2.0(-7)	<4.0(-8)	<3.0(-7)	<3.0(-7)	<2.0(-7)
MN-54	3.20±1.2(-8)	<5.0(-8)	<3.0(-8)	<3.0(-8)	3.90±2.1(-8)
FE-59	<5.0(-8)	<5.0(-8)	<8.0(-8)	<6.0(-8)	<4.0(-8)
CO-57	<2.0(-8)	<3.0(-8)	<2.0(-8)	<3.0(-8)	<1.0(-8)
CO-58	8.80±1.2(-8)	2.10±.30(-7)	<3.0(-8)	<1.0(-7)	5.80±1.4(-8)
CO-60	<1.0(-7)	<7.0(-8)	1.00±.70(-8)	<7.0(-8)	<5.0(-8)
ZN-65	<5.0(-8)	<5.0(-8)	<6.0(-8)	<5.0(-8)	<6.0(-8)
ZR-95	<3.0(-8)	<5.0(-8)	<5.0(-8)	<5.0(-8)	<6.0(-8)
NB-95	<3.0(-8)	<4.0(-8)	<4.0(-8)	<3.0(-8)	<2.0(-8)
MO-99	<2.0(-8)	<4.0(-8)	<2.0(-8)	<4.0(-8)	<2.0(-8)
RU-103	<2.0(-8)	<5.0(-8)	<3.0(-8)	<3.0(-8)	<2.0(-8)
AG-110M	<9.0(-8)	<9.0(-8)	<8.0(-8)	<1.0(-7)	<5.0(-8)
SB-124	<4.0(-8)	<3.0(-8)	<5.0(-8)	<5.0(-8)	<3.0(-8)
SB-125	<6.0(-8)	<4.0(-8)	<7.0(-8)	<7.0(-8)	<5.0(-8)
BA-140	<7.0(-8)	<5.0(-8)	<1.0(-7)	<1.0(-7)	<8.0(-8)
LA-140	<3.0(-8)	<7.0(-8)	<4.0(-8)	<4.0(-8)	<3.0(-8)
CE-141	<3.0(-8)	<3.0(-8)	<4.0(-8)	<5.0(-8)	<3.0(-8)
CE-143	<5.0(-8)	<1.4(-7)	<7.0(-8)	<2.0(-7)	<9.0(-8)
CE-144	<2.0(-7)	<3.0(-8)	<2.0(-7)	<2.0(-7)	<1.0(-7)
NP-239	<8.0(-8)	<5.0(-8)	<1.0(-7)	<2.0(-7)	<8.0(-8)

TABLE B.23 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM MISCELLANEOUS WASTE EVAPORATOR DEMINERALIZER B

MBE CONDENSATE DEMIN-B OUT

DATE 2/15
TIME 1418

NUCLIDE	MICROCURIES/MILLILITER
I-131	2.50±1.1(-8)
I-133	<5.0(-8)
CS-134	4.00±.40(-7)
CS-136	<3.0(-8)
CS-137	6.20±.10(-7)
CR-51	<2.0(-7)
MN-54	1.40±1.1(-8)
FE-59	<4.0(-8)
CO-57	<1.0(-8)
CO-58	3.90±.10(-8)
CO-60	<5.0(-8)
ZN-65	<7.0(-8)
ZR-95	<3.0(-8)
NB-95	<3.0(-8)
MO-99	<2.0(-8)
RU-103	<2.0(-8)
AG-110M	<1.0(-7)
SB-124	<2.0(-8)
SB-125	<5.0(-8)
BA-140	<7.0(-8)
LA-140	<4.0(-8)
CE-141	<3.0(-8)
CE-143	<2.0(-7)
CE-144	<1.0(-7)
NP-239	<2.0(-7)

TABLE B.23A

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM MISCELLANEOUS WASTE EVAPORATOR CONDENSATE DEMINERALIZER B - BETA ANALYSIS RESULTS

DATE	10/25
TIME	1447

NUCLIDE	MICROCURIES/MILLILITER
H-3	1.49 ± 0.07(-1)
C-14	4.9 ± 0.5(-7)
P-32	<1(-7)
FE-55	1.9 ± 0.1(-6)
NI-63	2.7 ± 0.1(-7)
SR-89	<2(-8)
SR-90	2.1 ± 0.6(-8)
Y-91	<4(-9)

TABLE B.24

RADIONUCLIDE CONCENTRATIONS IN INLET TO MISCELLANEOUS WASTE TANK FILTER - DEMINERALIZER

MISC WASTE OIL AGG. FILTER-DEMIN INLET

DATE 1/10
TIME 1355

NUCLIDE	MICROCURIES/MILLILITER
I-131	1.60±.01(-3)
I-133	1.58±.07(-4)
CS-134	1.33±.02(-3)
CS-136	6.40±.50(-5)
CS-137	1.64±.02(-3)
NA-24	1.40±.20(-5)
CR-51	3.67±.09(-3)
MN-54	1.41±.02(-3)
FE-59	3.89±.10(-4)
CO-57	1.15±.04(-4)
CO-58	3.92±.01(-2)
CO-60	2.80±.04(-3)
ZN-65	1.40±.70(-5)
ZR-95	2.77±.10(-4)
NB-95	5.30±.10(-4)
MO-99	1.39±.04(-4)
RU-103	8.10±.70(-5)
AG-110M	1.70±.20(-4)
SB-124	2.21±.07(-4)
SB-125	3.70±.20(-4)
LA-140	3.50±.20(-5)
CE-141	1.40±.60(-5)
CE-144	6.10±2.4(-5)

TABLE B.25

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM MISCELLANEOUS WASTE TANK FILTER-DEMINERALIZER

MISC WASTE TTL ABS. FILTER-DEMIN OUTLET

DATE 1/10
TIME 1357

NUCLIDE	MICROCURIES/MILLILITER
I-131	<2.9(-6)
I-133	<3.8(-6)
CS-134	1.20±.20(-5)
CS-136	<3.0(-6)
CS-137	6.20±2.8(-6)
NA-24	<4.0(-7)
CR-51	8.60±.70(-4)
MN-54	1.36±.04(-4)
FE-59	1.80±.50(-5)
CO-57	<2.3(-6)
CO-58	6.80±.10(-3)
CO-60	4.40±.10(-4)
ZN-65	4.50±2.3(-6)
ZR-95	2.50±.50(-5)
NB-95	5.50±.60(-5)
MO-99	<1.6(-6)
RU-103	<4.8(-6)
AG-110M	1.20±.60(-5)
SB-124	2.40±.30(-5)
SB-125	1.70±.40(-5)
LA-140	2.60±.70(-6)
CE-141	<2.8(-6)
CE-144	<1.4(-5)

TABLE B.26

RADIONUCLIDE CONCENTRATIONS IN INLET TO SPENT FUEL POOL FILTER

SPENT FUEL POOL FILTER INLET

DATE	9/21	10/11	11/ 8	11/16	11/29
TIME	1046	1340	1515	1208	940
NUCLIDE	MICROCURIES/MILLILITER				
I-131	<7.6(-8)	<8.2(-8)	<2.4(-8)	<9.9(-8)	1.71±.02(-4)
I-132	<9.9(-7)	<2.7(-7)	<2.1(-7)	NOTE 1	<2.3(-5)
I-134	<7.1(-6)	1.25±.11(-5)	3.28±.61(-5)	NOTE 1	1.39±.07(-3)
CS-134	2.67±.24(-7)	3.83±.41(-7)	8.48±.78(-7)	1.15±.11(-6)	3.20±.05(-4)
CS-136	<1.8(-7)	<9.2(-8)	<3.4(-8)	<1.8(-7)	<2.0(-5)
CS-137	5.45±.27(-7)	1.39±.33(-6)	1.83±.05(-6)	1.98±.13(-6)	4.04±.05(-4)
CS-138	<1.3(-5)	<9.6(-6)	<7.6(-6)	NOTE 1	<8.3(-4)
CR-51	<6.2(-7)	<7.3(-8)	<2.3(-7)	<7.7(-7)	6.31±.18(-4)
MN-54	8.79±.29(-7)	2.78±.27(-7)	3.54±.20(-7)	3.20±.19(-6)	1.01±.02(-4)
FE-59	<1.9(-7)	<8.8(-8)	<4.9(-8)	<3.0(-7)	NOTE 1
CO-57	3.54±1.3(-8)	7.40±1.8(-8)	2.60±1.0(-8)	<9.7(-8)	1.50±.12(-5)
CO-58	1.56±.07(-6)	1.11±.05(-6)	8.13±.34(-7)	2.50±.13(-6)	7.59±.06(-3)
CO-60	2.64±.06(-6)	1.16±.09(-6)	1.75±.09(-6)	8.58±.25(-6)	2.27±.03(-4)
ZR-95	<1.8(-7)	<7.9(-8)	<4.4(-8)	<2.2(-7)	1.29±.43(-5)
NB-95	<9.9(-8)	<1.6(-7)	<8.0(-8)	<1.6(-7)	3.57±.24(-5)
MO-99	<6.3(-8)	<6.5(-8)	<1.6(-8)	<1.1(-7)	2.79±.12(-5)
RU-103	<8.2(-8)	<8.6(-8)	<2.5(-8)	<1.2(-7)	1.05±.29(-5)
AG-110M	5.62±3.3(-7)	<7.3(-7)	6.93±.52(-7)	<4.5(-7)	1.13±.38(-5)
SB-124	<1.2(-7)	<9.8(-8)	<3.6(-8)	<1.3(-7)	3.84±.18(-5)
SB-125	4.84±.69(-7)	5.18±1.1(-7)	5.32±.62(-7)	7.75±2.1(-7)	2.43±.65(-5)
TE-132	<8.0(-8)	<8.9(-8)	<1.9(-8)	<9.0(-8)	8.77±1.5(-6)
BA-140	<2.9(-7)	<9.5(-8)	<9.0(-8)	<4.5(-7)	<8.0(-6)
LA-140	<7.1(-8)	<7.4(-8)	<1.8(-8)	<8.9(-8)	1.19±.10(-5)
CE-141	<1.2(-7)	<5.8(-8)	<2.5(-8)	<1.6(-7)	<3.9(-6)
NP-239	<2.9(-7)	<6.5(-8)	<8.4(-8)	<4.7(-7)	4.14±1.0(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.26 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN INLET TO SPENT FUEL POOL FILTER

SPENT FUEL POOL FILTER INLET

DATE	12/ 6	12/12	1/23	2/27
TIME	1204	1139	1052	1129
NUCLIDE	MICROCURIES/MILLILITER			
I-131	1.38±.10(-4)	2.58±.03(-5)	6.33±1.3(-7)	<2.8(-7)
I-132	<2.6(-5)	2.14±.45(-6)	NOTE 1	<1.9(-6)
I-134	1.08±.08(-3)	9.16±.14(-5)	NOTE 1	4.60±.21(-4)
CS-134	5.10±.10(-4)	1.10±.02(-4)	5.40±.17(-6)	5.64±.23(-6)
CS-136	2.78±.37(-5)	4.69±.18(-6)	<1.8(-7)	<3.0(-7)
CS-137	5.83±.09(-4)	1.28±.01(-4)	7.09±.17(-6)	8.87±.22(-6)
CS-138	3.99±1.5(-4)	<1.7(-6)	NOTE 1	NOTE 1
CR-51	7.10±.42(-4)	2.38±.02(-4)	1.28±.08(-5)	1.71±.13(-5)
MN-54	1.46±.04(-4)	3.53±.06(-5)	4.18±.20(-6)	1.71±.03(-5)
FE-59	3.77±.52(-5)	9.83±.42(-6)	5.97±1.8(-7)	2.03±.25(-6)
CO-57	1.88±.29(-5)	4.38±.16(-6)	5.04±.58(-7)	9.94±.87(-7)
CO-58	8.70±.09(-3)	2.01±.04(-3)	1.00±.02(-4)	2.03±.03(-4)
CO-60	3.38±.12(-4)	9.06±.15(-5)	1.20±.04(-5)	4.14±.10(-5)
ZR-95	1.64±.46(-5)	5.13±.36(-6)	3.66±1.6(-7)	2.17±.23(-6)
NB-95	5.54±.50(-5)	1.63±.14(-5)	2.65±.14(-6)	5.44±.22(-6)
MO-99	<5.7(-6)	6.29±2.5(-7)	<2.2(-7)	<2.3(-7)
RU-103	2.23±.61(-5)	2.85±.41(-6)	2.64±1.0(-7)	<4.0(-7)
AG-110M	7.49±.99(-5)	2.00±.05(-5)	4.77±.27(-6)	5.38±.54(-6)
SB-124	3.15±.82(-5)	8.47±.47(-6)	6.22±.30(-6)	5.54±.27(-6)
SB-125	<2.9(-5)	8.76±.35(-6)	9.23±.36(-6)	9.86±.53(-6)
TE-132	<7.1(-6)	<5.0(-7)	<2.1(-7)	<2.4(-7)
BA-140	<6.2(-5)	7.02±1.0(-6)	<8.1(-7)	<1.2(-7)
LA-140	1.83±.25(-5)	2.88±.15(-6)	<2.2(-7)	<6.4(-8)
CE-141	<1.0(-5)	2.71±.25(-6)	2.94±.97(-7)	3.15±1.5(-7)
NP-239	<2.2(-5)	<1.1(-6)	<8.6(-7)	<6.2(-7)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHMETIC OPERATIONS WITH < NUMBERS

TABLE B.26A

RADIONUCLIDE CONCENTRATIONS IN INLET TO SPENT FUEL POOL FILTER - ALPHA AND BETA ANALYSIS RESULTS

DATE	10/11	11/8	11/16	11/29
TIME	1341	850	1212	1000
NUCLIDE		MICROCURIES/MILLILITER		
H-3	9.8 ± 0.5(-2)	1.07 ± 0.05(-1)	1.05 ± 0.05(-1)	1.01 ± 0.05(-1)
C-14	7.3 ± 0.7(-8)	*	8 ± 1(-8)	4.3 ± 0.4(-7)
P-32	<2(-7)	*	*	*
FE-55	1.86 ± 0.08(-6)	*	*	4.34 ± 0.03(-4)
NI-63	2.27 ± 0.05(-6)	*	*	2.54 ± 0.01(-4)
SR-89	<2(-8)	*	*	2.52 ± 0.04(-5)
SR-90	1.2 ± 0.2(-7)	*	*	3.22 ± 0.03(-6)
Y-91	<2(-8)	*	*	4.2 ± 0.3(-6)
PU-238	1.53 ± 0.08(-9)	*	*	*
PU-239,240	1.14 ± 0.01(-7)	*	*	*
AM-241	1.18 ± 0.04(-8)	*	*	*
CM-242	1.4 ± 0.4(-10)	*	*	*
CM-244	7.6 ± 0.3(-9)	*	*	*

* ANALYSIS NOT PERFORMED

TABLE B.27

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM SPENT FUEL POOL FILTER

SPENT FUEL POOL FILTER OUTLET

DATE	9/12	9/21	10/11	11/ 8	11/16
TIME	1339	1054	1354	1530	1204
NUCLIDE	MICROCURIES/MILLILITER				
I-131	<3.0(-8)	<5.7(-8)	<9.1(-8)	<1.1(-7)	<7.1(-8)
I-132	<3.0(-6)	<1.4(-7)	<7.9(-7)	<1.6(-4)	NOTE 1
I-134	NOTE 1	2.77±.63(-6)	1.30±.10(-4)	NOTE 1	NOTE 1
CS-134	2.23±.29(-7)	1.89±.36(-7)	6.82±.49(-7)	9.56±1.0(-7)	8.12±.67(-7)
CS-136	<5.4(-8)	<6.3(-8)	7.67±2.2(-8)	<2.1(-7)	<1.6(-7)
CS-137	4.76±.33(-7)	5.91±.31(-7)	2.13±.37(-6)	1.91±.12(-6)	1.93±.14(-6)
CS-138	NOTE 1	<4.3(-6)	NOTE 1	NOTE 1	NOTE 1
CR-51	2.65±1.2(-7)	<3.3(-7)	<7.7(-8)	<1.1(-6)	<5.4(-7)
MN-54	8.63±.36(-7)	1.23±.18(-7)	1.31±.24(-7)	1.13±.02(-5)	3.18±1.9(-7)
FE-59	<6.6(-8)	<9.4(-8)	<1.1(-7)	<3.8(-7)	<1.0(-7)
CO-57	7.50±1.3(-8)	<3.3(-8)	2.80±1.2(-8)	3.83±.36(-7)	5.09±2.5(-8)
CO-58	1.12±.05(-6)	6.87±.36(-7)	1.00±.04(-6)	7.25±.17(-6)	6.66±.62(-7)
CO-60	2.93±.08(-6)	6.94±.41(-7)	7.48±.82(-7)	2.68±.04(-5)	1.22±.11(-6)
ZR-95	<4.9(-8)	<9.3(-8)	<8.3(-8)	<2.4(-7)	<1.1(-7)
NB-95	<7.4(-8)	<9.0(-8)	<1.5(-7)	<1.7(-7)	<6.6(-8)
MO-99	<2.4(-8)	<3.3(-8)	<7.3(-8)	<7.3(-8)	<6.3(-8)
RU-103	<3.3(-8)	<4.7(-8)	<7.9(-8)	<1.1(-7)	<6.2(-8)
AG-110M	7.11±1.1(-7)	5.48±.95(-7)	<1.1(-6)	<7.1(-7)	<2.3(-7)
SB-124	<4.4(-8)	<7.2(-8)	<9.8(-8)	<9.0(-8)	<7.9(-8)
SB-125	6.51±1.1(-7)	5.12±.85(-7)	5.33±.66(-7)	5.24±2.1(-7)	6.84±1.1(-7)
TE-132	<2.9(-8)	<3.9(-8)	<6.9(-8)	<8.7(-8)	<7.5(-8)
BA-140	1.71±.66(-7)	<1.8(-7)	<8.6(-8)	<4.7(-7)	<2.5(-7)
LA-140	<2.5(-8)	<4.7(-8)	<1.4(-7)	<6.9(-8)	<8.9(-8)
CE-141	<3.5(-8)	<6.3(-8)	<5.2(-8)	<1.2(-7)	<9.0(-8)
NP-239	<8.3(-8)	<1.6(-7)	<5.9(-8)	<3.2(-7)	<2.7(-7)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.27 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM SPENT FUEL POOL FILTER

SPENT FUEL POOL FILTER OUTLET

DATE	11/29	12/ 6	12/13	1/23	2/27
TIME	938	1206	1155	1055	1127
NUCLIDE	MICROCURIES/MILLILITER				
I-131	1.77±.04(-4)	1.22±.0[illegible](-4)	4.10±.13(-5)	<5.5(-7)	<3.0(-7)
I-132	3.08±.41(-5)	<1.4(-5)	<2.9(-5)	NOTE 1	<2.9(-6)
I-134	1.52±.07(-3)	9.54±.60(-4)	1.49±.05(-4)	NOTE 1	1.55±.06(-3)
CS-134	3.35±.05(-4)	5.17±.06(-4)	1.47±.02(-4)	5.44±.25(-6)	5.76±.19(-6)
CS-136	1.58±.07(-5)	2.28±.21(-5)	9.76±1.5(-6)	<3.9(-7)	<2.4(-7)
CS-137	4.18±.06(-4)	5.98±.07(-4)	1.83±.02(-4)	7.22±.26(-6)	9.12±.20(-6)
CS-138	<3.2(-4)	<1.5(-4)	<6.7(-6)	NOTE 1	NOTE 1
CR-51	3.49±.14(-4)	7.89±.25(-4)	1.30±.01(-3)	5.01±.24(-5)	1.04±.10(-5)
MN-54	8.27±.18(-5)	1.47±.04(-4)	3.49±.03(-4)	4.02±.07(-5)	1.02±.02(-5)
FE-59	2.09±.11(-5)	3.43±.44(-5)	1.26±.03(-4)	8.97±.33(-6)	1.09±.26(-6)
CO-57	1.16±.06(-5)	1.85±.19(-5)	3.09±.22(-5)	1.31±.10(-6)	6.18±.83(-7)
CO-58	6.83±.06(-3)	8.75±.10(-3)	8.70±.09(-3)	3.97±.09(-4)	1.48±.02(-4)
CO-60	1.79±.03(-4)	3.40±.06(-4)	6.04±.04(-4)	6.18±.06(-5)	2.51±.05(-5)
ZR-95	5.88±1.3(-6)	2.34±.40(-5)	8.34±.21(-5)	7.77±.39(-6)	1.06±.20(-6)
NB-95	1.80±.09(-5)	4.43±.31(-5)	1.58±.03(-4)	1.64±.06(-5)	4.33±.30(-6)
MO-99	2.95±.08(-5)	4.78±1.7(-6)	<1.7(-6)	<4.7(-7)	<1.6(-7)
RU-103	1.51±1.1(-6)	1.03±.31(-5)	1.31±.21(-5)	<3.9(-7)	<2.8(-7)
AG-110M	3.66±.18(-5)	5.72±.32(-5)	3.77±.34(-5)	5.06±.50(-6)	5.01±.34(-6)
SB-124	4.07±.16(-5)	4.64±.31(-5)	1.95±.06(-5)	6.56±.31(-6)	4.98±.26(-6)
SB-125	1.79±.32(-5)	2.23±.83(-5)	2.62±.35(-5)	9.12±.69(-6)	9.89±.45(-6)
TE-132	8.86±1.1(-6)	<3.6(-6)	<1.8(-6)	<4.2(-7)	<1.7(-7)
BA-140	2.22±.43(-5)	3.55±1.1(-5)	<1.2(-5)	<2.1(-6)	<1.1(-6)
LA-140	1.11±.05(-5)	2.14±.15(-5)	4.91±.32(-6)	<5.5(-7)	<5.5(-8)
CE-141	<1.9(-6)	<9.1(-6)	9.38±3.8(-6)	<3.7(-7)	<2.5(-7)
NP-239	2.74±.61(-5)	<1.1(-5)	<8.3(-6)	<1.6(-6)	<5.4(-7)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMETIC OPERATIONS WITH < NUMBERS

TABLE B.28

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM SPENT FUEL POOL DEMINERALIZER

SPENT FUEL POOL DEMINERLIZER OUTLET

DATE	9/12	9/21	10/11	11/ 8	11/16
TIME	1352	1101	1358	1525	1158
NUCLIDE	MICROCURIES/MILLILITER				
I-131	<3.8(-8)	2.40±1.0(-8)	<1.3(-7)	<5.3(-8)	<3.9(-8)
I-132	<1.0(-6)	<2.6(-6)	<2.5(-6)	<5.0(-7)	NOTE 1
I-134	NOTE 1	<2.9(-5)	NOTE 1	<1.7(-5)	NOTE 1
CS-134	2.35±2.2(-7)	2.52±.18(-7)	4.49±.46(-7)	7.92±.44(-7)	9.44±.38(-7)
CS-136	<7.4(-8)	<6.7(-8)	<1.1(-7)	<8.8(-8)	<6.7(-8)
CS-137	5.22±.49(-7)	5.96±.15(-7)	1.88±.25(-6)	1.61±.05(-6)	1.89±.07(-6)
CS-138	NOTE 1	NOTE 1	NOTE 1	<3.4(-6)	NOTE 1
CR-51	<3.9(-7)	<1.8(-7)	<7.1(-8)	<4.6(-7)	<3.5(-7)
MN-54	1.99±.05(-6)	1.34±.07(-7)	4.76±.41(-7)	3.71±.06(-6)	1.44±.04(-6)
FE-59	<1.2(-7)	<4.6(-8)	<1.2(-7)	<1.4(-7)	<1.1(-7)
CO-57	1.87±.16(-7)	<1.6(-8)	5.46±1.3(-8)	2.21±.24(-7)	1.11±.19(-7)
CO-58	5.40±.12(-6)	3.05±.10(-7)	1.19±.08(-6)	4.74±.08(-6)	2.05±.05(-6)
CO-60	1.14±.02(-5)	7.00±.22(-7)	2.59±.12(-6)	1.72±.02(-5)	7.45±.13(-6)
ZR-95	<9.4(-8)	<3.5(-8)	<9.4(-8)	<1.2(-7)	<9.7(-8)
NB-95	5.54±2.6(-8)	<3.7(-8)	<1.1(-7)	<9.4(-8)	<6.5(-8)
MO-99	<2.4(-8)	<1.9(-8)	3.46±1.1(-8)	<3.1(-8)	<3.7(-8)
RU-103	<4.4(-8)	<2.0(-8)	4.86±1.7(-8)	<5.4(-8)	<4.0(-8)
AG-110M	2.42±.97(-7)	2.06±.23(-7)	<7.8(-7)	4.32±1.2(-7)	5.71±.86(-7)
SB-124	5.54±2.4(-8)	4.84±1.0(-8)	<8.5(-8)	<5.0(-8)	<4.5(-8)
SB-125	6.60±.81(-7)	4.58±.15(-7)	4.77±.65(-7)	4.49±.98(-7)	6.60±.66(-7)
TE-132	<3.6(-8)	<2.0(-8)	<7.1(-8)	<3.7(-8)	<3.6(-8)
BA-140	<1.6(-7)	<7.7(-8)	<8.4(-8)	<1.9(-7)	<1.8(-7)
LA-140	<2.5(-8)	<2.9(-8)	<1.1(-7)	<5.1(-8)	<6.5(-8)
CE-141	<5.3(-8)	<3.0(-8)	<5.5(-8)	<6.6(-8)	<4.7(-8)
NP-239	<1.0(-7)	<7.1(-8)	<6.1(-8)	<1.8(-7)	<2.0(-7)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.28 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN OUTLET FROM SPENT FUEL POOL DEMINERALIZER

SPENT FUEL POOL DEMINERALIZER OUTLET

DATE	11/29	12/ 7	12/13	1/23	2/27
TIME	942	1210	1159	1058	1125
NUCLIDE	MICROCURIES/MILLILITER				
I-131	1.95±.28(-6)	7.11±.58(-6)	1.06±.01(-5)	5.65±1.4(-7)	<1.9(-7)
I-132	8.03±1.0(-6)	<4.3(-6)	<5.2(-7)	NOTE 1	<2.6(-6)
I-134	1.70±.49(-5)	1.09±.12(-4)	1.33±.07(-5)	NOTE 1	6.09±1.7(-4)
CS-134	1.35±.29(-6)	1.98±.57(-6)	1.06±.14(-6)	1.49±.11(-6)	5.23±.17(-6)
CS-136	<4.6(-7)	<6.8(-7)	<1.4(-7)	<2.1(-7)	<1.7(-7)
CS-137	2.04±.31(-6)	1.91±.99(-6)	2.09±.10(-6)	3.16±.16(-6)	8.28±.20(-6)
CS-138	<1.6(-5)	<3.9(-5)	<9.1(-7)	NOTE 1	NOTE 1
CR-51	1.42±.03(-4)	1.69±.05(-4)	1.31±.01(-4)	1.03±.08(-5)	6.41±.85(-6)
MN-54	1.05±.03(-5)	2.91±.08(-5)	1.13±.01(-5)	2.11±.12(-6)	3.69±.13(-6)
FE-59	8.41±.50(-6)	1.08±.09(-5)	5.87±.14(-6)	4.36±1.7(-7)	7.00±1.5(-7)
CO-57	1.41±.22(-6)	2.56±.41(-6)	1.77±.08(-6)	3.20±.60(-7)	4.08±.60(-7)
CO-58	5.36±.07(-4)	8.20±.10(-4)	6.55±.07(-4)	9.93±.09(-5)	8.84±.11(-5)
CO-60	3.82±.12(-5)	9.27±.14(-5)	4.25±.05(-5)	7.81±.18(-6)	1.36±.03(-5)
ZR-95	2.60±.38(-6)	6.91±.84(-6)	3.09±.14(-6)	7.45±1.1(-7)	8.56±3.8(-7)
NB-95	6.28±.32(-6)	1.08±.06(-5)	7.63±.16(-6)	1.41±.18(-6)	1.54±.10(-6)
MO-99	<3.2(-7)	<5.4(-7)	<1.8(-7)	<2.7(-7)	<1.1(-7)
RU-103	2.36±.42(-6)	<1.9(-6)	2.01±.16(-6)	<2.6(-7)	<2.7(-7)
AG-110M	1.76±.55(-6)	5.02±1.4(-6)	2.87±.18(-6)	6.78±1.7(-7)	7.35±2.2(-7)
SB-124	<2.6(-7)	<3.8(-7)	1.29±.07(-6)	6.20±.30(-6)	4.82±.26(-6)
SB-125	2.00±.81(-6)	<3.0(-6)	1.15±.24(-6)	9.26±.32(-6)	8.76±.37(-6)
TE-132	4.15±.23(-6)	8.28±3.6(-7)	3.40±.83(-7)	<3.3(-7)	<1.9(-7)
BA-140	<2.5(-6)	<4.5(-6)	<9.2(-7)	<1.1(-6)	<6.0(-7)
LA-140	2.52±.22(-6)	1.75±.28(-6)	5.49±.32(-7)	<3.3(-7)	<5.2(-8)
CE-141	<5.9(-7)	<1.0(-6)	1.02±.09(-6)	<2.5(-7)	<2.1(-7)
NP-239	<1.2(-6)	<2.7(-6)	<5.6(-7)	<1.7(-6)	<4.3(-7)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.29

RADIONUCLIDE CONCENTRATIONS IN SPENT FUEL POOL DIP SAMPLES

SPENT FUEL POOL DIP SAMPLE

DATE	10/11	11/ 8	11/29	12/ 6	12/12
TIME	1313	1515	1000	1217	1139
NUCLIDE	MICROCURIES/MILLILITER				
I-131	<1.3(-7)	<2.4(-8)	1.63±.03(-4)	1.27±.05(-4)	2.58±.03(-5)
I-132	<1.3(-5)	<2.1(-7)	<1.5(-5)	<1.2(-5)	2.14±.45(-6)
I-134	NOTE 1	3.28±.61(-5)	4.97±.42(-4)	4.96±.21(-4)	9.16±.14(-5)
CS-134	2.30±.07(-6)	8.48±.78(-7)	2.90±.04(-4)	5.24±.08(-4)	1.10±.02(-4)
CS-136	8.48±2.6(-8)	<3.4(-8)	<4.8(-5)	2.37±.39(-5)	4.69±.16(-6)
CS-137	4.91±.21(-6)	1.83±.05(-6)	3.90±.08(-4)	6.20±.08(-4)	1.28±.01(-4)
CS-138	NOTE 1	<7.6(-6)	<6.8(-5)	<7.7(-5)	<1.7(-6)
CR-51	<9.3(-8)	<2.3(-7)	5.43±.21(-4)	8.24±.27(-4)	2.38±.02(-4)
MN-54	3.17±.29(-7)	3.54±.20(-7)	9.69±.29(-5)	1.64±.04(-4)	3.53±.06(-5)
FE-59	<1.2(-7)	<4.9(-8)	2.92±.19(-5)	4.69±.43(-5)	9.83±.42(-6)
CO-57	8.45±4.0(-8)	2.80±1.0(-8)	9.37±1.2(-6)	1.61±.19(-5)	4.38±.16(-6)
CO-58	1.07±.05(-6)	8.13±.34(-7)	7.22±.10(-3)	9.19±.08(-3)	2.01±.04(-3)
CO-60	1.36±.08(-6)	1.75±.09(-6)	2.11±.03(-4)	3.60±.05(-4)	9.06±.15(-5)
ZR-95	1.15±.54(-7)	<4.4(-8)	1.52±.63(-5)	2.99±.37(-5)	5.13±.36(-6)
NB-95	<1.8(-7)	<8.0(-8)	5.19±.28(-5)	6.62±.48(-5)	1.63±.14(-5)
MO-99	<9.6(-8)	<1.6(-8)	3.15±.18(-5)	5.42±2.1(-6)	6.29±2.5(-7)
RU-103	<1.0(-7)	<2.5(-8)	1.07±.25(-5)	1.39±.29(-5)	2.85±.41(-6)
AG-110M	7.69±1.6(-7)	6.93±.52(-7)	<1.0(-4)	6.24±.50(-5)	2.00±.05(-5)
SB-124	<6.5(-8)	<3.6(-8)	3.43±.20(-5)	4.35±.27(-5)	8.47±.47(-6)
SB-125	6.83±.99(-7)	5.32±.62(-7)	<6.5(-6)	3.18±.87(-5)	8.76±.35(-6)
TE-132	<1.1(-7)	<1.9(-8)	1.58±.30(-5)	<4.2(-6)	<5.0(-7)
BA-140	<1.1(-7)	<9.0(-8)	<7.7(-6)	<2.7(-5)	7.02±1.0(-6)
LA-140	<1.1(-7)	<1.8(-8)	1.04±.07(-5)	1.84±.13(-5)	2.85±.15(-6)
CE-141	<8.3(-8)	<3.5(-8)	<5.2(-6)	8.23±4.0(-6)	2.71±.25(-6)
NP-239	<9.9(-8)	<6.4(-8)	3.46±.98(-5)	<1.3(-5)	<1.1(-6)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.29A

RADIONUCLIDE CONCENTRATIONS IN SPENT FUEL POOL DIP SAMPLES - BETA ANALYSIS RESULTS

DATE	12/12
TIME	1139

NUCLIDE	MICROCURIES/MILLILITER
H-3	1.07 ± 0.05(-1)
C-14	1.1 ± 0.1(-6)
FE-55	1.71 ± 0.02(-4)
NI-63	2.07 ± 0.01(-4)
SR-89	1.13 ± 0.01(-5)
SR-90	1.37 ± 0.02(-6)
Y-91	5.7 ± 0.4(-6)

TABLE B.30

RADIONUCLIDE CONCENTRATIONS IN SPENT FUEL POOL CAVITY SAMPLES

SPENT FUEL POOL CAVITY SAMPLE

DATE	11/22	11/29	12/ 6
TIME	1530	1513	1030
NUCLIDE	MICROCURIES/MILLILITER		
I-131	2.16±.01(-3)	5.00±.05(-4)	3.04±.10(-4)
I-132	NOTE 1	6.60±1.4(-5)	2.44±.90(-5)
I-134	NOTE 1	NOTE 1	3.47±.16(-4)
CS-134	1.36±.03(-3)	1.20±.02(-3)	9.52±.20(-4)
CS-136	1.41±.06(-4)	4.80±.20(-5)	5.84±.52(-5)
CS-137	1.54±.01(-3)	1.52±.01(-3)	1.15±.01(-3)
CS-138	NOTE 1	NOTE 1	<2.0(-5)
CR-51	1.32±.03(-3)	2.14±.02(-3)	1.41±.10(-3)
MN-54	5.35±.04(-4)	2.91±.04(-4)	3.31±.13(-4)
FE-59	1.13±.05(-4)	1.06±.02(-4)	9.83±.75(-5)
CO-57	3.69±.19(-5)	3.80±.30(-5)	4.91±.62(-5)
CO-58	2.37±.03(-2)	2.38±.01(-2)	1.63±.02(-2)
CO-60	9.14±.20(-4)	6.30±.10(-4)	7.19±.12(-4)
ZR-95	4.92±.49(-5)	5.80±.30(-5)	3.55±.96(-5)
NB-95	1.01±.05(-4)	1.20±.03(-4)	1.09±.08(-4)
MO-99	5.75±.10(-4)	9.00±.10(-5)	1.61±.48(-5)
RU-103	1.97±.36(-5)	2.80±.30(-5)	1.89±.80(-5)
AG-110M	5.18±.53(-5)	1.21±.04(-4)	1.19±.18(-4)
SB-124	8.68±.58(-5)	1.33±.02(-4)	7.51±.80(-5)
SB-125	5.40±.83(-5)	1.20±.07(-4)	<5.9(-5)
TE-132	1.78±.96(-5)	NOTE 1	1.15±.48(-5)
BA-140	1.05±.23(-4)	1.11±.10(-4)	<6.9(-5)
LA-140	1.05±.03(-3)	2.90±.10(-5)	2.78±.27(-5)
CE-141	<7.0(-6)	7.00±2.0(-6)	<1.4(-5)
NP-239	2.47±.38(-4)	1.00±.20(-4)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMATIC OPERATIONS WITH < NUMBERS

TABLE B.30A

RADIONUCLIDE CONCENTRATIONS IN SPENT FUEL POOL CAVITY SAMPLES - BETA ANALYSIS RESULTS

DATE	11/22	11/29
TIME	1530	950
NUCLIDE		MICROCURIES/MILLILITER
H-3	9.5 ± 0.5(-2)	9.9 ± 0.5(-2)
C-14	1.8 ± 0.2(-6)	1.0 ± 0.1(-6)
FE-55	1.222 ± 0.004(-3)	8.70 ± 0.04(-4)
NI-63	1.709 ± 0.002(-3)	8.6 ± 0.4(-2)
SR-89	7.81 ± 0.06(-5)	8.48 ± 0.07(-5)
SR-90	5.79 ± 0.05(-6)	1.01 ± 0.01(-5)
Y-91	6.4 ± 0.4(-6)	2.1 ± 0.1(-5)

TABLE B.31

NOBLE GAS CONCENTRATIONS IN WASTE GAS DECAY TANKS

DATE	10/25	11/ 3	11/20	2/12	2/15
TIME	1518	1150	1455	1350	1020
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
AR-41	<1.3(-6)	<2.2(-6)	<5.8(-8)	<6.0(-7)	<1.9(-6)
KR-85M	<3.2(-7)	<1.0(-6)	<3.0(-8)	<6.4(-8)	4.90±.90(-6)
KR-85	2.13±.07(-3)	4.60±.50(-4)	6.20±.10(-4)	2.03±.02(-3)	1.32±.06(-2)
KR-88	<3.0(-7)	<7.3(-6)	<1.8(-7)	<1.0(-6)	<7.4(-6)
XE-131M	1.05±.04(-4)	<2.6(-5)	<1.6(-6)	1.14±.01(-4)	3.55±.05(-3)
XE-133M	<1.3(-7)	<4.4(-6)	<3.2(-7)	5.30±.20(-6)	3.80±.60(-5)
XE-133	3.50±.10(-4)	3.54±.09(-5)	5.20±.10(-6)	7.80±.20(-4)	8.20±.20(-2)
XE-135	2.20±.60(-7)	2.90±.20(-6)	<2.6(-9)	2.77±.05(-6)	5.60±.10(-5)

TABLE B.32

RADIONUCLIDE CONCENTRATIONS IN WASTE GAS DECAY TANKS

DATE	10/25	11/ 3	11/20	2/12	2/15
TIME	1518	1150	1455	1350	1020
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
I-131	2.60±.40(-12)	<6.2(-12)	2.56±.07(-8)	4.80±.30(-10)	4.00±.20(-10)
I-133	<2.1(-12)	<3.5(-11)	NOTE 1	<1.8(-11)	NOTE 1
I-135	<7.6(-11)	<6.1(-9)	NOTE 1	<1.8(-10)	NOTE 1
CS-134	1.10±.20(-12)	6.00±5.4(-12)	<5.8(-12)	1.10±.70(-11)	<1.6(-12)
CS-136	<7.0(-13)	<3.0(-12)	<1.3(-11)	<7.0(-12)	<8.4(-13)
CS-137	3.80±.30(-12)	1.40±.20(-11)	<8.3(-12)	1.90±.90(-11)	<1.7(-12)
H-3	1.70±.20(-6)	1.60±.60(-6)	9.60±1.5(-7)	4.60±.70(-6)	5.50±1.1(-6)
C-14	6.50±.30(-4)	5.50±.30(-4)	7.00±.30(-4)	3.90±.20(-4)	9.30±.50(-4)
NA-24	<3.6(-12)	<9.8(-12)	NOTE 1	<3.0(-11)	NOTE 1
CR-51	<5.0(-12)	<2.2(-11)	<6.8(-11)	<1.1(-10)	6.30±3.6(-12)
MN-54	5.40±2.5(-13)	<3.1(-12)	<2.0(-11)	6.10±5.2(-12)	<8.6(-13)
FE-59	<1.2(-12)	<7.2(-12)	<7.9(-11)	1.30±1.1(-11)	<1.3(-12)
CO-57	<5.2(-13)	<1.5(-12)	<3.5(-12)	<6.4(-12)	6.40±2.3(-13)
CO-58	7.50±2.1(-13)	<4.2(-12)	<6.3(-12)	3.70±1.6(-11)	2.40±.90(-12)
CO-60	4.30±2.1(-12)	4.20±.40(-11)	1.50±.70(-11)	1.30±.20(-10)	5.20±1.6(-12)
ZN-65	<1.8(-12)	<5.8(-12)	<1.6(-11)	<3.4(-11)	<3.1(-12)
SR-91	<2.0(-11)	<2.5(-11)	NOTE 1	<7.0(-11)	NOTE 1
ZR-95	<1.0(-12)	<6.2(-12)	<3.5(-11)	<1.6(-11)	<6.4(-13)
NB-95	<9.0(-13)	<2.8(-12)	<3.9(-12)	<9.8(-12)	<7.3(-13)
MO-99	<5.2(-13)	<1.8(-12)	NOTE 1	<6.1(-12)	<4.3(-11)
RU-103	<5.6(-13)	<2.5(-12)	<1.2(-12)	<8.8(-12)	<1.1(-12)
RU-106D	<5.6(-13)	<3.1(-11)	<3.8(-12)	<1.1(-10)	8.20±2.7(-12)
AG-110M	<8.8(-13)	<3.6(-12)	<4.9(-12)	<1.3(-11)	<2.2(-12)
SB-124	<1.6(-12)	<6.5(-12)	<7.0(-12)	<2.6(-11)	<5.9(-13)
SB-125	<1.9(-12)	<6.8(-12)	<3.2(-11)	<3.0(-11)	<1.7(-12)
TE-129M	<1.7(-11)	<8.4(-11)	NOTE 1	2.80±.00(-10)	NOTE 1
TE-131M	<6.6(-12)	<2.3(-11)	NOTE 1	<3.6(-11)	NOTE 1
TE132	<5.0(-13)	<1.9(-12)	NOTE 1	<8.8(-12)	NOTE 1
BA-140	<2.8(-12)	<7.5(-12)	<3.2(-11)	<3.2(-11)	<1.6(-12)
LA-140	<8.1(-13)	<3.7(-12)	<2.8(-10)	<1.4(-10)	NOTE 1
CE-141	<7.4(-13)	<2.7(-12)	<7.8(-12)	<1.2(-11)	<9.2(-13)
CE-143	<1.4(-12)	<1.2(-10)	NOTE 1	<1.6(-11)	NOTE 1
CE-144	<3.3(-11)	<1.2(-11)	<2.9(-11)	<5.0(-11)	<3.7(-12)
EU-152	<1.4(-12)	<6.2(-12)	<3.1(-11)	<2.4(-11)	<2.5(-12)
EU-154	<1.7(-12)	<9.3(-12)	<1.8(-11)	<3.0(-11)	<3.1(-12)
EU-155	<1.5(-12)	<6.7(-12)	NOTE 1	<3.2(-11)	<1.2(-12)
W-187	<4.7(-12)	<1.3(-11)	NOTE 1	<7.2(-10)	NOTE 1
NP-239	<1.9(-12)	<6.4(-12)	NOTE 1	<2.2(-11)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.33

ACTIVITY RELEASE RATES FROM MAIN STACK

DATE	9/11	9/14	9/27	10/12	10/26
TIME	1805	1550	1250	900	1700
NUCLIDE	MICROCURIES/SECOND				
I-131	3.10±1.7(-6)	3.70±1.0(-6)	2.40±1.0(-6)	4.80±1.7(-6)	8.70±5.6(-7)
CS-134	<8.5(-6)	<7.7(-7)	<5.8(-7)	<2.5(-7)	<1.8(-7)
CS-136	<2.9(-6)	<5.0(-7)	3.10±1.9(-7)	<3.7(-7)	<1.8(-7)
CS-137	1.90±.50(-5)	6.00±2.9(-7)	4.80±2.3(-7)	<1.3(-7)	<4.1(-7)
CR-51	<2.5(-6)	<2.5(-6)	<1.9(-6)	<1.1(-6)	<1.7(-6)
MN-54	<3.1(-6)	<2.1(-8)	<3.1(-7)	<5.0(-7)	<2.1(-7)
FE-59	<4.8(-5)	<2.3(-6)	<9.8(-7)	<1.8(-6)	<1.2(-6)
CO-57	<3.5(-7)	<3.7(-8)	<1.4(-7)	<1.8(-7)	<5.2(-8)
CO-58	<2.5(-6)	<6.6(-7)	6.60±3.1(-7)	<2.7(-7)	<2.1(-7)
CO-60	<9.6(-6)	<1.8(-6)	<5.6(-7)	<2.1(-7)	<9.1(-7)
ZN-65	<8.1(-6)	<1.2(-6)	<5.2(-7)	<6.2(-7)	<3.1(-7)
ZR-95	<2.7(-6)	<1.2(-6)	<6.6(-7)	<4.6(-7)	<2.3(-7)
NB-95	3.10±1.9(-7)	<4.4(-7)	<7.1(-7)	<1.8(-7)	<3.7(-7)
RU-103	<3.1(-6)	<2.7(-7)	<6.6(-7)	<3.9(-7)	<2.7(-7)
RU-106	<1.7(-5)	<1.0(-6)	<7.3(-7)	<1.5(-7)	<3.7(-7)
AG-110M	<4.6(-6)	<2.9(-7)	<5.2(-7)	<3.7(-7)	<4.1(-7)
SB-124	<7.1(-6)	<3.3(-7)	<4.8(-7)	<5.4(-7)	<2.5(-7)
SB-125	<7.3(-6)	<1.6(-6)	<1.6(-6)	<1.1(-6)	<5.2(-7)
BA-140	<1.4(-5)	<1.3(-6)	<6.2(-7)	<8.5(-7)	<8.9(-7)
LA-140	<4.6(-6)	<1.5(-6)	<1.4(-6)	<1.4(-5)	<9.8(-7)
CE-141	<3.1(-6)	<7.9(-7)	<2.5(-7)	<2.3(-7)	<2.7(-7)
EU-152	<7.5(-6)	<7.9(-7)	<7.1(-7)	<7.3(-7)	<1.7(-6)
EU-154	<7.7(-6)	<9.8(-7)	<2.7(-7)	<2.9(-6)	<1.3(-6)

TABLE B.33 (cont'd)

ACTIVITY RELEASE RATES FROM MAIN STACK

DATE	11/ 9	11/20	12/ 7	12/21	1/ 4
TIME	918	1645	1225	1300	1048
NUCLIDE	MICROCURIES/SECOND				
I-131	7.70±.60(-5)	1.70±.30(-5)	3.50±.50(-5)	5.50±.50(-5)	1.03±.07(-4)
CS-134	<1.2(-6)	9.80±1.9(-7)	4.30±.10(-5)	1.13±.07(-5)	4.20±.50(-6)
CS-136	<1.2(-6)	<2.5(-7)	<1.7(-6)	<5.8(-7)	<5.3(-7)
CS-137	<1.2(-6)	2.28±.04(-6)	1.33±.04(-4)	3.80±.20(-5)	1.40±.10(-5)
CR-51	<3.7(-6)	<8.3(-7)	<2.2(-5)	3.60±.00(-6)	<1.1(-5)
MN-54	<2.1(-6)	<2.9(-7)	7.00±3.1(-7)	<3.9(-7)	9.50±3.9(-7)
FE-59	<1.6(-6)	<1.1(-6)	<3.1(-7)	<7.1(-7)	<1.1(-6)
CO-57	<3.9(-7)	<5.0(-8)	<8.1(-7)	<9.9(-8)	<5.0(-7)
CO-58	<2.3(-6)	<2.7(-7)	1.20±.50(-6)	<6.3(-7)	<1.0(-6)
CO-60	9.10±1.7(-6)	5.40±3.1(-7)	5.60±.70(-6)	4.70±.60(-6)	4.00±.60(-6)
ZN-65	<2.0(-6)	<8.1(-7)	<1.2(-6)	<2.6(-8)	<5.8(-7)
ZR-95	<2.0(-6)	<5.6(-7)	<7.1(-7)	8.20±4.0(-7)	<6.9(-7)
NB-95	<1.4(-6)	<2.1(-7)	<6.5(-7)	<3.1(-7)	<6.1(-7)
RU-103	<1.1(-6)	<6.6(-8)	<2.8(-6)	<6.4(-7)	<7.3(-7)
RU-106	<8.1(-6)	<4.1(-6)	<1.3(-5)	<3.2(-6)	<2.5(-6)
AG-110M	<1.8(-6)	<1.8(-7)	9.10±3.9(-7)	<3.9(-7)	<1.1(-6)
SB-124	<1.3(-6)	<8.1(-7)	<1.5(-5)	<3.8(-6)	<2.1(-6)
SB-125	<2.9(-6)	<8.5(-7)	<6.9(-6)	<2.1(-6)	<2.8(-6)
BA-140	<1.3(-6)	<1.2(-6)	<8.5(-6)	<2.7(-6)	<3.2(-6)
LA-140	<6.4(-7)	<8.7(-6)	<4.3(-6)	<1.3(-6)	<4.4(-6)
CE-141	<1.7(-6)	<3.3(-7)	<2.2(-6)	<1.4(-7)	<8.8(-7)
EU-152	<1.3(-6)	<2.7(-7)	<7.0(-6)	<1.4(-6)	<2.9(-6)
EU-154	<3.9(-6)	<4.6(-7)	<2.4(-6)	<3.4(-7)	<6.5(-7)

TABLE B.33 (cont'd)

ACTIVITY RELEASE RATES FROM MAIN STACK

DATE	1/18	2/ 1	2/15	3/ 1
TIME	1022	1100	1349	938
NUCLIDE	MICROCURIES/SECOND			
I-131	4.90±1.5(-6)	3.20±2.1(-7)	<7.2(-6)	<2.8(-6)
CS-134	<6.4(-7)	<4.1(-7)	<5.1(-7)	<2.3(-6)
CS-136	<5.0(-7)	<4.3(-7)	<8.1(-7)	<6.6(-7)
CS-137	6.80±2.7(-7)	<5.7(-7)	4.10±2.0(-7)	2.00±.60(-6)
CR-51	<3.5(-6)	<9.5(-7)	<5.8(-6)	<4.7(-6)
MN-54	<5.7(-7)	<2.3(-7)	<7.1(-7)	<1.0(-6)
FE-59	<7.6(-7)	<1.2(-6)	<1.4(-6)	<8.4(-6)
CO-57	<1.1(-7)	<1.1(-7)	1.40±.50(-7)	<2.5(-7)
CO-58	<6.1(-7)	<3.9(-7)	<8.5(-7)	<3.6(-7)
CO-60	<1.1(-6)	<5.7(-7)	<1.9(-7)	<1.5(-6)
ZN-65	<1.1(-6)	<4.3(-7)	<7.1(-7)	<1.6(-6)
ZR-95	<1.7(-6)	<9.5(-7)	<3.7(-7)	<6.2(-7)
NB-95	<3.7(-7)	<4.7(-7)	<5.8(-7)	<8.9(-7)
RU-103	<2.7(-7)	<6.4(-8)	<4.8(-7)	<4.9(-7)
RU-106	<1.5(-6)	<6.7(-7)	<2.3(-6)	<8.3(-6)
AG-110M	<7.1(-7)	<5.5(-7)	<1.2(-6)	<9.1(-7)
SB-124	<1.7(-7)	<5.1(-8)	<5.7(-7)	<1.0(-6)
SB-125	<5.7(-7)	<5.1(-7)	<1.3(-6)	<1.5(-6)
BA-140	<1.8(-7)	<5.9(-7)	<5.8(-7)	<3.0(-6)
LA-140	<7.8(-7)	<3.2(-6)	<2.6(-6)	<2.8(-6)
CE-141	<3.4(-7)	<2.6(-7)	<4.5(-7)	<1.0(-6)
EU-152	<7.4(-7)	<1.3(-6)	<1.0(-6)	<3.0(-6)
EU-154	<3.6(-7)	<9.1(-7)	<4.3(-6)	<3.6(-6)

TABLE B.34

ACTIVITY RELEASE RATES AT SAMPLING STATION #1

DATE	9/13	9/27	10/12	10/26	11/ 9
TIME	1635	1112	920	1215	907
NUCLIDE	MICROCURIES/SECOND				
I-131	1.02±.02(-4)	1.72±.08(-5)	6.66±.20(-5)	2.39±.12(-5)	1.92±.04(-4)
CS-134	<8.2(-8)	<1.0(-7)	2.62±1.8(-8)	<7.1(-8)	1.02±.39(-7)
CS-136	<8.2(-8)	<1.6(-8)	<5.1(-8)	<3.3(-8)	<1.4(-7)
CS-137	<3.3(-8)	1.02±.35(-7)	4.31±2.4(-8)	7.83±3.1(-8)	3.92±.78(-7)
CR-51	6.27±2.7(-7)	<3.7(-7)	<1.5(-7)	<3.5(-7)	<1.2(-6)
MN-54	<1.7(-7)	4.31±2.4(-8)	<2.4(-8)	<8.6(-8)	1.88±.55(-7)
FE-59	<2.9(-7)	<1.4(-7)	<2.0(-7)	<1.4(-7)	<2.4(-7)
CO-57	<5.9(-8)	<1.7(-8)	<1.7(-8)	<1.3(-8)	3.39±.86(-8)
CO-58	1.32±.16(-6)	4.31±.78(-7)	9.79±.78(-7)	1.10±.12(-6)	2.62±.24(-6)
CO-60	8.22±5.5(-8)	6.27±3.5(-8)	<3.9(-8)	<8.6(-8)	2.11±.51(-7)
ZN-65	<5.9(-8)	<9.4(-8)	<2.9(-7)	<2.9(-8)	<2.4(-7)
ZR-95	<1.1(-7)	<5.1(-8)	<1.1(-7)	<3.9(-8)	<7.4(-8)
NB-95	<9.0(-8)	<4.7(-8)	<5.1(-8)	<4.7(-8)	<7.4(-8)
RU-103	<1.3(-7)	<3.1(-8)	<6.7(-8)	<3.9(-8)	<3.3(-8)
RU-106	<1.9(-6)	<4.7(-7)	<9.8(-7)	<1.1(-6)	<2.0(-6)
AG-110M	<1.2(-7)	<1.7(-8)	<9.8(-8)	<5.1(-8)	<5.9(-8)
SB-124	<1.0(-7)	2.86±1.5(-8)	<7.4(-6)	<3.9(-8)	<2.0(-7)
SB-125	<2.4(-7)	<1.3(-7)	<1.6(-7)	<9.8(-8)	<2.0(-7)
BA-140	<1.2(-7)	<1.9(-7)	<8.6(-8)	<1.9(-7)	<2.1(-7)
LA-140	<1.1(-7)	<1.2(-7)	<3.9(-7)	<2.6(-7)	<1.6(-6)
CE-141	<1.5(-7)	2.11±.94(-8)	<2.2(-8)	<6.3(-8)	<1.5(-7)
EU-152	1.72±.82(-7)	7.44±3.5(-8)	<1.5(-7)	<1.3(-7)	<2.9(-7)
EU-154	<3.1(-7)	<1.2(-7)	<1.1(-7)	<7.1(-8)	<5.1(-8)

TABLE B.34 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #1

DATE	11/20	12/ 7	12/21	1/ 4	1/18
TIME	1016	1350	1440	1255	1150
NUCLIDE	MICROCURIES/SECOND				
I-131	1.37±.08(-5)	5.87±.78(-6)	4.62±.16(-5)	2.44±.03(-4)	2.31±.04(-4)
CS-134	6.66±1.6(-8)	3.45±.63(-7)	<4.3(-8)	<1.8(-7)	<5.5(-8)
CS-136	<2.9(-8)	<8.2(-8)	<2.5(-8)	<2.2(-7)	<2.2(-8)
CS-137	1.61±.51(-7)	8.22±1.2(-7)	<1.5(-7)	<1.6(-7)	<4.7(-8)
CR-51	<3.7(-7)	2.43±.76(-6)	<4.7(-7)	<1.1(-6)	<6.3(-7)
MN-54	7.44±2.7(-8)	3.64±.67(-7)	<3.5(-8)	<1.8(-7)	7.44±2.7(-8)
FE-59	<4.7(-8)	<3.3(-7)	<5.5(-8)	<2.9(-7)	<5.1(-8)
CO-57	6.27±3.1(-9)	4.31±1.6(-9)	<3.5(-9)	<1.1(-7)	<5.9(-8)
CO-58	1.06±.08(-6)	9.16±.31(-6)	5.87±.78(-7)	5.87±1.2(-7)	5.48±.78(-7)
CO-60	1.06±.47(-7)	7.05±.78(-7)	<7.1(-8)	1.68±.74(-7)	7.44±2.7(-8)
ZN-65	<6.7(-8)	<5.1(-8)	<4.7(-8)	<2.6(-7)	<1.3(-7)
ZR-95	<8.2(-8)	8.62±3.1(-8)	<5.1(-8)	<2.6(-7)	<4.3(-8)
NB-95	<4.7(-8)	1.76±.63(-7)	<2.5(-8)	<2.1(-7)	<9.8(-8)
RU-103	<2.4(-8)	<2.3(-7)	<8.6(-9)	<2.0(-7)	<1.8(-8)
RU-106	<9.8(-7)	<7.1(-6)	<3.5(-7)	<9.8(-7)	<6.7(-7)
AG-110M	<3.1(-8)	<1.3(-7)	<5.1(-8)	<2.8(-7)	<7.4(-8)
SB-124	<6.3(-8)	<3.5(-7)	<1.3(-8)	1.68±.55(-7)	<5.9(-8)
SB-125	<6.3(-8)	<5.1(-7)	<1.8(-7)	<5.1(-7)	<4.7(-8)
BA-140	<7.4(-8)	<9.8(-7)	<3.6(-8)	<5.9(-7)	<1.2(-7)
LA-140	<2.4(-8)	<1.9(-7)	<2.7(-7)	<2.9(-6)	<2.9(-7)
CE-141	<2.4(-8)	<1.5(-7)	<4.3(-8)	<3.1(-7)	9.40±2.7(-8)
EU-152	<9.0(-8)	<5.5(-7)	<2.4(-8)	<6.7(-7)	<2.4(-7)
EU-154	<4.7(-8)	<9.4(-8)	<1.6(-8)	<4.7(-7)	<7.1(-8)

TABLE B.34 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #1

DATE	2/ 1	2/15	3/ 1
TIME	1155	1320	1310
NUCLIDE		MICROCURIES/SECOND	
I-131	2.39±.12(-5)	6.34±.16(-5)	3.84±.01(-5)
CS-134	<4.7(-8)	<1.2(-8)	<1.4(-7)
CS-136	<3.9(-8)	<4.3(-8)	<4.3(-8)
CS-137	<5.9(-8)	8.62±3.1(-8)	<2.7(-7)
CR-51	<5.1(-7)	<3.9(-7)	<4.7(-7)
MN-54	<5.5(-8)	<1.6(-8)	<8.2(-8)
FE-59	<4.7(-8)	<7.4(-8)	<3.8(-7)
CO-57	2.58±.90(-8)	<1.9(-8)	5.48±2.0(-8)
CO-58	1.57±.43(-7)	1.17±.35(-7)	<2.0(-7)
CO-60	<1.3(-7)	<1.1(-7)	<1.1(-7)
ZN-65	<9.0(-8)	<5.9(-8)	<1.1(-7)
ZR-95	<9.0(-8)	<5.5(-8)	<9.4(-8)
NB-95	<3.0(-8)	<2.0(-8)	<7.8(-8)
RU-103	<1.9(-8)	<4.7(-8)	<6.3(-8)
RU-106	<7.1(-7)	<5.9(-7)	<1.2(-6)
AG-110M	<3.6(-8)	<3.8(-8)	<1.2(-7)
SB-124	<3.9(-8)	<1.5(-8)	<6.7(-8)
SB-125	<1.3(-7)	<6.7(-8)	<3.0(-7)
BA-140	<1.6(-7)	<7.8(-8)	<3.4(-7)
LA-140	<3.6(-7)	<1.4(-7)	<2.6(-7)
CE-141	5.87±1.6(-9)	<1.1(-8)	1.64±.47(-7)
EU-152	<1.2(-7)	<6.3(-8)	<3.8(-7)
EU-154	<2.4(-7)	<5.9(-8)	<2.4(-7)

TABLE B.35

ACTIVITY RELEASE RATES AT SAMPLING STATION #2

DATE	9/13	9/27	10/12	10/26	11/ 9
TIME	1635	1112	920	1215	907
NUCLIDE	MICROCURIES/SECOND				
I-131	<1.6(-6)	7.47±3.1(-7)	4.89±3.1(-7)	<1.2(-6)	4.45±.10(-4)
CS-134	<1.2(-7)	<1.2(-7)	5.15±2.1(-8)	<2.0(-8)	<7.5(-7)
CS-136	<1.3(-7)	<3.1(-7)	<1.7(-7)	<1.4(-7)	<6.2(-7)
CS-137	<2.4(-7)	1.52±.67(-7)	3.09±.77(-7)	<2.5(-7)	4.64±2.1(-7)
CR-51	<7.5(-7)	7.92±2.8(-7)	<9.0(-7)	<8.0(-7)	7.98±1.8(-6)
MN-54	<3.9(-7)	1.08±.18(-6)	1.75±.18(-6)	4.64±1.3(-7)	3.09±.26(-6)
FE-59	<3.9(-7)	<3.4(-7)	<5.2(-8)	<2.4(-7)	<9.8(-7)
CO-57	<9.5(-8)	6.18±1.8(-8)	9.01±1.8(-8)	4.64±1.6(-8)	1.80±.75(-7)
CO-58	1.42±.90(-7)	1.93±.23(-6)	1.70±.18(-6)	<6.7(-7)	3.12±.10(-5)
CO-60	<6.2(-7)	2.09±.23(-6)	3.97±.18(-6)	<1.5(-6)	7.21±.52(-6)
ZN-65	<4.1(-8)	<4.6(-7)	<3.6(-7)	<2.2(-7)	<4.4(-7)
ZR-95	<1.7(-7)	<9.5(-8)	<2.8(-7)	<1.5(-7)	<4.6(-7)
NB-95	<8.0(-8)	<2.2(-7)	<2.0(-7)	<1.9(-7)	4.64±1.8(-7)
RU-103	<1.5(-7)	<1.9(-7)	<1.1(-7)	<1.1(-7)	<2.4(-7)
RU-106	<5.2(-7)	<3.1(-6)	<1.7(-6)	<7.5(-7)	<2.5(-5)
AG-110M	<1.7(-7)	<4.4(-7)	<5.7(-8)	<1.5(-7)	<6.7(-7)
SB-124	<1.4(-7)	<1.1(-7)	<1.9(-7)	<2.2(-7)	1.03±.23(-6)
SB-125	<2.1(-7)	<2.0(-7)	<1.0(-7)	<2.8(-7)	<1.5(-6)
BA-140	<1.6(-6)	<5.7(-7)	<6.2(-7)	<2.8(-7)	<3.6(-6)
LA-140	<8.0(-6)	<6.7(-7)	<1.1(-6)	<4.6(-7)	<9.0(-6)
CE-141	<2.1(-7)	<1.1(-7)	1.18±.28(-7)	<1.0(-7)	<6.2(-7)
EU-152	<7.5(-8)	1.75±.46(-7)	<2.8(-7)	<7.5(-8)	5.15±1.8(-7)
EU-154	<3.1(-7)	<1.8(-7)	<1.3(-7)	<5.4(-7)	<4.1(-7)

TABLE B.35 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #2

DATE	11/20	12/ 7	12/21	1/ 4	1/18
TIME	1016	1350	1440	1255	1150
NUCLIDE	MICROCURIES/SECOND				
I-131	7.08±.16(-4)	4.89±.26(-5)	9.79±1.3(-6)	5.15±1.0(-6)	3.86±.13(-7)
CS-134	2.45±.57(-6)	<8.5(-7)	<2.8(-9)	3.35±1.0(-7)	<1.4(-7)
CS-136	<1.3(-6)	<8.0(-7)	6.18±.09(-8)	<3.1(-7)	<1.0(-7)
CS-137	3.61±.77(-6)	3.86±2.3(-7)	4.89±1.6(-8)	<1.3(-6)	2.52±.85(-7)
CR-51	1.24±.05(-4)	1.29±.26(-5)	4.12±.77(-7)	2.42±.75(-6)	8.24±3.9(-7)
MN-54	1.65±.10(-5)	2.83±.26(-6)	1.11±.23(-7)	1.44±.21(-6)	2.19±.82(-7)
FE-59	1.08±.10(-5)	7.47±3.6(-7)	<5.2(-8)	<5.2(-7)	<3.9(-7)
CO-57	1.13±.23(-6)	2.83±1.3(-7)	<8.2(-9)	5.15±1.8(-8)	6.18±1.6(-8)
CO-58	5.23±.03(-4)	7.88±.16(-5)	4.25±.16(-6)	2.21±.08(-5)	3.86±.26(-6)
CO-60	3.79±.05(-5)	8.50±.52(-6)	3.61±.26(-7)	2.83±.26(-6)	3.86±.77(-7)
ZN-65	<2.3(-6)	<7.7(-7)	<5.2(-9)	<6.2(-7)	<1.7(-7)
ZR-95	4.12±.52(-6)	4.12±1.6(-7)	<8.2(-8)	<6.4(-7)	<1.1(-7)
NB-95	9.01±.52(-6)	1.36±.26(-6)	<2.6(-8)	2.32±.95(-7)	<1.1(-7)
RU-103	3.09±.77(-6)	3.61±.52(-6)	1.55±.08(-6)	5.15±2.1(-7)	<1.4(-7)
RU-106	<3.4(-4)	<5.7(-5)	<3.6(-6)	<1.6(-5)	<3.4(-6)
AG-110M	2.37±.34(-6)	3.09±1.0(-7)	<5.9(-9)	<4.9(-7)	<9.0(-8)
SB-124	<4.1(-6)	6.70±2.3(-7)	2.19±.95(-8)	<7.0(-7)	<2.3(-7)
SB-125	<4.6(-6)	<2.4(-6)	<7.7(-8)	<9.8(-7)	<2.2(-7)
BA-140	<7.5(-6)	<4.6(-6)	<1.4(-8)	<2.2(-6)	<3.9(-7)
LA-140	<1.1(-6)	<1.3(-6)	<8.0(-7)	<1.2(-6)	<7.5(-7)
CE-141	4.38±2.3(-7)	<6.4(-7)	<1.8(-8)	1.24±.41(-7)	2.83±1.3(-8)
EU-152	<4.4(-6)	<2.4(-6)	<7.5(-8)	<1.3(-6)	<6.2(-7)
EU-154	<1.3(-6)	<4.6(-7)	<2.1(-7)	<1.6(-7)	<4.4(-7)

TABLE B.35 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #2

DATE	2/ 1	2/15
TIME	1155	1320
NUCLIDE		MICROCURIES/SECOND
I-131	8.50±4.6(-7)	8.24±1.8(-7)
CS-134	<1.5(-7)	<7.2(-7)
CS-136	<5.7(-8)	<6.2(-7)
CS-137	<2.6(-7)	<9.5(-7)
CR-51	1.31±.44(-6)	6.95±2.3(-6)
MN-54	<3.6(-7)	5.41±.52(-6)
FE-59	<2.6(-7)	1.11±.34(-6)
CO-57	<8.5(-8)	2.82±1.0(-7)
CO-58	2.52±.28(-6)	6.95±.16(-5)
CO-60	6.18±1.3(-7)	1.18±.05(-5)
ZN-65	<4.9(-7)	<9.5(-7)
ZR-95	<2.1(-7)	6.95±3.1(-7)
NB-95	<2.8(-7)	1.39±.31(-6)
RU-103	<2.3(-7)	<9.5(-7)
RU-106	<3.4(-6)	<4.4(-5)
AG-110M	<1.9(-7)	<8.8(-7)
SB-124	<3.4(-7)	<1.3(-6)
SB-125	4.64±1.8(-7)	<2.1(-6)
BA-140	<3.9(-7)	<3.1(-6)
LA-140	<1.4(-6)	<9.3(-7)
CE-141	<1.8(-7)	<5.9(-7)
EU-152	6.44±1.8(-7)	7.98±2.6(-7)
EU-154	<1.5(-7)	<5.9(-7)

TABLE B.36

ACTIVITY RELEASE RATES AT SAMPLING STATION #3

DATE	9/13	9/27	10/12	10/26	11/ 9
TIME	1458	1015	940	1145	847
NUCLIDE	MICROCURIES/SECOND				
I-131	4.90±.10(-4)	7.10±.50(-5)	2.10±.10(-4)	5.10±.50(-5)	1.64±.01(-2)
CS-134	<6.0(-6)	6.90±5.5(-7)	1.30±.50(-6)	NOTE 1	4.20±.80(-6)
CS-136	<4.0(-6)	4.10±2.6(-7)	<5.4(-7)	NOTE 1	<3.3(-6)
CS-137	<7.6(-6)	<3.6(-6)	<2.9(-6)	NOTE 1	6.10±1.7(-6)
CR-51	4.00±.20(-4)	1.90±.10(-4)	1.96±.09(-4)	NOTE 1	1.70±.10(-4)
MN-54	2.90±.20(-5)	1.30±.10(-5)	1.43±.06(-5)	NOTE 1	1.50±.10(-5)
FE-59	1.50±.20(-6)	6.80±.90(-6)	7.70±.80(-6)	NOTE 1	7.50±1.3(-6)
CO-57	2.30±1.5(-6)	1.40±.50(-6)	1.30±.20(-6)	NOTE 1	1.40±.60(-6)
CO-58	1.09±.01(-3)	5.48±.06(-4)	7.01±.05(-4)	NOTE 1	6.95±.08(-4)
CO-60	5.50±.20(-5)	3.50±.10(-5)	3.25±.09(-5)	NOTE 1	3.70±.10(-5)
ZN-65	<7.6(-6)	<4.1(-6)	<9.5(-7)	NOTE 1	<4.6(-6)
ZR-95	6.90±1.9(-6)	4.10±1.0(-6)	1.90±.90(-6)	NOTE 1	<5.3(-6)
NB-95	2.00±.20(-5)	7.40±1.2(-6)	1.00±.10(-5)	NOTE 1	8.20±1.6(-6)
RU-103	<7.1(-6)	9.20±7.5(-7)	3.00±1.3(-6)	NOTE 1	<5.5(-6)
RU-106	<6.5(-4)	<3.6(-4)	<4.2(-4)	NOTE 1	3.90±1.7(-4)
AG-110M	6.20±1.3(-6)	3.00±.80(-6)	3.00±.30(-6)	NOTE 1	3.00±.80(-7)
SB-124	<1.1(-5)	<1.3(-6)	<3.4(-6)	NOTE 1	<7.2(-6)
SB-125	<1.3(-5)	<7.4(-6)	<6.3(-6)	NOTE 1	3.60±1.9(-6)
BA-140	<2.7(-5)	<1.4(-5)	<1.5(-5)	NOTE 1	<2.1(-5)
LA-140	<4.0(-6)	<5.7(-6)	<4.7(-5)	NOTE 1	<1.1(-5)
CE-141	<4.7(-6)	8.60±4.2(-7)	<1.9(-6)	NOTE 1	<3.9(-6)
EU-152	<1.5(-5)	<8.4(-6)	<6.8(-6)	NOTE 1	<1.1(-5)
EU-154	<2.9(-6)	<1.9(-6)	<1.2(-6)	NOTE 1	<1.6(-6)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.36 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #3

DATE	11/20	12/ 7	12/21	1/ 4	1/18
TIME	1220	1505	920	1345	1607
NUCLIDE	MICROCURIES/SECOND				
I-131	7.70±.20(-4)	3.30±1.1(-4)	8.70±.20(-4)	7.40±.10(-4)	2.38±.70(-4)
CS-134	1.50±.60(-6)	1.80±.70(-6)	2.00±.60(-6)	1.30±.50(-6)	9.80±2.3(-7)
CS-136	<1.6(-6)	<2.4(-6)	<1.5(-6)	<8.3(-7)	<3.7(-7)
CS-137	5.30±1.2(-6)	3.50±1.0(-6)	2.50±.60(-7)	9.70±4.2(-7)	1.30±.30(-6)
CR-51	2.70±.50(-5)	6.80±1.2(-5)	3.00±.50(-5)	1.20±.30(-5)	3.10±1.5(-6)
MN-54	1.60±.10(-5)	1.20±.10(-5)	6.00±.60(-6)	3.70±.60(-6)	1.30±.30(-6)
FE-59	3.60±.70(-6)	2.60±.90(-6)	1.80±.90(-6)	<2.0(-6)	<5.1(-7)
CO-57	8.30±2.2(-7)	9.60±2.2(-7)	5.40±1.6(-7)	4.40±1.7(-7)	1.80±.50(-7)
CO-58	2.31±.03(-4)	3.95±.05(-4)	1.64±.03(-4)	9.20±.30(-5)	2.80±.10(-5)
CO-60	3.70±.10(-5)	2.90±.10(-5)	1.87±.09(-5)	8.10±.60(-6)	3.80±.40(-6)
ZN-65	<2.6(-6)	<3.1(-6)	<1.8(-6)	<9.9(-7)	<7.0(-7)
ZR-95	<2.4(-6)	3.20±1.1(-6)	<2.7(-6)	<1.9(-6)	<4.9(-7)
NB-95	3.20±.60(-6)	5.30±1.2(-6)	2.30±.50(-6)	1.60±.40(-6)	3.70±1.8(-7)
RU-103	<2.0(-6)	1.60±.90(-6)	<1.1(-6)	<1.7(-6)	<6.8(-7)
RU-106	2.40±.50(-4)	<2.6(-4)	<1.2(-4)	<5.7(-5)	<2.2(-5)
AG-110M	1.50±.20(-6)	3.00±.60(-6)	1.40±.30(-6)	9.70±4.1(-7)	<9.6(-7)
SB-124	<2.9(-6)	<4.3(-6)	6.10±1.2(-6)	<1.9(-6)	<1.2(-6)
SB-125	<4.8(-6)	<7.1(-6)	<3.7(-6)	<2.8(-6)	<1.7(-6)
BA-140	9.50±8.3(-7)	<1.3(-5)	<7.6(-6)	<6.5(-6)	<2.7(-6)
LA-140	<3.3(-6)	<1.2(-5)	<1.4(-6)	<2.2(-6)	<1.8(-6)
CE-141	<1.6(-6)	<1.8(-6)	<1.1(-6)	<1.1(-6)	3.70±1.2(-7)
EU-152	<4.7(-6)	<6.8(-6)	1.60±.40(-6)	<4.1(-6)	<1.8(-6)
EU-154	<1.9(-6)	<2.6(-6)	<3.2(-7)	<1.3(-6)	<7.3(-7)

TABLE B.36 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #3

DATE	2/ 1	2/ 8	2/15	2/22	3/ 1
TIME	1325	950	1128	1220	1023
NUCLIDE	MICROCURIES/SECOND				
I-131	4.00±.30(-5)	6.20±.90(-5)	1.80±.30(-5)	1.42±.07(-4)	1.30±.07(-4)
CS-134	<6.7(-7)	1.90±.70(-7)	<1.6(-6)	<3.1(-7)	<4.6(-7)
CS-136	<2.8(-7)	<2.3(-7)	7.60±3.7(-7)	<7.4(-8)	<1.3(-6)
CS-137	7.90±2.9(-7)	4.90±1.2(-7)	1.00±.30(-6)	<7.8(-7)	<3.4(-6)
CR-51	<5.2(-6)	1.90±.50(-6)	<4.7(-6)	2.80±1.0(-6)	<7.9(-6)
MN-54	<2.9(-7)	2.70±.80(-7)	2.80±.70(-6)	8.60±2.4(-7)	<1.4(-6)
FE-59	<1.3(-6)	<3.8(-7)	<1.5(-6)	<1.4(-6)	<9.6(-7)
CO-57	<1.5(-7)	<1.1(-7)	1.50±.60(-8)	<2.1(-7)	<1.5(-7)
CO-58	8.40±1.0(-6)	3.40±.30(-6)	5.90±1.0(-6)	8.50±1.0(-6)	1.00±.20(-5)
CO-60	8.30±2.8(-7)	2.60±.50(-7)	2.60±.20(-5)	9.90±4.9(-7)	2.30±.80(-6)
ZN-65	<9.1(-7)	<2.7(-7)	<1.8(-6)	<4.6(-7)	<7.0(-7)
ZR-95	<1.6(-6)	<1.6(-7)	<1.9(-6)	<1.2(-6)	<3.2(-6)
NB-95	<7.0(-7)	<2.2(-7)	<1.3(-6)	<8.5(-7)	<2.0(-6)
RU-103	4.20±2.0(-7)	<9.7(-8)	<2.6(-7)	<6.9(-7)	<8.1(-7)
RU-106	<9.5(-6)	<1.2(-5)	<9.7(-6)	<1.4(-5)	<1.6(-5)
AG-110M	<1.8(-7)	<3.2(-7)	1.40±.40(-6)	<9.4(-7)	<2.0(-6)
SB-124	<7.7(-7)	<3.0(-7)	<1.2(-6)	<3.3(-7)	<8.7(-7)
SB-125	<2.0(-6)	<6.2(-7)	<2.6(-6)	<9.6(-7)	<2.0(-6)
BA-140	<2.6(-6)	<7.8(-7)	<2.1(-6)	<2.6(-7)	<2.2(-6)
LA-140	<8.7(-7)	<3.1(-6)	<1.2(-5)	<5.0(-6)	<9.0(-6)
CE-141	<2.0(-7)	<2.7(-7)	<2.5(-7)	<1.8(-7)	<1.0(-6)
EU-152	<1.8(-6)	<8.6(-7)	<1.7(-6)	<1.2(-6)	<5.3(-6)
EU-154	<9.5(-7)	<4.4(-7)	<5.8(-7)	<1.9(-6)	<3.0(-6)

TABLE B.36 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #3

DATE 3/ 7
TIME 1335

NUCLIDE	MICROCURIES/SECOND
I-131	1.00±.06(-4)
CS-134	<2.8(-6)
CS-136	<8.0(-7)
CS-137	<1.1(-6)
CR-51	<5.7(-6)
MN-54	<1.4(-6)
FE-59	<3.7(-6)
CO-57	<4.4(-7)
CO-58	3.00±.90(-6)
CO-60	<2.8(-6)
ZN-65	<2.7(-6)
ZR-95	<1.0(-6)
NB-95	<1.2(-6)
RU-103	<1.2(-6)
RU-106	<1.2(-5)
AG-110M	<2.6(-6)
SB-124	<1.0(-6)
SB-125	<2.4(-6)
BA-140	<4.8(-6)
LA-140	<2.2(-6)
CE-141	<1.2(-6)
EU-152	<7.1(-6)
EU-154	<3.2(-6)

TABLE B.37

ACTIVITY RELEASE RATES AT SAMPLING STATION #4

DATE	1/ 8	1/18	2/ 1	2/ 8	2/15
TIME	1342	1638	1635	940	943
NUCLIDE	MICROCURIES/SECOND				
I-131	2.58±.04(-4)	2.08±.04(-4)	3.50±.20(-5)	3.90±.30(-5)	1.70±.10(-5)
CS-134	4.00±2.0(-7)	3.60±.70(-7)	<3.0(-7)	1.90±.70(-7)	<1.1(-7)
CS-136	<1.4(-6)	<9.4(-8)	<1.6(-7)	<2.3(-7)	<1.5(-7)
CS-137	<2.0(-6)	4.10±1.0(-7)	5.10±1.5(-7)	4.90±1.2(-7)	2.00±.90(-7)
CR-51	3.70±.40(-5)	1.50±.50(-6)	3.00±.90(-6)	1.90±.50(-6)	<4.6(-7)
MN-54	4.10±.50(-6)	2.80±.70(-7)	2.00±.70(-7)	2.70±.80(-7)	<2.2(-7)
FE-59	1.60±.40(-6)	<1.2(-7)	<1.1(-6)	<3.8(-7)	<1.4(-6)
CO-57	4.50±1.5(-7)	6.40±1.9(-8)	<1.6(-7)	<1.1(-7)	<1.6(-8)
CO-58	2.30±.03(-6)	7.50±.40(-6)	8.40±.60(-6)	3.40±.30(-6)	1.70±.20(-6)
CO-60	2.34±.07(-5)	9.00±1.1(-7)	1.20±.20(-6)	2.60±.50(-7)	5.00±1.7(-7)
ZN-65	<2.2(-6)	<1.9(-7)	<4.0(-7)	<2.7(-7)	<1.3(-7)
ZR-95	<2.3(-6)	<1.9(-7)	<3.4(-7)	<1.6(-7)	<1.9(-7)
NB-95	3.40±.50(-6)	<2.5(-7)	<3.5(-7)	<2.2(-7)	<1.1(-7)
RU-103	7.00±3.0(-7)	<2.9(-7)	<3.8(-7)	<9.7(-8)	<2.6(-7)
RU-106	<1.4(-4)	<5.8(-6)	<8.7(-6)	<2.9(-6)	<2.6(-6)
AG-110M	1.80±.30(-6)	2.40±.50(-7)	<4.1(-7)	<3.2(-7)	<3.2(-7)
SB-124	<2.3(-6)	<3.3(-7)	3.80±1.8(-7)	<3.0(-7)	1.60±.70(-7)
SB-125	<3.8(-6)	<4.4(-7)	<6.6(-7)	<6.2(-7)	<1.8(-7)
BA-140	<5.7(-6)	<8.3(-7)	5.70±2.2(-7)	<7.8(-7)	<4.1(-7)
LA-140	<1.0(-5)	<8.0(-7)	<1.2(-7)	<3.1(-6)	<5.2(-7)
CE-141	<1.1(-6)	<1.8(-7)	<2.2(-7)	<2.7(-7)	<1.4(-7)
EU-152	<3.9(-6)	2.20±.50(-7)	<5.5(-7)	<6.6(-7)	<1.8(-7)
EU-154	<1.5(-6)	<7.8(-7)	<3.9(-7)	<4.4(-7)	<3.6(-7)

TABLE B.37 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #4

DATE	2/22	3/ 1	3/ 7
TIME	1110	1053	1455
NUCLIDE		MICROCURIES/SECOND	
I-131	1.05±.04(-4)	6.20±.30(-5)	9.30±.30(-5)
CS-134	<2.9(-7)	<7.1(-7)	<9.2(-7)
CS-136	<8.5(-8)	<6.2(-7)	<2.1(-7)
CS-137	3.00±1.1(-7)	7.80±2.6(-7)	7.80±3.2(-7)
CR-51	<6.2(-7)	<3.6(-6)	<2.4(-6)
MN-54	<1.4(-7)	<4.2(-7)	<5.5(-7)
FE-59	<3.8(-7)	<1.7(-6)	<1.0(-6)
CO-57	<3.3(-8)	<2.3(-7)	<1.4(-7)
CO-58	4.80±.40(-6)	1.10±.30(-6)	<2.7(-6)
CO-60	9.90±1.7(-7)	<8.1(-7)	4.30±2.2(-7)
ZN-65	<3.8(-7)	<4.9(-7)	<5.0(-7)
ZR-95	<2.6(-7)	<5.2(-7)	<1.5(-7)
NB-95	<1.9(-7)	<2.6(-7)	<1.3(-7)
RU-103	<1.8(-7)	<3.7(-7)	<3.0(-7)
RU-106	<5.5(-6)	<6.3(-6)	<8.4(-6)
AG-110M	<3.2(-7)	<3.4(-7)	<2.8(-7)
SB-124	<2.4(-7)	<3.5(-7)	<4.4(-7)
SB-125	<2.1(-7)	<7.6(-7)	<1.0(-6)
BA-140	<4.6(-7)	<3.3(-7)	<9.7(-7)
LA-140	<1.4(-6)	<1.3(-6)	<9.3(-7)
CE-141	<1.4(-7)	<2.2(-7)	2.70±1.2(-7)
EU-152	<1.6(-7)	<1.7(-6)	<2.0(-6)
EU-154	<4.6(-7)	<3.7(-6)	<1.0(-6)

TABLE B.38

ACTIVITY RELEASE RATES AT SAMPLING STATION #5

DATE	1/18	2/ 1	2/ 8	2/15	2/22
TIME	1638	1615	930	925	1120
NUCLIDE	MICROCURIES/SECOND				
I-131	2.60±.30(-6)	2.40±1.6(-7)	6.90±.50(-8)	2.30±1.1(-7)	9.50±.90(-6)
CS-134	2.00±.30(-7)	1.40±.40(-7)	1.00±.40(-7)	1.30±.30(-7)	<2.9(-7)
CS-136	<2.7(-8)	<1.7(-7)	<1.0(-7)	<1.8(-8)	<3.5(-7)
CS-137	2.70±.50(-8)	3.80±1.0(-7)	1.70±.60(-7)	1.50±.50(-7)	2.10±.80(-7)
CR-51	<1.7(-7)	<5.4(-7)	<1.4(-7)	<7.6(-7)	<2.5(-6)
MN-54	<3.2(-8)	7.50±3.3(-8)	<9.5(-8)	<1.4(-8)	<2.8(-7)
FE-59	<1.1(-7)	<1.5(-7)	<2.5(-7)	<4.7(-8)	<6.9(-7)
CO-57	<2.0(-8)	6.10±1.6(-8)	2.20±.90(-8)	<3.3(-8)	<1.6(-7)
CO-58	7.50±2.9(-8)	4.40±1.1(-7)	2.20±.70(-7)	8.30±3.6(-8)	<2.9(-7)
CO-60	<9.1(-8)	<2.0(-7)	<1.6(-7)	<5.9(-8)	<3.6(-7)
ZN-65	<8.0(-8)	<1.1(-7)	<2.4(-7)	<5.1(-7)	<6.7(-7)
ZR-95	<3.7(-8)	<1.1(-7)	<1.2(-7)	<5.4(-8)	<5.1(-7)
NB-95	<4.6(-8)	<1.2(-7)	<6.1(-8)	<1.1(-7)	<2.6(-7)
RU-103	<3.0(-8)	<8.4(-8)	<6.8(-8)	<1.9(-8)	<3.2(-7)
RU-106	<4.8(-7)	<1.1(-6)	<9.5(-7)	<8.3(-7)	<3.3(-6)
AG-110M	<6.3(-8)	<9.3(-8)	<1.3(-7)	<8.6(-9)	<4.4(-7)
SB-124	<9.4(-8)	<1.0(-7)	<1.9(-7)	<9.7(-8)	<3.7(-7)
SB-125	<6.9(-8)	<2.9(-7)	<2.2(-7)	<3.1(-7)	<9.2(-7)
BA-140	<2.6(-7)	<6.0(-7)	<1.8(-7)	<6.2(-8)	<1.1(-6)
LA-140	<3.0(-7)	<8.4(-7)	<1.2(-6)	<7.2(-7)	<2.5(-6)
CE-141	<3.6(-8)	5.60±2.2(-8)	<3.7(-9)	<7.1(-8)	<2.7(-7)
EU-152	<1.2(-7)	<3.0(-7)	<2.6(-8)	<2.6(-8)	<8.9(-7)
EU-154	<1.3(-7)	<3.5(-7)	<8.4(-7)	<8.2(-7)	<7.3(-7)

TABLE B.39

ACTIVITY RELEASE RATES AT SAMPLING STATION #6

DATE	1/25	2/ 1	2/ 8	2/15	2/22
TIME	1750	1642	940	956	1100
NUCLIDE	MICROCURIES/SECOND				
I-131	8.00±.80(-6)	3.20±.60(-6)	5.10±.90(-6)	2.00±.40(-6)	3.70±.20(-5)
CS-134	<1.1(-7)	3.90±1.6(-8)	<1.3(-7)	<3.5(-8)	<4.2(-7)
CS-136	<6.5(-8)	<4.2(-8)	<8.4(-8)	<7.1(-8)	<4.0(-7)
CS-137	<9.2(-8)	7.90±2.3(-8)	<1.6(-7)	<1.2(-7)	<4.4(-7)
CR-51	<6.7(-7)	2.20±.80(-7)	<7.0(-7)	<2.1(-7)	<2.3(-6)
MN-54	<1.0(-7)	8.10±1.9(-8)	<9.6(-8)	<1.2(-7)	<3.7(-7)
FE-59	<2.3(-7)	7.70±3.3(-8)	<2.8(-7)	<2.1(-7)	<5.0(-7)
CO-57	<4.3(-9)	1.30±.30(-8)	3.70±1.3(-8)	<4.2(-8)	<1.9(-7)
CO-58	4.70±1.1(-7)	7.80±.60(-8)	5.50±1.2(-7)	6.80±1.3(-7)	1.00±.20(-6)
CO-60	<1.1(-7)	2.30±.30(-7)	<2.4(-7)	1.10±.50(-7)	<4.4(-7)
ZN-65	<2.8(-8)	<7.4(-8)	<2.6(-7)	<6.4(-7)	<8.0(-7)
ZR-95	<1.3(-7)	<4.8(-8)	<1.3(-7)	<3.5(-8)	<4.8(-7)
NB-95	<1.1(-7)	<2.2(-8)	<5.6(-8)	<1.2(-7)	<3.0(-7)
RU-103	<4.3(-8)	1.10±.50(-8)	<1.2(-7)	<3.7(-8)	<3.4(-7)
RU-106	<1.0(-6)	<6.5(-7)	<9.7(-7)	<1.2(-6)	<3.9(-6)
AG-110M	<1.2(-7)	2.70±1.0(-8)	<2.7(-7)	<9.0(-8)	<5.5(-7)
SB-124	<1.5(-7)	<4.7(-8)	<4.7(-8)	<1.6(-7)	<3.7(-7)
SB-125	<1.3(-7)	<9.3(-8)	<2.2(-7)	<6.4(-8)	<7.6(-7)
BA-140	<2.0(-7)	<1.2(-7)	<6.6(-7)	<2.0(-7)	<1.4(-6)
LA-140	<3.7(-7)	<9.1(-8)	<9.7(-7)	<7.4(-7)	<1.5(-6)
CE-141	<7.3(-8)	1.50±.50(-8)	<8.8(-8)	<9.0(-8)	<4.0(-7)
EU-152	<1.4(-7)	<7.3(-8)	<3.1(-7)	<7.8(-8)	<9.7(-7)
EU-154	<2.0(-7)	<5.9(-9)	<5.0(-7)	<1.8(-7)	<7.6(-7)

TABLE B.39 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #6

DATE	3/ 1	3/ 7
TIME	1053	1405
NUCLIDE		MICROCURIES/SECOND
I-131	5.10±.80(-6)	2.90±.50(-6)
CS-134	<6.0(-8)	<3.9(-7)
CS-136	<2.9(-7)	<6.3(-8)
CS-137	<1.6(-7)	<3.5(-7)
CR-51	<1.7(-6)	<1.1(-6)
MN-54	<2.0(-7)	<4.3(-7)
FE-59	<1.2(-6)	<3.4(-7)
CO-57	<5.7(-8)	<1.0(-7)
CO-58	<2.0(-7)	3.70±1.6(-7)
CO-60	<4.1(-7)	<3.8(-7)
ZN-65	<3.2(-7)	<3.1(-10)
ZR-95	<9.3(-8)	<2.1(-7)
NB-95	<2.4(-7)	<1.7(-7)
RU-103	<9.9(-8)	<1.6(-7)
RU-106	<1.4(-6)	<8.4(-7)
AG-110M	<1.8(-7)	<3.1(-7)
SB-124	<2.8(-7)	<3.3(-7)
SB-125	<4.1(-7)	<4.6(-7)
BA-140	<1.3(-7)	<4.4(-7)
LA-140	<4.5(-7)	<6.3(-7)
CE-141	<8.0(-8)	<2.8(-7)
EU-152	<5.0(-7)	<6.7(-7)
EU-154	<7.6(-7)	<4.0(-7)

TABLE B.40

ACTIVITY RELEASE RATES AT SAMPLING STATION #7

DATE	1/26	2/ 1	2/ 8	2/15	2/22
TIME	1805	1705	922	1135	1205
NUCLIDE	MICROCURIES/SECOND				
I-131	6.20±.70(-7)	3.60±.50(-6)	3.90±.70(-6)	2.60±.40(-6)	2.50±.10(-5)
CS-134	<8.2(-9)	<8.3(-8)	<1.2(-7)	<7.6(-8)	<3.3(-7)
CS-136	<1.2(-8)	<2.6(-8)	<7.9(-8)	<8.1(-8)	<4.6(-7)
CS-137	<2.3(-9)	<2.6(-7)	<7.7(-8)	<1.1(-7)	<3.7(-7)
CR-51	<3.2(-8)	<1.4(-6)	<4.0(-7)	<1.6(-7)	<2.2(-6)
MN-54	<1.1(-8)	9.50±4.6(-8)	<4.7(-8)	<1.5(-7)	<3.0(-7)
FE-59	<3.2(-9)	<2.1(-7)	<2.2(-7)	<9.8(-8)	<4.2(-7)
CO-57	3.70±1.2(-9)	<7.8(-8)	2.00±.90(-8)	<1.4(-8)	<1.6(-7)
CO-58	<1.6(-8)	1.60±.60(-7)	<1.6(-7)	<1.0(-7)	<5.2(-7)
CO-60	<1.3(-8)	<2.2(-7)	<1.8(-7)	<4.8(-8)	<3.1(-7)
ZN-65	<5.4(-9)	<1.9(-7)	<2.5(-7)	<3.8(-8)	<3.1(-7)
ZR-95	<1.1(-8)	<3.3(-7)	<2.1(-7)	<5.4(-8)	<5.5(-7)
NB-95	<3.7(-9)	<2.1(-7)	<2.3(-8)	<1.1(-7)	<3.2(-7)
RU-103	<4.3(-9)	<6.2(-8)	<5.1(-8)	<2.1(-8)	<3.0(-7)
RU-106	<4.7(-8)	<5.1(-7)	<6.4(-7)	<7.5(-7)	<2.8(-6)
AG-110M	<1.8(-8)	<9.3(-8)	<3.4(-8)	<1.4(-7)	<4.5(-7)
SB-124	<3.3(-9)	<1.4(-7)	<6.0(-8)	<1.7(-7)	<2.7(-7)
SB-125	<1.3(-9)	<4.8(-7)	<1.0(-7)	<1.6(-7)	<2.3(-7)
BA-140	<1.2(-8)	<4.3(-7)	<2.3(-7)	<7.1(-8)	<1.1(-6)
LA-140	<7.2(-8)	<5.2(-7)	<4.8(-6)	<3.7(-7)	<1.3(-6)
CE-141	<3.3(-9)	<1.8(-7)	9.60±2.7(-8)	<3.9(-8)	<3.1(-7)
EU-152	<3.6(-8)	<5.7(-7)	<2.0(-7)	<1.3(-7)	<7.7(-7)
EU-154	<9.1(-9)	<4.2(-7)	<1.2(-7)	<1.1(-7)	<6.9(-7)

TABLE B.40 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #7

DATE	3/ 1	3/ 7
TIME	1155	1430
NUCLIDE	MICROCURIES/SECOND	
I-131	2.70±.10(-5)	1.40±.10(-5)
CS-134	<1.2(-7)	<1.7(-7)
CS-136	<1.8(-7)	<1.9(-7)
CS-137	<2.0(-7)	<8.5(-8)
CR-51	<4.5(-7)	1.10±.50(-6)
MN-54	<1.8(-7)	1.80±.90(-7)
FE-59	<3.8(-7)	<1.8(-6)
CO-57	1.30±.50(-7)	<2.4(-8)
CO-58	<2.6(-7)	5.70±1.8(-7)
CO-60	<3.4(-7)	<4.8(-7)
ZN-65	<2.3(-7)	<6.5(-8)
ZR-95	<4.9(-7)	<1.6(-7)
NB-95	<2.7(-7)	<8.7(-8)
RU-103	<1.9(-7)	<5.7(-8)
RU-106	<8.6(-7)	<1.4(-6)
AG-110M	<3.7(-7)	<1.3(-7)
SB-124	<2.4(-7)	<1.2(-7)
SB-125	<5.4(-7)	<4.3(-7)
BA-140	<3.7(-7)	<4.8(-7)
LA-140	<4.6(-7)	<7.0(-7)
CE-141	<1.7(-7)	<6.6(-8)
EU-152	<5.7(-7)	<3.5(-7)
EU-154	<5.4(-7)	<4.7(-7)

TABLE B.41

ACTIVITY RELEASE RATES AT SAMPLING STATION #8

DATE	1/26	2/ 1	2/ 8	2/15	2/22
TIME	1805	1705	922	1135	1205
NUCLIDE	MICROCURIES/SECOND				
I-131	3.80±.50(-6)	2.00±.40(-6)	1.20±.40(-6)	5.20±3.1(-6)	4.90±.60(-6)
CS-134	<9.5(-8)	<1.3(-7)	<4.4(-8)	<1.9(-8)	<3.1(-7)
CS-136	<6.0(-8)	<4.4(-8)	<9.2(-8)	<8.3(-8)	<2.8(-7)
CS-137	<9.3(-8)	<8.5(-8)	<9.3(-8)	<8.6(-8)	<3.0(-7)
CR-51	<3.6(-7)	<9.5(-7)	<8.7(-8)	<5.7(-8)	<1.8(-6)
MN-54	<2.6(-8)	<8.6(-8)	<3.0(-8)	<1.7(-7)	<2.6(-7)
FE-59	<3.2(-7)	<1.9(-7)	<1.9(-7)	<1.1(-8)	<5.0(-7)
CO-57	<1.2(-8)	<3.4(-8)	<2.3(-8)	<8.8(-9)	<1.4(-7)
CO-58	5.60±1.1(-7)	2.00±.80(-7)	<1.0(-7)	9.80±4.0(-8)	<2.2(-7)
CO-60	<9.5(-8)	<2.2(-7)	<1.0(-7)	<6.3(-8)	<3.3(-7)
ZN-65	<5.3(-7)	<2.1(-7)	<6.6(-8)	<1.0(-7)	<5.0(-7)
ZR-95	<1.3(-7)	<1.1(-7)	<1.0(-7)	<3.4(-8)	<3.9(-7)
NB-95	<7.9(-8)	<1.3(-7)	<1.6(-8)	<1.4(-8)	<2.7(-7)
RU-103	<5.7(-8)	<1.6(-7)	<4.9(-8)	<1.2(-7)	<2.4(-7)
RU-106	<1.0(-6)	<7.0(-7)	<2.7(-7)	<4.9(-7)	<2.7(-6)
AG-110M	<1.1(-7)	<6.8(-8)	<6.0(-8)	<5.4(-8)	<3.1(-7)
SB-124	<5.8(-8)	<1.0(-7)	<2.2(-8)	<1.4(-7)	<2.6(-7)
SB-125	<1.2(-7)	<1.8(-7)	<3.5(-8)	<8.4(-8)	<6.2(-7)
BA-140	<1.7(-7)	<3.5(-7)	<3.1(-7)	<1.3(-7)	<1.1(-6)
LA-140	<7.8(-7)	<9.2(-7)	<1.2(-6)	<3.7(-7)	1.60±.00(-6)
CE-141	<9.5(-8)	9.20±3.6(-8)	3.30±1.4(-8)	<2.9(-8)	<2.6(-7)
EU-152	<1.2(-7)	1.50±.70(-7)	<1.4(-7)	<2.6(-7)	<6.1(-7)
EU-154	<1.2(-7)	<9.1(-8)	<1.1(-7)	<2.5(-7)	<5.6(-7)

TABLE B.41 (cont'd)

ACTIVITY RELEASE RATES AT SAMPLING STATION #8

DATE	3/ 1	3/ 7
TIME	1155	1430
NUCLIDE	MICROCURIES/SECOND	
I-131	1.16±.08(-5)	7.20±.80(-6)
CS-134	<1.0(-7)	<3.0(-7)
CS-136	<2.0(-7)	<2.3(-7)
CS-137	<1.8(-7)	<1.1(-7)
CR-51	<3.5(-7)	1.50±.60(-6)
MN-54	<1.2(-7)	<7.9(-8)
FE-59	<1.6(-7)	<3.5(-7)
CO-57	<8.6(-8)	<1.2(-7)
CO-58	<2.2(-7)	<4.2(-7)
CO-60	2.50±1.3(-7)	<4.2(-7)
ZN-65	<2.7(-8)	<2.1(-7)
ZR-95	<3.4(-7)	<2.4(-7)
NB-95	<3.2(-7)	<2.1(-7)
RU-103	<7.9(-8)	1.30±.60(-7)
RU-106	<1.2(-6)	<1.2(-6)
AG-110M	<2.1(-7)	<1.7(-7)
SB-124	<9.5(-8)	<1.8(-7)
SB-125	<1.9(-7)	<2.9(-7)
BA-140	<1.2(-7)	<6.8(-7)
LA-140	<2.4(-7)	<3.2(-7)
CE-141	<1.4(-7)	<1.3(-7)
EU-152	<3.4(-7)	<6.3(-7)
EU-154	<3.0(-8)	<4.4(-7)

TABLE B.42

ACTIVITY RELEASE RATES AT SAMPLING STATION #9

DATE	2/ 9	2/15	3/ 1
TIME	1427	1150	1207
NUCLIDE	MICROCURIES/SECOND		
I-131	2.00±.10(-5)	5.60±.10(-5)	2.27±.08(-5)
CS-134	<4.7(-8)	<5.0(-8)	<9.4(-9)
CS-136	<5.1(-8)	<4.5(-8)	<3.3(-6)
CS-137	<5.3(-8)	<5.1(-8)	<6.1(-9)
CR-51	<1.8(-7)	<4.1(-7)	<2.0(-7)
MN-54	<3.7(-8)	<3.8(-8)	<2.9(-8)
FE-59	<2.3(-8)	<8.7(-8)	<3.9(-8)
CO-57	<2.0(-8)	<2.4(-8)	<8.0(-9)
CO-58	9.10±2.9(-8)	5.20±1.7(-8)	<1.4(-8)
CO-60	<6.0(-8)	<5.6(-8)	<3.0(-8)
ZN-65	<4.3(-8)	<8.0(-8)	<2.4(-8)
ZR-95	<6.1(-8)	<6.5(-8)	<3.3(-8)
NB-95	<4.7(-8)	<4.0(-8)	<2.5(-8)
RU-103	<3.0(-8)	<4.0(-8)	<7.4(-9)
RU-106	NOTE 1	<5.1(-7)	<8.3(-8)
AG-110M	<5.6(-8)	<6.6(-8)	<1.5(-8)
SB-124	<1.4(-8)	<3.5(-8)	<2.1(-8)
SB-125	<8.6(-8)	<9.3(-8)	<2.8(-8)
BA-140	<9.7(-8)	<1.9(-7)	<4.4(-8)
LA-140	<4.2(-7)	<2.1(-7)	<5.1(-7)
CE-141	<4.7(-8)	<5.0(-8)	<5.0(-8)
EU-152	<1.2(-7)	<1.4(-7)	<7.8(-8)
EU-154	<1.2(-7)	<1.5(-7)	<2.1(-8)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.43

ACTIVITY RELEASE RATES AT SAMPLING STATION #10T

DATE	11/11	11/20	12/ 7
TIME	1300	1210	1515
NUCLIDE	MICROCURIES/CUBIC CENTIMETER		
I-131	1.09±.06(-11)	2.80±.20(-12)	3.40±.30(-12)
CS-134	<5.7(-14)	<2.1(-14)	1.10±.30(-13)
CS-136	<9.3(-15)	<1.4(-14)	<9.1(-14)
CS-137	9.70±2.9(-14)	5.50±1.6(-14)	8.60±3.4(-14)
CR-51	<1.4(-13)	<1.1(-13)	1.00±.30(-12)
MN-54	<4.0(-14)	6.40±1.6(-14)	4.80±.60(-13)
FE-59	<4.9(-14)	<5.5(-14)	2.00±.50(-13)
CO-57	<9.9(-15)	<7.2(-15)	<3.5(-14)
CO-58	6.60±.70(-13)	7.40±.60(-13)	6.20±.20(-12)
CO-60	<4.2(-14)	9.00±1.6(-14)	6.60±.50(-13)
ZN-65	<6.4(-14)	<3.3(-14)	<6.1(-14)
ZR-95	<5.2(-14)	<1.4(-14)	<1.6(-13)
NB-95	<2.2(-14)	<1.2(-14)	1.20±.40(-14)
RU-103	<1.7(-14)	<2.0(-14)	<1.3(-13)
RU-106	<5.6(-13)	<6.3(-13)	<4.9(-12)
AG-110M	<3.5(-14)	<3.7(-14)	6.00±1.8(-14)
SB-124	<4.8(-14)	<2.8(-14)	<1.8(-13)
SB-125	<2.9(-14)	<4.7(-14)	<2.6(-13)
BA-140	<1.0(-13)	<8.0(-14)	<6.0(-13)
LA-140	<5.5(-13)	<2.3(-13)	<9.5(-13)
CE-141	<2.1(-14)	<1.6(-14)	<8.2(-14)
EU-152	<4.9(-15)	<3.3(-14)	<2.4(-13)
EU-154	<1.3(-13)	<1.6(-14)	<1.1(-13)

TABLE B.44

ACTIVITY RELEASE RATES AT SAMPLING STATION #11T

DATE	11/28	12/ 7
TIME	1445	1525
NUCLIDE	MICROCURIES/CUBIC CENTIMETER	
I-131	1.80±.30(-12)	<9.0(-14)
CS-134	5.70±1.4(-14)	1.20±.40(-13)
CS-136	<2.4(-14)	<1.6(-13)
CS-137	1.10±.30(-14)	2.00±.70(-13)
CR-51	<9.6(-14)	2.80±.60(-12)
MN-54	5.20±2.0(-14)	1.79±.09(-12)
FE-59	<5.6(-14)	4.90±.90(-13)
CO-57	<1.3(-14)	7.70±2.4(-14)
CO-58	4.80±.60(-13)	2.00±.04(-11)
CO-60	2.60±.40(-13)	1.45±.09(-12)
ZN-65	<1.7(-14)	<2.2(-13)
ZR-95	<1.3(-13)	2.00±.80(-13)
NB-95	<2.7(-14)	4.70±.90(-13)
RU-103	<5.5(-14)	<2.3(-3)
RU-106	<6.8(-13)	<1.4(-11)
AG-110M	<2.7(-14)	1.40±.40(-13)
SB-124	<4.4(-14)	<3.5(-13)
SB-125	<1.2(-13)	<5.3(-13)
BA-140	<6.4(-14)	<6.8(-13)
LA-140	<1.8(-13)	<2.4(-12)
CE-141	<2.9(-14)	<1.8(-13)
EU-152	<2.1(-14)	<5.0(-13)
EU-154	<3.3(-13)	<1.1(-13)

TABLE B.45

ACTIVITY RELEASE RATES AT SAMPLING STATION #12T

DATE 12/21
TIME 1135

NUCLIDE	MICROCURIES/CUBIC CENTIMETER
I-131	7.30±2.4(-13)
CS-134	5.70±2.0(-14)
CS-136	<2.2(-13)
CS-137	1.70±.70(-13)
CR-51	1.90±.60(-12)
MN-54	8.60±.90(-13)
FE-59	4.90±1.1(-13)
CO-57	6.90±2.3(-14)
CO-58	1.01±.03(-11)
CO-60	1.09±.08(-12)
ZN-65	<2.8(-13)
ZR-95	1.60±.70(-13)
NB-95	4.10±.60(-14)
RU-103	<2.5(-13)
RU-106	<7.2(-12)
AG-110M	9.80±5.0(-14)
SB-124	<2.9(-13)
SB-125	<4.4(-13)
BA-140	<9.7(-13)
LA-140	<1.0(-11)
CE-141	<2.6(-13)
EU-152	<5.8(-13)
EU-154	<4.0(-13)

TABLE B.46

ACTIVITY RELEASE RATES AT SAMPLING STATION #13T

DATE	12/21	1/ 4
TIME	936	1525
NUCLIDE	MICROCURIES/CUBIC CENTIMETER	
I-131	2.40±1.2(-13)	3.40±.30(-12)
CS-134	<1.1(-13)	<4.0(-14)
CS-136	<1.1(-13)	<1.6(-14)
CS-137	7.20±2.6(-14)	7.30±2.5(-14)
CR-51	2.80±1.6(-13)	3.20±1.2(-13)
MN-54	1.60±.40(-13)	1.90±.30(-13)
FE-59	<1.8(-13)	<7.2(-14)
CO-57	1.60±.90(-14)	<2.1(-14)
CO-58	2.00±.10(-12)	2.00±.10(-12)
CO-60	2.00±.30(-13)	3.00±.30(-13)
ZN-65	<2.1(-13)	<3.3(-14)
ZR-95	<1.6(-13)	<1.1(-13)
NB-95	<1.3(-13)	9.10±2.4(-14)
RU-103	6.00±3.0(-14)	<5.6(-14)
RU-106	<1.4(-12)	<1.5(-12)
AG-110M	<1.4(-13)	<4.7(-14)
SB-124	<1.1(-13)	<8.3(-14)
SB-125	<3.4(-13)	<1.2(-13)
BA-140	<4.6(-13)	<2.9(-13)
LA-140	<2.1(-12)	<2.6(-14)
CE-141	<8.7(-14)	<5.7(-14)
EU-152	<3.5(-13)	<1.3(-13)
EU-154	<2.6(-13)	<1.6(-14)

TABLE B.47

RADIONUCLIDE CONCENTRATIONS IN COVER GAS IN COOLANT WASTE HOLDUP TANK T-610B

DATE 3/ 6
TIME 1135

NUCLIDE	MICROCURIES/CUBIC CENTIMETERS
I-131	4.15±.07(-10)
CS-134	<8.8(-13)
CS-136	<4.1(-13)
CS-137	8.80±3.3(-13)
CR-51	<1.5(-12)
MN-54	<2.4(-13)
FE-59	<5.4(-13)
CO-57	<2.0(-13)
CO-58	<1.2(-12)
CO-60	<1.4(-12)
ZN-65	<1.6(-12)
ZR-95	<1.2(-12)
NB-95	<8.7(-13)
RU-103	<2.6(-13)
RU-106	<5.4(-12)
AG-110M	<7.0(-13)
SB-124	<8.4(-13)
SB-125	<8.7(-13)
BA-140	<1.6(-12)
LA-140	<4.8(-12)
CE-141	<6.4(-13)
EU-152	<2.6(-12)
EU-154	<2.3(-12)

TABLE B.48

RADIONUCLIDE CONCENTRATIONS IN COVER GAS IN COOLANT WASTE HOLDUP TANK T-610A

DATE 3/ 7
TIME 1140

NUCLIDE	MICROCURIES/CUBIC CENTIMETERS
I-131	7.10±.30(-11)
CS-134	4.70±.40(-12)
CS-136	<5.3(-13)
CS-137	1.70±.10(-11)
CR-51	<7.0(-12)
MN-54	1.10±.30(-12)
FE-59	<1.4(-12)
CO-57	1.80±.70(-13)
CO-58	3.30±.10(-11)
CO-60	7.50±.60(-12)
ZN-65	<1.3(-12)
ZR-95	<1.6(-12)
NB-95	<1.0(-12)
RU-103	<1.2(-12)
RU-106	<3.0(-11)
AG-110M	<1.2(-12)
SB-124	<2.8(-12)
SB-125	<3.2(-12)
BA-140	<3.3(-12)
LA-140	<7.6(-13)
CE-141	<7.0(-13)
EU-152	<3.2(-12)
EU-154	<3.2(-13)

TABLE B.49

RADIONUCLIDE CONCENTRATIONS IN COVER GAS IN COOLANT WASTE RECEIVER TANK T-607B

DATE 2/23
TIME 1415

NUCLIDE	MICROCURIES/CUBIC CENTIMETERS
I-131	1.56±.10(-9)
CS-134	4.00±.50(-10)
CS-136	<7.0(-11)
CS-137	3.20±.70(-10)
CR-51	<4.8(-10)
MN-54	<4.5(-11)
FE-59	<1.3(-10)
CO-57	<5.2(-11)
CO-58	6.30±.60(-10)
CO-60	9.30±1.0(-10)
ZN-65	<1.6(-10)
ZR-95	<1.9(-10)
NB-95	<9.6(-11)
RU-103	<6.2(-11)
RU-106	<7.4(-10)
AG-110M	<2.4(-10)
SB-124	<1.3(-10)
SB-125	<1.6(-10)
BA-140	<2.6(-10)
LA-140	<1.5(-10)
CE-141	<9.6(-11)
EU-152	<1.6(-10)
EU-154	<2.4(-10)

TABLE B.50

RADIONUCLIDE CONCENTRATIONS IN COVER GAS IN COOLANT WASTE RECEIVER TANK T-607A

DATE	2/27	2/28
TIME	1540	930
NUCLIDE	MICROCURIES/CUBIC CENTIMETERS	
I-131	3.33±.01(-9)	1.44±.01(-9)
CS-134	3.90±2.6(-9)	<2.4(-9)
CS-136	<5.2(-10)	<8.0(-10)
CS-137	<5.9(-10)	<1.6(-9)
CR-51	<4.6(-9)	<8.8(-9)
MN-54	<4.0(-10)	<9.3(-10)
FE-59	<9.0(-10)	<2.4(-9)
CO-57	<2.8(-10)	<5.5(-10)
CO-58	<5.6(-10)	<1.4(-9)
CO-60	3.80±.60(-9)	7.10±1.4(-9)
ZN-65	<4.6(-10)	<1.9(-9)
ZR-95	<6.0(-10)	<1.5(-9)
NB-95	<3.4(-10)	<9.4(-10)
RU-103	<3.8(-10)	<8.6(-10)
RU-106	<4.0(-9)	<7.6(-9)
AG-110M	<1.2(-9)	<3.4(-9)
SB-124	<1.1(-9)	<2.3(-9)
SB-125	<8.6(-10)	<2.2(-9)
BA-140	<1.4(-9)	<4.0(-9)
LA-140	<8.4(-10)	<1.4(-9)
CE-141	<6.6(-10)	<1.4(-9)
EU-152	<1.4(-9)	<2.8(-9)
EU-154	<1.2(-9)	<3.2(-9)

TABLE B.51

MAIN STACK IODINE SPECIES

MAIN STACK IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
9/11 -	9/14	<5.5(-5)	<2.3(-5)	<4.0(-5)	3.10±1.6(-5)	<4.3(-5)	3.10±1.6(-5)
9/14 -	9/27	<1.9(-7)	<7.0(-7)	<5.1(-7)	3.70±1.2(-6)	<2.6(-6)	3.70±1.2(-6)
9/27 -	10/12	<6.4(-7)	<9.3(-7)	<2.0(-6)	2.40±1.0(-6)	<1.2(-6)	2.40±1.0(-6)
10/12 -	10/26	<2.3(-7)	<4.9(-6)	<2.4(-6)	4.80±1.3(-6)	<5.0(-6)	4.80±1.3(-6)
10/26 -	11/ 9	<4.8(-7)	<5.5(-7)	<6.5(-6)	8.70±5.5(-7)	<5.9(-7)	8.70±5.5(-7)
11/ 9 -	11/20	1.29±.45(-6)	5.30±1.7(-6)	7.20±2.0(-6)	6.28±.54(-5)	<6.5(-6)	7.66±.60(-5)
11/20 -	12/ 7	<1.2(-6)	<1.4(-6)	<2.8(-7)	1.70±.30(-5)	<7.1(-7)	1.70±.30(-5)
12/ 7 -	12/21	<6.0(-6)	<5.3(-6)	<2.9(-6)	3.20±.50(-5)	3.00±.90(-6)	3.50±.51(-5)
12/21 -	1/ 4	<1.4(-6)	<1.0(-5)	<3.1(-6)	5.50±.50(-5)	<2.2(-6)	5.50±.50(-5)
1/ 4 -	1/18	<3.4(-6)	<8.4(-6)	<3.6(-6)	1.04±.07(-4)	<3.3(-6)	1.04±.07(-4)
1/18 -	2/ 1	<3.8(-7)	<1.3(-6)	<1.5(-6)	4.90±1.5(-6)	<1.6(-6)	4.90±1.5(-6)
2/ 1 -	2/15	3.20±2.1(-7)	<8.5(-6)	<8.8(-6)	<6.1(-6)	<8.0(-6)	3.20±2.1(-7)
2/15 -	3/ 1	<1.4(-6)	<2.3(-6)	<2.4(-6)	<1.1(-6)	<1.6(-6)	NOTE 2
3/ 1 -	3/13	<9.9(-7)	<2.4(-6)	<6.1(-7)	<8.1(-7)	<2.1(-7)	NOTE 2

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.
NOTE 2: ALL DATA TO BE SUMMED ARE LESS-THANS OR THE DATUM IS MISSING.

TABLE B.52

SAMPLING STATION #1 IODINE SPECIES

STATION #1 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
9/13 -	9/27	7.83±.39(-6)	5.91±.16(-5)	2.27±.12(-5)	1.17±.08(-5)	<1.7(-7)	1.01±.02(-4)
9/27 -	10/12	1.57±.12(-6)	5.09±.39(-6)	8.62±.78(-6)	1.72±.27(-6)	<1.0(-7)	1.70±.09(-5)
10/12 -	10/26	4.66±.24(-6)	3.84±.12(-5)	1.92±.16(-5)	4.31±.39(-6)	<2.9(-7)	6.66±.20(-5)
10/26 -	11/ 9	2.31±.16(-6)	1.29±.08(-5)	7.44±.39(-6)	1.37±.27(-6)	<1.9(-7)	2.40±.09(-5)
11/ 9 -	11/20	1.80±.08(-5)	1.25±.03(-4)	3.68±.16(-5)	1.21±.08(-5)	<3.5(-7)	1.92±.04(-4)
11/20 -	12/ 7	2.11±.16(-6)	4.70±.39(-6)	3.60±.39(-6)	3.17±.35(-6)	<4.3(-7)	1.36±.07(-5)
12/ 7 -	12/21	5.87±1.6(-7)	3.68±.47(-6)	9.79±3.5(-7)	7.83±2.4(-7)	<3.2(-7)	6.03±.65(-6)
12/21 -	1/ 4	3.76±.20(-6)	2.94±.12(-5)	5.09±.39(-6)	7.83±.78(-6)	<3.1(-7)	4.61±.15(-5)
1/ 4 -	1/18	1.68±.04(-5)	1.90±.03(-4)	1.96±.08(-5)	1.72±.08(-5)	<6.1(-1)	2.44±.03(-4)
1/18 -	2/ 1	1.29±.04(-5)	1.92±.04(-4)	1.49±.08(-5)	1.14±.08(-5)	<3.3(-8)	2.31±.04(-4)
2/ 1 -	2/15	2.82±.20(-6)	1.41±.08(-5)	3.76±.51(-6)	3.21±.47(-6)	<7.4(-7)	2.39±.11(-5)
2/15 -	3/ 1	1.88±.16(-6)	4.31±.16(-5)	1.21±.08(-5)	5.09±.39(-6)	<1.1(-7)	6.22±.18(-5)
3/ 1 -	3/13	2.58±.24(-6)	2.58±.12(-5)	6.66±.39(-6)	3.37±.39(-6)	<1.5(-7)	3.84±.13(-5)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.53

SAMPLING STATION #2 IODINE SPECIES

STATION #2 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
9/13 -	9/27	<1.1(-7)	<3.4(-7)	<2.3(-7)	<1.5(-6)	<5.4(-7)	NOTE 2
9/27 -	10/12	<3.9(-7)	7.47±3.1(-7)	<5.9(-7)	<1.3(-6)	<4.1(-7)	7.47±3.1(-7)
10/12 -	10/26	5.67±3.1(-8)	<5.7(-7)	<7.5(-7)	<3.1(-7)	4.38±3.1(-7)	4.95±3.1(-7)
10/26 -	11/ 9	<1.8(-7)	<5.7(-7)	<4.6(-7)	<5.9(-7)	<7.0(-7)	NOTE 2
11/ 9 -	11/20	3.01±.13(-5)	6.44±.26(-5)	1.57±.05(-4)	1.93±.05(-4)	<1.1(-6)	4.45±.08(-4)
1/20 -	12/ 7	2.63±.16(-5)	1.39±.08(-4)	2.01±.10(-4)	3.35±.10(-4)	<4.4(-6)	7.01±.17(-4)
12/ 7 -	12/21	5.15±.77(-6)	1.44±.18(-5)	1.62±.18(-5)	1.34±.16(-5)	6.18±3.1(-7)	4.98±.31(-5)
12/21 -	1/ 4	1.31±.08(-6)	3.09±.77(-6)	3.61±.77(-6)	2.03±.57(-6)	<1.8(-6)	1.00±.12(-5)
1/ 4 -	1/18	1.11±.49(-6)	1.47±.49(-6)	8.76±3.1(-7)	1.16±.44(-6)	4.38±2.3(-7)	5.05±.91(-6)
1/18 -	2/ 1	3.86±.13(-7)	<5.4(-7)	<5.4(-7)	<6.2(-7)	<1.0(-6)	3.86±.13(-7)
2/ 1 -	2/15	2.21±.64(-7)	6.44±4.6(-7)	<2.0(-6)	<1.8(-6)	<2.2(-6)	8.65±4.7(-7)
2/15 -	3/ 1	8.24±1.8(-7)	<2.0(-7)	<8.0(-7)	<4.4(-8)	<5.4(-7)	8.24±1.8(-7)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.
NOTE 2: ALL DATA TO BE SUMMED ARE LESS-THANS OR THE DATUM IS MISSING.

TABLE B.54

SAMPLING STATION #3 IODINE SPECIES

STATION #3 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL COI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
9/13 -	9/27	<1.6(-5)	6.20±.40(-5)	3.60±.40(-5)	3.90±.10(-4)	<1.3(-6)	4.88±.11(-4)
9/27 -	10/12	2.70±1.9(-6)	6.00±1.2(-6)	1.10±.20(-5)	5.00±.40(-5)	9.20±5.6(-7)	7.06±.50(-5)
10/12 -	10/26	<1.0(-5)	2.80±.60(-5)	3.20±.60(-5)	1.51±.08(-4)	<2.6(-6)	2.11±.12(-4)
11/ 9 -	11/20	7.42±.09(-4)	1.49±.02(-3)	1.08±.01(-2)	3.38±.04(-3)	5.10±1.4(-6)	1.64±.01(-2)
11/20 -	12/ 7	1.00±.20(-5)	6.20±.70(-5)	2.30±.10(-4)	4.60±.20(-4)	<8.7(-6)	7.62±.24(-4)
12/ 7 -	12/21	2.20±1.1(-6)	9.90±2.3(-6)	4.50±.30(-5)	2.75±.10(-4)	<2.9(-6)	3.32±.11(-4)
12/21 -	1/ 4	2.20±.90(-6)	6.10±2.2(-6)	1.30±.20(-5)	8.50±.20(-4)	4.80±1.4(-6)	8.76±.20(-4)
1/ 4 -	1/18	1.60±.60(-6)	1.40±.20(-5)	4.80±.30(-5)	6.70±.10(-4)	6.70±1.4(-6)	7.40±.11(-4)
1/18 -	2/ 1	2.10±.50(-6)	1.30±.20(-5)	1.10±.20(-5)	2.08±.07(-4)	3.50±1.0(-6)	2.38±.08(-4)
2/ 1 -	2/ 8	<1.1(-6)	7.30±1.7(-6)	1.00±.20(-5)	2.10±.20(-5)	2.00±.90(-6)	4.03±.34(-5)
2/ 8 -	2/15	<1.5(-6)	1.10±.30(-5)	1.70±.50(-5)	3.40±.70(-5)	<9.6(-6)	6.20±.91(-5)
2/15 -	2/22	9.40±3.8(-7)	2.30±.90(-6)	2.90±1.1(-6)	1.20±.20(-5)	<2.5(-6)	1.81±.25(-5)
2/22 -	3/ 1	3.10±.60(-6)	2.00±.30(-5)	3.10±.30(-5)	8.60±.60(-5)	1.90±.80(-6)	1.42±.07(-4)
3/ 1 -	3/ 7	3.20±.60(-6)	3.10±.30(-5)	3.80±.30(-5)	5.70±.40(-5)	5.20±1.6(-6)	1.34±.06(-4)
3/ 7 -	3/13	<2.5(-6)	1.90±.30(-5)	2.10±.30(-5)	5.70±.50(-5)	3.00±1.1(-6)	1.00±.07(-4)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.55

SAMPLING STATION #4 IODINE SPECIES

STATION #4 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
1/ 8 -	1/18	1.50±.90(-6)	4.10±.70(-6)	1.11±.01(-5)	2.40±.05(-4)	1.20±.40(-6)	2.58±.05(-4)
1/18 -	2/ 1	1.60±.20(-6)	4.70±.60(-6)	5.90±.70(-6)	1.96±.04(-4)	<3.0(-7)	2.08±.04(-4)
2/ 1 -	2/ 8	3.90±1.6(-7)	5.00±.80(-6)	7.60±.80(-6)	2.20±.20(-5)	<4.6(-7)	3.50±.23(-5)
2/ 8 -	2/15	6.60±2.1(-7)	6.30±1.3(-6)	7.80±1.2(-6)	2.40±.20(-5)	<2.4(-6)	3.88±.27(-5)
2/15 -	2/22	1.60±.80(-7)	2.30±.50(-6)	1.90±.50(-6)	1.30±.10(-5)	<6.0(-7)	1.74±.12(-5)
2/22 -	3/ 1	1.70±.30(-6)	1.10±.10(-5)	2.20±.20(-5)	7.00±.30(-5)	1.30±.40(-6)	1.06±.04(-4)
3/ 1 -	3/ 7	1.40±.30(-6)	8.30±1.0(-6)	2.20±.20(-5)	3.00±.20(-5)	<1.6(-6)	6.17±.30(-5)
3/ 7 -	3/13	1.90±.40(-6)	1.03±.90(-5)	1.33±.90(-5)	6.60±.30(-5)	1.20±.50(-6)	9.27±1.3(-5)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.56

SAMPLING STATION #5 IODINE SPECIES

STATION #5 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
1/18 -	2/ 1	7.10±4.4(-8)	6.90±.20(-7)	3.70±1.2(-7)	1.20±.20(-6)	2.10±1.1(-7)	2.54±.26(-6)
2/ 1 -	2/ 8	<2.0(-7)	<1.5(-6)	<9.5(-7)	2.40±1.6(-7)	<5.9(-7)	2.40±1.6(-7)
2/ 8 -	2/15	6.90±5.0(-8)	<1.2(-6)	<1.3(-6)	<1.3(-6)	<1.1(-6)	6.90±5.0(-8)
2/15 -	2/22	<3.4(-8)	2.30±1.1(-7)	<2.9(-7)	<3.4(-8)	<1.2(-7)	2.30±1.1(-7)
2/22 -	3/ 4	<9.0(-8)	2.20±.40(-6)	2.40±.50(-6)	4.80±.60(-6)	<8.6(-7)	9.40±.88(-6)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.57

SAMPLING STATION #6 IODINE SPECIES

STATION #6 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
1/25 -	2/ 1	9.90±1.6(-7)	3.80±.60(-6)	2.00±.40(-6)	1.10±.30(-6)	<5.1(-7)	7.89±.80(-6)
2/ 1 -	2/ 8	2.80±.40(-7)	9.50±3.2(-7)	7.20±3.7(-7)	1.20±.30(-6)	<3.6(-7)	3.15±.58(-6)
2/ 8 -	2/15	1.60±.70(-7)	1.30±.50(-6)	1.40±.50(-6)	2.30±.60(-6)	<1.4(-6)	5.16±.93(-6)
2/15 -	2/22	<8.6(-8)	2.90±1.3(-7)	<5.3(-7)	1.70±.40(-6)	<5.6(-7)	1.99±.42(-6)
2/22 -	3/ 1	<5.5(-8)	1.60±.40(-6)	1.80±.40(-7)	3.30±.20(-5)	5.20±2.5(-7)	3.53±.21(-5)
3/ 1 -	3/ 7	<2.2(-7)	1.40±.30(-6)	2.10±.60(-6)	1.70±.40(-6)	<9.7(-7)	5.20±.78(-6)
3/ 7 -	3/13	2.80±1.3(-7)	8.20±3.1(-7)	1.20±.30(-6)	5.50±2.0(-7)	<4.6(-7)	2.85±.49(-6)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.58

SAMPLING STATION #7 IODINE SPECIES

STATION #7 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
1/26 -	2/ 1	<1.9(-8)	1.60±.40(-7)	9.30±2.8(-8)	3.20±.50(-7)	4.70±1.9(-8)	6.20±.72(-7)
2/ 1 -	2/ 8	<3.7(-7)	1.10±.30(-6)	4.10±1.5(-7)	1.70±.30(-7)	3.70±1.8(-7)	2.05±.38(-6)
2/ 8 -	2/15	<1.2(-7)	9.70±3.3(-7)	7.00±2.9(-7)	2.20±.50(-6)	<1.1(-6)	3.87±.67(-6)
2/15 -	2/22	<2.0(-7)	6.50±2.4(-7)	<7.0(-7)	2.00±.40(-6)	<9.4(-7)	2.65±.47(-6)
2/22 -	3/ 1	<5.5(-8)	3.90±.50(-6)	7.00±.70(-6)	1.41±.09(-5)	<1.8(-7)	2.50±.12(-5)
3/ 1 -	3/ 7	<4.2(-7)	4.50±.50(-6)	5.60±.60(-6)	1.50±.09(-5)	2.60±.40(-6)	2.77±.13(-5)
3/ 7 -	3/13	<3.2(-7)	1.80±.40(-6)	3.20±.50(-6)	7.90±.70(-6)	1.40±.30(-6)	1.43±.10(-5)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.59

SAMPLING STATION #8 IODINE SPECIES

STATION #8 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
1/26 -	2/ 1	6.60±1.2(-7)	2.10±.40(-6)	4.30±2.0(-7)	6.40±2.4(-7)	<4.2(-7)	3.83±.52(-6)
2/ 1 -	2/ 8	4.10±1.2(-7)	8.10±2.7(-7)	5.30±2.2(-7)	3.10±1.6(-7)	<4.6(-7)	2.06±.40(-6)
2/ 8 -	2/15	8.90±4.4(-8)	3.10±2.0(-7)	7.70±3.1(-7)	<1.1(-6)	<8.3(-7)	1.17±.37(-6)
2/15 -	2/22	<5.9(-8)	6.50±2.7(-7)	7.20±2.2(-7)	3.90±3.1(-6)	NOTE 2	5.27±3.1(-6)
2/22 -	3/ 1	<2.6(-7)	2.20±.40(-6)	1.50±.30(-6)	1.20±.30(-6)	<3.1(-7)	4.90±.58(-6)
3/ 1 -	3/ 7	1.80±.70(-7)	4.30±.50(-6)	6.00±.50(-6)	1.20±.30(-6)	<2.0(-7)	1.17±.08(-5)
3/ 7 -	3/13	2.80±1.2(-7)	2.60±.40(-6)	3.50±.50(-6)	8.20±2.7(-7)	<2.6(-7)	7.20±.71(-6)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.
NOTE 2: ALL DATA TO BE SUMMED ARE LESS-THANS OR THE DATUM IS MISSING.

TABLE B.60

SAMPLING STATION #9 IODINE SPECIES

STATION #9 IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL COI-2	HOI IPH	ORGANIC AGX	CHARCOAL	TOTAL NOTE 1
		MICROCURIES/SECOND					
2/ 9 -	2/15	5.20±.60(-7)	1.50±.10(-5)	4.40±.40(-6)	5.30±.40(-6)	<5.2(-7)	2.52±.12(-5)
2/15 -	3/ 1	3.10±.50(-6)	3.90±.10(-5)	8.80±.30(-6)	2.80±.20(-6)	<1.5(-7)	5.37±.12(-5)
3/ 1 -	3/13	3.20±1.6(-6)	1.30±.05(-5)	4.20±1.1(-6)	2.20±.20(-6)	<7.4(-8)	2.26±.20(-5)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.61

SAMPLING STATION #10T IODINE SPECIES

STATION #10T IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/CUBIC CENTIMETER					
11/11	- 11/20	1.35±.09(-12)	6.70±1.1(-13)	2.30±.30(-12)	3.30±.30(-12)	<1.2(-14)	7.62±.45(-12)
11/20	- 12/ 7	<2.8(-14)	<2.4(-13)	5.80±.90(-13)	6.20±.80(-13)	<6.0(-14)	1.20±.12(-12)
12/ 7	- 12/21	<1.7(-13)	<1.9(-13)	<6.7(-13)	2.00±.20(-12)	<4.2(-14)	2.00±.20(-12)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.62

SAMPLING STATION #11T IODINE SPECIES

STATION #11T IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE					
		PARTICULATE FILTER	ELEMENTAL COI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/CUBIC CENTIMETER					
11/28	12/ 7	3.50±.60(-13)	9.80±1.8(-13)	4.60±2.3(-13)	<2.7(-13)	<1.5(-14)	1.79±.30(-12)
12/ 7	12/21	<1.5(-13)	<3.4(-13)	<2.0(-13)	<3.1(-13)	<6.6(-14)	NOTE 2

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.
NOTE 2: ALL DATA TO BE SUMMED ARE LESS-THANS OR THE DATUM IS MISSING.

TABLE B.63

SAMPLING STATION #12T IODINE SPECIES

STATION #12T IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE					
		PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/CUBIC CENTIMETER					
12/21 -	12/31	2.10±1.0(-13)	2.10±1.0(-13)	3.10±1.5(-13)	<6.9(-13)	<1.1(-12)	7.30±2.1(-13)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.64

SAMPLING STATION #13T IODINE SPECIES

STATION #13T IODINE SPECIES BREAKDOWN

DATE ON	DATE OFF	I-131 CHEMICAL STATE: PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/CUBIC CENTIMETER					
12/21 -	1/ 4	<2.7(-13)	<7.7(-13)	<6.1(-13)	1.20±.60(-13)	<2.2(-13)	1.20±.60(-13)
1/ 4 -	1/18	2.10±.50(-14)	1.10±.20(-13)	3.90±1.3(-13)	1.70±.20(-12)	<3.1(-13)	2.22±.24(-12)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.65

IODINE SPECIES IN COOLANT WASTE RECEIVER TANK T-607A COVER GAS

COOLANT WASTE RECEIVER TANK(T-607A)

DATE ON	DATE OFF	I-131 CHEMICAL STATE PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	CHARCOAL	TOTAL NOTE 1
		MICROCURIES/CUBIC CENTIMETER					
2/27 -	2/28	<3.1(-13)	4.20±2.5(-13)	<5.2(-12)	3.32±.01(-9)	1.23±.09(-11)	3.33±.01(-9)
2/28 -	2/28	<8.0(-13)	<1.1(-12)	4.90±.80(-12)	1.30±.01(-9)	9.30±.40(-11)	1.40±.01(-9)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.66

IODINE SPECIES IN COOLANT WASTE RECEIVER TANK T-607B COVER GAS

COOLANT WASTE RECEIVER TANK(T-607B)

DATE ON	DATE OFF	I-131 CHEMICAL STATE					
		PARTICULATE FILTER	/ ELEMENTAL CDI-2	/ HOI IPH	/ ORGANIC AGX	/ CHARCOAL	/ TOTAL NOTE 1
		MICROCURIES/CUBIC CENTIMETER					
2/23 -	2/26	<1.2(-11)	3.80±.70(-13)	2.10±.20(-12)	1.74±.01(-9)	1.54±.02(-11)	1.76±.01(-9)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.67

IODINE SPECIES IN COOLANT WASTE HOLDUP TANK T-610A COVER GAS

COOLANT WASTE HOLDUP TANK(T-610A)

DATE ON	DATE OFF	I-131 CHEMICAL STATE					
		PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/CUBIC CENTIMETER					
3/ 8 -	3/ 9	1.10±.40(-12)	<2.9(-12)	<2.9(-12)	6.50±.30(-11)	4.40±1.2(-12)	7.05±.33(-11)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.68

IODINE SPECIES IN COOLANT WASTE HOLDUP TANK T-610B COVER GAS

COOLANT WASTE HOLDUP TANK(T-610B)

DATE ON	DATE OFF	I-131 CHEMICAL STATE					
		PARTICULATE FILTER	ELEMENTAL CDI-2	HOI IPH	ORGANIC AGX	ORGANIC CHARCOAL	TOTAL NOTE 1
		MICROCURIES/CUBIC CENTIMETER					
3/ 7 -	3/ 8	<4.1(-13)	<9.4(-13)	<6.1(-13)	4.12±.07(-10)	2.70±.70(-12)	4.15±.07(-10)

NOTE 1: THE TOTAL COLUMN IS THE SUM OF THE REAL DATA ONLY, ANY LESS-THANS ARE IGNORED.

TABLE B.69

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	10/23	10/24	10/25	10/26	10/27
TIME	1230	1130	1130	1130	1000
NUCLIDE	MICROCURIES/SECOND				
KR-85M	3.12±.14(0)	1.80±.21(1)	4.86±.02(1)	4.44±.24(0)	1.28±.01(1)
KR-85	7.38±.70(-1)	2.51±.17(0)	6.30±.49(0)	2.82±1.4(0)	<1.4(0)
KR-88	<6.6(0)	<3.3(1)	7.43±.13(1)	<3.2(0)	1.57±.04(1)
XE-131M	2.49±.10(0)	<2.6(1)	<9.0(1)	9.17±.50(0)	<1.8(1)
XE-133M	5.36±.05(0)	3.74±.02(1)	7.17±.15(1)	2.98±.02(1)	2.82±.02(1)
XE-133	3.19±.19(2)	1.74±.03(3)	3.44±.06(3)	1.57±.14(3)	1.27±.02(3)
XE-135	2.42±.02(1)	2.70±.02(2)	3.96±.04(2)	8.38±.19(1)	1.79±.02(2)

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	10/28	10/29	10/30	10/31	11/ 1
TIME	1000	1000	1000	1000	1000
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.69±.38(-1)	3.64±.04(0)	1.90±.03(0)	2.33±.07(1)	3.02±.04(1)
KR-85	4.97±1.4(-1)	<4.1(-1)	<1.1(-3)	<1.0(-1)	<6.1(-2)
KR-88	2.51±.11(0)	5.57±.19(0)	2.74±.11(-1)	8.10±.63(0)	1.17±.07(1)
XE-131M	<3.9(0)	<2.8(0)	1.97±.69(-1)	NOTE 1	NOTE 1
XE-133M	8.78±.07(0)	1.12±.01(1)	1.39±.02(0)	NOTE 1	NOTE 1
XE-133	4.39±.22(2)	5.34±.28(2)	1.36±.08(2)	NOTE 1	NOTE 1
XE-135	3.44±.03(1)	5.02±.09(1)	8.70±.12(0)	NOTE 1	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE TIME	11/ 2 1100	11/ 3 1100	11/ 4 1100	11/ 5 1100	11/ 6 1100
NUCLIDE			MICROCURIES/SECOND		
KR-85M	4.71±.08(1)	4.04±.38(0)	8.74±.27(0)	3.03±.18(0)	<4.4(0)
KR-85	<1.4(0)	4.59±.64(-1)	<5.1(0)	<2.6(0)	<5.4(0)
KR-88	2.86±.30(2)	<1.8(1)	1.64±.38(1)	6.87±1.7(0)	<5.5(2)
XE-131M	NOTE 1	2.23±.26(0)	<6.6(0)	<3.2(0)	5.24±.71(0)
XE-133M	NOTE 1	9.94±.08(0)	1.56±.08(1)	7.68±1.5(0)	1.63±.06(1)
XE-133	NOTE 1	4.44±.22(2)	5.70±.35(2)	4.14±.23(2)	5.78±.53(2)
XE-135	NOTE 1	4.97±.07(1)	1.23±.04(2)	5.83±.12(1)	3.67±.09(1)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	11/ 7	11/ 8	11/ 9	11/10	11/11
TIME	1730	1200	1200	1200	1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.57±.04(0)	6.42±.16(0)	1.57±.02(0)	2.30±.19(0)	1.85±.37(0)
KR-85	<1.2(0)	<3.1(0)	<3.1(-1)	<3.4(0)	<1.1(-2)
KR-88	2.95±.35(0)	1.49±.15(1)	3.18±.10(0)	4.20±1.2(0)	<1.3(2)
XE-131M	<6.7(-1)	<1.7(0)	<3.6(-1)	<6.4(-1)	NOTE 1
XE-133M	1.59±.04(0)	2.67±.16(0)	1.28±.01(0)	9.88±1.2(-1)	NOTE 1
XE-133	6.04±.31(1)	1.01±.04(2)	5.99±.32(1)	5.24±.25(1)	NOTE 1
XE-135	1.17±.02(1)	3.07±.04(1)	1.07±.01(1)	1.26±.02(1)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	11/12	11/14	11/14	11/15	11/16
TIME	1200	200	1200	1200	1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.19±.09(0)	6.28±.05(-1)	1.53±.14(0)	5.84±.39(-2)	<4.4(-2)
KR-85	<8.4(-2)	<2.6(-1)	9.01±.80(-1)	2.67±.53(-1)	4.23±.21(0)
KR-88	<6.6(0)	9.16±.44(-1)	<7.8(0)	<2.6(-2)	<5.2(-2)
XE-131M	3.58±.40(-1)	<7.5(-1)	5.18±.65(-1)	7.41±.38(-1)	<5.7(1)
XE-133M	1.02±.02(0)	1.28±.02(0)	1.56±.02(0)	1.28±.01(1)	2.81±.05(1)
XE-133	4.60±.22(1)	6.63±.31(1)	8.43±.40(1)	1.03±.04(2)	1.98±.02(3)
XE-135	8.76±.14(0)	6.52±.07(0)	1.27±.01(1)	4.75±.05(0)	3.79±.11(1)

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	11/17	11/18	11/19	11/20	11/21
TIME	1200	1200	1200	1200	900
NUCLIDE	MICROCURIES/SECOND				
KR-85M	<1.4(-1)	<2.8(-3)	<1.0(-2)	<3.7(-3)	<1.4(-2)
KR-85	<3.0(0)	<1.2(-1)	1.17±.08(0)	5.75±1.0(-1)	3.67±.26(-1)
KR-88	<8.4(-1)	<2.8(-2)	<2.9(-2)	<4.3(-2)	<8.4(-2)
XE-131M	8.39±1.0(0)	9.43±.31(-1)	4.34±.57(0)	1.69±.04(0)	1.23±.17(0)
XE-133M	1.28±.01(1)	1.02±.01(0)	3.78±.05(0)	1.08±.02(0)	1.95±.03(-1)
XE-133	9.25±.39(2)	9.02±.58(1)	3.90±.14(2)	1.29±.07(2)	5.93±.19(1)
XE-135	4.53±.04(0)	8.70±.13(-2)	7.21±.15(-2)	5.05±1.0(-3)	<1.2(-3)

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	11/28	11/29	11/30	12/ 6	12/ 7
TIME	1200	1200	1200	1200	1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	<1.7(-3)	<1.9(-3)	<2.3(-2)	<1.7(-3)	<2.8(-3)
KR-85	1.81±.45(-1)	1.57±.47(-1)	<1.4(-1)	3.50±.64(-1)	4.09±.26(0)
KR-88	<2.1(-2)	<3.6(-2)	<3.6(-1)	<2.1(-2)	<2.8(-2)
XE-131M	4.58±.22(-1)	5.55±1.1(-1)	7.76±.32(-1)	2.00±.13(-1)	6.14±.47(-1)
XE-133M	2.92±.21(-2)	2.17±.48(-2)	<2.1(-3)	<3.5(-3)	<6.6(-3)
XE-133	1.25±.04(1)	1.44±.10(1)	7.22±.40(0)	2.62±.12(0)	2.98±.13(0)
XE-135	<1.5(-3)	<7.8(-4)	1.21±.74(-3)	<8.8(-4)	6.06±4.0(-3)

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE TIME	12/ 8 1200	12/ 9 1200	12/10 1200	12/11 1200	12/12 1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	<9.4(-1)	<6.9(-4)	<1.6(-3)	<2.2(-3)	<6.4(-3)
KR-85	2.01±.50(-1)	<3.2(-2)	<9.1(-2)	<5.2(-2)	<1.7(-1)
KR-88	<1.1(-1)	<1.3(-2)	<2.4(-2)	<3.3(-2)	<1.2(-1)
XE-131M	2.72±.11(-1)	2.34±.12(-1)	1.41±.10(-1)	1.03±.10(-1)	1.26±.16(-1)
XE-133M	<7.4(-3)	<1.7(-3)	<2.8(-3)	<2.9(-3)	<4.3(-3)
XE-133	2.62±.11(0)	2.52±.11(0)	1.18±.06(0)	7.63±.36(-1)	9.63±.59(-1)
XE-135	<2.5(-2)	<4.5(-4)	<7.3(-4)	<8.8(-4)	<1.9(-3)

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	12/13	12/14	12/19	12/20	12/21
TIME	1200	1300	1200	1400	1400
NUCLIDE	MICROCURIES/SECOND				
KR-85M	<9.1(-3)	1.06±.44(-3)	<4.0(-1)	1.38±.10(-1)	NOTE 1
KR-85	<2.0(-1)	3.97±.58(0)	1.43±.34(0)	1.06±.25(0)	1.26±.06(0)
KR-88	<4.1(-2)	<1.1(-3)	<7.8(0)	3.36±.61(-1)	NOTE 1
XE-131M	1.77±1.8(-1)	8.35±.36(-1)	2.48±.12(0)	1.98±.09(0)	1.35±.06(0)
XE-133M	<5.3(-3)	<2.9(-2)	<3.3(-2)	<2.0(-2)	7.81±.14(0)
XE-133	1.06±.02(0)	3.52±.14(0)	7.01±.22(0)	5.60±.18(0)	2.05±.17(2)
XE-135	<1.3(-3)	3.73±2.8(-4)	<2.8(-2)	6.06±.32(-2)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	1/ 3	1/ 4	1/ 5	1/ 6	1/ 7
TIME	1500	1200	1200	1200	1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	2.94±.02(0)	1.35±.02(0)	NOTE 1	4.96±1.6(0)	NOTE 1
KR-85	2.51±.19(0)	8.41±.41(0)	6.62±.21(0)	1.42±.04(1)	NOTE 1
KR-88	3.59±.19(0)	8.21±1.2(-1)	NOTE 1	NOTE 1	NOTE 1
XE-131M	<2.1(1)	<4.3(1)	<1.8(2)	<1.1(2)	NOTE 1
XE-133M	3.40±.01(1)	4.70±.04(1)	1.14±.03(2)	8.20±.07(1)	NOTE 1
XE-133	1.69±.02(3)	2.59±.06(3)	1.09±.05(4)	4.60±.07(3)	NOTE 1
XE-135	5.69±.03(1)	5.06±.07(1)	2.84±.08(2)	1.42±.03(2)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	1/ 8	1/ 9	1/10	1/16	1/21
TIME	1200	1200	1200	2000	1300
NUCLIDE	MICROCURIES/SECOND				
KR-85M	4.52±.08(-1)	1.32±.03(0)	5.50±.18(-1)	9.28±1.2(-1)	1.65±.10(0)
KR-85	1.74±.01(0)	3.63±.42(0)	7.49±.13(0)	<5.3(0)	<2.4(0)
KR-88	9.83±.72(-1)	1.48±.11(0)	4.34±.24(-1)	<2.3(0)	<5.3(-1)
XE-131M	5.11±.79(-1)	1.02±.08(0)	<1.4(1)	NOTE 1	9.25±.49(0)
XE-133M	2.90±.02(0)	5.75±.04(0)	1.87±.00(1)	NOTE 1	4.07±.08(1)
XE-133	2.02±.07(2)	4.11±.17(2)	1.64±.15(-1)	NOTE 1	2.52±.09(3)
XE-135	2.87±.02(0)	9.32±.04(0)	1.73±.00(1)	NOTE 1	6.28±.03(1)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	1/22	1/23	1/24	1/25	1/26
TIME	1200	1200	1200	1200	1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	2.91±.90(0)	2.82±.29(-1)	1.57±.13(-1)	4.15±.12(-1)	3.87±.41(-1)
KR-85	<2.6(0)	<1.2(0)	3.70±.72(-1)	2.53±.51(-1)	<2.5(0)
KR-88	NOTE 1	<2.2(-1)	1.50±.14(-1)	4.24±.58(-1)	<6.9(-1)
XE-131M	4.49±.69(0)	1.53±.06(0)	<1.1(2)	6.18±2.3(-1)	9.43±1.9(-1)
XE-133M	1.85±.03(1)	5.02±.11(0)	9.36±.06(0)	2.64±.04(0)	1.79±.07(0)
XE-133	1.28±.04(3)	3.96±.12(2)	8.02±.08(2)	2.25±.10(2)	1.23±.18(2)
XE-135	1.34±.01(1)	3.69±.04(0)	4.32±.04(0)	3.66±.04(0)	3.01±.04(0)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	1/27	1/28	1/30	1/31	2/ 1
TIME	1200	1200	1200	1200	1730
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.55±.02(0)	2.95±.05(-1)	1.74±.03(-1)	4.87±.09(-1)	<3.0(1)
KR-85	<3.7(-1)	<9.8(-4)	<5.4(-2)	3.57±.31(-1)	<3.7(-2)
KR-88	1.91±.16(-1)	5.13±.36(-2)	1.41±.14(-1)	4.25±.35(-1)	<1.4(3)
XE-131M	1.75±.09(0)	<1.8(-1)	4.20±.88(-1)	<4.9(0)	NOTE 1
XE-133M	5.36±.11(0)	4.65±.04(0)	1.30±.01(0)	7.55±.02(0)	NOTE 1
XE-133	2.98±.65(3)	3.93±.21(2)	4.32±1.2(2)	5.09±.06(2)	NOTE 1
XE-135	1.12±.01(1)	6.21±.06(0)	2.01±.01(0)	1.00±.03(1)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	2/ 6	2/ 7	2/ 8	2/ 9	2/10
TIME	1200	1200	1200	1200	1000
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.76±1.0(-1)	3.40±.39(-1)	3.72±.06(-1)	<3.2(0)	1.04±.01(0)
KR-85	6.08±2.4(-2)	7.54±1.1(-2)	<1.1(-1)	<7.7(0)	<1.1(-1)
KR-88	NOTE 1	NOTE 1	4.37±.58(-1)	NOTE 1	9.49±.87(-1)
XE-131M	<1.2(-3)	8.41±.54(-1)	1.18±.12(0)	<6.8(-1)	<1.9(-3)
XE-133M	3.80±.05(0)	2.14±.01(0)	2.74±.03(0)	2.92±.13(0)	4.60±.03(0)
XE-133	3.16±.15(2)	1.54±.03(2)	1.82±.04(2)	1.94±.11(2)	2.90±.07(2)
XE-135	3.29±.02(0)	2.78±.03(0)	4.31±.06(0)	5.42±.13(0)	9.69±.05(0)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	2/11	2/12	2/13	2/14	2/21
TIME	1000	1000	1000	1000	1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	3.60±.35(-1)	1.09±.51(-1)	1.32±.03(-1)	9.52±1.1(-1)	4.69±.78(-1)
KR-85	<9.6(-3)	<1.4(0)	2.31±.10(0)	<1.4(0)	<4.0(0)
KR-88	<2.8(-1)	<2.1(0)	1.27±.11(-1)	<1.0(0)	<1.2(0)
XE-131M	2.83±.20(0)	1.47±.18(0)	1.15±.16(0)	7.78±.38(0)	NOTE 1
XE-133M	7.30±.07(0)	3.69±.11(0)	2.64±.01(0)	1.89±.05(1)	NOTE 1
XE-133	5.29±.34(2)	2.85±.11(2)	2.10±.04(2)	1.46±.03(1)	NOTE 1
XE-135	1.06±.02(1)	2.66±.05(0)	1.84±.01(0)	1.78±.02(1)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.69 (cont'd)

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	2/27	2/28
TIME	1400	1200
NUCLIDE		MICROCURIES/SECOND
KR-85M	9.90±2.8(-3)	7.96±.08(0)
KR-85	3.25±.23(-1)	<1.4(0)
KR-88	3.04±.53(-2)	1.61±.01(1)
XE-131M	<4.5(0)	<1.1(2)
XE-133M	7.30±.02(0)	4.22±.13(1)
XE-133	1.27±.13(3)	4.50±.51(3)
XE-135	1.42±.01(0)	4.15±.11(1)

TABLE B.69 (cont'd

NOBLE GAS RELEASE RATES IN MAIN STACK

DATE	2/22	2/23	2/24	2/25	2/26
TIME	1200	1630	930	1200	1400
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.14±.05(0)	1.30±.36(-1)	4.53±.46(-1)	<5.5(-1)	6.02±2.3(-2)
KR-85	<3.2(0)	<1.4(-2)	<1.6(0)	<2.5(0)	<6.5(-1)
KR-88	<6.5(-1)	<2.5(-1)	<3.0(-1)	<1.3(1)	<1.8(-1)
XE-131M	2.39±.22(0)	2.26±.57(0)	1.97±.11(0)	1.05±.06(0)	3.74±.39(0)
XE-133M	5.56±.09(0)	6.97±.22(0)	5.20±.04(0)	2.30±.04(0)	8.52±.10(0)
XE-133	4.01±.08(2)	4.73±.11(2)	3.37±.06(2)	1.62±.02(2)	6.65±.11(2)
XE-135	5.57±.07(0)	8.88±.10(0)	6.28±.05(0)	6.08±.12(0)	8.33±.05(0)

TABLE B.70

GASEOUS ^3H SPECIES AND RELEASES
FOR SAMPLING STATIONS SYSTEM #1-#3 AND THE MAIN STACK

		Station #2		Station #3		Feeder	Main Stack	
Off Date	Sta #1 µCi/sec	µCi/sec	% Oxidizable	µCi/sec	% Oxidizable	Total µCi/sec	µCi/sec	% Oxidizable
9/27							1.65	3.2
10/12							1.54	1.5
10/26		4.3(-1)	0.0	9.2(-1)	1.8	1.35	1.76	1.1
11/9		4.7(-1)	0.0	4.2(-1)	1.1	0.89	1.87	0.1
11/20		5.9(-1)	0.1	4.1(-1)	0.0	1.00	1.5(-2)**	
12/7		5.7(-1)	0.3	4.3(-1)	0.0	1.00	2.0	0.0
12/21		1.30	0.0	2.4(-1)	0.4	1.54	2.5	0.0
1/4	2.0(-3)	1.60	0.0	3.3(-1)	0.7	1.93	2.5	0.0
1/18	4.6(-3)	1.40	0.0	5.9(-1)	1.0	1.99	2.7	0.1
2/1	1.1(-3)	1.10	0.0	7.4(-2)	35.1	1.17	2.3	0.0
2/15	2.4(-3)	4.3(-1)**	0.0	7.5(-2)	36.0	0.51	2.3	0.0
3/1	2.2(-3)	9.6(-2)**	0.2	2.0(-1)	0.1	0.30	0.16*	
3/13	1.3(-3)	1.0(-1)**	0.0	9.2(-1)	0.5	1.02	3.0	0.0

* Oxidized ^3H sampler only.

** Sampler malfunction.

TABLE B.71

^3H RELEASE RATES AT SAMPLING STATIONS #4-#8
(μCi/sec)

Off Date	Sta #4	Sta #6	Sta #5	Sta #7	Sta #8
2/15	6.4(-1)	4.0(-1)	6.3(-2)	4.5(-2)	1.4(-3)
3/1	8.3(-1)	5.4(-1)	6.8(-2)	6.0(-2)	7.0(-4)
3/13	8.2(-1)	9.9(-2)	*	4.8(-2)	1.4(-3)
Avg.	7.6(-1)	3.5(-1)	6.5(-2)	5.1(-2)	1.2(-3)

* Sampler not operating

TABLE B.72

GASEOUS ^{14}C SPECIES AND RELEASES

Off Date	µCi/sec Sta #1	µCi/sec Sta #2	% Oxidizable	µCi/sec Sta #3	% Oxidizable	µCi/sec Feeder Total	µCi/sec Main Stack	% Oxidizable
10/26	***	5.3(-2)	65.0	1.18(-1)	0.0	1.71(-1)	1.41(-1)	99.0
11/9		7.8(-3)	81.0	6.0(-2)	0.0	6.78(-2)	6.2(-2)	19.0
11/20		8.4(-3)	67.0	2.7(-1)	0.0	2.8(-1)	1.0(-3)*	
12/7		5.3(-2)	70.0	1.13(-2)	0.0	6.53(-2)	1.76(-1)	15.0
12/21		3.72(-2)	0.0	2.2(-2)	34.0	5.92(-2)	1.08(-1)	25.0
1/4		1.16(-2)	0.0	2.2(-2)	79.0	3.36(-2)	4.8(-2)	41.0
1/18		9.1(-3)	0.0	1.64(-1)*	66.0	1.73(-1)	3.6(-2)	61.0
2/1		1.1(-2)	0.0	5.0(-3)	0.0	1.6(-2)	5.7(-2)	0.0
2/15		8.6(-3)*	0.0	4.2(-3)*	0.0	1.3(-2)	**	
3/1		2.1(-2)*	0.0	5.5(-2)*	0.0	7.6(-2)	1.2(-2)*	
3/13		2.2(-3)*	0.0	2.3(-2)*	79.1	2.5(-2)	5.6(-2)	0.0
Avg.		2.4(-2)	35.4	7.3(-2)	16.1	1.30(-1)	8.6(-2)	32.5

* Sampler not operating correctly.

** Lost Sample

*** No ^{14}C sampler installed at System #1

TABLE B.73

ANALYSES FOR ALPHA AND BETA NUCLIDES IN VENTILATION SAMPLES

	Main Stack Sample $\mu Ci/cm^3$				
Sample Date	^{55}Fe	^{63}Ni	^{91}Y	^{89}Sr	^{90}Sr
10/12-10/26/78	1.8 ± 0.6(-12)	1.7 ± 0.1(-12)	5.6 ± 2.4(-13)	*	*
10/26-11/9/78	*	*	*	<1.2(-12)	<4.3(-15)
11/20-12/7/78	*	*	*	<6.7(-13)	5.3 ± 3.9(-15)
12/7-12/21/78	2.2 ± 0.7(-13)	2.6 ± 0.2(-13)	<8(-14)	*	*
1/18-2/1/79	*	*	*	5.8 ± 3.4(-13)	<4.8(-15)
2/15-3/1/79	7.0 ± 2.3(-14)	7.4 ± 0.4(-13)	1.2 ± 0.5(-13)	*	*

Analysis of Main Stack HEPA Filter

Nuclide	μCi/filter[1]
^{55}Fe	10. ± 2
^{63}Ni	1.8 ± 0.1
^{91}Y	8 ± 1(-2)
^{89}Sr	2.3 ± 0.8(-1)
^{90}Sr	6.2 ± 0.4(-3)
^{238}Pu	1.2 ± 0.2(-4)
^{239}Pu	3.1 ± 0.2(-4)
^{241}Am	8.4 ± 0.4(-4)
^{242}Cm	6.0 ± 0.6(-4)
^{244}Cm	3 ± 2(-5)

* Not analyzed for this nuclide.

[1] This filter is one of 36 in the filter bank.

TABLE B.74

RADIONUCLIDE CONCENTRATIONS IN CONTAINMENT AIR SAMPLES

DATE	9/ 8	10/12	10/12	10/26	11/18
TIME	1025	1119	1610	1908	1030
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
I-131	2.69±.63(-8)	1.43±.04(-9)	1.50±.10(-10)	1.13±.02(-9)	1.80±.10(-11)
I-132	<1.9(-10)	<2.7(-11)	<8.2(-11)	<1.7(-10)	NOTE 1
I-133	7.00±.10(-9)	1.34±.06(-9)	1.40±.20(-10)	6.00±.20(-10)	NOTE 1
I-135	<7.5(-10)	8.[illegible]±1.[illegible](-10)	7.[illegible]±2.[illegible](-11)	<3.5(-12)	NOTE 1
RB-88	1.50±.50(-11)	NOTE 1	9.80±.90(-8)	<1.8(-12)	NOTE 1
CS-134	<1.1(-10)	<1.2(-10)	<1.0(-11)	<4.1(-13)	<3.1(-12)
CS-136	<1.5(-10)	<6.7(-12)	<8.0(-11)	<5.9(-13)	<3.1(-12)
CS-137	1.60±.50(-10)	<8.4(-11)	<2.0(-10)	<3.6(-12)	<2.6(-12)
NA-24	<2.8(-10)	<4.0(-11)	<4.8(-11)	<3.3(-12)	NOTE 1
CR-51	<5.2(-10)	<5.[illegible](-11)	<9.8(-11)	<3.4(-13)	<1.6(-11)
MN-54	<9.3(-11)	<1.1(-10)	<8.9(-11)	<2.6(-12)	5.80±.20(-11)
MN-56	<1.2(-9)	<4.4(-10)	<4.3(-10)	<6.5(-11)	NOTE 1
FE-59	<3.6(-10)	<6.7(-11)	<2.7(-11)	<5.6(-13)	<3.6(-12)
CO-57	<2.1(-11)	<3.1(-12)	<8.3(-12)	<8.7(-14)	1.80±.30(-12)
CO-58	<1.6(-10)	<1.6(-10)	<3.8(-11)	<9.7(-14)	1.40±.03(-10)
CO-60	<1.7(-10)	<1.6(-10)	<3.4(-10)	6.00±1.0(-12)	<6.4(-12)
ZN-65	<2.8(-10)	<8.7(-11)	<1.8(-10)	<1.6(-13)	NOTE 1
SR-91	<4.0(-10)	<6.6(-11)	<1.3(-10)	<2.6(-12)	NOTE 1
Y-93	<5.6(-10)	<8.1(-12)	<3.3(-11)	<4.4(-12)	NOTE 1
ZR-95	<2.2(-10)	<3.5(-11)	<1.1(-10)	<9.9(-13)	<4.5(-12)
NB-95	<8.9(-11)	<2.8(-12)	<1.4(-10)	<3.9(-13)	<3.2(-12)
MO-99	<2.3(-11)	<3.1(-11)	<2.6(-12)	<6.6(-13)	<3.0(-11)
RU-103	<7.9(-11)	<1.3(-11)	<7.3(-11)	1.20±.30(-12)	<2.5(-12)
RUD-106	<9.8(-10)	<2.0(-12)	<6.9(-11)	<1.3(-12)	<3.2(-11)
AG-110M	<1.5(-10)	<9.5(-11)	<6.6(-11)	<1.2(-14)	1.30±.70(-12)
SB-124	<4.3(-10)	<1.1(-11)	<1.3(-10)	<6.4(-13)	<3.2(-12)
SB-125	<1.7(-10)	<9.4(-12)	<5.3(-11)	<3.8(-13)	<4.9(-12)
TE-129M	<3.0(-9)	<2.9(-11)	<4.1(-11)	<6.1(-13)	NOTE 1
TE-129	<1.7(-9)	<3.1(-10)	<3.3(-11)	<1.7(-10)	NOTE 1
TE-131M	<5.1(-10)	NOTE 1	<3.4(-11)	<1.7(-12)	NOTE 1
TE-132	<4.3(-11)	<3.6(-11)	<7.8(-12)	<6.6(-13)	NOTE 1
BA-139	<2.1(-10)	<1.2(-11)	<2.0(-11)	<9.0(-13)	NOTE 1
BA-140	<2.5(-10)	<1.4(-11)	<4.8(-11)	<2.9(-14)	<8.2(-12)
LA-140	<2.4(-10)	<6.7(-11)	<6.0(-11)	<9.2(-13)	NOTE 1
CE-141	<4.2(-11)	<1.2(-11)	<1.3(-11)	<4.8(-13)	<1.5(-12)
CE-143	<7.4(-11)	<1.2(-11)	<4.3(-11)	<1.5(-12)	<6.6(-12)
CE-144	<2.0(-10)	<4.4(-11)	<8.5(-12)	<1.4(-13)	NOTE 1
EU-152	<1.4(-10)	<4.8(-13)	<9.9(-12)	<1.1(-13)	<5.6(-12)
EU-154	<4.3(-10)	<1.4(-11)	<1.4(-10)	<1.0(-13)	<3.6(-12)
EU-155	<9.2(-11)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
W-187	<3.2(-10)	<4.8(-11)	<8.6(-11)	<2.1(-12)	NOTE 1
NP-239	<8.2(-11)	<2.3(-11)	<3.7(-11)	<1.1(-13)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.74 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN CONTAINMENT AIR SAMPLES

DATE	1/ 8	1/17	1/23	1/24	1/25
TIME	1321	1001	1409	1545	1000
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
I-131	3.21±.01(-8)	1.10±.01(-8)	5.24±.01(-8)	2.59±.01(-8)	3.38±.01(-8)
I-132	<1.2(-12)	<8.0(-11)	<3.6(-11)	<4.2(-11)	<3.4(-11)
I-133	1.08±.01(-8)	1.34±.01(-8)	1.12±.01(-8)	3.93±.04(-9)	7.73±.04(-9)
I-135	1.80±.60(-9)	2.00±.10(-9)	2.40±.10(-9)	1.18±.07(-9)	2.20±.10(-9)
RB-88	1.44±.09(-7)	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	7.20±.80(-11)	2.30±.10(-10)	1.82±.09(-10)	1.68±.06(-10)	2.30±.07(-10)
CS-136	<6.2(-12)	<6.0(-12)	8.00±2.0(-12)	1.80±.70(-12)	4.00±1.0(-12)
CS-137	1.15±.06(-10)	3.39±.08(-10)	2.59±.07(-10)	2.54±.07(-10)	3.16±.08(-10)
NA-24	5.10±.70(-11)	1.20±.10(-10)	2.50±.70(-11)	2.90±.80(-11)	8.00±1.0(-11)
CR-51	<2.2(-11)	<3.0(-11)	<2.4(-11)	<1.2(-11)	<1.6(-11)
MN-54	4.00±3.0(-12)	<7.0(-12)	4.00±1.0(-12)	<1.1(-13)	2.00±1.0(-12)
MN-56	<8.0(-11)	<1.2(-10)	<1.0(-10)	<1.4(-10)	<7.4(-11)
FE-59	<1.1(-11)	<1.3(-11)	<2.0(-12)	<2.2(-12)	<4.0(-12)
CO-57	<2.2(-12)	<2.6(-12)	<1.3(-12)	<9.0(-13)	<1.0(-11)
CO-58	1.20±.30(-11)	2.80±.40(-11)	2.60±.20(-11)	<1.4(-12)	1.60±.20(-11)
CO-60	<1.0(-11)	3.50±.10(-10)	7.00±2.0(-12)	<1.4(-12)	<2.6(-12)
ZN-65	<1.6(-11)	<1.2(-11)	<3.2(-12)	<2.5(-12)	<4.2(-12)
SR-91	<1.7(-11)	<3.8(-11)	<1.8(-11)	<1.1(-11)	<1.5(-11)
Y-93	<3.8(-12)	<9.6(-11)	<7.4(-11)	<4.0(-11)	<4.4(-11)
ZR-95	<9.6(-12)	8.00±4.0(-12)	<2.6(-12)	<1.2(-12)	6.00±2.0(-12)
NB-95	<3.8(-12)	<6.0(-12)	<2.0(-12)	<1.1(-12)	<1.7(-12)
MO-99	4.80±.20(-11)	2.00±.20(-11)	1.30±.10(-11)	5.60±.20(-12)	1.90±.10(-11)
RU-103	<3.2(-12)	<4.0(-12)	<2.6(-12)	<1.4(-12)	<2.2(-12)
RUD-106	<3.8(-11)	<4.2(-11)	<2.2(-11)	<1.4(-11)	<1.8(-11)
AG-110M	<1.4(-11)	<2.0(-11)	<6.8(-12)	<3.5(-12)	<3.6(-12)
SB-124	<2.0(-11)	<7.2(-12)	<5.0(-12)	<3.2(-12)	<3.4(-12)
SB-125	<9.8(-12)	1.50±.60(-11)	<7.4(-12)	<4.8(-12)	<6.4(-12)
TE-129M	<1.2(-11)	<1.5(-10)	<5.4(-11)	<3.2(-11)	<5.0(-11)
TE-129	<2.0(-10)	<7.4(-9)	<6.6(-9)	<9.0(-10)	<1.2(-9)
TE-131M	<1.9(-10)	<3.0(-11)	<1.6(-11)	<6.1(-12)	<1.2(-11)
TE-132	<2.2(-12)	<3.0(-12)	<2.0(-12)	<1.3(-12)	<2.2(-12)
BA-139	<3.4(-11)	<7.4(-10)	<1.8(-10)	<7.3(-11)	<1.6(-10)
BA-140	<1.2(-11)	<1.6(-10)	1.20±.60(-11)	<6.0(-12)	<8.2(-12)
LA-140	<8.2(-12)	<5.6(-12)	<3.0(-12)	<2.0(-12)	<2.4(-12)
CE-141	<4.0(-12)	<4.8(-12)	<4.0(-12)	<1.8(-12)	<2.2(-12)
CE-143	<8.6(-12)	<7.4(-12)	<5.4(-12)	<3.3(-12)	<4.0(-12)
CE-144	<1.8(-11)	<2.2(-11)	<1.5(-11)	<8.0(-13)	<9.0(-12)
EU-152	<1.2(-11)	<2.0(-11)	<9.2(-12)	<5.9(-12)	<1.1(-11)
EU-154	<1.3(-11)	<1.3(-11)	<5.0(-12)	<3.1(-12)	<3.6(-12)
EU-155	<2.8(-11)	<2.8(-11)	<5.6(-12)	<2.4(-12)	<3.6(-12)
W-187	<1.2(-10)	<2.8(-11)	<1.6(-12)	<1.1(-11)	<1.2(-11)
NP-239	<8.0(-11)	<1.5(-11)	<6.0(-12)	<3.5(-12)	<4.2(-12)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.74 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN CONTAINMENT AIR SAMPLES

DATE	2/ 4	2/ 5	2/ 6	2/ 6	2/ 6
TIME	1314	1506	1122	1510	2205
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
I-131	1.23±.01(-8)	3.56±.01(-9)	2.09±.02(-9)	1.61±.02(-9)	1.56±.01(-9)
I-132	<1.7(-11)	<4.2(-11)	<2.0(-10)	<1.1(-10)	<9.8(-11)
I-133	6.54±.03(-9)	2.04±.02(-9)	1.34±.03(-9)	1.30±.08(-9)	1.35±.02(-9)
I-135	2.17±.07(-9)	4.50±.30(-10)	4.90±.80(-10)	4.00±.40(-10)	6.40±.40(-10)
RB-88	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	1.97±.02(-10)	6.50±.20(-11)	1.80±.10(-10)	1.96±.07(-10)	1.96±.04(-10)
CS-136	3.60±.50(-12)	1.00±.60(-8)	<3.2(-12)	<3.5(-12)	3.60±.80(-12)
CS-137	2.87±.04(-10)	9.10±.20(-11)	2.67±.06(-10)	2.74±.09(-10)	2.97±.05(-10)
NA-24	8.10±.30(-11)	2.[illegible]±.30(-11)	5.80±1.2(-11)	8.30±1.0(-11)	8.70±.70(-11)
CR-51	<5.6(-12)	<8.0(-12)	<2.3(-11)	<1.6(-11)	<1.5(-11)
MN-54	<1.2(-12)	<8.2(-13)	<3.0(-12)	<4.6(-12)	<1.2(-12)
MN-56	<2.9(-11)	<1.1(-10)	<4.9(-10)	<1.6(-10)	<9.3(-11)
FE-59	<1.4(-12)	<1.1(-12)	<5.0(-12)	<3.0(-12)	<2.2(-12)
CO-57	<3.6(-13)	<3.8(-13)	<2.8(-12)	<1.2(-12)	<6.6(-13)
CO-58	3.50±.40(-12)	1.30±.70(-12)	6.70±2.9(-12)	<1.1(-11)	6.40±1.0(-12)
CO-60	<1.0(-12)	<2.0(-12)	<6.8(-12)	<4.2(-12)	<2.0(-12)
ZN-65	<1.8(-12)	<1.8(-12)	<6.2(-12)	<5.4(-12)	<2.5(-12)
SR-91	<6.1(-12)	<5.0(-12)	<2.5(-11)	<1.8(-11)	<1.3(-11)
Y-93	<1.7(-11)	<1.8(-11)	<8.8(-11)	<5.7(-11)	<3.0(-11)
ZR-95	<9.7(-13)	<1.5(-12)	<4.2(-12)	<3.4(-12)	<2.0(-12)
NB-95	<6.9(-13)	<6.6(-13)	<3.3(-12)	<1.5(-12)	<1.4(-12)
MO-99	6.70±.50(-12)	2.60±.30(-12)	6.40±1.2(-12)	8.50±.90(-12)	7.10±.50(-12)
RU-103	<1.1(-12)	<1.0(-12)	<3.2(-12)	<1.9(-12)	<1.4(-12)
RUD-106	<8.6(-12)	<8.4(-12)	<4.0(-11)	<2.0(-11)	<1.5(-11)
AG-110M	<1.9(-12)	<1.8(-12)	<7.3(-12)	<5.3(-12)	<3.3(-12)
SB-124	<1.1(-12)	<1.6(-12)	<7.2(-12)	<4.0(-12)	<1.6(-12)
SB-125	<2.7(-12)	<2.9(-12)	<7.4(-12)	<6.5(-12)	<3.9(-12)
TE-129M	<1.9(-11)	<1.7(-11)	<8.4(-11)	<4.9(-11)	<3.3(-11)
TE-129	<9.6(-10)	NOTE 1	NOTE 1	<1.6(-8)	<5.7(-8)
TE-131M	<4.4(-12)	<3.8(-12)	<1.7(-11)	<9.1(-12)	<6.5(-12)
TE-132	<5.3(-13)	<2.3(-13)	<2.1(-12)	<1.5(-12)	<9.1(-13)
BA-139	<8.7(-11)	<6.9(-10)	<5.1(-9)	<1.1(-9)	<8.4(-10)
BA-140	<4.0(-12)	<3.4(-12)	<1.7(-11)	<8.2(-12)	<6.6(-12)
LA-140	<8.0(-13)	<9.0(-13)	<4.1(-12)	<2.5(-12)	<1.1(-12)
CE-141	<1.7(-12)	<8.4(-13)	<3.4(-12)	<2.2(-12)	<1.3(-12)
CE-143	<1.4(-12)	<1.4(-12)	<5.4(-12)	<4.2(-12)	<2.5(-12)
CE-144	<2.9(-12)	<3.0(-12)	<2.5(-11)	<9.6(-12)	<5.6(-12)
EU-152	<3.3(-12)	<2.0(-12)	<8.6(-12)	<6.6(-12)	<3.7(-12)
EU-154	<1.5(-12)	<1.6(-12)	<6.6(-12)	<4.2(-12)	<3.6(-12)
EU-155	<4.5(-12)	<1.0(-13)	<5.1(-12)	<4.0(-12)	<1.8(-12)
W-187	<7.4(-12)	<4.4(-12)	<3.9(-11)	<1.4(-11)	<8.8(-12)
NP-239	<2.1(-12)	<2.0(-12)	<1.2(-11)	<5.0(-12)	<2.9(-12)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.74 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN CONTAINMENT AIR SAMPLES

DATE	2/ 7	2/ 7	2/ 8	2/ 9	2/ 9
TIME	906	1457	913	857	1055
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
I-131	1.40±.02(-9)	1.29±.01(-9)	1.25±.01(-9)	1.25±.02(-9)	1.34±.02(-9)
I-132	NOTE 1	<5.4(-11)	<1.1(-10)	<4.0(-11)	<7.9(-11)
I-133	1.08±.03(-9)	1.10±.01(-9)	1.21±.01(-9)	1.27±.03(-9)	1.38±.03(-9)
I-135	3.20±.50(-10)	5.30±.40(-10)	6.50±.50(-10)	8.00±.90(-10)	6.20±1.1(-10)
RB-88	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	9.40±.40(-11)	1.69±.06(-10)	1.89±.04(-10)	2.20±.10(-10)	1.74±.05(-10)
CS-136	<1.8(-12)	4.70±1.8(-12)	3.30±1.0(-12)	6.60±2.0(-12)	3.40±1.5(-12)
CS-137	1.34±.08(-10)	2.65±.09(-10)	2.81±.05(-10)	3.20±.10(-10)	2.76±.06(-10)
NA-24	2.20±.70(-11)	6.20±1.0(-11)	9.20±.80(-11)	1.20±.20(-10)	7.60±.90(-11)
CR-51	<1.3(-11)	<2.0(-11)	<1.2(-11)	<3.8(-11)	<2.0(-12)
MN-54	<1.9(-12)	<2.2(-12)	<1.9(-12)	<5.5(-12)	<2.9(-12)
MN-56	<4.0(-9)	<1.4(-10)	<1.2(-10)	<2.2(-10)	<1.3(-10)
FE-59	<3.1(-12)	<3.6(-12)	<5.0(-12)	<1.1(-12)	<5.1(-12)
CO-57	<1.2(-12)	<1.0(-12)	<7.2(-13)	<3.2(-12)	<1.6(-12)
CO-58	<2.2(-12)	<2.6(-12)	<2.2(-12)	1.42±.07(-11)	5.90±1.5(-12)
CO-60	<3.4(-12)	<2.8(-12)	<1.8(-12)	1.00±.60(-11)	5.20±2.2(-12)
ZN-65	<2.4(-12)	<5.0(-12)	<2.0(-12)	<1.1(-12)	<6.0(-12)
SR-91	<2.6(-11)	<1.6(-11)	<1.2(-11)	<3.0(-11)	<1.7(-11)
Y-93	<1.0(-11)	<4.6(-11)	<4.0(-11)	<9.0(-11)	<5.0(-11)
ZR-95	<2.4(-12)	<4.2(-12)	<2.0(-12)	<8.2(-12)	<4.8(-12)
NB-95	<1.2(-13)	<1.5(-12)	<1.4(-12)	<4.4(-12)	<2.1(-12)
MO-99	3.60±3.7(-12)	5.40±.80(-12)	6.10±.70(-12)	1.10±.20(-11)	1.20±.10(-11)
RU-103	<1.6(-12)	<2.0(-12)	<1.7(-12)	<5.3(-12)	<2.6(-12)
RUD-106	<2.6(-11)	<1.7(-11)	<1.6(-12)	<5.2(-11)	<2.4(-11)
AG-110M	<6.3(-12)	<4.0(-12)	<4.0(-12)	<1.3(-11)	<9.4(-12)
SB-124	<3.4(-12)	<4.2(-12)	<2.1(-12)	<1.2(-11)	<4.6(-12)
SB-125	<4.4(-12)	<8.8(-12)	<6.4(-12)	<1.4(-11)	<7.6(-12)
TE-129M	<4.1(-11)	<3.3(-11)	<4.0(-11)	<1.3(-10)	<6.4(-11)
TE-129	NOTE 1	<5.2(-9)	<7.4(-9)	<9.7(-9)	<9.3(-9)
TE-131M	<9.6(-12)	<9.4(-12)	<9.2(-12)	<3.2(-11)	<1.3(-11)
TE-132	<1.4(-12)	<1.4(-13)	<1.2(-12)	<3.4(-12)	<1.6(-12)
BA-139	NOTE 1	<4.0(-10)	<6.4(-10)	<1.0(-9)	<7.0(-10)
BA-140	<7.6(-12)	<8.0(-12)	<6.0(-12)	<2.2(-11)	<1.1(-11)
LA-140	<2.7(-12)	<3.1(-12)	<1.9(-12)	<6.4(-12)	<3.7(-12)
CE-141	<2.1(-12)	<2.1(-12)	<1.9(-12)	<6.2(-12)	<4.2(-12)
CE-143	<3.6(-12)	<4.6(-12)	<3.1(-12)	<8.4(-12)	<4.6(-12)
CE-144	<8.0(-12)	<8.5(-12)	<8.0(-12)	<3.8(-11)	<1.1(-11)
EU-152	<4.8(-12)	<5.6(-12)	<4.4(-12)	<1.5(-11)	<6.9(-12)
EU-154	<4.6(-12)	<4.5(-12)	<2.8(-12)	<1.2(-11)	<6.6(-12)
EU-155	<2.8(-12)	<2.9(-12)	<4.4(-12)	<1.8(-11)	<8.0(-12)
W-187	<1.4(-11)	<1.3(-11)	<9.7(-12)	<2.4(-11)	<1.6(-11)
NP-239	<6.4(-12)	<4.5(-12)	<3.4(-12)	<1.6(-11)	<6.6(-12)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.74 (cont'd)

RADIONUCLIDE CONCENTRATIONS IN CONTAINMENT AIR SAMPLES

DATE	2/ 9	2/10	2/11	2/12	3/ 6
TIME	1600	845	834	841	1200
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
I-131	4.69±.04(-9)	3.05±.02(-9)	7.39±.06(-9)	8.28±.05(-9)	5.11±.01(-8)
I-132	<2.0(-12)	<1.8(-12)	<3.0(-11)	<1.3(-11)	NOTE 1
I-133	5.57±.05(-9)	2.44±.02(-9)	7.44±.04(-9)	8.08±.06(-9)	NOTE 1
I-135	3.17±.09(-9)	5.06±.50(-10)	3.90±.10(-9)	3.00±.10(-9)	NOTE 1
RB-88	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
CS-134	2.08±.09(-10)	9.20±.30(-11)	1.74±.04(-10)	2.11±.06(-10)	8.26±.08(-10)
CS-136	2.40±1.1(-12)	2.90±.60(-12)	1.90±.80(-12)	3.00±1.7(-12)	5.30±1.1(-12)
CS-137	3.31±.09(-10)	1.28±.06(-10)	2.67±.04(-10)	3.08±.07(-10)	1.22±.02(-9)
NA-24	1.00±.08(-10)	3.20±.50(-11)	7.10±.60(-11)	6.90±1.1(-11)	NOTE 1
CR-51	<1.5(-11)	<1.1(-11)	<1.4(-11)	<1.2(-11)	<8.5(-11)
MN-54	<3.0(-12)	<8.0(-12)	<2.0(-12)	<2.4(-12)	2.90±1.0(-12)
MN-56	<4.6(-11)	<6.4(-11)	<5.7(-11)	<2.6(-10)	NOTE 1
FE-59	<8.4(-12)	<1.8(-12)	<3.0(-12)	<3.6(-12)	<5.8(-12)
CO-57	<1.0(-12)	<5.0(-13)	<6.7(-13)	<8.0(-13)	<4.0(-12)
CO-58	3.70±1.3(-12)	4.10±.80(-12)	<4.6(-12)	<2.6(-12)	4.20±1.3(-12)
CO-60	1.70±1.6(-12)	<1.6(-12)	<1.7(-12)	5.50±1.8(-12)	<3.8(-12)
ZN-65	<5.1(-12)	<1.8(-12)	<4.4(-12)	<3.0(-12)	<7.2(-12)
SR-91	<1.3(-11)	<4.8(-12)	<1.1(-11)	<2.8(-11)	NOTE 1
Y-93	<4.0(-11)	<2.4(-11)	<3.2(-11)	<6.2(-11)	NOTE 1
ZR-95	<5.1(-12)	<1.4(-13)	<3.4(-12)	<4.0(-12)	1.00±.00(-11)
NB-95	<1.9(-12)	<1.1(-12)	<1.2(-12)	<1.4(-12)	<5.0(-12)
MO-99	8.80±.80(-12)	5.00±.40(-12)	5.30±.50(-12)	8.30±.80(-12)	<4.7(-11)
RU-103	<2.8(-12)	<9.2(-13)	<1.6(-12)	<1.8(-12)	<1.0(-11)
RUD-106	<2.2(-11)	<1.0(-11)	<1.2(-11)	<1.7(-11)	<4.1(-11)
AG-110M	<6.1(-12)	<2.6(-12)	<4.8(-12)	<6.4(-12)	<5.6(-12)
SB-124	<3.4(-12)	<2.4(-12)	<4.2(-12)	<3.6(-12)	<2.3(-10)
SB-125	<6.4(-12)	<3.0(-12)	<4.4(-12)	<5.4(-12)	<4.1(-11)
TE-129M	<6.6(-11)	<2.3(-11)	<3.8(-11)	<3.6(-11)	NOTE 1
TE-129	<5.0(-10)	<1.1(-10)	<1.2(-9)	<1.9(-8)	NOTE 1
TE-131M	<1.2(-11)	<6.2(-12)	<9.6(-12)	<2.2(-11)	NOTE 1
TE-132	<1.3(-12)	<8.4(-13)	<1.4(-12)	<1.2(-12)	NOTE 1
BA-139	<7.6(-11)	<1.4(-10)	<1.2(-10)	<1.1(-9)	NOTE 1
BA-140	<8.4(-12)	<8.0(-12)	<7.4(-12)	<8.2(-12)	1.60±.60(-11)
LA-140	<2.2(-12)	<1.7(-12)	<1.9(-12)	<2.4(-12)	<6.8(-12)
CE-141	<1.8(-12)	<1.1(-12)	<1.4(-12)	<2.2(-12)	<1.2(-11)
CE-143	<4.0(-12)	<2.0(-12)	<2.6(-12)	<4.5(-12)	NOTE 1
CE-144	<8.2(-12)	<6.4(-12)	<7.3(-12)	<9.5(-12)	<3.3(-11)
EU-152	<5.8(-12)	<4.4(-12)	<4.2(-12)	<4.6(-12)	<3.7(-11)
EU-154	<5.0(-12)	<2.3(-12)	<3.4(-12)	<3.6(-12)	<4.1(-12)
EU-155	<2.8(-12)	<1.4(-12)	<2.4(-12)	<2.1(-12)	NOTE 1
W-187	<1.1(-11)	<8.4(-12)	<9.2(-12)	<1.3(-11)	NOTE 1
NP-239	<4.5(-12)	<2.6(-12)	<4.2(-12)	<3.3(-12)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.75

RELEASE RATES IN CONTAINMENT STACK EXHAUST

DATE	10/27	11/ 9	11/20	12/ 7
TIME	1225	918	1645	1225
NUCLIDE	MICROCURIES/SECOND			
I-131	5.20±.70(-5)	2.40±.50(-5)	1.90±.50(-6)	2.50±1.0(-6)
CS-134	NOTE 1	2.50±.10(-5)	<1.1(-6)	<2.1(-6)
CS-136	<7.8(-7)	<2.6(-6)	<8.9(-7)	<1.8(-6)
CS-137	1.90±.60(-5)	7.80±.40(-5)	8.60±3.7(-7)	<1.4(-6)
C-14	7.80±.40(-2)	1.15±.07(-1)	3.90±.20(-1)	1.11±.04(-1)
H-3	1.08±.04(0)	1.30±.07(0)	1.72±.07(0)	1.80±.10(-1)
CR-51	NOTE 1	<3.0(-5)	<6.3(-6)	<1.8(-5)
MN-54	<2.3(-7)	<3.7(-6)	<1.1(-6)	<1.6(-6)
FE-59	<8.9(-7)	<7.8(-6)	<7.8(-7)	<2.6(-6)
CO-57	<2.1(-7)	<1.7(-6)	<8.2(-8)	3.00±1.3(-7)
CO-58	<3.7(-7)	<2.4(-6)	3.30±.20(-5)	9.30±4.8(-7)
CO-60	<9.7(-7)	1.60±.60(-6)	3.30±.70(-6)	<4.1(-7)
ZN-65	<1.7(-6)	<6.3(-6)	<3.0(-7)	<2.5(-6)
ZR-95	<7.4(-7)	<5.2(-6)	<7.1(-7)	<3.5(-6)
NB-95	<5.2(-7)	<4.1(-6)	<6.7(-7)	<9.3(-7)
RU-103	NOTE 1	<3.7(-6)	<7.8(-7)	<1.2(-6)
RUD-106	<3.4(-6)	<2.2(-5)	<3.3(-5)	<6.7(-6)
AG-110M	<9.7(-7)	<6.0(-6)	<4.1(-7)	<1.7(-6)
SB-124	<3.7(-7)	<1.3(-5)	6.30±3.7(-7)	<1.7(-6)
SB-125	<2.2(-6)	<1.6(-5)	<6.7(-7)	<4.1(-6)
BA-140	<2.5(-6)	<1.2(-5)	<2.6(-6)	<4.1(-6)
LA-140	<6.0(-6)	<5.2(-6)	<2.3(-6)	<1.8(-5)
CE-141	<2.6(-6)	<3.6(-6)	<2.7(-7)	8.60±2.6(-7)
EU-152	<6.0(-7)	<1.3(-5)	<4.8(-7)	<4.5(-6)
EU-154	<3.6(-6)	<8.2(-6)	<1.0(-6)	<1.2(-6)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.76

ACTIVITY RATES IN CONTAINMENT PURGE EXHAUST FILTER INLET

DATE	10/30	11/ 6	1/19
TIME	1534	958	940
NUCLIDE	MICROCURIES/SECOND		
I-131	9.10±.07(-3)	7.94±.04(-3)	7.74±.07(-3)
I-132	<3.2(-4)	<1.4(-3)	NOTE 1
I-133	6.19±.06(-3)	1.02±.05(-2)	8.30±.20(-3)
I-134	<4.8(-3)	<1.5(-2)	NOTE 1
I-135	4.82±.40(-3)	<3.1(-4)	NOTE 1
CS-134	4.21±.47(-5)	1.30±.10(-4)	6.10±.70(-4)
CS-136	<3.2(-6)	<5.2(-6)	9.00±3.0(-6)
CS-137	5.75±.47(-5)	2.00±.10(-4)	1.22±.10(-3)
NA-24	6.02±2.0(-5)	<7.1(-5)	<2.6(-4)
CR-51	<2.4(-5)	<2.4(-5)	<3.4(-6)
MN-54	<3.5(-6)	<2.8(-6)	1.70±.30(-5)
MN-56	<5.8(-4)	<8.6(-3)	NOTE 1
FE-59	<6.5(-6)	<5.6(-6)	<7.2(-6)
CO-57	<1.7(-6)	<2.0(-6)	<2.2(-7)
CO-58	2.01±1.3(-6)	<1.8(-5)	1.40±.10(-4)
CO-60	<2.5(-6)	<1.9(-5)	2.10±.50(-5)
ZN-65	<5.5(-6)	<5.2(-6)	<8.3(-6)
SR-91	<6.2(-5)	<1.6(-4)	<6.5(-3)
Y-93	<2.0(-4)	<5.6(-4)	<1.4(-2)
ZR-95	<6.7(-6)	6.00±3.0(-6)	<6.5(-6)
NB-95	<3.0(-6)	<3.2(-6)	<4.1(-6)
MO-99	<3.2(-6)	<4.1(-6)	5.00±.30(-5)
RU-103	<2.5(-6)	<3.3(-6)	<5.0(-6)
RUD-106	<2.3(-5)	<2.9(-5)	<4.5(-5)
AG-110M	<4.8(-6)	<8.6(-6)	<9.6(-6)
SB-124	<6.6(-6)	<7.1(-6)	<5.8(-6)
SB-125	<6.5(-6)	<7.4(-6)	<1.3(-5)
TE-129M	1.27±.47(-4)	<8.9(-5)	<1.1(-4)
TE-131M	<2.5(-5)	<4.1(-5)	<1.1(-4)
TE-132	<3.0(-6)	4.00±2.0(-6)	<5.6(-6)
BA-140	<8.7(-6)	<1.3(-5)	<2.4(-5)
LA-140	<4.8(-6)	<1.0(-5)	<2.1(-5)
CE-141	<3.2(-6)	<3.6(-6)	<4.5(-6)
CE-143	<8.7(-6)	<2.1(-5)	<3.8(-5)
CE-144	<1.3(-5)	<1.8(-5)	<1.4(-2)
EU-152	<8.0(-6)	<7.8(-6)	<1.2(-5)
EU-154	<7.4(-6)	<6.0(-9)	<7.6(-6)
EU-155	<6.5(-6)	<1.2(-5)	<1.3(-5)
W-187	<2.5(-5)	<6.0(-5)	<2.4(-5)
NP-239	<8.7(-6)	<1.9(-5)	<2.2(-6)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.77

ACTIVITY RATES IN CONTAINMENT PURGE EXHAUST FILTER OUTLET

DATE	10/30	11/ 6	1/19
TIME	1534	958	940
NUCLIDE	MICROCURIES/SECOND		
I-131	1.02±.05(-4)	1.10±.30(-5)	9.00±2.0(-5)
I-132	<7.1(-3)	<7.4(-4)	NOTE 1
I-133	7.20±2.0(-5)	<6.2(-5)	2.30±1.6(-5)
I-134	NOTE 1	<3.7(-2)	NOTE 1
I-135	<7.6(-3)	<1.9(-4)	<1.0(-3)
CS-134	<3.7(-6)	4.00±1.0(-6)	1.60±.40(-5)
CS-136	<2.5(-6)	<1.8(-6)	NOTE 1
CS-137	<1.2(-5)	<4.5(-6)	2.00±.80(-5)
NA-24	<2.2(-5)	<3.7(-5)	<4.3(-5)
CR-51	<1.9(-5)	<1.0(-5)	<3.5(-5)
MN-54	<2.6(-6)	3.00±1.0(-6)	2.00±.40(-5)
MN-56	<6.0(-3)	<1.9(-3)	NOTE 1
FE-59	<4.5(-6)	<3.1(-6)	<1.3(-5)
CO-57	<1.3(-5)	1.50±.40(-6)	<3.8(-6)
CO-58	<2.5(-5)	<2.0(-5)	1.60±.20(-4)
CO-60	<3.4(-5)	1.40±3.0(-6)	2.20±.20(-4)
ZN-65	<6.0(-6)	<3.2(-6)	<1.6(-5)
SR-91	<1.1(-4)	<8.9(-5)	<7.8(-4)
Y-93	<2.5(-4)	<2.5(-4)	<7.4(-3)
ZR-95	<4.1(-6)	<2.8(-6)	<9.4(-9)
NB-95	<2.5(-6)	<2.4(-6)	<8.6(-6)
MO-99	<2.0(-6)	<2.5(-6)	<5.5(-6)
RU-103	<1.9(-6)	<3.5(-6)	<5.1(-6)
RUD-106	<2.3(-5)	<2.2(-5)	<6.2(-5)
AG-110M	<3.3(-6)	<5.2(-6)	<2.3(-5)
SB-124	<4.8(-6)	<4.5(-6)	<1.0(-5)
SB-125	<5.6(-6)	<4.8(-6)	<1.6(-5)
TE-129M	<9.7(-5)	<6.0(-5)	<1.6(-4)
TE-131M	<3.1(-5)	<2.0(-5)	<7.4(-5)
TE-132	<1.9(-6)	<2.0(-6)	<4.7(-6)
BA-140	<8.6(-6)	<6.0(-6)	<2.0(-5)
LA-140	<4.5(-6)	<6.7(-6)	<1.1(-5)
CE-141	<2.2(-6)	<2.7(-6)	<7.0(-6)
CE-143	<7.8(-6)	<1.3(-5)	<2.3(-5)
CE-144	<1.0(-5)	<1.2(-5)	<3.1(-5)
EU-152	<6.0(-6)	<3.2(-6)	<1.2(-5)
EU-154	<7.1(-6)	<4.8(-6)	<2.3(-5)
EU-155	<4.5(-6)	<6.0(-6)	<2.3(-5)
W-187	<2.3(-5)	<3.4(-5)	<6.6(-6)
NP-239	<7.8(-6)	<1.1(-5)	<2.1(-5)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.78

RADIONUCLIDE CONCENTRATIONS IN CONTAINMENT INTERNAL CLEANUP SYSTEM INLET

DATE	11/ 2	11/ 9
TIME	1645	1545
NUCLIDE	MICROCURIES/CUBIC CENTIMETER	
I-131	2.87±.02(-10)	6.23±.03(-10)
I-132	1.70±.40(-11)	<2.2(-10)
I-133	2.28±.02(-10)	6.19±.06(-10)
I-134	<1.3(-11)	<5.3(-7)
I-135	1.23±.08(-10)	3.00±1.0(-11)
CS-134	4.00±.10(-12)	9.30±.20(-12)
CS-136	<1.2(-13)	4.60±.60(-13)
CS-137	5.70±.20(-12)	1.34±.03(-11)
NA-24	8.40±.80(-12)	2.70±.90(-12)
CR-51	<4.5(-11)	<8.1(-13)
MN-54	<1.0(-10)	<7.7(-14)
MN-56	<4.0(-12)	<3.2(-11)
FE-59	<2.4(-14)	<1.2(-13)
CO-57	<1.4(-14)	<5.3(-14)
CO-58	2.30±.50(-13)	2.90±.80(-13)
CO-60	<1.1(-13)	<5.2(-13)
ZN-65	<6.6(-11)	<1.3(-13)
SR-91	<1.6(-12)	<5.8(-12)
Y-93	<6.8(-13)	<2.6(-11)
ZN-95	<4.4(-14)	<1.1(-13)
NB-95	<4.9(-11)	<7.2(-14)
MO-99	1.00±.30(-13)	<1.6(-13)
RU-103	<1.0(-13)	<8.9(-14)
RUD-106	<1.0(-13)	<6.7(-13)
AG-110M	<1.6(-12)	<2.2(-13)
SB-124	<1.6(-12)	<1.1(-13)
SB-125	<5.1(-14)	<2.6(-13)
TE-129M	<1.3(-12)	<2.1(-12)
TE-131M	<4.6(-13)	<2.6(-12)
TE-132	<1.4(-13)	<1.9(-13)
BA-140	<1.1(-13)	<4.1(-13)
LA-140	<3.2(-13)	<1.9(-13)
CE-141	<3.7(-14)	<1.1(-13)
CE-143	<3.8(-13)	<7.2(-13)
CE-144	<1.2(-14)	<4.2(-13)
EU-152	<1.0(-13)	<3.0(-13)
EU-154	<8.0(-13)	<1.1(-13)
W-187	<8.0(-13)	<3.1(-12)
NP-239	<2.0(-11)	<5.1(-13)

TABLE B.79

RADIONUCLIDE CONCENTRATIONS IN CONTAINMENT INTERNAL CLEANUP SYSTEM OUTLET

DATE	11/ 2	11/ 9
TIME	1645	1545
NUCLIDE	MICROCURIES/CUBIC CENTIMETER	
I-131	1.79±.06(-11)	3.94±.05(-11)
I-132	3.80±2.9(-12)	<1.4(-10)
I-133	2.69±.06(-11)	4.20±.20(-11)
I-134	<7.5(-12)	NOTE 1
I-135	2.10±.30(-11)	<6.8(-12)
CS-134	3.70±.20(-12)	8.50±.20(-12)
CS-136	<9.0(-14)	4.20±.50(-13)
CS-137	5.30±.10(-12)	1.26±.02(-11)
NA-24	7.70±.80(-12)	<4.0(-12)
CR-51	<3.6(-14)	<3.3(-14)
MN-54	7.00±2.0(-14)	1.50±.40(-13)
MN-56	<1.1(-12)	<1.6(-10)
FE-59	<7.5(-14)	<6.3(-14)
CO-57	<4.3(-14)	<8.2(-15)
CO-58	3.00±.50(-13)	6.00±.90(-13)
CO-60	<1.3(-13)	1.80±.80(-13)
ZN-65	<1.1(-13)	<1.6(-13)
SR-91	<1.5(-12)	<2.0(-7)
Y-93	<6.9(-13)	<1.0(-12)
ZN-95	<1.1(-13)	<6.5(-9)
NB-95	<3.4(-14)	<3.6(-14)
MO-99	<1.3(-13)	<1.1(-14)
RU-103	<1.0(-13)	<6.9(-14)
RUD-106	<1.0(-13)	<5.7(-14)
AG-110M	<1.5(-13)	<3.6(-12)
SB-124	<1.0(-13)	<3.6(-14)
SB-125	<1.0(-13)	<2.8(-13)
TE-129M	<8.8(-14)	<1.4(-12)
TE-131M	<2.4(-13)	<6.4(-13)
TE-132	<5.4(-14)	<1.4(-9)
BA-140	<1.0(-13)	<1.8(-12)
LA-140	<2.4(-13)	<4.6(-13)
CE-141	<1.0(-14)	<1.0(-13)
CE-143	<3.4(-15)	<1.1(-12)
CE-144	<1.1(-14)	<6.0(-13)
EU-152	<3.7(-14)	<2.0(-13)
EU-154	<7.1(-14)	<1.4(-13)
W-187	<6.2(-13)	<1.8(-12)
NP-239	<1.8(-14)	<2.0(-13)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.80

NOBLE GAS CONCENTRATIONS IN CONTAINMENT AIR SAMPLES

DATE	9/ 7	9/ 8	10/12	10/12	10/26
TIME	1402	1130	1127	1608	2010
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
AR-41	3.60±.70(-6)	5.10±.80(-6)	5.00±1.0(-6)	9.80±6.5(-7)	4.00±.30(-6)
KR-85M	5.60±.30(-6)	9.10±.70(-6)	6.40±.60(-6)	<3.0(-6)	5.30±.90(-7)
KR-85	<1.0(-4)	<8.8(-5)	<2.3(-6)	<1.8(-6)	<4.0(-7)
KR-87	<8.4(-7)	<1.5(-6)	<8.4(-7)	<1.8(-6)	<3.0(-8)
KR-88	<2.9(-6)	5.00±2.0(-6)	<8.1(-6)	<7.0(-6)	<3.0(-7)
XE-131M	8.00±1.0(-5)	<7.4(-5)	<4.1(-6)	6.60±.90(-4)	1.80±.20(-5)
XE-133M	6.90±.30(-5)	7.60±.30(-5)	7.40±.60(-5)	7.00±.20(-4)	2.60±.10(-5)
XE-133	6.40±.10(-3)	6.90±.20(-3)	5.50±.20(-3)	7.30±.50(-2)	1.92±.04(-3)
XE-135M	<3.9(-6)	5.00±2.0(-6)	<1.6(-6)	<5.1(-6)	<8.2(-7)
XE-135	1.10±.01(-4)	1.40±.10(-4)	9.60±.20(-5)	8.10±.10(-4)	1.22±.03(-5)
XE-137	<7.2(-4)	<3.2(-3)	NOTE 1	NOTE 1	<3.9(-7)
XE-138	<8.1(-6)	<1.2(-5)	<4.1(-7)	<3.8(-6)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.80 (cont'd)

NOBLE GAS CONCENTRATIONS IN CONTAINMENT AIR SAMPLES

DATE	1/ 9	2/ 9	2/ 9	2/12	2/13
TIME	1120	855	1610	840	845
NUCLIDE	MICROCURIES/CUBIC CENTIMETER				
AR-41	<6.2(-7)	3.60±.70(-6)	NOTE 1	6.00±1.7(-6)	<3.7(-6)
KR-85M	1.70±.10(-6)	1.40±.20(-6)	<6.4(-6)	<6.6(-7)	<8.6(-7)
KR-85	<3.0(-5)	<8.4(-5)	<1.5(-4)	<1.5(-5)	<8.6(-5)
KR-87	<3.2(-7)	<1.0(-7)	NOTE 1	<9.2(-7)	<8.0(-6)
KR-88	<9.4(-7)	<3.2(-6)	<4.6(-4)	<6.9(-6)	<1.2(-6)
XE-131M	5.10±.70(-5)	4.10±1.0(-5)	<1.8(-5)	<3.0(-5)	<1.2(-5)
XE-133M	1.02±.03(-4)	2.24±.30(-5)	1.80±.50(-5)	2.80±.30(-5)	1.10±.20(-5)
XE-133	9.10±.20(-3)	2.28±.06(-3)	2.15±.05(-3)	2.41±.07(-3)	1.11±.05(-3)
XE-135M	<2.0(-6)	<3.2(-6)	NOTE 1	<6.4(-6)	NOTE 1
XE-135	3.70±.20(-5)	1.98±.06(-5)	2.20±.20(-5)	2.10±.10(-5)	8.10±.70(-6)
XE-137	NOTE 1	NOTE 1	NOTE 1	NOTE 1	NOTE 1
XE-138	<3.2(-6)	<6.7(-6)	NOTE 1	<2.6(-5)	NOTE 1

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.81

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE	10/24	10/25	10/26	10/27	10/28
TIME	1541	1430	1130	1000	1000
NUCLIDE	MICROCURIES/SECOND				
KR-85M	<1.6(0)	8.95±.31(-1)	1.41±.08(0)	2.04±.01(2)	2.40±.02(1)
KR-85	<7.2(-1)	9.12±2.5(-1)	<1.9(0)	<3.9(1)	<5.5(-2)
KR-88	<1.7(2)	5.36±1.8(-1)	<2.6(0)	5.00±.17(2)	5.70±.27(0)
XE-131M	9.08±.58(1)	9.25±.72(0)	<3.4(0)	1.27±.08(2)	8.29±2.6(0)
XE-133M	1.78±.03(1)	1.68±.01(1)	4.15±.30(0)	2.76±.02(2)	2.36±.03(1)
XE-133	1.06±.11(3)	1.25±.07(3)	2.50±.19(2)	1.42±.05(4)	1.34±.09(3)
XE-135	2.15±.02(1)	1.11±.01(1)	2.77±.09(1)	1.85±.04(3)	1.77±.03(2)

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE	10/29	10/30	10/31	11/ 1	11/ 2
TIME	1040	1000	1100	1100	1500
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.77±.02(2)	1.34±.01(0)	2.77±.02(1)	5.64±.05(1)	6.70±.04(1)
KR-85	<3.6(1)	<1.6(-3)	<1.9(-2)	<1.4(-1)	<4.3(0)
KR-88	4.32±.10(2)	3.30±.11(-1)	5.64±.15(0)	2.32±.10(1)	1.18±.02(2)
XE-131M	<9.9(1)	<1.1(-2)	<1.3(0)	<9.5(-1)	<2.4(1)
XE-133M	7.42±.21(1)	4.45±.13(-1)	5.04±.07(1)	3.92±.06(1)	4.76±.02(1)
XE-133	2.54±.10(3)	3.08±.15(1)	2.27±.10(3)	1.63±.09(3)	1.55±.01(3)
XE-135	1.01±.02(3)	5.34±.06(0)	3.70±.05(2)	3.86±.05(2)	4.40±.03(2)

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE TIME	11/ 3 1100	11/ 4 1100	11/ 5 1100	11/ 6 1100	11/ 7 1830
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.95±.33(0)	3.11±.03(0)	2.37±.03(1)	<1.7(0)	8.89±.26(-1)
KR-85	<1.9(-1)	<4.7(-1)	<3.5(0)	<1.6(0)	<2.0(-1)
KR-88	<3.4(1)	4.13±.30(0)	6.20±.18(1)	<2.5(2)	1.21±.08(0)
XE-131M	1.84±.23(0)	<2.6(0)	<2.7(0)	1.29±.27(0)	8.74±4.4(-1)
XE-133M	9.04±.08(0)	7.61±.23(0)	6.33±.07(0)	4.51±.19(0)	1.96±.03(0)
XE-133	3.70±.26(2)	3.16±.16(2)	2.10±.09(2)	1.91±.10(2)	8.37±.57(1)
XE-135	4.31±.08(1)	3.49±.04(1)	7.83±.13(1)	2.45±.04(1)	1.08±.02(1)

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE TIME	11/ 8 1200	11/ 9 1200	11/10 1200	11/11 1200	11/12 1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	1.88±.11(0)	1.08±.04(1)	2.58±.16(0)	4.04±.20(0)	4.05±1.2(-1)
KR-85	<4.0(0)	<8.5(0)	<3.0(0)	4.33±.90(-1)	<1.8(-1)
KR-88	<2.6(0)	1.58±.26(1)	2.94±1.5(0)	<6.6(0)	<1.4(1)
XE-131M	<6.6(-1)	7.09±1.6(0)	<1.7(0)	3.10±.25(0)	1.45±.08(0)
XE-133M	9.10±1.9(-1)	1.40±.05(1)	3.09±.22(0)	1.03±.01(1)	4.27±.07(0)
XE-133	3.19±.21(1)	6.01±.44(2)	1.48±.11(2)	4.52±.26(2)	2.17±.15(2)
XE-135	7.21±.09(0)	9.26±.05(1)	2.44±.11(1)	5.31±.03(1)	1.32±.01(1)

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE TIME	11/13 1200	11/14 1200	11/15 1200	11/16 1200	11/17 1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	2.98±.05(0)	1.37±.20(0)	1.11±.04(0)	<1.9(-2)	<3.4(-1)
KR-85	<4.7(-1)	8.05±1.6(-1)	1.98±.16(0)	6.79±.94(-1)	<1.2(-1)
KR-88	3.84±.19(0)	<1.3(1)	1.04±.42(-1)	<9.4(-2)	<4.3(0)
XE-131M	7.35±.74(-1)	<1.3(1)	<2.5(1)	2.75±.61(0)	5.84±.27(-1)
XE-133M	2.50±.03(0)	1.79±.01(1)	2.41±.00(1)	6.91±.05(0)	8.59±.15(-1)
XE-133	1.13±.06(2)	1.08±.02(3)	1.38±.02(3)	4.37±.17(2)	7.30±.33(1)
XE-135	1.12±.01(1)	4.67±.01(1)	8.39±.15(1)	6.10±.02(0)	2.47±.08(-1)

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE TIME	11/18 1200	11/19 1200	11/20 1200	11/21 900	11/28 1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	<1.8(-3)	<1.9(-2)	<1.1(-2)	<1.5(-2)	4.17±2.1(-3)
KR-85	<1.0(-1)	2.94±.18(0)	2.35±.30(0)	5.30±.26(-1)	<1.7(-1)
KR-88	<4.3(-2)	<6.0(-2)	<5.3(-2)	<6.4(-2)	<6.5(-2)
XE-131M	1.71±.22(-1)	9.25±1.8(0)	9.08±1.4(0)	6.26±.80(0)	1.53±.05(0)
XE-133M	2.32±.08(-1)	8.52±.13(0)	5.55±.04(0)	7.81±.20(-1)	3.53±.88(-2)
XE-133	1.90±.12(1)	6.71±.22(2)	6.86±.27(2)	2.22±.06(2)	1.51±.19(1)
XE-135	1.51±.13(-2)	1.79±.05(-1)	3.16±.29(-2)	<1.9(-1)	2.17±.87(-1)

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE	11/29	11/30	12/ 5	12/ 6	12/ 7
TIME	1200	1200	1200	1200	1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	<1.6(-3)	<8.4(-2)	<3.8(-5)	<4.3(-3)	<2.7(-3)
KR-85	<2.2(-4)	7.92±2.6(-2)	<1.1(-1)	1.20±.09(0)	1.62±.09(0)
KR-88	<1.0(-2)	<1.1(1)	<4.7(-5)	<5.9(-1)	<1.8(-2)
XE-131M	2.06±.69(-1)	7.34±.20(-1)	4.70±.19(-1)	1.83±.04(0)	4.11±.05(0)
XE-133M	1.61±.52(-3)	6.20±1.8(-3)	4.42±1.7(-3)	1.43±.43(-2)	2.06±.20(-2)
XE-133	2.11±.13(0)	5.29±.38(0)	7.19±.36(0)	3.49±.15(1)	7.06±.43(1)
XE-135	<5.7(-4)	<1.1(-2)	<1.5(-4)	<1.8(-3)	<8.4(-4)

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE TIME	12/ 8 1200	12/ 9 1200	12/12 1200	12/13 1800	12/14 1300
NUCLIDE			MICROCURIES/SECOND		
KR-85M	<1.0(1)	<3.7(-3)	<1.6(0)	<9.4(-2)	<3.6(-2)
KR-85	<1.1(0)	<1.5(-1)	<1.2(0)	<3.7(0)	<6.0(0)
KR-88	<1.1(4)	<4.7(-2)	<7.6(1)	<3.9(-1)	<2.9(-2)
XE-131M	<2.4(-1)	<5.2(-1)	<5.2(-1)	7.66±2.6(-1)	1.17±.32(0)
XE-133M	<3.9(-2)	<7.2(-3)	<6.8(-2)	<4.7(-2)	<2.0(-1)
XE-133	8.76±.49(-1)	7.91±.24(-1)	4.91±.49(-1)	7.50±.08(0)	3.08±.17(0)
XE-135	<1.6(-1)	<1.8(-3)	<6.1(-2)	<9.5(-3)	<3.0(-2)

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE	12/19	12/20	1/17	1/18	1/19
TIME	1200	1400	1200	1200	1200
NUCLIDE	MICROCURIES/SECOND				
KR-85M	<1.4(-1)	<9.8(-1)	4.33±.31(0)	3.11±.15(0)	<5.6(1)
KR-85	<6.4(0)	<1.2(1)	<4.6(0)	<4.9(0)	<2.9(1)
KR-86	<1.4(0)	<3.9(0)	<5.8(0)	4.70±1.2(0)	NOTE 1
XE-131M	<1.2(0)	<4.1(0)	NOTE 1	<1.6(0)	5.18±2.1(-1)
XE-133M	<2.7(-1)	3.59±2.7(-1)	NOTE 1	3.19±.06(0)	5.04±.14(0)
XE-133	6.09±.76(-1)	<4.2(-1)	NOTE 1	1.61±.05(2)	2.39±.09(2)
XE-135	<6.0(-2)	<2.3(-1)	NOTE 1	1.28±.02(1)	1.86±.03(1)

NOTE 1: THESE DATA POINTS HAVE BEEN LEFT OFF DUE TO HALF LIFE CORRECTIONS OR OTHER PROBLEMS ASSOCIATED WITH ARITHEMITIC OPERATIONS WITH < NUMBERS

TABLE B.81 (cont'd)

NOBLE GAS RELEASE RATES IN CONTAINMENT PURGE EXHAUST

DATE	1/26
TIME	1000

NUCLIDE	MICROCURIES/SECOND
KR-85M	5.54±.13(-1)
KR-85	<6.0(-2)
KR-88	2.69±.24(-1)
XE-131M	<3.7(-1)
XE-133M	2.98±.02(0)
XE-133	9.12±1.0(2)
XE-135	1.12±.01(1)

TABLE B.82

REACTOR BUILDING ATMOSPHERE ^{14}C AND TRITIUM SPECIES
(During Non-Refueling Period)

Date	Oxidizable[1] ^{3}H (%)	Total ^{3}H ($\mu Ci/cm^3$)	Oxidizable ^{14}C (%)	Total ^{14}C ($\mu Ci/cm^3$)
9/7/78	0.1	3.1 ± 0.1(-6)	89.5	2.2 ± 0.1(-6)
1/8/79	0.0	1.28 ± 0.06(-6)	83.0	1.06 ± 0.05(-6)
1/23/79	0.0	2.5 ± 0.1(-6)	28.0	6.1 ± 0.3(-8)
2/5/79[2]	2.3	1.2 ± 0.4(-8)	0.0	9.6 ± 0.5(-9)
2/8/79[3]	33.3	1.5 ± 0.3(-8)	0.0	4.4 ± 1.2(-10)

1. Represents the fraction of total tritium or ^{14}C detected which is oxidizable to HOT or CO_2.

2. Sample taken just prior to operation of the reactor building A-500A emergency cooling system.

3. Sample taken just after A-500A emergency cooling system stopped.

TABLE B.83

REACTOR BUILDING EXHAUST ^{14}C AND TRITIUM SPECIES
(During Refueling Outage)

Date	Oxidizable ^{3}H (%)	Total ^{3}H ($\mu Ci/sec$)[2]	Oxidizable ^{14}C (%)	Total ^{14}C ($\mu Ci/sec$)[2]
10/27-11/9/78	[1]	1.08 ± 0.04(0)	[1]	7.8 ± 0.4(-2)
11/9-	0.1	1.30 ± 0.07(0)	60.0	1.15 ± 0.07(-1)
11/20-12/7/78	0.3	1.72 ± 0.07(0)	[1]	3.9 ± 0.2(-1)
12/7-12/21/78	39.0	1.8 ± 0.1(-1)	89.0	1.11 ± 0.04(-1)

[1] Not available due to sampler malfunction.

2. Duct flow used to calculate release rate is 78,900 cfm.

APPENDIX C

This appendix contains certain equipment specifications, plant information pertinent to the in-plant measurements, and the piping and instrumentation drawings (P&ID's).

TABLE C.1

EQUIPMENT SPECIFICATIONS
BORIC ACID/MISCELLANEOUS WASTE EVAPORATOR SYSTEM

Boric Acid/Miscellaneous Waste Concentrator System

Maxim P/N 91504-01/91505-01

Type	Vacuum - Single Stage
Processing Rate	30 GPM
Feed Composition	100-13,000 ppm boric acid/ miscellaneous waste
Materials & Construction	304/316 stainless steel
Design Life	40 years
Bottoms Concentration	Normal 4% boric acid, maximum 15%
Distillate Composition	Maximum 10 ppm boron Maximum 0.05 ppm oxygen Maximum 2.0 micromhos/cm. pH 6-8
Decontamination Factor	10^6
BA/MW Concentrator Feed Tank	Maxim P/N 79014-01/79015-01
Capacity, U. S. Gallons	Maximum 1200 Normal 1000
Design Pressure	15 psig, ASME Section III
Design Temperature	250°F
Operating Pressure	20" Hg. - Vacuum
Operating Temperature	160°F.
Materials - Wetted Parts	304/316 stainless steel

TABLE C.1 (cont'd)

EQUIPMENT SPECIFICATIONS
BORIC ACID/MISCELLANEOUS WASTE EVAPORATOR SYSTEM

BA/MW Concentrator Feed Tank Electrical Heater	Maxim P/N 78078-32	
Power Rating	9 KW	
Material	304 stainless steel	
Design Pressure	150 psig	
Electric Power	480/60/3	
BA/MW Concentrator Feed Tank Heater	Maxim P/N 75030-01/75031-01	
Type	U-tube	
	Shell Side	Tube Side
Fluid	Boric Acid/ Miscellaneous Waste	Steam
Design Pressure, ASME Section III (1968)	15 psig	110 psig
Design Temperature	160°F.	240°F.
Design Pressure Drop	0.1 psi	0.1 psi
Design Flow Rate	15,000 lbs/hr.	157 lbs/hr.
Materials	304/316	304/316
BA/MW Concentrator - Gas Stripper Condenser	Maxim P/N 79019-01/79020-01	
Type	U-tube	
Heat Transfer Design	15,000 btu/hr.	
	Shell Side	Tube Side
Fluid	Water vapor	Cooling water
Design Pressure	125 psig	110 psig

TABLE C.1 (cont'd)

EQUIPMENT SPECIFICATIONS
BORIC ACID/MISCELLANEOUS WASTE EVAPORATOR SYSTEM

	Shell Side	Tube Side
Design Temperature	250°F.	250°F.
Pressure Loss, Design	0.1 psi	8 psi
Design Flow	15,000 lb/hr.	630,000 lb/hr.
Operating Inlet Temperature	160°F.	95°F.
Operating Outlet Temperature	160°F.	122°F.
Materials of Construction	304/316	304/316
BA/MW Concentrator - Evaporator	Maxim P/N 91010-01/91011-01	
Type	HRC-850-A Single stage submerged tube with double vapor scrubber	
Distillate Rate	30 GPM	
Feed Composition	100-150,000 ppm boric acid	
Distillate	Avg. 10 ppm boron, maximum	
Materials - Wetted Parts	304/316	
BA/MW Evaporator Heater	Maxim P/N 79021-01/79022-01	
Type	U-tube, 635 sq. ft.	
Heat Transfer Rate	15×10^6 btu/hr.	
	Shell Side	Tube Side
Fluid	Boric acid	Steam
Operating Pressure	20" Vac	10 psig
Design Pressure	15 psig	30 psig
BA/MW Concentrator - Evaporator Condenser	Maxim P/N 79019-01/79020-01	
Type	U-tube	

TABLE C.1 (cont'd)

EQUIPMENT SPECIFICATIONS
BORIC ACID/MISCELLANEOUS WASTE EVAPORATOR SYSTEM

	Shell Side	Tube Side
Fluid	Water vapor	System coolant water
Operating Pressure	20" Vac	30 psig
Design Pressure	15 psig	110 psig
Operating Inlet Temperature	160°F.	95°F.
Operating Outlet Temperature	160°F.	122° F.
Design Flow	15,000 lb/hr.	630,000 lb/hr.
BA/MW Concentrator - Distillate Reservoir	Maxim P/N 79010-01/79011-01	
Design Pressure	15 psig, ASME SECTION III (1968)	
Design Temperature	250°F. Maximum	
Capacity, U. S. Gallons	100	
Operating Pressure	20" Vac	
Operating Temperature	160°F.	
Materials of Construction	304/316 stainless steel	
BA/MW Concentrator - Gas Stripper Vacuum Pumps	Maxim P/N 78127-31	
Make	SIHI Model CLO 2402KK	
Type	Rotary, liquid ring, direct drive water sealed	
Speed	1750 rpm	
Connection	1 1/4" flange	
Electrical Supply	460/60/3	
Design Capacity	9 cfm @ 20" Hg.-Vac./260°F.	

TABLE C.1 (cont'd)

EQUIPMENT SPECIFICATIONS
BORIC ACID/MISCELLANEOUS WASTE EVAPORATOR SYSTEM

Operating Discharge Pressure	12 psig
Operating Temperature	160°F.
Time Required to Reduce From Atm. to Des. Pressure	30 minutes
Motor Size	1 hp
Materials of Construction	316 stainless steel

Furnished in duplicate on each system with sealing water reservoir - air separator and seal water cooler (15 GPM).

BA/MW Concentrator - Evaporator Vacuum Pumps	Maxim P/N 78127-31

Same as Gas Stripper Vacuum System

BA/MW Concentrator Feed Pre-Heater	Maxim P/N 79023-01/79024-01
Type	U-tube, 2-pass
Heat Transfer Rate, Design	1,500,000 btu/hr.

	Shell Side	Tube Side
Design Pressure *ASME Section VIII (1968) **ASME Section III (1968)	110 psig*	110psig**
Design Temperature	240°F.	70-195°F.
Design Pressure Drop	0.2 psig	2 psig
Nozzle Size	3" in 1" out	1 1/2"
Design Flow	1500 lb/hr.	15,000 lb/hr.
Fluid	Steam	BA/MW system feed
Design Temperature In	240°F.	70°F.

TABLE C.1 (cont'd)

EQUIPMENT SPECIFICATIONS
BORIC ACID/MISCELLANEOUS WASTE EVAPORATOR SYSTEM

	Shell Side	Tube Side
Design Temperature Out	240°F.	195°F.
Materials of Construction	304/316	304/316
BA/MW Concentrator Distillate Cooler	Maxim P/N 79025-01/79026-01	
Type	U-tube, 4-pass	
Heat Transfer Rate, Design	562,000 btu/hr.	
	Shell Side	Tube Side
Design Pressure *ASME Section VIII (1968) **ASME Section III (1968)	110 psig*	110 psig**
Design Temperature	450°F.	225°F.
Design Pressure Drop	2 psi	2 psi
Fluid	Cooling water	Distillate
Nozzle Size	2"	1 1/2" in 2" out
BA/MW Concentrator Feed Pump	Maxim P/N 78128-32	
Type	Crane GM-7 1/2 L-34H-1S	
Impeller Dia. Inches	6 1/2	
Operating Temperature	160°F.	
Operating GPM	200	
Operating T. D. H.	36 feet	
Required NPSH	2-3 feet	
Inlet Connections	4" - 150 lb. F.F. ASA	
Outlet Connections	3" - 150 lb. F.F. ASA	

TABLE C.1 (cont'd)

EQUIPMENT SPECIFICATIONS
BORIC ACID/MISCELLANEOUS WASTE EVAPORATOR SYSTEM

Motor RPM	1750
Materials of Construction	316 stainless steel
BA/MW Concentrator Distillate Pumps	Maxim P/N 78128-31
Type	Crane GVBS-5K-153H-1S
Impeller Dia. Inches	6
Operating Temperature	160°F.
Operating GPM	30
Operating T.D.H.	115 feet
Required NPSH	2 feet
Inlet Connection	3" 150 lb. F.F. ASA
Outlet Connection	1 1/2" 150 lb. F.F. ASA
Motor RPM	3450
Materials of Construction	316 stainless steel
BA/MW Concentrator Concentrates Removal Pump	Maxim P/N 78128-33
Type	Crane GB-1 1/2K-751-H-1S
Impeller Dia. Inches	5 1/4
Operating Temperature	160°F.
Operating GPM	30
Operating T.D.H.	100
Required NPSH	6
Inlet Connection	1"
Outlet Connection	3/4"

TABLE C.1 (cont'd)

EQUIPMENT SPECIFICATIONS
BORIC ACID/MISCELLANEOUS WASTE EVAPORATOR SYSTEM

Motor RPM	3450
Materials of Construction	316 stainless steel

FIGURE C.1

LEVELS FOR COOLANT RADWASTE SYSTEM RECEIVER TANKS (T607A AND B)

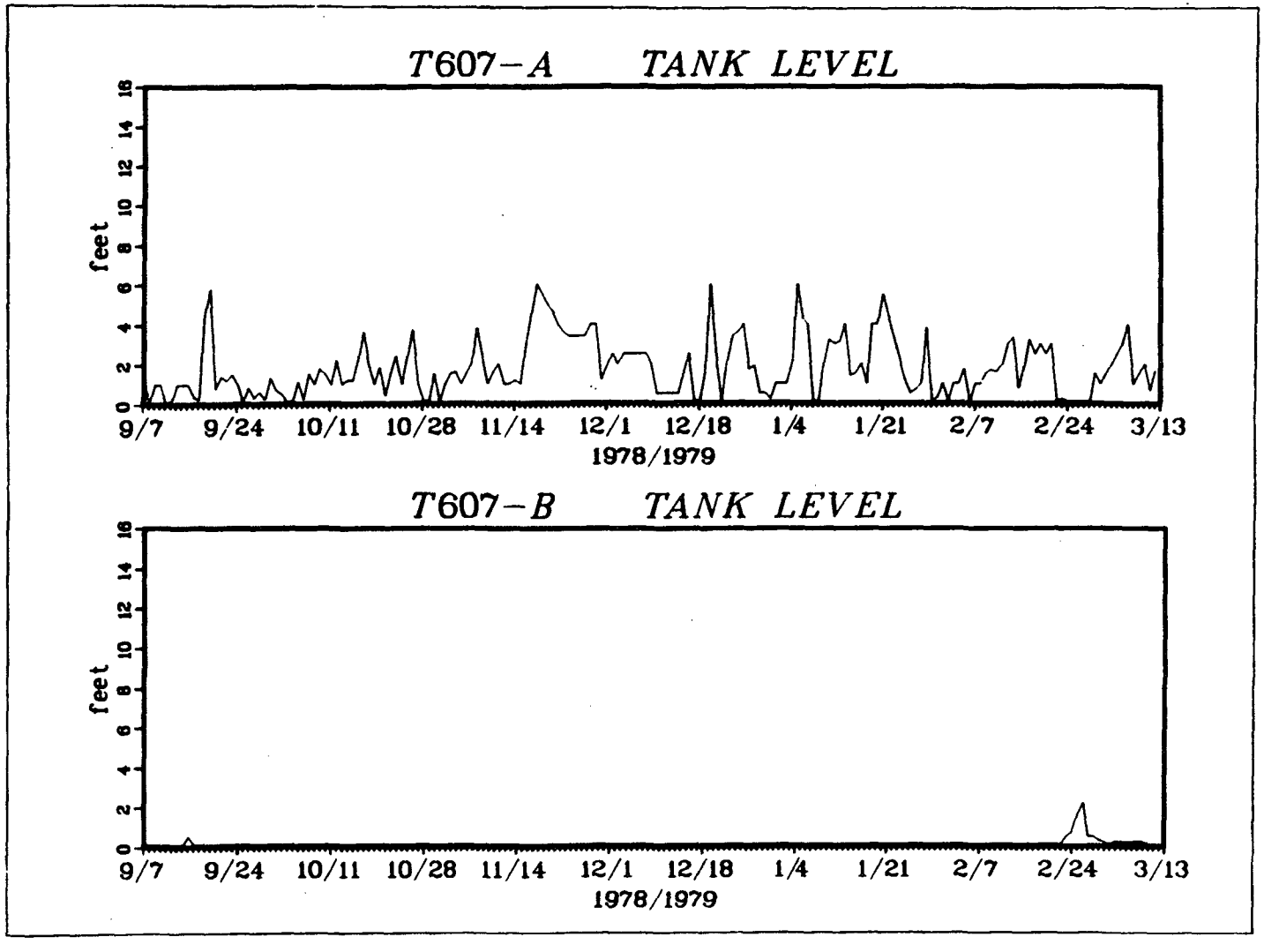


FIGURE C.2

LEVELS FOR COOLANT RADWASTE SYSTEM HOLDUP TANKS (T610A AND B)

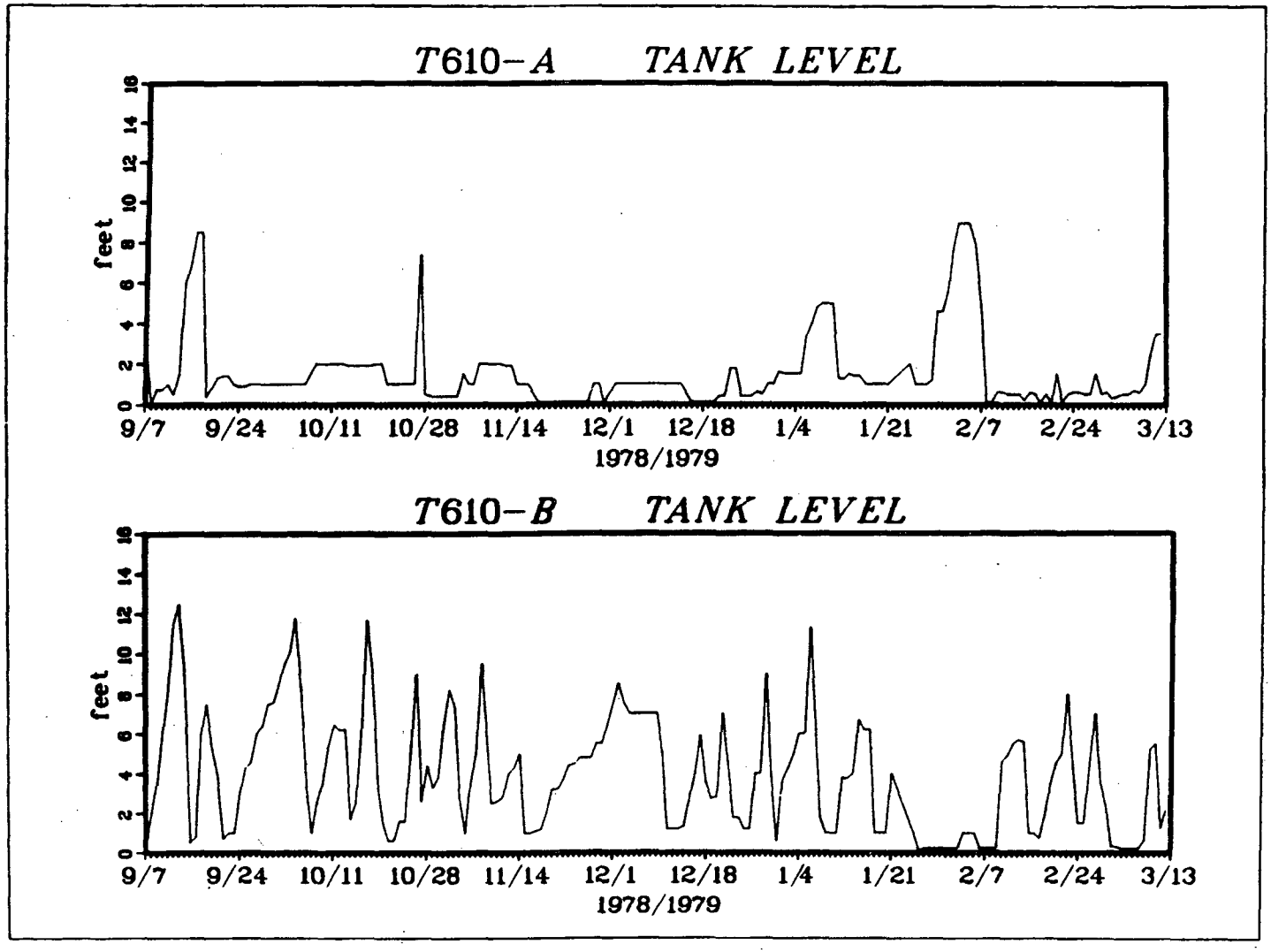


FIGURE C.3

LEVELS FOR MISCELLANEOUS WASTE CONDENSATE STORAGE TANKS (T674A AND B)

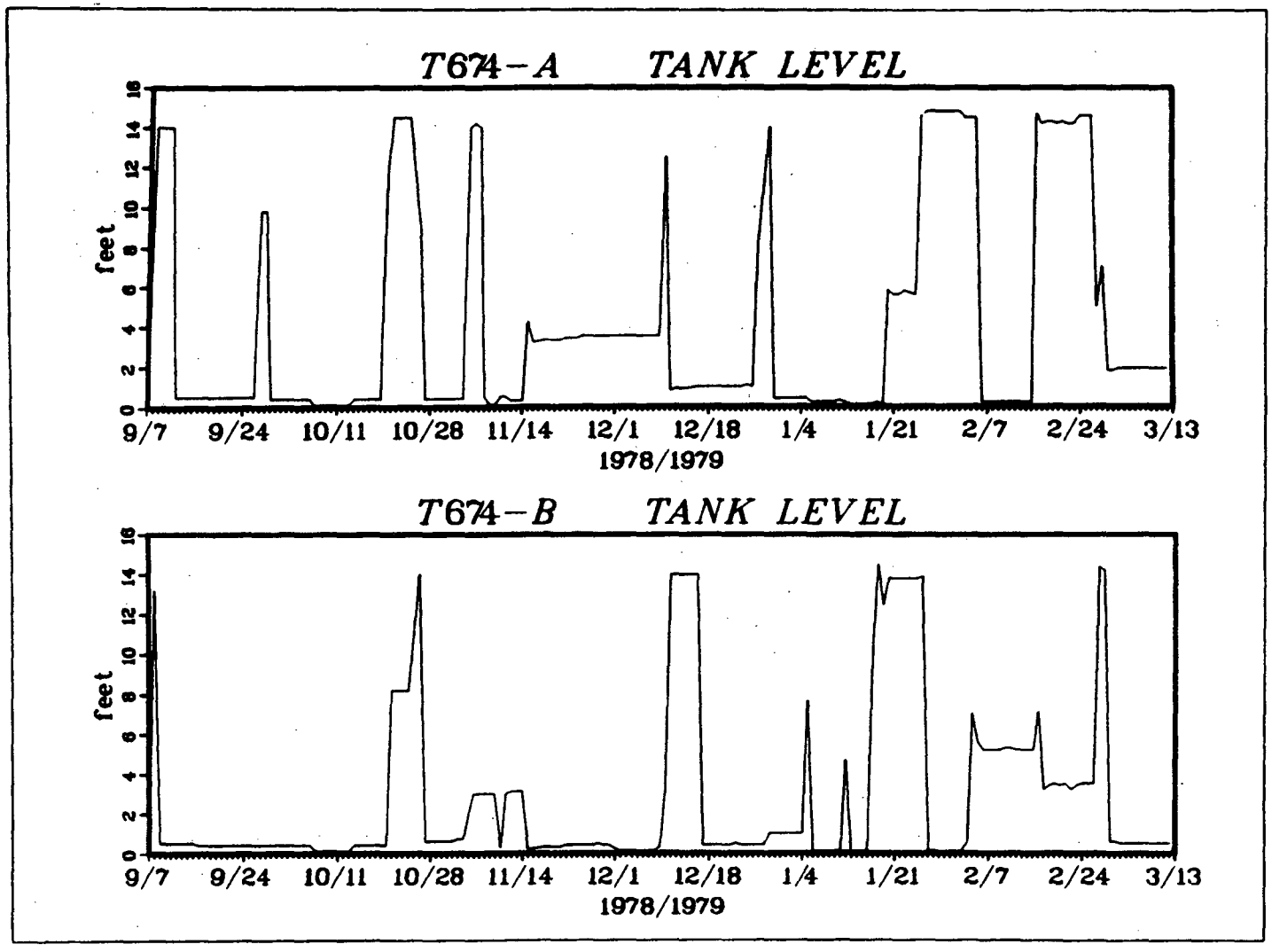


FIGURE C.4

LEVELS FOR MISCELLANEOUS WASTES CONCENTRATE HOLD TANKS (T679A AND B)

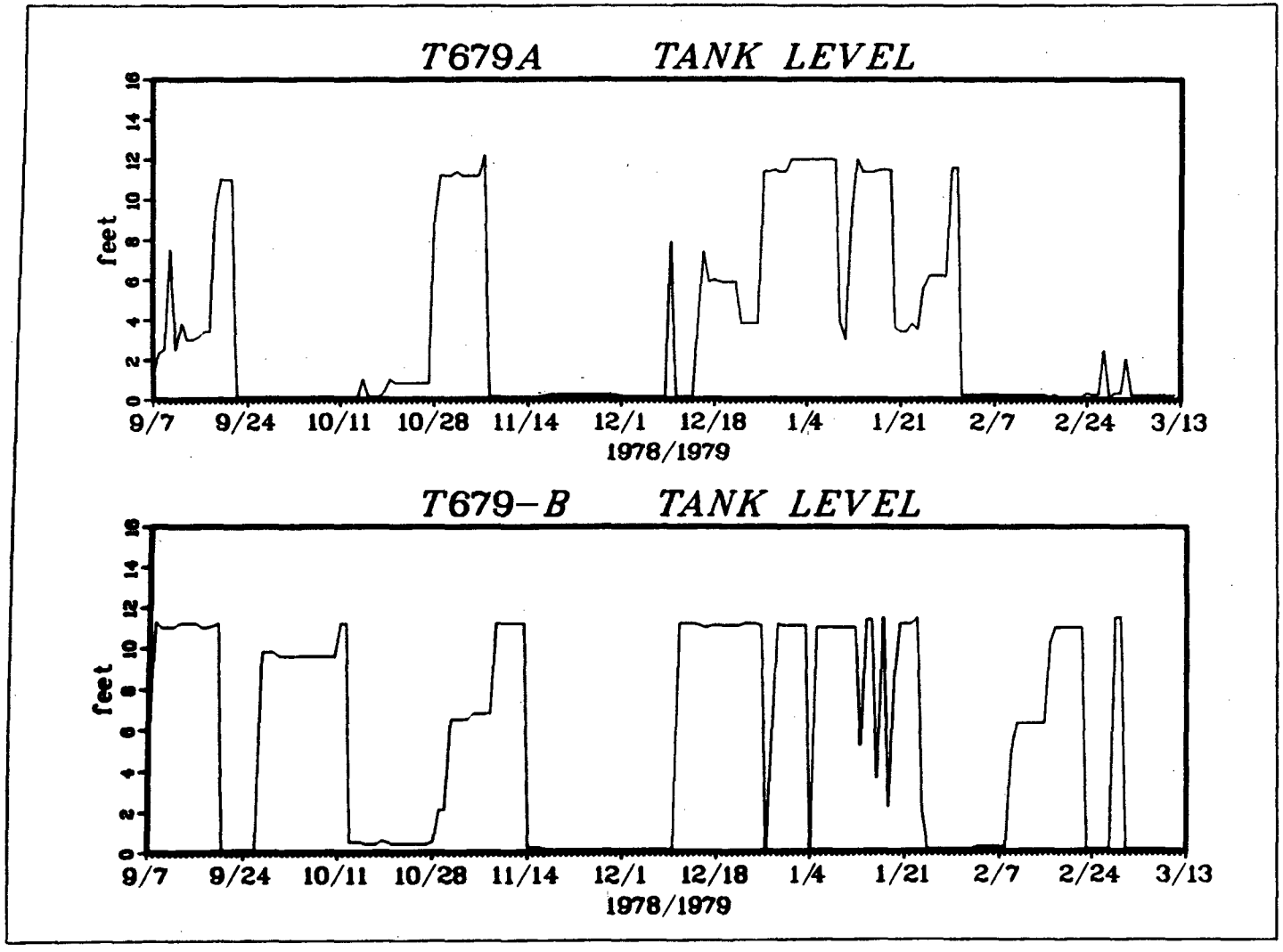


FIGURE C.5

LEVELS FOR SPENT REGENERANT TANKS (T689A AND B)

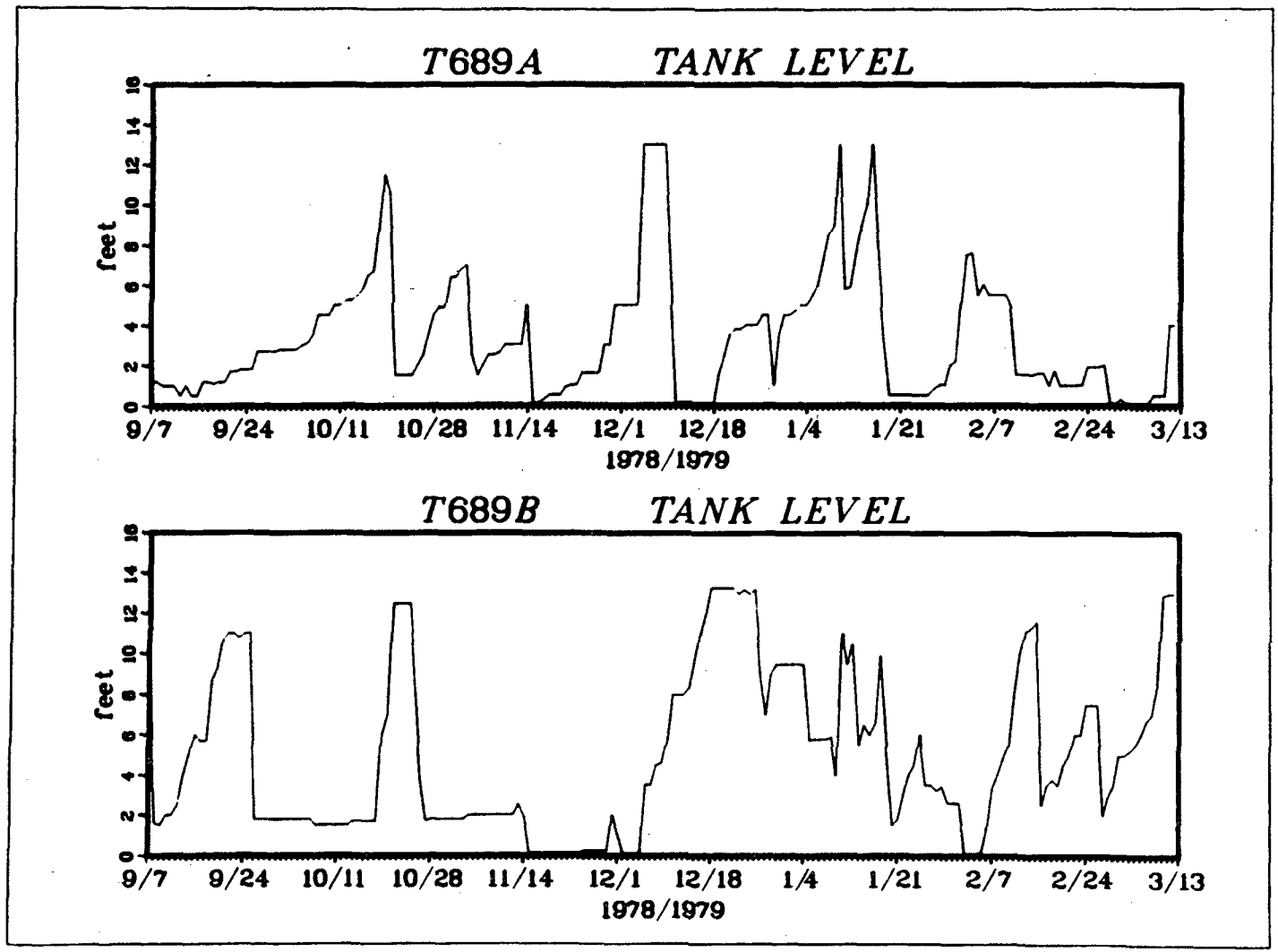


FIGURE C.6

LEVELS FOR MISCELLANEOUS WASTE TANK (T667) AND CONCENTRATED BORIC ACID STORAGE TANK (T704)

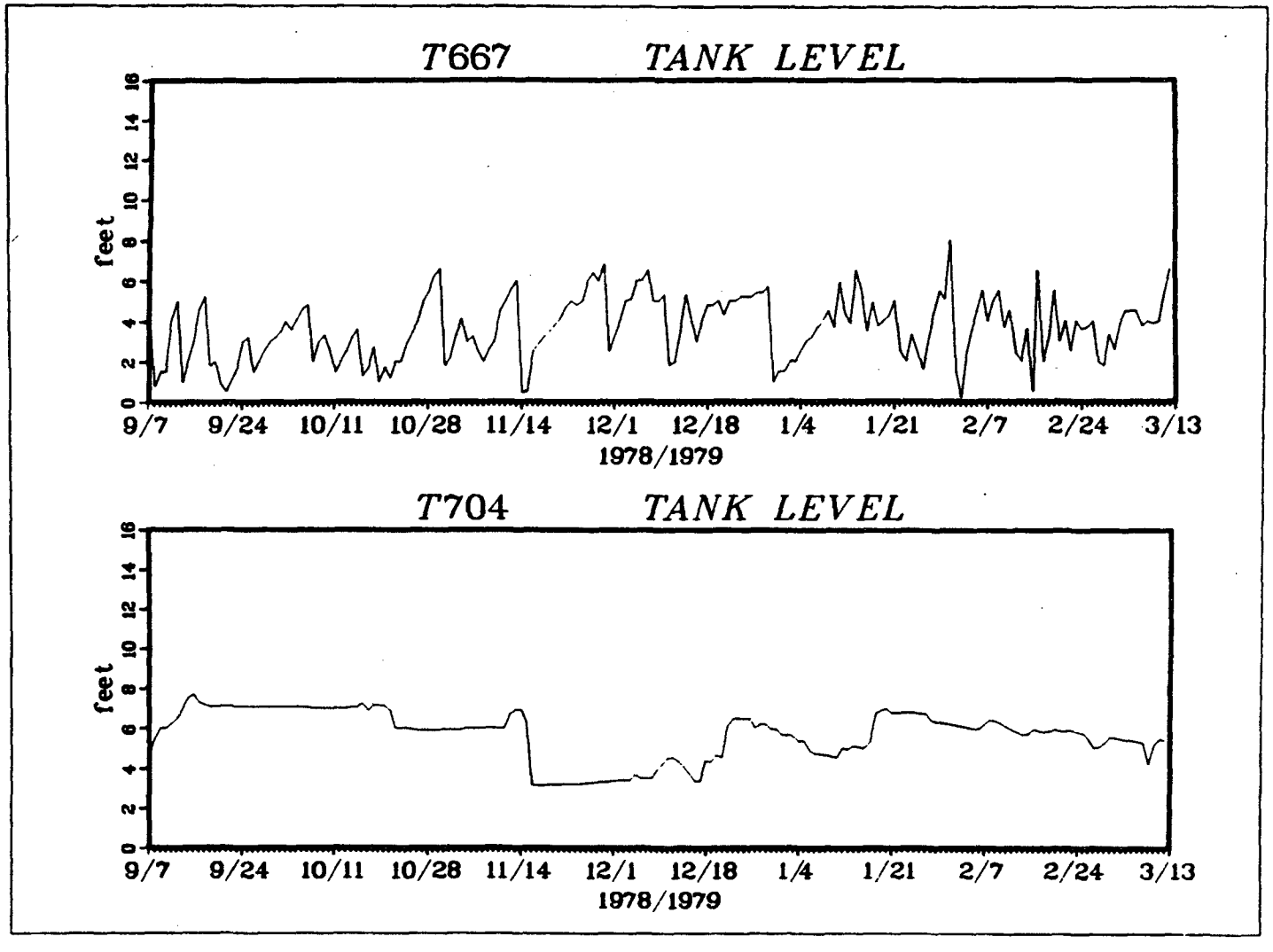


FIGURE C.7

LEVELS FOR DEMINERALIZED REACTOR COOLANT STORAGE TANK (T621) AND MISCELLANEOUS WASTE HOLDUP TANK (T993)

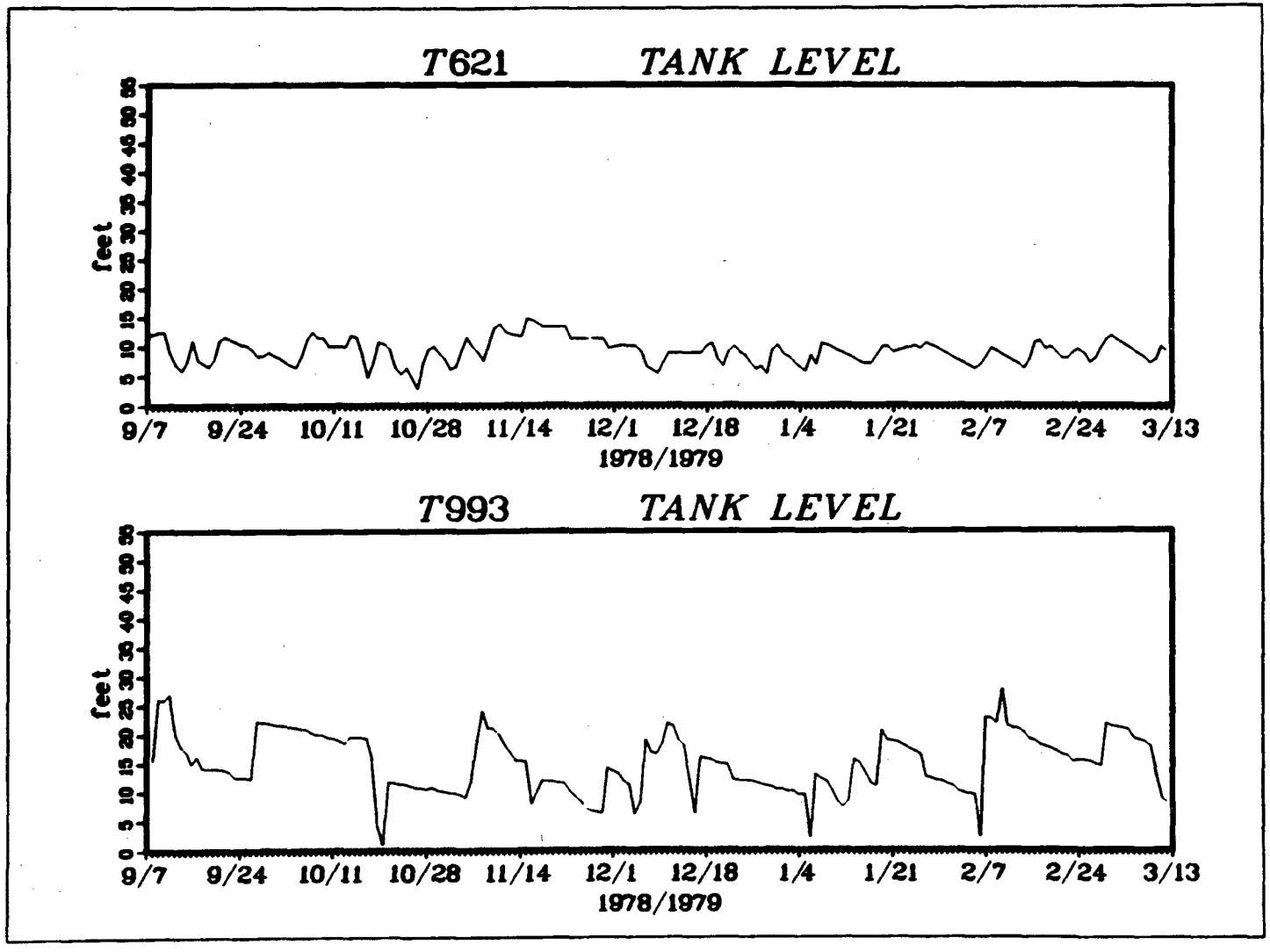
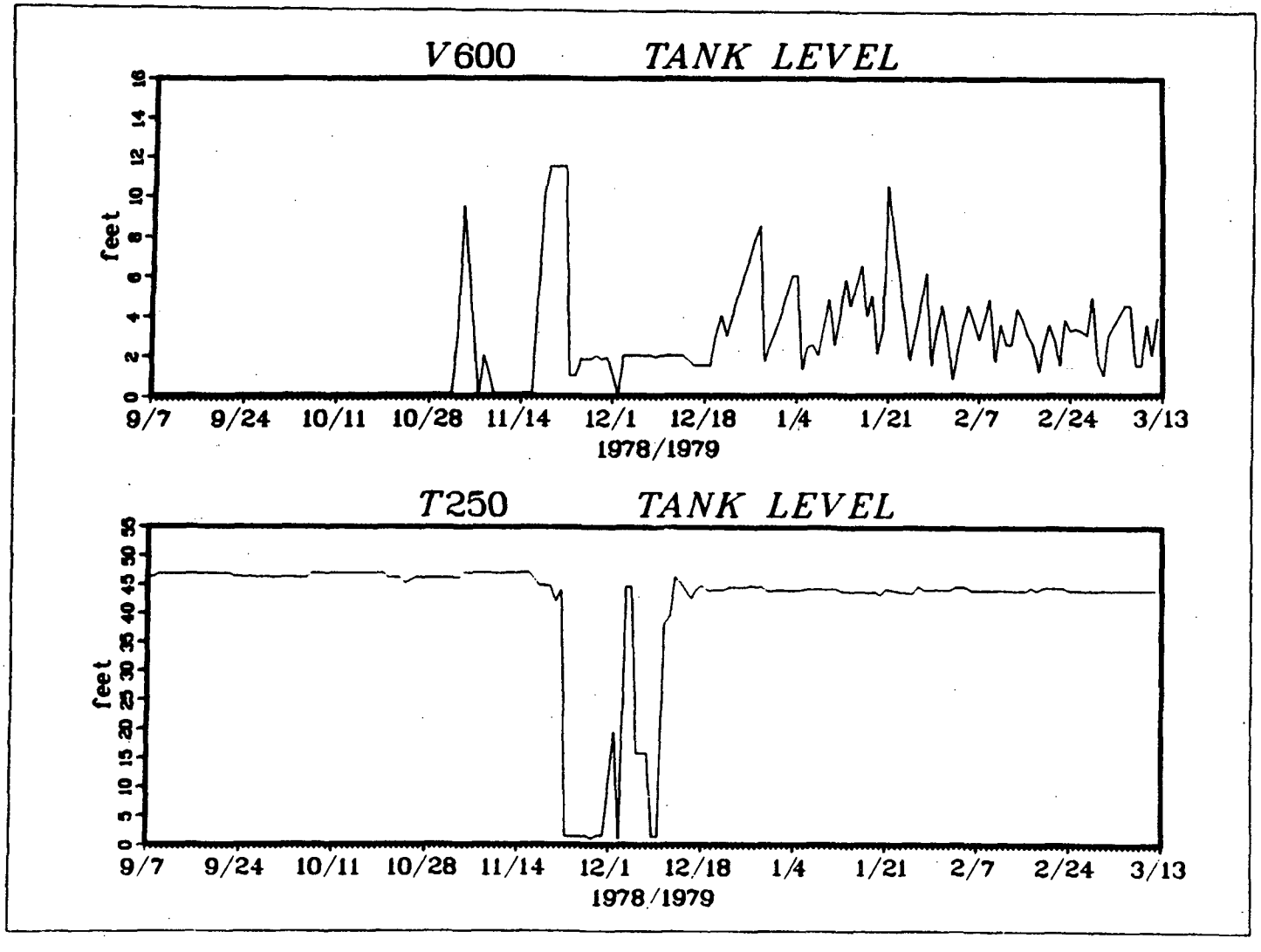


FIGURE C.8

LEVELS FOR REACTOR COOLANT DRAIN TANK (V600) AND BORATED WASTE STORAGE TANK (T250)



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This report presents data obtained at Rancho Seco as a part of the In-Plant Source Term Measurement Program in operating pressurized water reactors (PWR's). The work was conducted for the Office of Nuclear Regulatory Research in support of the Effluent Treatment Systems Branch of the Office of Nuclear Reactor Regulation. The primary objective of this program is to provide the Nuclear Regulatory Commission (NRC) with operational data that can be used in evaluation of plant designs for liquid and gaseous waste treatment systems.

Data presented were obtained at the Rancho Seco Nuclear Generating Station, operated by the Sacramento Municipal Utility District (SMUD), located near Clay Station, California, 35 miles southeast of Sacramento, California. In-plant measurements were conducted during the time period from September, 1978 to March, 1979. This plant is the fourth in a planned series of six operating PWR's to be studied, two from each of the major PWR vendors. Data from all plants will be combined and interpreted to provide a data base for radioisotope inventory in plant systems, radioactive waste treatment system performance, and source terms for both liquid and gaseous systems.

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