# ATTACHMENT 2

## SEABROOK STATION

## CORE DAMAGE ASSESSMENT METHODOLOGY

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## 1.0 INTRODUCTION

This report is prepared in response to an NRC request to provide a method to assess core damage following a severe accident at Seabrook Station. For the purposes of this report, core damage is to be inferred from the fraction of fission products released from the fuel. Based on the physical and chemical properties of the various fission products, estimates of the severity of the release can be made. Methods are given to characterize a release as resulting from Clad Damage, Fuel Overheat, or Fuel Melt. Measurements of fission products in the reactor coolant and containment atmosphere are the main sources of information for this assessment. Auxiliary indicators that will provide supporting data are core exit thermocouples, subcooling margin monitoring, reactor vessel water level indicator, containment hydrogen concentration, and the in-containment high range radiation monitors.

This Core Damage Assessment methodology is provided to allow early estimates of fission products released from the fuel and thus available for a potential further release to the environment. No effort is made to estimate the physical condition of core structural members in this methodology. Determination of the physical condition of the core is considered to be a recovery period function and will require data and analysis beyond the scope of this report. Further, the concept of "fraction failed fuel" is rejected in this methodology. Only after the core has been examined can such a phrase be applied and even then the term "fraction failed fuel" would have to be carefully defined. It is important to note that this methodology imposes no requirements on information that must be supplied. The approach of this methodology is to use the information available to make an engineering judgment on the severity of core damage. The accuracy of the estimate will obviously improve as more data becomes available to evaluate. In general, the philosophy of this methodology is: "Make the best engineering judgment possible with the information available."

In this methodology, samples shall be evaluated at the time the sample is taken. Any decay corrections required shall only be to the time of sampling. A severe accident must be viewed as a transient event taking place, perhaps, over a period of several hours or even days. Actions taken to mitigate the accident or inadvertent occurrences may cause transfer of fluids from one part of the system to another. For example, fission products confined to the Primary Coolant System may at some later time transport to the Reactor Building floor due to leakage. This could occur rapidly or over an extended period of time. For these reasons this Core Damage Assessment is based on evaluation of samples at the time of sampling, but not decay corrected back to some other time such as reactor shutdown.

Primary dependence of this Core Damage Assessment Methodology is on primary coolant and containment atmosphere samples, with supporting data available from auxiliary indicators discussed in Section 5.0. The overall approach is first to obtain the concentration (uCi/gm or uCi/$cm^3$) for each sample. This concentration is then multiplied by the mass or volume of the sampled medium to obtain an estimate of the number of curies of the various fission products that are in that medium. This is then divided by the core inventory of that fission product at the time of sampling to obtain, for each fission product, the fraction of the core inventory in the sampled medium.

For each fission product measured, the fractions of the core inventory in all sampled media are added together to obtain the total release fraction. The release fractions of specific radionuclides provide the primary input to estimate the severity of core damage. If samples of different media were taken at different times, other auxiliary indicators and engineering judgement should be used in estimating the total release fractions of the core inventories and the severity of core damage.

Application of this methodology is dependent upon the ability to obtain and analyze the required samples and accurately predict the mass or volume that the sample represents. Post-accident sampling systems have been installed and should assure the availability of samples. Analytical techniques for determining the nuclides contained in the sample are not much different than those employed in normal operation and can be verified by measurements at other laboratories. Determination of the mass associated with liquid samples, however, may not be easy. In any accident scenario a basic question is "Where is the water"? This question must be addressed before this core damage assessment methodology can be applied. The sequence of events during the course of the accident will determine the answer to this question.

Section 4.0 discusses the mass inventory and provides design values for the Primary System and associated tanks.

The technical basis for Core Damage Assessment is given in Section 2.0 of this report. This section discusses the fission products expected to be released under different levels of over temperature conditions in the fuel. The expected core inventory of the fission product indicators is also discussed. Based on this information, the sampling program described in Section 3.0, and the auxiliary indicators discussed in Section 5.0, the methods described in Section 6.0 can be used to estimate the severity of the release and the category of the accident.

## 2.0 TECHNICAL BASIS FOR CORE DAMAGE ASSESSMENT

A complete evaluation for a Core Damage Assessment would require samples from every volume containing radioactive material. This could include demineralizers, filters, tanks, drains, all building air as well as sumps and primary and secondary coolant systems. If this were available, the number of curies of each nuclide in each system could be added to obtain the total number of curies of every nuclide released. One could then estimate the severity of the release based on the fractions of the various radionuclides escaping the fuel. This information could then be further refined by including data from the radiation monitor, hydrogen analyzers, analysis of the core thermal-hydraulic conditions, operator actions, and visual inspections to develop a complete accident scenario. Such a task could take months and is not the purpose of this evaluation.

The basis for this Core Damage Assessment is to obtain, as quickly as possible, an evaluation of as many samples as are available from locations containing fission products, and determine the number of curies released from the fuel. The released fraction of the inventory of each measured nuclide, factoring in information available from auxiliary indicators, then allows one to make a judgement of the severity of the release.

However, in using this methodology, one should keep in mind that the estimated release fractions of some fission products may be less than what they should have been because of deposition in the primary system and the containment (Reference 19). The only exceptions are noble gases if there is no significant unaccountable release to the atmosphere. Because of their inert property, noble gases do not interact easily with any medium. Therefore, in classifying the severity of core damage, one should rely more on the release fractions of noble gases (Xe and Kr) than those of other fission products (I, Cs, and others).

### 2.1 Estimated Levels of Core Damage

The categories chosen for description of core damage are four progressive levels: No Significant Damage, Clad Failure, Fuel Overheat, and Fuel Melt. It is important to recognize that a severe accident may result in each of these categories existing in some part of the core. Fuel melt may

TABLE 2.1

Progressive Material Interactions and Damage Expected in Fuel Rods During Core Melt Accidents

(Adapted from Reference 1)

| | | |
|---|---|---|
| 1. | Ballooning of Zircaloy cladding | ( $1300^{o}F$) |
| 2. | Rupture of Zircaloy cladding | ($1380-1950^{o}F$) |
| 3. | Oxidation of metal components and hydrogen generation | ($1470-1650^{o}F$) |
| 4. | Embrittlement of fuel rod by oxidation | |
| 5. | Reaction between solid $UO_2$ and solid metallic Zircaloy | ($2550-3450^{o}F$) |
| 6. | Solid metallic Zircaloy-$ZrO_2$ eutectic melting | ( $3450^{o}F$) |
| 7. | Melting of remaining metallic Zircaloy | ( $3600^{o}F$) |
| 8. | Dissolution and liquefaction of $UO_2$ in the Zircaloy-$ZrO_2$ eutectic | ( $3450^{o}F$) |
| 9. | Possible breach of $ZrO_2$ shell as a result of volume expansion accompanying liquefaction | |
| 10. | Flow-down or candling of liquified fuel and Zircaloy | |
| 11. | Melting of remaining solid $ZrO_2$ | ( $4890^{o}F$) |
| 12. | Melting of remaining $UO_2$ | ( $5100^{o}F$) |

occur in parts of the core, fuel overheat in others, and clad failure or no damage in the remainder.

This methodology, describes an approach that can lead to estimates of the maximum category and, perhaps to estimate the fraction in lower categories. Table 2.1 (adapted from Reference 1) shows a correlation of expected fuel damage with temperature.

From Table 2.1 one readily observes that the severity of fuel damage increases as the fuel temperature increases. Preventing fuel rods from overheating is one of the most important safety functions in a nuclear power plant. Even though the core exit thermocouples provide some indication about the fuel temperature, the direct measurement of fuel rod temperature is not available in current nuclear power reactors. Therefore, one has to rely on other measurements to estimate the severity of core damage.

It has long been recognized that fuel damage always results in releasing radionuclides from the damaged fuel rod to the reactor coolant, thus increasing the radionuclide concentrations in the coolant. The greater the fuel damage, the greater the radioactivity release would be. The Rogovin Report (Reference 3), provides a rationale for selecting specific radionuclides to estimate the severity of core damage. Based on the rationale of estimating core damage in Rogovin's report, this methodology uses the release fractions of certain key radionuclides as a primary indicator for estimating the severity of core damage.

## 2.2 Core Inventories

The confidence level of a Core Damage Assessment depends on the validity of the sample data, the ability to establish the mass or volume associated with the sample and the accuracy of the assumed fission product core inventories. The first step in a Core Damage Assessment program would be to determine, as accurately as possible, the fission product inventories for the affected cycle using ORIGEN2 (Reference 2). In the interim, representative inventories are provided in Appendix A and Appendix B.

The Seabrook core is modeled as three regions - one region having three irradiation cycles, one region having two irradiation cycles, and one region having only one irradiation cycle. For this methodology, a design basis thermal power of 3,654 MWt is used. The three regions are assumed to have operated at a specific power of 40.03 MW/Mtu for 300, 600 and 900 effective full power days, respectively (Reference 15). The initial mass of uranium of each region is 30.427 Mtu with U-235 initial enrichment of 3.1%.

The source inventories for selected fission products and actinides calculated by ORIGEN2 code during irradiation are shown in Appendix A. This appendix shows the buildup of selected nuclides as a function of irradiation time and is the sum of three regions. Appendix B shows the decay of source inventories after shutdown from a full power operation cycle.

The inventories given in the appendices are based on full power irradiation during a typical cycle. If the reactor has not operated at 100% power prior to shutdown, a power correction factor should be considered. This correction factor depends on the decay constant of the nuclide. For purposes of this methodology, the correction factor discussed here is only used as a quick estimate of the fission product inventories using the inventories given in Appendices A and B.

(1) Radionuclides With Half-Lives Less Than 1 Day (See Table 2.4)

$$\text{Power Correction Factor} = \frac{\text{Average Power for Prior 4 Days}}{\text{3654 MWt}}$$

(2) Radionuclides With Half-Lives Between 1 Day and 1 Year (See Table 2.4)

$$\text{Power Correction Factor} = \frac{\text{Average Power for Prior 30 Days}}{\text{3654 MWt}}$$

(3) Radionuclides With Half-Lives Greater Than 1 Year (See Table 2.4)

For a few nuclides of interest that have half-life around one year or longer, a power correction factor, which accounts for the approximately linear buildup of activity as a function of effective

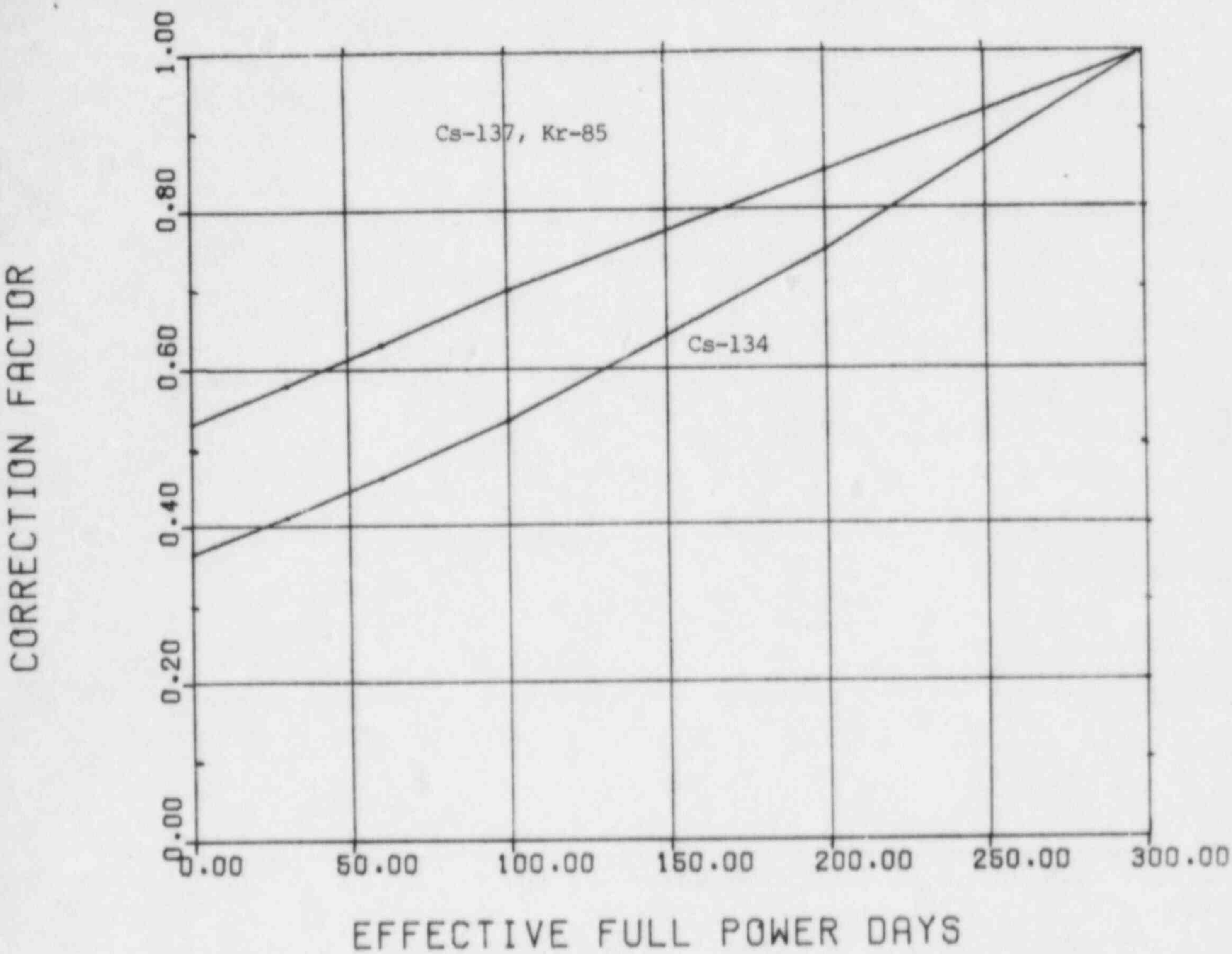



FIGURE 2.1

POWER CORRECTION FACTORS VERSUS
EFFECTIVE FULL POWER DAYS FOR
LONG HALF-LIFE FISSION PRODUCTS

full power days, is shown in Figure 2.1. The effective full power days, or EFPD, are calculated from the beginning of the current cycle up to the time of reactor shutdown as follows:

$$EFPD = \sum_{i=1}^{N} \frac{Pi}{3654} t_i$$

where:

Pi = Power level in MWt during time interval i

$t_i$ = Time in days for the interval i

N = Number of time intervals having different power level

Due to the production characteristics of Cs-134, its power correction factor curve in Figure 2.1 is different from other long half-life fission products, such as Cs-137 and Kr-85.

The power correction factor of a radionuclide determined from one of the above equations is then multiplied by its inventory at the time of interest after reactor shutdown using the inventories shown in Appendix B. Some interpolation may be required if the time of interest falls between the decay time steps in Appendix B.

## 2.3 Characteristic Fission Products

Both the identification and quantity of the fission products measured can provide information about the severity of the release. Due to their chemical properties and volatility, some nuclides will be released at lower temperatures than others. Table 2.3 (adapted from Reference 3) shows the fission product and actinide radionuclides in decreasing order of volatility.

For a Clad Failure release one would expect to see the noble gases Krypton and Xenon with small amounts of Iodine and Cesium. Based on the experience at TMI-2, Fuel Overheat will only add substantial quantities of Cesium and Iodine. Strontium and Barium may be in the range of a few percent and there may be traces of Mo, Ru, Ag, Ce, Sb, Zr, Cd, Rb, Nb, Y, Pr, Am, Pa, Cm, and Eu (References 4, 5, 6, 7, 8, 9, 10, 14).

A Fuel Melt category would release larger fractions of the nuclides than released in a Fuel Overheat.

The ability to measure the characteristic nuclides will depend on the inventory of the nuclide, its half-life, and whether it has gamma rays that will not be obscured by other nuclides. This will be discussed further in Section 2.4.

### 2.3.1 Fission Product Release from Clad Failure

During normal operation, some of the gaseous and volatile fission products would migrate from the fuel pellet and reside in the gap between fuel pellet and cladding. A release resulting from clad failure alone will release only fission products in the gap between the fuel pellet and the cladding. The ability to identify such a release depends primarily on the absence of fission products indicative of fuel overheat. A clad failure would release primarily noble gases with smaller amounts of cesium and iodine.

In estimating the quantity of fission gases in the fuel-clad gap, or the so-called "gap inventory", the diffusion model of ANS 5.4 (Reference 11) has been used by several studies. However, the average gap inventory stated in these studies varies significantly. For example, the average released fraction of the total core to the gap for Xe-133 varies from $8.9 \times 10^{-4}$ to $8.7 \times 10^{-2}$. Thus, the uncertainty in arriving at the gap inventory is rather large. A large uncertainty is also shown in the small amount of data available from experimental measurements (Reference 12). Because of this, no attempt is made to analytically predict the amount of fission products in the fuel-clad gap. The approach for classifying core damage as resulting from clad failures is to recognize a condition where there was a substantial release of noble gases only accompanied by small cesium and iodine releases with almost no other fission products released.

TABLE 2.2

Fission Products and Actinides in Decreasing Order of Volatility

I. Noble Gases

Xe
Kr

II. Halogens

I
Br

III. Alkali Metals

Cs
Rb

IV. Tellurium

Te

V. Alkaline Earths

Sr
Ba

VI. Noble Metals

Ru
Rh
Pd
Mo
Tc

VII. Rare Earths

Y
Np
Pu

VIII. Refractory Oxides

Zr
Nb

### 2.3.2 Fission Product Release from Fuel Overheat

The Fuel Overheat category is defined as a release resulting from temperatures high enough to cause clad failures but insufficient to melt the fuel. The release mechanism for fuel overheat is characterized by grain boundary release and diffusion release from the $UO_2$ grains (Reference 13). This release mechanism begins at approximately 1350$^{o}$C (2460$^{o}$F), and is driven by the vaporization of noble gases, iodines, and cesiums previously accumulated at the grain boundaries. Approximately equal amounts of noble gases, iodines, and cesiums are expected to be released from the grain boundaries. For high burnup fuel rods, the release fraction of these elements could be as high as 60 or 70% of the total fuel rod inventory. In addition, there may be a smaller amounts of strontium and barium, less than 1% of the total fuel rod inventory, and traces of those nuclides listed in Section 2.3. Fuel overheat will probably be accompanied by releases of hydrogen from $Zr-H_2O$ reaction of the clad material. This will be discussed further in Section 5.1.

### 2.3.3 Fission Product Release from Fuel Melt

A Fuel Melt will result in large releases of the noble gases, cesiums, iodines, and larger fractions of the nonvolatile fission products than would be expected from a fuel overheat. Although TMI-II would be classified as a Fuel Overheat accident, there was apparently some fuel melted. Fuel melt would be indicated by larger fractions released of the Alkaline Earths, Noble Metals, Rare Earths, and Refractory Oxides. Releases of Strontiums and Bariums in excess of a few percent of the inventory may be a good indication of fuel melting. In addition, there will probably be large quantities of hydrogen produced by the zirconium water reaction.

## 2.4 Principal Radionuclide Used to Characterize Core Damage

The ability to detect a radionuclide will depend on the inventory at shutdown, the half life, the time of sampling, the energy and branching ratio of the characteristic gamma rays, the efficiency of the detector, and the absence of other strong gammas at nearly the same energy. These factors were evaluated to develop the list of nuclides in Table 2.4 showing the nuclides indicative of the different levels of core damage.

The choice of characteristic gamma rays for the nuclides shown in Table 2.4 was based on the following:

1. The nuclide inventory present three hours after shutdown, and

2. A fuel melt condition with equal release of all fission products.

Under this condition each of the nuclides, except the cesiums, should be detectable. In a fuel melt condition with large releases of the Noble Metals, Rare Earths, and Refractory Oxides, all of the cesium nuclides may be obscured.

TABLE 2.3

Principal Radionuclides

| Level of Core Damage | Nuclide | Physical* Half Life | Characteristic Gamma Energy (keV) |
|---|---|---|---|
| Clad Failure | 85M Kr | 4.48 h | 151.18, 451.00 |
| | 87 Kr | 76.3 m | 1175.40, 1337.96, 2011.88 |
| | 88 Kr | 2.84 h | 1518.39, 1529.77, 2195.84 |
| | 133 Xe | 5.25 d | 81.00, 160.60 |
| | 135 Xe | 9.09 h | 249.79 |
| Fuel Overheat | 131 I | 8.04 d | 364.48 |
| | 132 I | 2.30 h | 667.69, 630.22, 954.55 |
| | 133 I | 20.8 h | 529.87 |
| | 134 I | 52.6 m | 884.09 |
| | 135 I | 6.61 h | 1260.41, 1131.51 |
| | 134 Cs | 2.06 Y | 604.66, 795.76 |
| | 136 Cs | 13.1 d | 340.57 |
| | 137 Cs | 30.1 Y | 661.64 |
| | 140 Ba | 12.8 d | 537.38, 304.82 |
| | 140 La | 40.2 h | 1596.18, 487.02, 815.74 |
| | 91 Sr | 9.5 h | 1024.30 |
| | 92 Sr | 2.71 h | 1383.94 |
| Fuel Melt | 91 Y | 58.5 d | 555.37 |
| | 93 Y | 10.1 h | 266.9 |
| | 95 Zr | 64.0 d | 756.72 |
| | 95 Nb | 35.1 d | 765.78 |
| | 97 Nb | 72.1 M | 657.92 |
| | 103 Ru | 39.3 d | 497.08 |
| | 143 Ce | 33.0 h | 293.26 |
| | 239 Np | 2.35 d | 277.60, 209.75 |

*Note that some nuclides may not decay as their physical half lives because of precursor effects. The effective half life can be determined from the inventories given in Appendix B.

## 3.0 SAMPLING SYSTEMS

Analysis of samples from the post-accident sampling systems provides the most important information in assessing the status of the core under accident conditions. The radionuclide concentrations of the containment atmosphere and reactor coolant samples, along with the mass and volume of the sampling media, allow one to estimate the total curies released for each measured fission product. By ratioing the total release of each measured fission product to its core inventory, one can obtain the release fraction of that nuclide. The chemical properties of measured fission products and their release fractions provide the primary input to the estimation of the severity of core damage.

### 3.1 Containment Atmosphere Sampling System

The Containment Atmosphere Sampling System at Seabrook Station is part of the Hydrogen Monitoring System. The containment atmosphere is monitored by two completely independent hydrogen sampling and analysis systems. Both hydrogen analyzers are located outside the containment and have an operating range of up to 10% volume of hydrogen concentration. On the upstream feedline of each hydrogen analyzer, a bypass line equipped with a sampling device is provided. Grab samples of containment atmosphere may be obtained and analyzed for radionuclide concentration.

Two intakes of the Hydrogen Monitoring System are located opposite each other in the dome area at El. 183'-6". Each suction line feeds into one hydrogen analyzer.

In determining the specific activity in $uCi/cm^3$ of the containment air, adjustment should be considered for decay time between sampling and analysis, and any dilution used during the analysis. In addition, if the containment air is at higher pressure and temperature than the analyzed sample, a temperature and pressure correction must be made to ensure a value ($uCi/cm^3$) that is representative of the containment air.

## 3.2 Reactor Coolant Sampling System

Under accident conditions, the Post-Accident Sampling System provides the capability to obtain liquid samples from the following media:

a. Reactor coolant Loop 1 and 3 hot legs

b. Primary Auxiliary Building (PAB) Sump "A"

c. Containment recirculation sumps

d. Residual Heat Removal/Containment Building Spray (RHR/CBS) Vault

Reactor coolant sampling lines from the hot legs of Loops 1 and 3 come to a common line before entering the Primary Auxiliary Building. This line bypasses the sample heat exchangers and runs directly to the post-accident sampling panel.

During the recirculation mode after a loss-of-coolant accident, liquid is circulated from the containment recirculation sumps through containment spray pumps and RHR pumps and into reactor vessel or Containment Building spray nozzles to remove decay heat. Two independent containment recirculation sumps and sump pumps are located inside the containment. Samples are taken from the discharge of the pumps. In order to sample either one of the two sumps, each sample line is provided with a remotely operated solenoid valve before joining together in a common line that feeds into the post-accident sampling panel.

The sumps that may be sampled during post-accident operation, are the Primary Auxiliary Building Sump "A" and two sumps in the RHR/CBS Equipment Vaults 1 and 2. These sumps are sampled to detect any radioactive releases which would result from equipment leakage.

All electrically powered equipment (i.e., solenoid valves and sample pumps) whose operation is required to perform post-accident sampling is powered from an emergency backup power source.

To determine the specific activity in uCi/gm of the sampling medium, the result of the gamma spectral analysis should be adjusted for decay time between sampling and analysis, and any dilution used during the analysis. By multiplying the specific activity (uCi/gm) of the sampling medium for an individual nuclide by the mass of the sampling medium, one can obtain total activity of that nuclide in that medium. The estimation of mass and volume of the sampling media is discussed in Section 4.

### 3.3 Miscellaneous Samples

There are a number of miscellaneous locations from which samples could be drawn if radiation levels permit. Grab samples from several points in the primary auxiliary systems, outside containment, may be taken. These samples may be analyzed to determine if radioactivity has been transferred from the primary coolant system or containment sump to other systems, and to factor them into estimating the total released fraction from the core.

## 4.0 DETERMINATION OF MASS AND VOLUME ASSOCIATED WITH SAMPLES

In order to determine the number of curies in a sampled medium, it is necessary to know the mass or volume of that medium. This section discusses methods for determination of these values for the containment air volume, the primary coolant mass, and the accumulated mass in the sump.

### 4.1 Containment Air Volume

For samples from containment it is assumed that containment air is well mixed and that no stratification or pocketing exists. Thus, the volume associated with a containment air sample will be the free volume of the containment building. This has been determined to be $7.657 \times 10^{10}$ $cm^3$ ($2.704 \times 10^6$ $ft^3$) (Reference 15).

### 4.2 Liquid Sample Mass

The total mass of the sampling medium is necessary to determine the total activity as stated in Section 3.2. The mass in the Primary System, for the purpose of activity estimation prior to recirculation, will be based on the total system volume less voided portions of the system. Consideration will be given to injected mass based on information available at the time. During the recirculation mode, reactor coolant samples will include the containment floor liquid mass. The total mass for such samples may be estimated by summing the initial primary coolant mass and the mass injected into the containment from the Accumulator Tanks, the Refueling Water Storage Tank (RWST), and Spray Additive Tank (SAT), as applicable, to the specific accident scenario.

Table 4.1 provides data for calculating the water mass. The instrumentation listed in the table has readouts available in the Main Control Room. Data from this table and the accident-specific sequence of events will be used in estimating water mass.

In the event of loss-of-coolant accident, water would be released from the ruptured pipe to the containment floor. During the operation of the ECCS System and the Containment Building spray, the reactor cavity and the containment sumps will be filled with water up to El. (-) 26'. It is estimated that the total water volume below El. (-) 26' is 17,000 $ft^3$.

Two sump level indicators, CBS-LT-2384 and CBS-LT-2385, are provided for each of two containment recirculation sumps, respectively. They have the ability to measure from 0 to 5' above the -35' elevation. The relationship between level and water volume is approximately 1,000 $ft^3$/inch above El. (-) 35'. If the containment recirculation sumps are sampled, the mass of recirculation sump liquid can be estimated using the sump level indicators.

The methodology described above neglects water vapor in the containment and assumes the boundary between the Primary and Secondary Systems is intact.

## TABLE 4.1

### Components of Liquid Sample Mass Estimation

| Component | Total Volume ($ft^3$) | Initial Water Volume ($ft^3$) | Initial Water Density ($lbm/ft^3$) | Level Instrument | Range |
|---|---|---|---|---|---|
| Primary System (Reactor Vessel Level Indicator) | 10,465 (78,284 gal) | 10,465 (78,284 gal) | 44.14 | RC-LT-1311, 1312<br>RC-LT-1321, 1322 | Dynamic Range: 534" - 539"<br>Full Range: 0" - 1104" |
| Pressurizer ( 13,465 gal) | 1,800 (7,929 gal) | 1,060 | 37.07 | RC-LT-459, 460 | 221" - 479" |
| Accumulators (Total of 4) | 1,350 (10,099 gal) (1 of 4) | 850 (6,358 gal) (1 of 4) | 62 | SI-LT-950, 951, 952, 953, 954, 955, 956, 957 | --- |
| RWST | 63,500 (475,000 gal) | 60,156 (450,000 gal) | 62 | CBS-LT-2331, 2333 | --- |
| Spray Additive Tank | 1,430 (10,700 gal) | 1,430 (10,700 gal) | 62 | None | --- |
| Pressurizer Relief Tank | 1,800 (13,465 gal) | 1,350 (10,099 gal) | 62 | RC-LT-470 | --- |
| RHR/CBS Vault Sumps A and B | 105 each (786 gal) | 0 | 62 | None | --- |
| PAB Sump A | 105 each (786 gal) | 0 | 62 | None | --- |

## 5.0 AUXILIARY INDICATIONS

As has been discussed in previous sections, the Core Damage Assessment Methodology is primarily dependent on the post-accident sampling program. There are, however, a number of auxiliary indicators that can provide important information to aid in the decision process. This section addresses three of these: containment hydrogen concentration, Inadequate Core Cooling Monitoring System, and the containment radiation monitors.

### 5.1 Containment Hydrogen Concentration

Incore temperatures in excess of 800°C (1500°F) can result in hydrogen production by the reaction of Zirconium and steam. This reaction will produce about 21.8 moles of hydrogen for each kilogram of Zirconium reacted. The total mass of Zirconium in the core is 47,466 lbm or 21,530 kg, including fuel rod cladding and guide thimbles (Reference 16).

If hydrogen is produced, it should behave in a manner similar to the noble gases and thus be found in any location that the noble gases are. Based on the assumption that hydrogen reaches the containment volume and is well mixed, a correlation can be made of the amount of hydrogen measured in the containment air with the amount of Zirconium reacted. This correlation is shown in Figure 5.1.

Based on the measurement of hydrogen in the containment, Figure 5.1 can be used to estimate the fraction of the Zirconium reacted and thus the fraction of the core involved.

### 5.2 Inadequate Core Cooling Monitoring System

The Inadequate Core Cooling (ICC) Monitoring System installed at Seabrook Station includes the following:

- Core exit thermocouple (T/C) monitoring
- Core subcooling margin monitoring
- Reactor vessel level monitoring

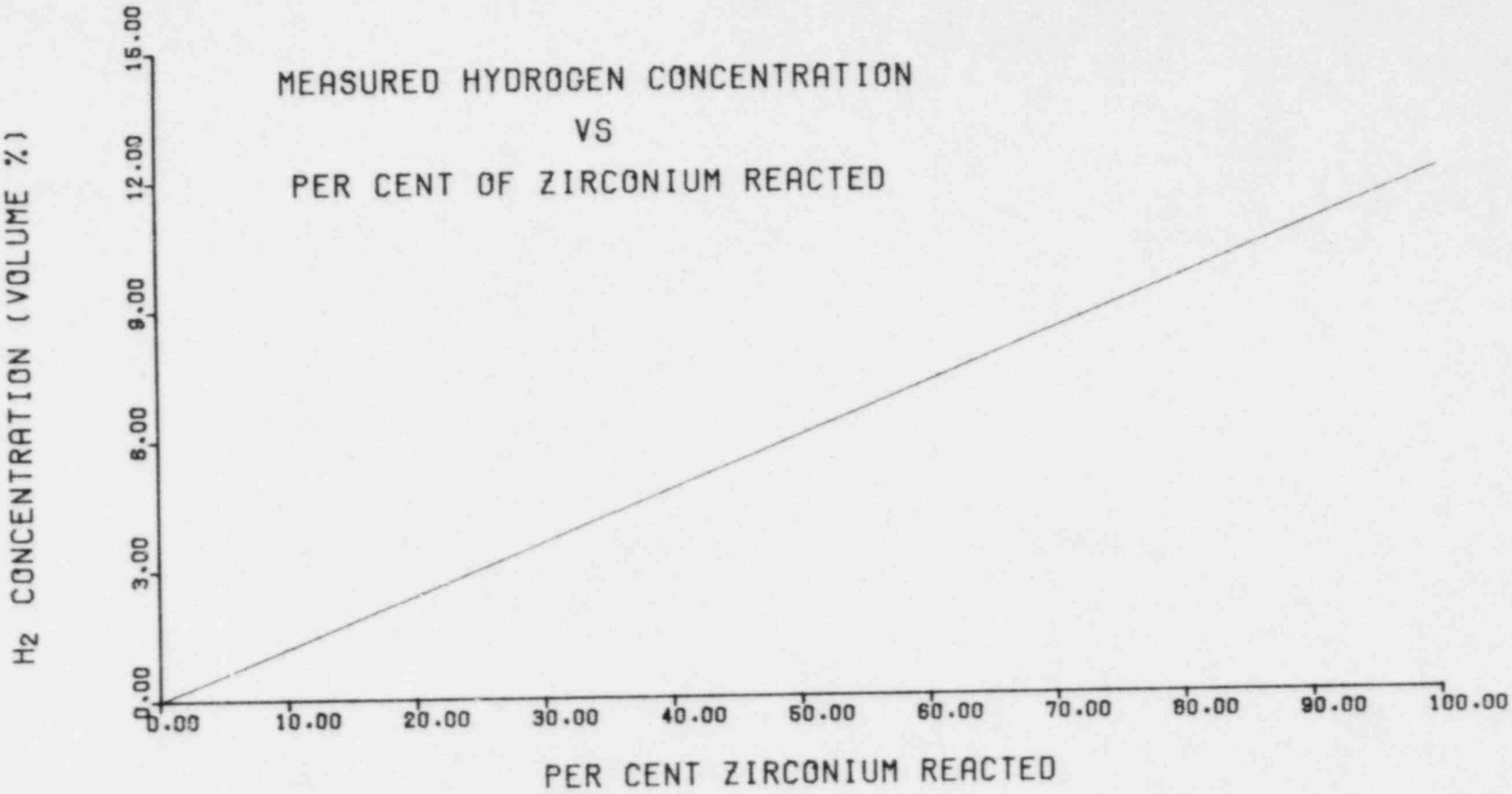



FIGURE 5.1
CONTAINMENT HYDROGEN CONCENTRAION
FRACTION OF CORE ZIRCONIUM REACTED

In general, the ICC monitoring subsystems can perhaps provide the earliest indication of potential damage to the fuel integrity. Quantitative interpretation of ICC monitoring data, however, is a difficult task dependent on many parameters. Therefore, the use of these ICC monitoring data is considered an auxiliary indicator to be used to support core damage estimates made from fission product measurements.

Each of the above ICC monitoring subsystems is discussed below:

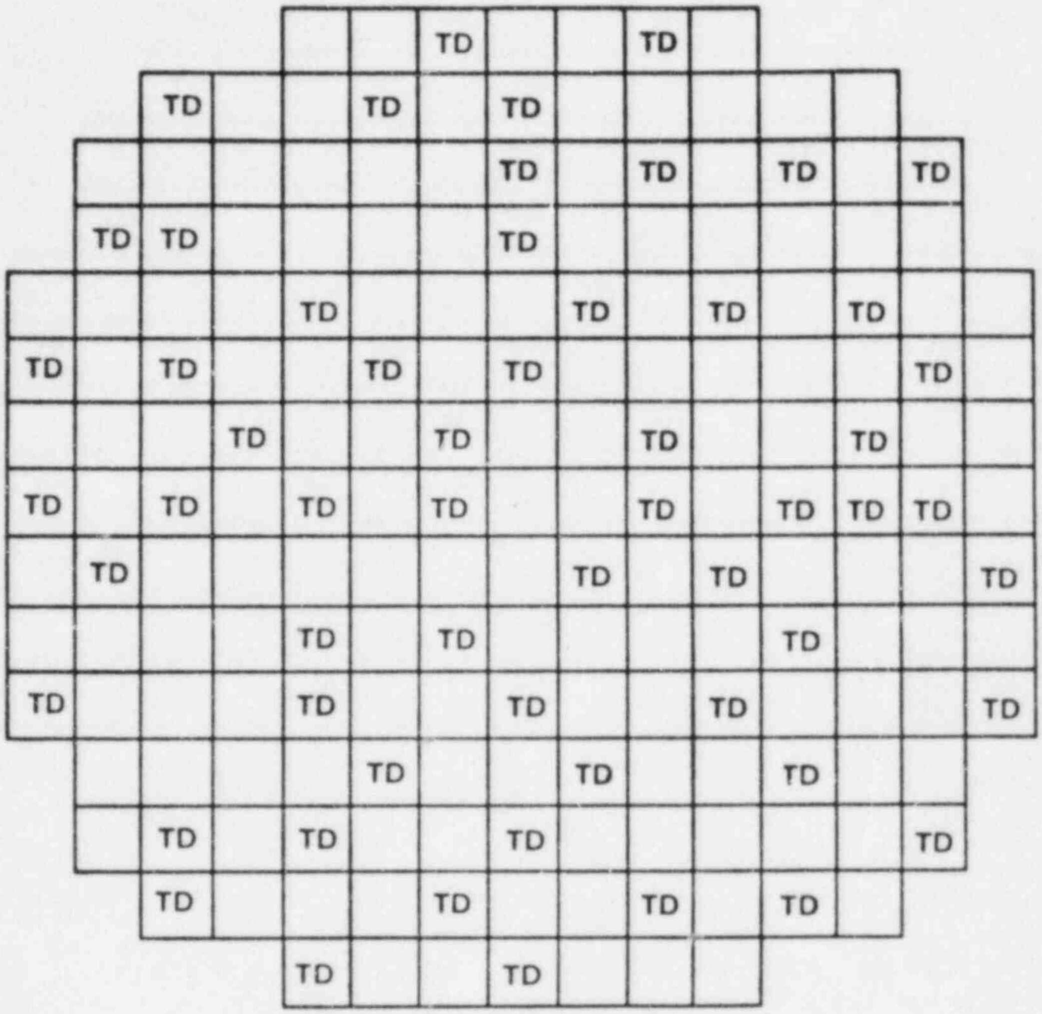
A. Core Exit Thermocouple System

The Core Exit Thermocouple System is a part of the Incore Instrumentation System. The latter consists of 58 thimble assemblies, each with five fixed neutron detectors and one Type K chromel-alumel thermocouple at fixed core outlet positions. The temperature range of the core exit T/C is from $0^{o}F$ to $1,650^{o}F$. Figure 5.2 shows the location of instrumented assemblies in the core. Measurements from these T/Cs are displayed in the Control Room.

Core exit temperature can be used together with core subcooling margin temperature to provide an indication of the onset and extent of core voiding. However, caution must be used in interpreting core exit thermocouple data. The location of the T/Cs and the system parameters of the Primary Coolant System must be considered. For example, T/Cs near the periphery of the core may receive reflux cooling from the drainage of hot leg water and, therefore, not be indicative of the cladding temperatures at those locations.

B. Core Subcooling Margin Monitor

The core subcooling margin monitor provides an indication of the temperature margin of reaching saturation at a given Reactor Coolant System pressure. The input to the core subcooling margin monitor includes the following:




T = THERMOCOUPLE (58)
D = MOVABLE INCORE DETECTOR (58 LOCATIONS)

FIGURE 5.2

CORE EXIT THERMOCOUPLE LOCATIONS

- Wide-range RCS pressure (2 channels)

- Core exit compensated thermocouple temperatures (58 channels)

The RCS subcooling margin is calculated based upon the wide-range RCS pressure and compensated core exit thermocouple readings. The calculated subcooling margin values are displayed at the display panels in the Control Room. If the coolant is in the vicinity of saturation, it is indicative of the possibility for voiding and clad heatup. If the coolant is in a saturated or superheated state, clad damage is a good possibility. Therefore, the core subcooling margin monitor and the core exit T/C monitor provide an early indication of the onset of fuel damage.

C. Reactor Vessel Level Instrumentation System

The Reactor Vessel Level Instrumentation System (RVLIS) consists of two redundant independent trains that monitor the water level in the reactor vessel.

The system provides the operating staff with two instrumentation ranges (see Table 4.1). The full range RVLIS reading provides an indication of reactor vessel water level from the bottom of the vessel to the top of the vessel during natural circulation conditions. The dynamic head RVLIS reading provides an indication of reactor core, internals, and outlet nozzle pressure drop for any combination of operating reactor coolant pumps.

## 5.3 Containment Radiation Monitors

The in-containment radiation monitors provide early and direct indication of release of radionuclides from the fuel matrix through the reactor coolant into the containment. If there is a release of radioactivity into the containment following an accident, the radiation monitors can indicate the magnitude of the radioactivity release.

There are two independent channels of high range post-accident radiation monitors inside the containment, namely, 6576A and 6576B. These radiation monitors are Model RD-9 ion chamber detector from General Atomic, and have an operating range from 1R/hr up to $10^7$ R/hr.

### 5.3.1 Basis for Predicting Radiation Monitor Readings

In using high range radiation monitors to estimate the magnitude of fission products released, one should bear in mind that, the estimated dose rates of these radiation monitors depend on assumptions used in the estimation. These assumptions include the fraction of inventory released to the containment and the fission product behavior inside the containment. Because of the uncertainty and the incomplete understanding of the physiochemical behavior of the fission products and the thermal-hydraulic conditions inside the containment, it is difficult to interpret the radiation monitor reading under accident conditions, especially when one tries to take account of vapor and aerosols in the containment atmosphere.

In this methodology, the analysis of correlating the radiation monitor readings with different released fractions is based on the following assumptions:

1. Only the noble gases are considered. This approach is based on the experience from TMI-II and the conclusion of the recent IDCOR report, that the dominant nuclides in most severe accident cases are the noble gases (Page 2 of IDCOR 11.3, Reference 17).

2. Radioactive gases released from the fuel are all released into the containment, and uniformly mixed with the total free air volume. Some transient states may exist at certain times after the accident, such that this uniformly mixed assumption is not valid. However, continuous observation of the radiation monitor reading enables one to ascertain whether or not the condition is stabilized.

3. Containment integrity is not challenged after the accident. Therefore, leakage of the containment atmosphere is insignificant within the time period of concern (30 days after reactor shutdown).

The computer code QADMOD-G (Reference 18) is used to estimate the dose rate of the radiation monitors using the geometry of the radiation monitors inside the containment. Figure 5.3 shows the predicted dose rate versus percentage of release of noble gases in the core inventory for selected time steps after reactor shutdown.

Similarly, Figure 5.4 shows the predicted dose rate versus percentage of release of iodines in the core inventory for selected time steps after reactor shutdown. This is to be used only if it is suspected that significant fractions of the iodines have been released.

### 5.3.2 Interpretation of Predicted Radiation Monitor Readings

In general, noble gas release fractions below 0.001% are indicative of no fuel damage or minor clad damage. Values above 0.001% of noble gases released are indicative of some fraction of clad damage, and the 1% curve indicates a large fraction of the fuel having clad damage. The values between 1% and 100% are in the fuel overheat and fuel melt regions.

If there were significant amounts of airborne fission products other than noble gases present in the containment air, the radiation monitor readings would be different from those curves in Figure 5.3. Based on the current understanding of fission product behavior during LWR accidents, the released fraction of noble gases would likely be nearly 100% when the above condition exists. For example, if there were 100% noble gases and 25% iodines of the core inventory uniformly mixed with the containment atmosphere, using both Figures 5.3 and 5.4, the radiation monitor readings at 1 hour after reactor shutdown would be $4 \times 10^5$ R/hr, instead of $1 \times 10^5$ R/hr shown in Figure 5.3. It should be emphasized that the use of these predicted dose rate curves for radiation monitors is only for a confirmative and indicative purpose, and as a backup to direct measurements. To assess core damage, one should rely more on the sampling systems of the reactor coolant and containment atmosphere.

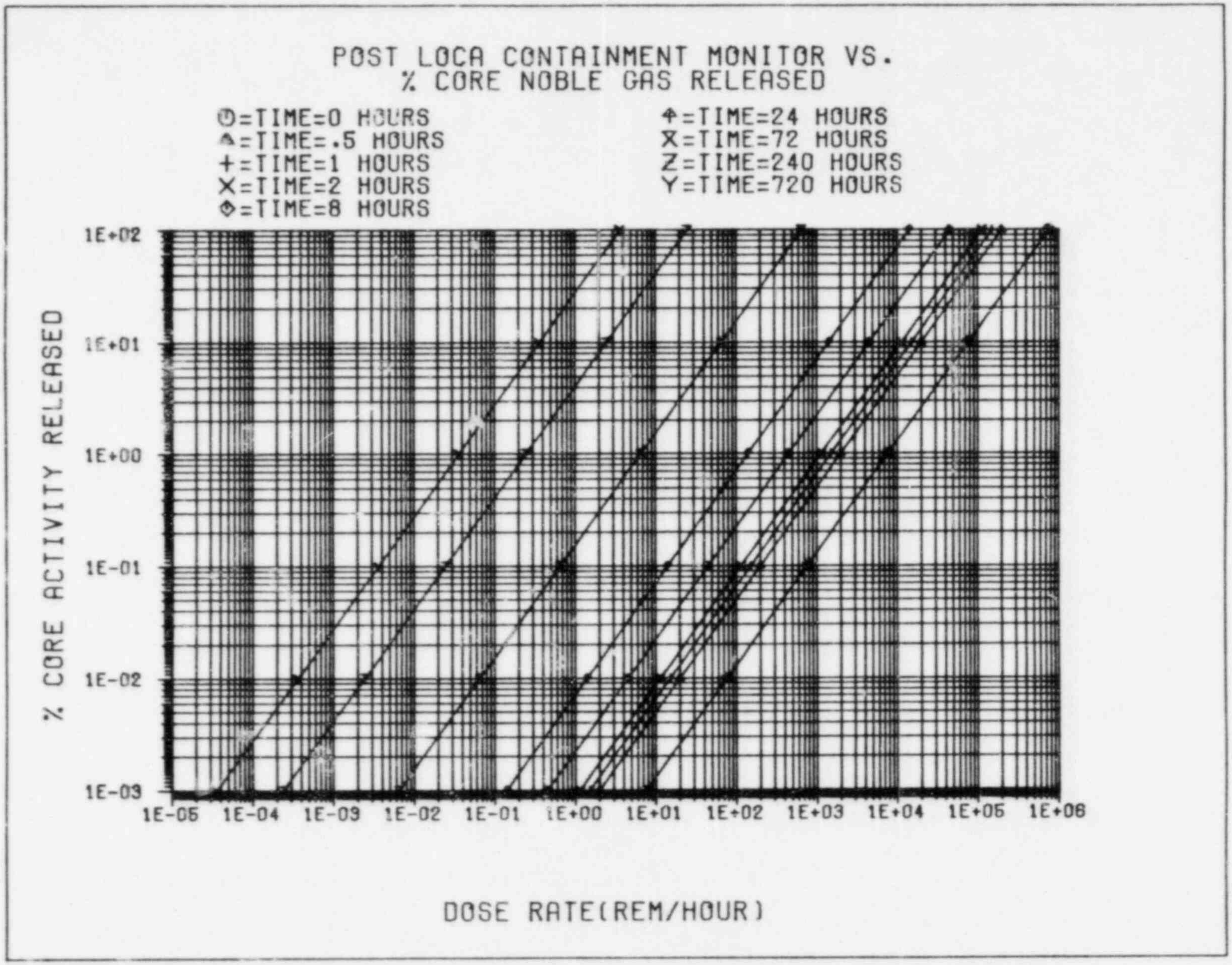



FIGURE 5.3
CONTAINMENT ACCIDENT AREA RADIATION MONITOR RESPONSE
VERSUS RELEASE PERCENTAGE OF NOBLE GAS INVENTORY

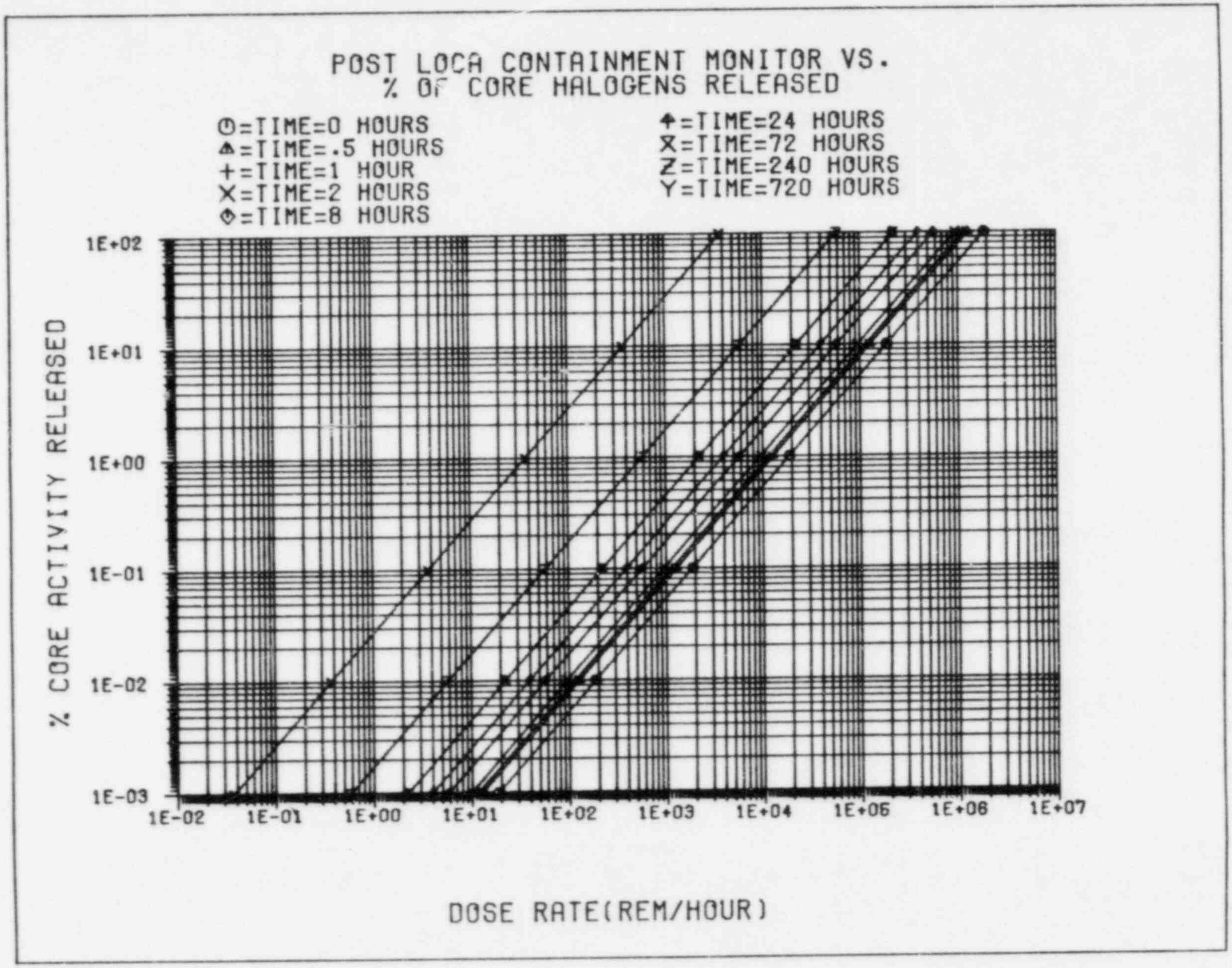



FIGURE 5.4
CONTAINMENT ACCIDENT AREA RADIATION MONITOR RESPONSE
VERSUS RELEASE PERCENTAGE OF IODINE INVENTORY

## 6.0 CORE DAMAGE ASSESSMENT APPROACH

This section discusses mechanisms to estimate the severity of core damage following an accident. Four categories have been chosen to describe the level of damage. These categories are:

I. No Significant Fuel Damage

II. Clad Failure

III. Fuel Overheat

IV. Fuel Melt

Based on discussions in the previous sections of this report and on the experience gained at TMI-II, Figure 6.1 has been constructed to provide an estimate of the category of fuel damage based on the fraction of various fission products released.

It should be noted that the boundaries between levels are not well known and should not be considered as definite. The final estimate of the level of damage must be based on an overall evaluation of all available data and not on a single parameter determined from Figure 6.1. To use Figure 6.1 it is first necessary to account for all fission products released from the core. Their location will obviously be determined by the event sequence, however it is difficult to envision a severe event that would not result in fission product releases to the primary coolant and containment atmosphere. In addition, there may be primary coolant discharged to the sump and perhaps transferred to tanks. Tables 6.1 through 6.3 are provided to aid in estimating the fraction of the fission products that have escaped the core. Similar tables should be created for other locations if required. As discussed previously, the fraction of the fission product inventory is to be determined at the time of sampling so the core inventory should be obtained from Appendix B for the time the sample was taken. Due to anomalies in the analysis of samples or inaccuracies in the inventories calculated by the ORIGEN2 code, different nuclides of the same element may show some differences in the fraction released. An average value should be determined for each element based on a best engineering judgement. After the fraction of the inventory contained in each location has been determined, Table 6.4 can be used to obtain the total fraction released from the core for the various elements detected. The total fraction as determined from Table 6.4 is used in Figure 6.1 to determine the category of damage. Table 6.5 is provided to summarize the estimates of core damage determined from fission product release, hydrogen generation, and the in-containment monitor response. Note that it may be difficult to distinguish between contiguous categories and that a designation I-II, II-III, or III-IV is acceptable in Table 6.5.

Because of a lack of data, Figure 6.1 does not include the noble metals, rare earths, or the refractory oxides. Appreciable fractions of these elements should be an indication that fuel melt has occurred. The accident at TMI-II apparently resulted in temperatures that caused some of the fuel to melt, however, the release of the noble metals, rare earths, and refractory oxides was negligible.

Once Table 6.5 has been completed, the best estimate of core damage is available from the information summarized in that table.

PRIMARY COOLANT

| NUCLIDE | CONCENTRATION (UCI/GM) | ACTIVITY (CI) | CORE INVENTORY (CI) AT T=_____(HRS) | FRACTION OF CORE | AVERAGE |
|---|---|---|---|---|---|
| KR 85M | -------- | -------- | -------------- | -------- | |
| KR 87 | -------- | -------- | -------------- | -------- | |
| KR 88 | -------- | -------- | -------------- | -------- | KR ---- |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| XE 133 | -------- | -------- | -------------- | -------- | |
| XE 135 | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | XE ---- |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| I 131 | -------- | -------- | -------------- | -------- | |
| I 132 | -------- | -------- | -------------- | -------- | |
| I 133 | -------- | -------- | -------------- | -------- | I ---- |
| I 134 | -------- | -------- | -------------- | -------- | |
| I 135 | -------- | -------- | -------------- | -------- | |
| CS 134 | -------- | -------- | -------------- | -------- | |
| CS 136 | -------- | -------- | -------------- | -------- | CS ---- |
| CS 137 | -------- | -------- | -------------- | -------- | |
| BA 140 | -------- | -------- | -------------- | -------- | |
| LA 140 | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| SR 91 | -------- | -------- | -------------- | -------- | |
| SR 92 | -------- | -------- | -------------- | -------- | SR ---- |
| Y 93 | -------- | -------- | -------------- | -------- | |
| ZR 95 | -------- | -------- | -------------- | -------- | |
| NB 97M | -------- | -------- | -------------- | -------- | |
| RU 103 | -------- | -------- | -------------- | -------- | |
| RH 107 | -------- | -------- | -------------- | -------- | |
| CE 141 | -------- | -------- | -------------- | -------- | |
| CE 143 | -------- | -------- | -------------- | -------- | CE ---- |
| EU 156 | -------- | -------- | -------------- | -------- | |
| NP 238 | -------- | -------- | -------------- | -------- | |
| NP 239 | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |

ACTIVITY(CI) = CONC(UCI/GM) X 10-6(CI/UCI) X MASS(GM)
CORE INVENTORY : OBTAINED FROM APPENDIX B,ADJUSTED IF NECESSARY
FRACTION OF CORE = ACTIVITY / INVENTORY

TABLE 6.

PRIMARY COOLANT EVALUATION

CONTAINMENT SUMP

| NUCLIDE | CONCENTRATION (UCI/GM) | ACTIVITY (CI) | CORE INVENTORY (CI) AT T=_____(HRS) | FRACTION OF CORE | AVERAGE |
|---|---|---|---|---|---|
| -------- | ------------ | -------- | ------------- | --------------- | ------- |
| KR 85M | -------- | -------- | -------------- | -------- | |
| KR 87 | -------- | -------- | -------------- | -------- | |
| KR 88 | -------- | -------- | -------------- | -------- | KR ---- |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| XE 133 | -------- | -------- | -------------- | -------- | |
| XE 135 | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | XE ---- |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| I 131 | -------- | -------- | -------------- | -------- | |
| I 132 | -------- | -------- | -------------- | -------- | |
| I 133 | -------- | -------- | -------------- | -------- | I ---- |
| I 134 | -------- | -------- | -------------- | -------- | |
| I 135 | -------- | -------- | -------------- | -------- | |
| CS 134 | -------- | -------- | -------------- | -------- | |
| CS 136 | -------- | -------- | -------------- | -------- | CS ---- |
| CS 137 | -------- | -------- | -------------- | -------- | |
| BA 140 | -------- | -------- | -------------- | -------- | |
| LA 140 | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| SR 91 | -------- | -------- | -------------- | -------- | |
| SR 92 | -------- | -------- | -------------- | -------- | SR ---- |
| Y 93 | -------- | -------- | -------------- | -------- | |
| ZR 95 | -------- | -------- | -------------- | -------- | |
| NB 97M | -------- | -------- | -------------- | -------- | |
| RU 103 | -------- | -------- | -------------- | -------- | |
| RH 107 | -------- | -------- | -------------- | -------- | |
| CE 141 | -------- | -------- | -------------- | -------- | |
| CE 143 | -------- | -------- | -------------- | -------- | CE ---- |
| EU 156 | -------- | -------- | -------------- | -------- | |
| NP 238 | -------- | -------- | -------------- | -------- | |
| NP 239 | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |

ACTIVITY(CI) = CONC(UCI/GM) X 10-6(CI/UCI) X MASS(GM)
CORE INVENTORY : OBTAINED FROM APPENDIX B, ADJUSTED IF NECESSARY
FRACTION OF CORE = ACTIVITY / INVENTORY

TABLE 6.2

CONTAINMENT SUMP EVALUATION

CONTAINMENT AIR

| NUCLIDE | CONCENTRATION (UCI/CM3) | ACTIVITY (CI) | CORE INVENTORY (CI) AT T=____(HRS) | FRACTION OF CORE | AVERAGE |
|---|---|---|---|---|---|
| -------- | ------------ | -------- | -------------- | --------------- | ------- |
| KR 85M | -------- | -------- | -------------- | -------- | |
| KR 87 | -------- | -------- | -------------- | -------- | |
| KR 88 | -------- | -------- | -------------- | -------- | KR ---- |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| XE 133 | -------- | -------- | -------------- | -------- | |
| XE 135 | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | XE ---- |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |
| -------- | -------- | -------- | -------------- | -------- | |

ACTIVITY(CI) = CONC(UCI/CM3) X 10-6(CI/UCI) X 7.66E+10(CM3)
CORE INVENTORY : OBTAINED FROM APPENDIX B,ADJUSTED IF NECESSARY
FRACTION OF CORE = ACTIVITY / INVENTORY

TABLE 6.3

CONTAINMENT AIR EVALUATION

FRACTION OF FISSION PRODUCTS
RELEASED FROM THE CORE

| ELEMENT | CONTAINMENT AIR | PRIMARY COOLANT | SUMP | MISC. TANKS | OTHERS | RELEASE TO ENVIRONMENT | TOTAL |
|---|---|---|---|---|---|---|---|
| KR | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| XE | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| I | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| CS | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| BA/LA | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| SR | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Y | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| ZR | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| NB | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| RU | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| RH | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| CE | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| EU | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| NP | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| ----- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| ----- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| ----- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| ----- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| ----- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |

TABLE 6.4

FRACTION OF FISSION PRODUCTS
RELEASED FROM THE CORE

SUMMARY OF CORE DAMAGE ESTIMATES

| INDICATOR | CATEGORY |
|---|---|
| ---------- | -------- |
| FISSION PRODUCT RELEASES : | |
| NOBLE GASES | ------ |
| IODINES | ------ |
| CESIUMS | ------ |
| NOBLE METALS (RU,RH,MO) | ------ |
| RARE EARTHS (Y,NP,EU,CE) | ------ |
| REFRACTORY OXIDES (ZR,NB) | ------ |
| HYDROGEN RELEASE | ------ |
| MONITOR RESPONSE | ------ |

CATAGORIES :

I NO DAMAGE

II CLAD DAMAGE

III FUEL OVERHEAT

IV FUEL MELT

TABLE 6.5

SUMMARY OF CORE DAMAGE ESTIMATE

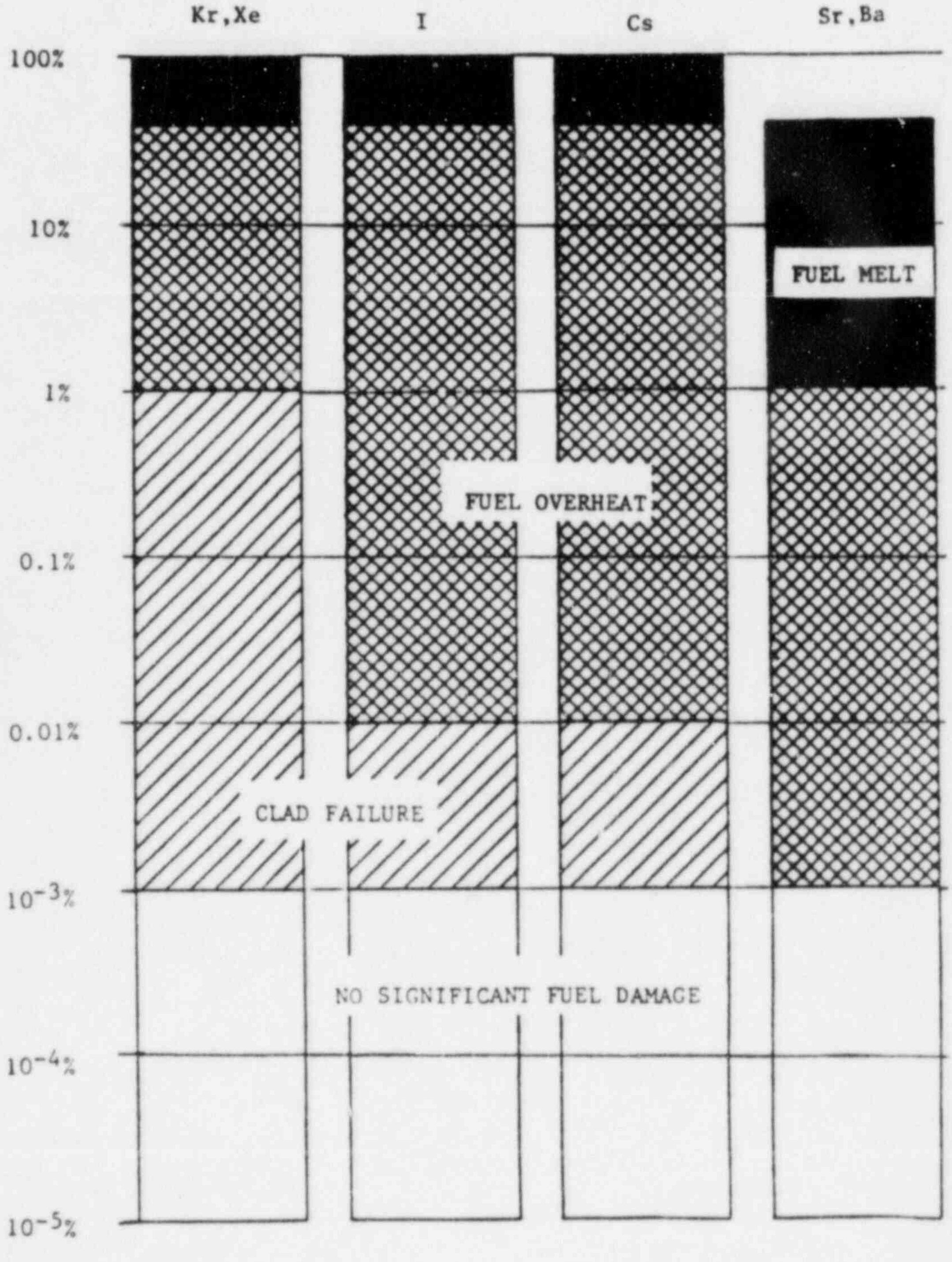



FIGURE 6.1

CORE DAMAGE SEVERITY CLASSIFICATION USING RELEASE FRACTIONS OF VARIOUS ELEMENTS

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# APPENDIX A

Selected Fission Product and Actinide Inventories from ORIGEN2 During an Operating Cycle of the Seabrook Station

Appendix A contains the results of the Reference ORIGEN2 calculation for Seabrook Station. The values presented represent the total core activity in curies during an irradiation cycle. Activities are given for operating times of 30 days, 60 days, 100 days, 200 days, and 300 days.

SEABROOK STATION
ORIGEN INVENTORIES (CURIES)
DURING IRRADIATION

| NUCLIDE | CHARGE | 30.0 D | 60.0 D | 100.0 D | 200.0 D | 300.0 D |
|---|---|---|---|---|---|---|
| 33 AS 77 | 1.453E-06 | 2.952E+05 | 2.944E+05 | 2.905E+05 | 2.793E+05 | 2.713E+05 |
| 34 SE 83 | 0. | 5.316E+06 | 5.280E+06 | 5.184E+06 | 4.933E+06 | 4.752E+06 |
| 35 BR 82 | 1.023E-07 | 2.143E+05 | 2.370E+05 | 2.645E+05 | 3.288E+05 | 3.960E+05 |
| 35 BR 83 | 0. | 1.391E+07 | 1.377E+07 | 1.348E+07 | 1.273E+07 | 1.219E+07 |
| 35 BR 84 | 0. | 2.498E+07 | 2.463E+07 | 2.397E+07 | 2.237E+07 | 2.117E+07 |
| 36 KR 83M | 0. | 1.391E+07 | 1.378E+07 | 1.348E+07 | 1.274E+07 | 1.220E+07 |
| 36 KR 85 | 3.448E+05 | 3.783E+05 | 4.115E+05 | 4.545E+05 | 5.560E+05 | 6.499E+05 |
| 36 KR 85M | 0. | 3.078E+07 | 3.033E+07 | 2.948E+07 | 2.742E+07 | 2.585E+07 |
| 36 KR 87 | 0. | 6.051E+07 | 5.945E+07 | 5.758E+07 | 5.309E+07 | 4.966E+07 |
| 36 KR 88 | 0. | 8.539E+07 | 8.388E+07 | 8.121E+07 | 7.482E+07 | 6.990E+07 |
| 37 RB 86 | 7.154E+03 | 5.292E+04 | 7.342E+04 | 8.836E+04 | 1.136E+05 | 1.381E+05 |
| 37 RB 88 | 0. | 8.642E+07 | 8.492E+07 | 8.227E+07 | 7.589E+07 | 7.098E+07 |
| 37 RB 89 | 0. | 1.117E+08 | 1.097E+08 | 1.062E+08 | 9.766E+07 | 9.109E+07 |
| 38 SR 89 | 3.062E+07 | 5.861E+07 | 7.648E+07 | 8.999E+07 | 9.893E+07 | 9.611E+07 |
| 38 SR 90 | 2.673E+06 | 2.933E+06 | 3.188E+06 | 3.518E+06 | 4.298E+06 | 5.019E+06 |
| 38 SR 91 | 0. | 1.407E+08 | 1.385E+08 | 1.346E+08 | 1.250E+08 | 1.177E+08 |
| 38 SR 92 | 0. | 1.485E+08 | 1.467E+08 | 1.430E+08 | 1.341E+08 | 1.274E+08 |
| 39 Y 91M | 0. | 8.161E+07 | 8.038E+07 | 7.810E+07 | 7.254E+07 | 6.832E+07 |
| 39 Y 91 | 4.350E+07 | 7.235E+07 | 9.267E+07 | 1.094E+08 | 1.236E+08 | 1.227E+08 |
| 39 Y 92 | 0. | 1.489E+08 | 1.472E+08 | 1.436E+08 | 1.346E+08 | 1.279E+08 |
| 39 Y 93 | 0. | 1.666E+08 | 1.653E+08 | 1.620E+08 | 1.536E+08 | 1.475E+08 |
| 39 Y 94 | 0. | 1.642E+08 | 1.633E+08 | 1.606E+08 | 1.535E+08 | 1.485E+08 |
| 40 ZR 95 | 5.856E+07 | 9.132E+07 | 1.149E+08 | 1.358E+08 | 1.586E+08 | 1.636E+08 |
| 40 ZR 97 | 0. | 1.697E+08 | 1.700E+08 | 1.689E+08 | 1.651E+08 | 1.631E+08 |
| 41 NB 95 | 8.735E+07 | 8.290E+07 | 9.271E+07 | 1.117E+08 | 1.475E+08 | 1.608E+08 |
| 41 NB 95M | 4.344E+05 | 6.117E+05 | 7.869E+05 | 9.907E+05 | 1.139E+06 | 1.177E+06 |
| 41 NB 96 | 5.216E-14 | 1.670E+05 | 1.849E+05 | 2.150E+05 | 2.747E+05 | 3.110E+05 |
| 41 NB 97 | 0. | 1.708E+08 | 1.712E+08 | 1.702E+08 | 1.664E+08 | 1.645E+08 |
| 41 NB 97M | 0. | 1.608E+08 | 1.612E+08 | 1.601E+08 | 1.565E+08 | 1.547E+08 |
| 41 NB 98M | 0. | 1.325E+06 | 1.382E+06 | 1.437E+06 | 1.533E+06 | 1.613E+06 |
| 42 MO 99 | 3.201E+01 | 1.798E+08 | 1.808E+08 | 1.802E+08 | 1.777E+08 | 1.771E+08 |
| 42 MO 101 | 0. | 1.621E+08 | 1.636E+08 | 1.640E+08 | 1.636E+08 | 1.647E+08 |
| 43 TC 99M | 3.084E+01 | 1.574E+08 | 1.583E+08 | 1.577E+08 | 1.556E+08 | 1.551E+08 |
| 43 TC 101 | 0. | 1.622E+08 | 1.637E+08 | 1.640E+08 | 1.637E+08 | 1.647E+08 |
| 43 TC 104 | 0. | 9.946E+07 | 1.033E+08 | 1.072E+08 | 1.149E+08 | 1.227E+08 |
| 44 RU 103 | 3.218E+07 | 7.263E+07 | 9.795E+07 | 1.179E+08 | 1.387E+08 | 1.477E+08 |
| 44 RU 105 | 0. | 7.533E+07 | 7.923E+07 | 8.343E+07 | 9.199E+07 | 1.003E+08 |
| 45 RH 103M | 2.901E+07 | 6.543E+07 | 8.825E+07 | 1.062E+08 | 1.249E+08 | 1.331E+08 |
| 45 RH 105 | 3.488E-05 | 6.880E+07 | 7.224E+07 | 7.596E+07 | 8.356E+07 | 9.076E+07 |
| 45 RH 105M | 0. | 2.109E+07 | 2.219E+07 | 2.336E+07 | 2.576E+07 | 2.807E+07 |
| 45 RH 106 | 1.666E+07 | 2.307E+07 | 2.540E+07 | 2.851E+07 | 3.645E+07 | 4.470E+07 |
| 45 RH 106M | 0. | 2.173E+06 | 2.322E+06 | 2.476E+06 | 2.789E+06 | 3.136E+06 |
| 45 RH 107 | 0. | 3.725E+07 | 4.004E+07 | 4.323E+07 | 5.012E+07 | 5.679E+07 |
| 46 PD 109 | 0. | 1.764E+07 | 1.913E+07 | 2.009E+07 | 2.486E+07 | 2.890E+07 |
| 46 PD 111 | 0. | 4.529E+06 | 4.798E+06 | 5.106E+06 | 5.785E+06 | 6.477E+06 |
| 46 PD 111M | 0. | 5.966E+04 | 6.446E+04 | 7.004E+04 | 8.235E+04 | 9.463E+04 |
| 46 PD 112 | 5.509E-16 | 2.636E+06 | 2.752E+06 | 2.880E+06 | 3.162E+06 | 3.461E+06 |

SEABROOK STATION
ORIGEN INVENTORIES (CURIES)
DURING IRRADIATION

| NUCLIDE | CHARGE | 30.0 D | 60.0 D | 100.0 D | 200.0 D | 300.0 D |
|---|---|---|---|---|---|---|
| 47 AG 109M | 1.324E-02 | 1.763E+07 | 1.912E+07 | 2.088E+07 | 2.485E+07 | 2.889E+07 |
| 47 AG 110M | 7.215E+04 | 8.505E+04 | 9.918E+04 | 1.198E+05 | 1.804E+05 | 2.545E+05 |
| 47 AG 111 | 1.401E+04 | 4.227E+06 | 4.746E+06 | 5.078E+06 | 5.822E+06 | 6.525E+06 |
| 47 AG 111M | 0. | 4.511E+06 | 4.781E+06 | 5.088E+06 | 5.765E+06 | 6.456E+06 |
| 47 AG 112 | 6.525E-16 | 2.644E+06 | 2.761E+06 | 2.890E+06 | 3.172E+06 | 3.472E+06 |
| 48 CD 115 | 8.692E-03 | 1.550E+06 | 1.590E+06 | 1.629E+06 | 1.709E+06 | 1.804E+06 |
| 48 CD 115M | 4.104E+04 | 8.194E+04 | 1.089E+05 | 1.316E+05 | 1.577E+05 | 1.706E+05 |
| 48 CD 117 | 0. | 9.181E+05 | 9.377E+05 | 9.556E+05 | 9.881E+05 | 1.027E+06 |
| 48 CD 117M | 0. | 4.978E+05 | 5.087E+05 | 5.186E+05 | 5.367E+05 | 5.580E+05 |
| 49 IN 115M | 2.894E+00 | 1.553E+06 | 1.593E+06 | 1.632E+06 | 1.713E+06 | 1.808E+06 |
| 49 IN 117 | 0. | 8.473E+05 | 8.656E+05 | 8.823E+05 | 9.127E+05 | 9.488E+05 |
| 49 IN 117M | 0. | 1.073E+06 | 1.096E+06 | 1.117E+06 | 1.155E+06 | 1.201E+06 |
| 49 IN 118 | 0. | 1.412E+06 | 1.440E+06 | 1.466E+06 | 1.512E+06 | 1.568E+06 |
| 50 SN 123 | 1.466E+05 | 1.763E+05 | 2.026E+05 | 2.329E+05 | 2.896E+05 | 3.279E+05 |
| 50 SN 123M | 0. | 1.379E+06 | 1.407E+06 | 1.432E+06 | 1.474E+06 | 1.525E+06 |
| 50 SN 125 | 1.120E+04 | 9.975E+05 | 1.143E+06 | 1.192E+06 | 1.275E+06 | 1.333E+06 |
| 50 SN 127 | 0. | 5.710E+06 | 5.881E+06 | 6.044E+06 | 6.342E+06 | 6.644E+06 |
| 50 SN 128 | 0. | 1.487E+07 | 1.514E+07 | 1.535E+07 | 1.564E+07 | 1.598E+07 |
| 51 SB 122 | 1.429E-02 | 7.702E+04 | 8.595E+04 | 9.708E+04 | 1.252E+05 | 1.567E+05 |
| 51 SB 124 | 1.911E+04 | 2.876E+04 | 3.732E+04 | 4.750E+04 | 7.002E+04 | 9.211E+04 |
| 51 SB 125 | 4.887E+05 | 5.294E+05 | 5.791E+05 | 6.475E+05 | 8.210E+05 | 9.944E+05 |
| 51 SB 126 | 2.009E+03 | 5.983E+04 | 7.382E+04 | 8.044E+04 | 9.027E+04 | 9.985E+04 |
| 51 SB 127 | 1.357E+02 | 8.828E+06 | 9.169E+06 | 9.506E+06 | 1.001E+07 | 1.049E+07 |
| 51 SB 128 | 0. | 1.111E+06 | 1.169E+06 | 1.228E+06 | 1.332E+06 | 1.419E+06 |
| 51 SB 128M | 0. | 1.590E+07 | 1.624E+07 | 1.650E+07 | 1.691E+07 | 1.734E+07 |
| 51 SB 129 | 0. | 2.824E+07 | 2.891E+07 | 2.947E+07 | 3.036E+07 | 3.129E+07 |
| 51 SB 130 | 0. | 8.938E+06 | 9.197E+06 | 9.428E+06 | 9.809E+06 | 1.017E+07 |
| 51 SB 131 | 0. | 8.093E+07 | 8.153E+07 | 8.154E+07 | 8.096E+07 | 8.115E+07 |
| 52 TE 127 | 5.331E+05 | 8.218E+06 | 8.624E+06 | 9.035E+06 | 9.695E+06 | 1.027E+07 |
| 52 TE 127M | 5.441E+05 | 6.258E+05 | 7.369E+05 | 8.630E+05 | 1.099E+06 | 1.259E+06 |
| 52 TE 129 | 5.582E+05 | 2.663E+07 | 2.779E+07 | 2.869E+07 | 2.983E+07 | 3.079E+07 |
| 52 TE 129M | 8.575E+05 | 2.362E+06 | 3.232E+06 | 3.851E+06 | 4.395E+06 | 4.598E+06 |
| 52 TE 131 | 7.361E-09 | 8.436E+07 | 8.523E+07 | 8.554E+07 | 8.551E+07 | 8.614E+07 |
| 52 TE 131M | 3.270E-08 | 1.312E+07 | 1.337E+07 | 1.355E+07 | 1.379E+07 | 1.407E+07 |
| 52 TE 132 | 2.617E+02 | 1.359E+08 | 1.374E+08 | 1.382E+08 | 1.376E+08 | 1.383E+08 |
| 52 TE 133 | 0. | 1.180E+08 | 1.185E+08 | 1.180E+08 | 1.163E+08 | 1.160E+08 |
| 52 TE 133M | 0. | 7.857E+07 | 7.836E+07 | 7.737E+07 | 7.461E+07 | 7.281E+07 |
| 52 TE 134 | 0. | 1.794E+08 | 1.783E+08 | 1.754E+08 | 1.683E+08 | 1.640E+08 |
| 53 I 129 | 1.013E+00 | 1.104E+00 | 1.201E+00 | 1.337E+00 | 1.689E+00 | 2.050E+00 |
| 53 I 130 | 0. | 1.434E+06 | 1.592E+06 | 1.794E+06 | 2.306E+06 | 2.879E+06 |
| 53 I 131 | 3.742E+05 | 8.700E+07 | 9.477E+07 | 9.594E+07 | 9.644E+07 | 9.730E+07 |
| 53 I 132 | 2.697E+02 | 1.376E+08 | 1.392E+08 | 1.401E+08 | 1.396E+08 | 1.405E+08 |
| 53 I 133 | 1.962E-13 | 2.017E+08 | 2.027E+08 | 2.021E+08 | 1.992E+08 | 1.983E+08 |
| 53 I 134 | 0. | 2.234E+08 | 2.241E+08 | 2.229E+08 | 2.190E+08 | 2.175E+08 |
| 53 I 135 | 0. | 1.879E+08 | 1.888E+08 | 1.883E+08 | 1.857E+08 | 1.852E+08 |

SEABROOK STATION
ORIGEN INVENTORIES (CURIES)
DURING IRRADIATION

| NUCLIDE | CHARGE | 30.0 D | 60.0 D | 100.0 D | 200.0 D | 300.0 D |
|---|---|---|---|---|---|---|
| 54 XE 131M | 5.720E+04 | 6.597E+05 | 9.773E+05 | 1.062E+06 | 9.709E+05 | 9.821E+05 |
| 54 XE 133 | 5.869E+04 | 1.893E+08 | 1.947E+08 | 1.960E+08 | 1.969E+08 | 1.981E+08 |
| 54 XE 133M | 3.771E-02 | 6.153E+06 | 6.207E+06 | 6.214E+06 | 6.178E+06 | 6.193E+06 |
| 54 XE 135 | 0. | 4.114E+07 | 4.098E+07 | 4.055E+07 | 3.949E+07 | 3.846E+07 |
| 54 XE 135M | 0. | 3.745E+07 | 3.795E+07 | 3.822E+07 | 3.844E+07 | 3.887E+07 |
| 54 XE 138 | 0. | 1.736E+08 | 1.733E+08 | 1.715E+08 | 1.664E+08 | 1.636E+08 |
| 55 CS 134 | 3.311E+06 | 3.722E+06 | 4.174E+06 | 4.838E+06 | 6.785E+06 | 9.062E+06 |
| 55 CS 134M | 0. | 2.015E+06 | 2.240E+06 | 2.515E+06 | 3.173E+06 | 3.872E+06 |
| 55 CS 136 | 7.412E+04 | 1.620E+06 | 2.093E+06 | 2.395E+06 | 2.936E+06 | 3.478E+06 |
| 55 CS 137 | 3.480E+06 | 3.827E+06 | 4.176E+06 | 4.640E+06 | 5.795E+06 | 6.944E+06 |
| 55 CS 138 | 0. | 1.903E+08 | 1.904E+08 | 1.887E+08 | 1.839E+08 | 1.813E+08 |
| 56 BA 135M | 9.951E-13 | 1.845E+03 | 2.115E+03 | 2.493E+03 | 3.687E+03 | 5.403E+03 |
| 56 BA 139 | 0. | 1.847E+08 | 1.849E+08 | 1.835E+08 | 1.792E+08 | 1.771E+08 |
| 56 BA 140 | 4.493E+06 | 1.443E+08 | 1.720E+08 | 1.770E+08 | 1.738E+08 | 1.718E+08 |
| 56 BA 141 | 0. | 1.681E+08 | 1.684E+08 | 1.672E+08 | 1.631E+08 | 1.610E+08 |
| 57 LA 140 | 5.170E+06 | 1.467E+08 | 1.788E+08 | 1.828E+08 | 1.774E+08 | 1.761E+08 |
| 57 LA 141 | 0. | 1.689E+08 | 1.691E+08 | 1.679E+08 | 1.639E+08 | 1.617E+08 |
| 57 LA 142 | 0. | 1.652E+08 | 1.652E+08 | 1.636E+08 | 1.591E+08 | 1.564E+08 |
| 58 CE 141 | 3.107E+07 | 9.602E+07 | 1.309E+08 | 1.526E+08 | 1.645E+08 | 1.641E+08 |
| 58 CE 143 | 7.582E-06 | 1.615E+08 | 1.611E+08 | 1.592E+08 | 1.537E+08 | 1.503E+08 |
| 58 CE 144 | 5.309E+07 | 5.971E+07 | 6.584E+07 | 7.318E+07 | 8.801E+07 | 9.884E+07 |
| 58 CE 146 | 0. | 8.534E+07 | 8.539E+07 | 8.467E+07 | 8.254E+07 | 8.144E+07 |
| 59 PR 142 | 0. | 3.037E+06 | 3.308E+06 | 3.696E+06 | 4.755E+06 | 5.936E+06 |
| 59 PR 143 | 5.286E+06 | 1.200E+08 | 1.482E+08 | 1.538E+08 | 1.518E+08 | 1.485E+08 |
| 59 PR 144 | 5.309E+07 | 6.056E+07 | 6.689E+07 | 7.429E+07 | 8.913E+07 | 9.998E+07 |
| 59 PR 144M | 6.371E+05 | 7.179E+05 | 7.914E+05 | 8.795E+05 | 1.058E+06 | 1.188E+06 |
| 59 PR 145 | 0. | 1.090E+08 | 1.089E+08 | 1.077E+08 | 1.043E+08 | 1.024E+08 |
| 59 PR 146 | 0. | 8.564E+07 | 8.569E+07 | 8.498E+07 | 8.286E+07 | 8.176E+07 |
| 60 ND 147 | 1.014E+06 | 5.684E+07 | 6.539E+07 | 6.646E+07 | 6.533E+07 | 6.482E+07 |
| 60 ND 149 | 0. | 3.574E+07 | 3.612E+07 | 3.628E+07 | 3.640E+07 | 3.689E+07 |
| 61 PM 147 | 7.037E+06 | 7.098E+06 | 7.651E+06 | 8.395E+06 | 9.807E+06 | 1.068E+07 |
| 61 PM 148 | 3.707E+04 | 1.430E+07 | 1.563E+07 | 1.731E+07 | 2.098E+07 | 2.336E+07 |
| 61 PM 148M | 5.488E+05 | 1.453E+06 | 1.604E+06 | 1.770E+06 | 2.161E+06 | 2.366E+06 |
| 61 PM 149 | 1.943E-01 | 3.921E+07 | 4.005E+07 | 4.069E+07 | 4.191E+07 | 4.324E+07 |
| 61 PM 151 | 6.471E-09 | 1.681E+07 | 1.720E+07 | 1.755E+07 | 1.819E+07 | 1.892E+07 |
| 61 PM 154 | 0. | 3.843E+06 | 4.001E+06 | 4.166E+06 | 4.508E+06 | 4.858E+06 |
| 62 SM 151 | 1.602E+04 | 1.807E+04 | 1.984E+04 | 2.142E+04 | 2.388E+04 | 2.568E+04 |
| 62 SM 153 | 9.697E-03 | 2.180E+07 | 2.354E+07 | 2.565E+07 | 3.068E+07 | 3.598E+07 |
| 63 EU 154 | 2.136E+05 | 2.411E+05 | 2.714E+05 | 3.155E+05 | 4.435E+05 | 5.946E+05 |
| 63 EU 155 | 1.522E+05 | 1.727E+05 | 1.936E+05 | 2.222E+05 | 3.003E+05 | 3.896E+05 |
| 63 EU 156 | 3.473E+05 | 4.769E+06 | 6.433E+06 | 7.692E+06 | 1.042E+07 | 1.361E+07 |
| 63 EU 156 | 3.473E+05 | 4.769E+06 | 6.433E+06 | 7.692E+06 | 1.042E+07 | 1.361E+07 |
| 64 GD 159 | 0. | 3.335E+05 | 3.604E+05 | 3.927E+05 | 4.688E+05 | 5.508E+05 |
| 92 U 239 | 0. | 1.824E+09 | 1.852E+09 | 1.877E+09 | 1.923E+09 | 1.991E+09 |
| 93 NP 238 | 6.326E-01 | 1.025E+07 | 1.148E+07 | 1.312E+07 | 1.760E+07 | 2.291E+07 |
| 93 NP 239 | 2.228E+02 | 1.821E+09 | 1.849E+09 | 1.874E+09 | 1.920E+09 | 1.988E+09 |
| 93 NP 240 | 0. | 2.072E+06 | 2.141E+06 | 2.204E+06 | 2.321E+06 | 2.495E+06 |
| 94 PU 241 | 3.939E+06 | 4.202E+06 | 4.496E+06 | 4.967E+06 | 6.479E+06 | 8.231E+06 |
| 94 PU 243 | 2.163E-07 | 7.049E+06 | 8.290E+06 | 9.977E+06 | 1.495E+07 | 2.174E+07 |
| 95 AM 244 | 0. | 7.470E+04 | 9.167E+04 | 1.169E+05 | 2.012E+05 | 3.231E+05 |
| 96 CM 242 | 5.061E+05 | 6.914E+05 | 8.778E+05 | 1.116E+06 | 1.695E+06 | 2.319E+06 |

APPENDIX B

Selected Fission Product and Actinide Inventories from ORIGEN2 Following Shutdown from a Full Power Operation Cycle of the Seabrook Station

Appendix B contains the results of the reference ORIGEN2 calculation for Seabrook Station. The values presented represent the total core activity in curies following shutdown from a full power, 300-day operating cycle. Activities are given for two time periods, 0.5 hour - 24 hours and 2 days - 180 days.

SEABROOK STATION
ORIGEN INVENTORIES (CURIES) AFTER SHUTDOWN
FROM A TYPICAL FULL POWER OPERATING CYCLE

| NUCLIDE | SHUTDOWN | 0.5 HR | 1.0 HR | 1.5 HR | 2.0 HR | 3.0 HR | 5.0 HR | 8.0 HR | 10.0 HR | 12.0 HR | 18.0 HR | 24.0 HR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 AS 77 | 2.713E+05 | 2.699E+05 | 2.683E+05 | 2.667E+05 | 2.651E+05 | 2.619E+05 | 2.554E+05 | 2.456E+05 | 2.389E+05 | 2.323E+05 | 2.127E+05 | 1.938E+05 |
| 34 SE 83 | 4.752E+06 | 1.898E+06 | 7.532E+05 | 2.989E+05 | 1.186E+05 | 1.868E+04 | 4.634E+02 | 1.810E+00 | 4.489E-02 | 1.114E-03 | 1.699E-08 | 2.593E-13 |
| 35 BR 82 | 3.960E+05 | 3.926E+05 | 3.888E+05 | 3.850E+05 | 3.812E+05 | 3.738E+05 | 3.594E+05 | 3.389E+05 | 3.258E+05 | 3.133E+05 | 2.785E+05 | 2.475E+05 |
| 35 BR 83 | 1.219E+07 | 1.102E+07 | 9.694E+06 | 8.451E+06 | 7.337E+06 | 5.503E+06 | 3.083E+06 | 1.291E+06 | 7.231E+05 | 4.048E+05 | 7.105E+04 | 1.247E+04 |
| 35 BR 84 | 2.117E+07 | 1.225E+07 | 6.371E+06 | 3.313E+06 | 1.723E+06 | 4.659E+05 | 3.406E+04 | 6.735E+02 | 4.925E+01 | 3.601E+00 | 1.408E-03 | 5.504E-07 |
| 36 KR 83M | 1.220E+07 | 1.210E+07 | 1.180E+07 | 1.132E+07 | 1.072E+07 | 9.335E+06 | 6.515E+06 | 3.379E+06 | 2.086E+06 | 1.259E+06 | 2.549E+05 | 4.823E+04 |
| 36 KR 85 | 6.499E+05 | 6.499E+05 | 6.499E+05 | 6.499E+05 | 6.500E+05 | 6.500E+05 | 6.500E+05 | 6.500E+05 | 6.501E+05 | 6.501E+05 | 6.501E+05 | 6.500E+05 |
| 36 KR 85M | 2.585E+07 | 2.422E+07 | 2.242E+07 | 2.075E+07 | 1.920E+07 | 1.645E+07 | 1.207E+07 | 7.590E+06 | 5.570E+06 | 4.088E+06 | 1.616E+06 | 6.387E+05 |
| 36 KR 87 | 4.966E+07 | 3.822E+07 | 2.910E+07 | 2.216E+07 | 1.687E+07 | 9.783E+06 | 3.289E+06 | 6.410E+05 | 2.155E+05 | 7.244E+04 | 2.752E+03 | 1.045E+02 |
| 36 KR 88 | 6.990E+07 | 6.193E+07 | 5.481E+07 | 4.852E+07 | 4.294E+07 | 3.364E+07 | 2.064E+07 | 9.923E+06 | 6.089E+06 | 3.737E+06 | 8.635E+05 | 1.995E+05 |
| 37 RB 86 | 1.381E+05 | 1.380E+05 | 1.379E+05 | 1.378E+05 | 1.377E+05 | 1.375E+05 | 1.370E+05 | 1.364E+05 | 1.360E+05 | 1.356E+05 | 1.343E+05 | 1.331E+05 |
| 37 RB 88 | 7.098E+07 | 6.693E+07 | 6.052E+07 | 5.396E+07 | 4.788E+07 | 3.756E+07 | 2.305E+07 | 1.110E+07 | 6.800E+06 | 4.173E+06 | 9.643E+05 | 2.228E+05 |
| 37 RB 89 | 9.109E+07 | 2.893E+07 | 7.375E+06 | 1.878E+06 | 4.780E+05 | 3.099E+04 | 1.302E+02 | 3.547E-02 | 1.490E-04 | 6.262E-07 | 4.646E-14 | 3.447E-21 |
| 38 SR 89 | 9.611E+07 | 9.610E+07 | 9.607E+07 | 9.605E+07 | 9.602E+07 | 9.597E+07 | 9.586E+07 | 9.569E+07 | 9.558E+07 | 9.547E+07 | 9.515E+07 | 9.482E+07 |
| 38 SR 90 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 | 5.019E+06 |
| 38 SR 91 | 1.177E+08 | 1.137E+08 | 1.096E+08 | 1.057E+08 | 1.019E+08 | 9.473E+07 | 8.187E+07 | 6.577E+07 | 5.684E+07 | 4.912E+07 | 3.171E+07 | 2.047E+07 |
| 38 SR 92 | 1.274E+08 | 1.121E+08 | 9.866E+07 | 8.681E+07 | 7.639E+07 | 5.915E+07 | 3.547E+07 | 1.646E+07 | 9.872E+06 | 5.919E+06 | 1.276E+06 | 2.750E+05 |
| 39 Y 91M | 6.832E+07 | 6.789E+07 | 6.679E+07 | 6.527E+07 | 6.351E+07 | 5.966E+07 | 5.192E+07 | 4.178E+07 | 3.612E+07 | 3.121E+07 | 2.015E+07 | 1.300E+07 |
| 39 Y 91 | 1.227E+08 | 1.227E+08 | 1.227E+08 | 1.227E+08 | 1.227E+08 | 1.227E+08 | 1.227E+08 | 1.226E+08 | 1.225E+08 | 1.225E+08 | 1.222E+08 | 1.220E+08 |
| 39 Y 92 | 1.279E+08 | 1.271E+08 | 1.251E+08 | 1.221E+08 | 1.183E+08 | 1.092E+08 | 8.854E+07 | 5.980E+07 | 4.452E+07 | 3.256E+07 | 1.186E+07 | 4.050E+06 |
| 39 Y 93 | 1.475E+08 | 1.442E+08 | 1.394E+08 | 1.347E+08 | 1.302E+08 | 1.216E+08 | 1.060E+08 | 8.626E+07 | 7.519E+07 | 6.555E+07 | 4.342E+07 | 2.877E+07 |
| 39 Y 94 | 1.485E+08 | 5.324E+07 | 1.792E+07 | 6.034E+06 | 2.031E+06 | 2.302E+05 | 2.957E+03 | 4.304E+00 | 5.528E-02 | 7.101E-04 | 1.505E-09 | 3.188E-15 |
| 40 ZR 95 | 1.636E+08 | 1.635E+08 | 1.635E+08 | 1.635E+08 | 1.634E+08 | 1.633E+08 | 1.632E+08 | 1.630E+08 | 1.628E+08 | 1.627E+08 | 1.622E+08 | 1.618E+08 |
| 40 ZR 97 | 1.631E+08 | 1.598E+08 | 1.565E+08 | 1.534E+08 | 1.503E+08 | 1.442E+08 | 1.329E+08 | 1.175E+08 | 1.082E+08 | 9.970E+07 | 7.795E+07 | 6.095E+07 |
| 41 NB 95 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 | 1.608E+08 |
| 41 NB 95M | 1.177E+06 | 1.177E+06 | 1.177E+06 | 1.177E+06 | 1.177E+06 | 1.176E+06 | 1.176E+06 | 1.175E+06 | 1.174E+06 | 1.174E+06 | 1.172E+06 | 1.170E+06 |
| 41 NB 96 | 3.110E+05 | 3.065E+05 | 3.019E+05 | 2.975E+05 | 2.931E+05 | 2.845E+05 | 2.681E+05 | 2.453E+05 | 2.312E+05 | 2.178E+05 | [illegible] | 1.525E+05 |
| 41 NB 97 | 1.645E+08 | 1.635E+08 | 1.620E+08 | 1.600E+08 | 1.578E+08 | 1.527E+08 | 1.418E+08 | 1.258E+08 | 1.160E+08 | 1.068E+08 | [illegible] | 6.542E+07 |
| 41 NB 97M | 1.547E+08 | 1.514E+08 | 1.483E+08 | 1.453E+08 | 1.423E+08 | 1.366E+08 | 1.258E+08 | 1.113E+08 | 1.025E+08 | 9.444E+07 | 7.384E+07 | 5.773E+07 |
| 41 NB 98M | 1.613E+06 | 1.077E+06 | 7.195E+05 | 4.804E+05 | 3.208E+05 | 1.431E+05 | 2.845E+04 | 2.523E+03 | 5.018E+02 | 9.980E+01 | 7.850E-01 | 6.174E-03 |
| 42 MO 99 | 1.771E+08 | 1.762E+08 | 1.753E+08 | 1.744E+08 | 1.734E+08 | 1.716E+08 | 1.681E+08 | 1.628E+08 | 1.595E+08 | 1.561E+08 | 1.466E+08 | 1.377E+08 |
| 42 MO 101 | 1.647E+08 | 4.011E+07 | 9.672E+06 | 2.332E+06 | 5.624E+05 | 3.271E+04 | 1.106E+02 | 2.176E-02 | 7.358E-05 | 2.498E-07 | 9.625E-15 | 3.723E-22 |
| 43 TC 99M | 1.551E+08 | 1.550E+08 | 1.550E+08 | 1.549E+08 | 1.547E+08 | 1.543E+08 | 1.531E+08 | 1.507E+08 | 1.487E+08 | 1.465E+08 | 1.393E+08 | 1.316E+08 |
| 43 TC 101 | 1.647E+08 | 9.560E+07 | 3.597E+07 | 1.166E+07 | 3.503E+06 | 2.792E+05 | 1.394E+03 | 3.820E-01 | 1.488E-03 | 5.596E-06 | 2.635E-13 | 1.129E-20 |
| 43 TC 104 | 1.227E+08 | 4.269E+07 | 1.362E+07 | 4.344E+06 | 1.386E+06 | 1.410E+05 | 1.460E+03 | 1.539E+00 | 1.594E-02 | 1.650E-04 | 1.833E-10 | 2.036E-16 |
| 44 RU 103 | 1.477E+08 | 1.477E+08 | 1.476E+08 | 1.476E+08 | 1.475E+08 | 1.474E+08 | 1.472E+08 | 1.469E+08 | 1.466E+08 | 1.464E+08 | 1.458E+08 | 1.451E+08 |
| 44 RU 105 | 1.003E+08 | 9.560E+07 | 8.863E+07 | 8.199E+07 | 7.583E+07 | 6.487E+07 | 4.747E+07 | 2.971E+07 | 2.174E+07 | 1.591E+07 | 6.234E+06 | 2.443E+06 |
| 45 RH 103M | 1.331E+08 | 1.330E+08 | 1.330E+08 | 1.330E+08 | 1.330E+08 | 1.329E+08 | 1.327E+08 | 1.324E+08 | 1.322E+08 | 1.320E+08 | 1.314E+08 | 1.308E+08 |
| 45 RH 105 | 9.075E+07 | 9.083E+07 | 9.084E+07 | 9.079E+07 | 9.067E+07 | 9.028E+07 | 8.895E+07 | 8.603E+07 | 8.370E+07 | 8.120E+07 | 7.333E+07 | 6.564E+07 |
| 45 RH 105M | 2.807E+07 | 2.684E+07 | 2.489E+07 | 2.302E+07 | 2.129E+07 | 1.821E+07 | 1.333E+07 | 8.343E+06 | 6.105E+06 | 4.468E+06 | 1.751E+06 | 6.859E+05 |
| 45 RH 106 | 4.470E+07 | 3.825E+07 | 3.825E+07 | 3.825E+07 | 3.825E+07 | 3.824E+07 | 3.824E+07 | 3.823E+07 | 3.822E+07 | 3.822E+07 | 3.820E+07 | 3.818E+07 |
| 45 RH 106M | 3.136E+06 | 2.679E+06 | 2.288E+06 | 1.955E+06 | 1.670E+06 | 1.218E+06 | 6.489E+05 | 2.522E+05 | 1.343E+05 | 7.150E+04 | 1.080E+04 | 1.631E+03 |
| 45 RH 107 | 5.679E+07 | 2.736E+07 | 1.053E+07 | 4.040E+06 | 1.550E+06 | 2.280E+05 | 4.934E+03 | 1.571E+01 | 3.400E-01 | 7.359E-03 | 7.460E-08 | 7.563E-13 |
| 46 PD 109 | 2.890E+07 | 2.835E+07 | 2.763E+07 | 2.693E+07 | 2.625E+07 | 2.493E+07 | 2.249E+07 | 1.927E+07 | 1.738E+07 | 1.568E+07 | 1.151E+07 | 8.454E+06 |
| 46 PD 111 | 6.477E+06 | 2.701E+06 | 1.085E+06 | 4.552E+05 | 2.083E+05 | 7.065E+04 | 3.729E+04 | 2.518E+04 | 1.957E+04 | 1.521E+04 | 7.141E+03 | 3.353E+03 |
| 46 PD 111M | 9.464E+04 | 8.895E+04 | 8.351E+04 | 7.841E+04 | 7.363E+04 | 6.491E+04 | 5.045E+04 | 3.456E+04 | 2.686E+04 | 2.088E+04 | 9.802E+03 | 4.602E+03 |
| 46 PD 112 | 3.461E+06 | 3.402E+06 | 3.344E+06 | 3.287E+06 | 3.230E+06 | 3.121E+06 | 2.913E+06 | 2.627E+06 | 2.452E+06 | 2.288E+06 | 1.860E+06 | 1.513E+06 |

SEABROOK STATION
ORIGEN INVENTORIES (CURIES) AFTER SHUTDOWN
FROM A TYPICAL FULL POWER OPERATING CYCLE

| NUCLIDE | SHUTDOWN | 0.5 HR | 1.0 HR | 1.5 HR | 2.0 HR | 3.0 HR | 5.0 HR | 8.0 HR | 10.0 HR | 12.0 HR | 18.0 HR | 24.0 HR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 AG 109M | 2.889E+07 | 2.836E+07 | 2.764E+07 | 2.694E+07 | 2.625E+07 | 2.494E+07 | 2.250E+07 | 1.928E+07 | 1.739E+07 | 1.569E+07 | 1.152E+07 | 8.457E+06 |
| 47 AG 110M | 2.545E+05 | 2.545E+05 | 2.545E+05 | 2.545E+05 | 2.544E+05 | 2.544E+05 | 2.544E+05 | 2.543E+05 | 2.542E+05 | 2.541E+05 | 2.540E+05 | 2.538E+05 |
| 47 AG 111 | 6.525E+06 | 6.521E+06 | 6.512E+06 | 6.501E+06 | 6.489E+06 | 6.465E+06 | 6.415E+06 | 6.342E+06 | 6.293E+06 | 6.744E+06 | 6.101E+06 | 5.961E+06 |
| 47 AG 111M | 6.456E+06 | 2.844E+06 | 1.157E+06 | 4.984E+05 | 2.394E+05 | 9.254E+04 | 5.327E+04 | 3.609E+04 | 2.807E+04 | 2.182E+04 | 1.023E+04 | 4.803E+03 |
| 47 AG 112 | 3.472E+06 | 3.468E+06 | 3.458E+06 | 3.443E+06 | 3.423E+06 | 3.374E+06 | 3.243E+06 | 3.004E+06 | 2.835E+06 | 2.666E+06 | 2.192E+06 | 1.789E+06 |
| 48 CD 115 | 1.804E+06 | 1.798E+06 | 1.789E+06 | 1.778E+06 | 1.767E+06 | 1.744E+06 | 1.699E+06 | 1.635E+06 | 1.593E+06 | 1.552E+06 | 1.436E+06 | 1.328E+06 |
| 48 CD 115M | 1.706E+05 | 1.706E+05 | 1.705E+05 | 1.705E+05 | 1.704E+05 | 1.703E+05 | 1.701E+05 | 1.698E+05 | 1.695E+05 | 1.693E+05 | 1.687E+05 | 1.680E+05 |
| 48 CD 117 | 1.027E+06 | 9.037E+05 | 7.909E+05 | 6.922E+05 | 6.058E+05 | 4.641E+05 | 2.723E+05 | 1.224E+05 | 7.180E+04 | 4.213E+04 | 8.509E+03 | 1.719E+03 |
| 48 CD 117M | 5.580E+05 | 5.051E+05 | 4.562E+05 | 4.120E+05 | 3.720E+05 | 3.034E+05 | 2.018E+05 | 1.095E+05 | 7.282E+04 | 4.844E+04 | 1.425E+04 | 4.195E+03 |
| 49 IN 115M | 1.808E+06 | 1.807E+06 | 1.806E+06 | 1.805E+06 | 1.802E+06 | 1.795E+06 | 1.774E+06 | 1.732E+06 | 1.699E+06 | 1.664E+06 | 1.552E+06 | 1.441E+06 |
| 49 IN 117 | 9.488E+05 | 9.403E+05 | 9.170E+05 | 8.829E+05 | 8.413E+05 | 7.457E+05 | 5.432E+05 | 3.140E+05 | 2.090E+05 | 1.367E+05 | 3.633E+04 | 9.411E+03 |
| 49 IN 117M | 1.201E+06 | 1.189E+06 | 1.158E+06 | 1.112E+06 | 1.057E+06 | 9.308E+05 | 6.756E+05 | 3.795E+05 | 2.491E+05 | 1.606E+05 | 4.070E+04 | 9.999E+03 |
| 49 IN 118 | 1.568E+06 | 1.040E+06 | 6.880E+05 | 4.550E+05 | 3.010E+05 | 1.317E+05 | 2.519E+04 | 2.109E+03 | 4.035E+02 | 7.721E+01 | 5.410E-01 | 3.791E-03 |
| 50 SN 123 | 3.279E+05 | 3.278E+05 | 3.278E+05 | 3.277E+05 | 3.277E+05 | 3.276E+05 | 3.275E+05 | 3.273E+05 | 3.271E+05 | 3.270E+05 | 3.265E+05 | 3.261E+05 |
| 50 SN 123M | 1.525E+06 | 9.155E+05 | 5.449E+05 | 3.244E+05 | 1.971E+05 | 6.841E+04 | 8.589E+03 | 3.820E+02 | 4.796E+01 | 6.021E+00 | 1.191E-02 | 2.357E-05 |
| 50 SN 125 | 1.333E+06 | 1.331E+06 | 1.329E+06 | 1.327E+06 | 1.325E+06 | 1.321E+06 | 1.313E+06 | 1.302E+06 | 1.294E+06 | 1.286E+06 | 1.263E+06 | 1.241E+06 |
| 50 SN 127 | 6.644E+06 | 5.635E+06 | 4.777E+06 | 4.051E+06 | 3.434E+06 | 2.469E+06 | 1.276E+06 | 4.740E+05 | 2.449E+05 | 1.266E+05 | 1.747E+04 | 2.411E+03 |
| 50 SN 128 | 1.598E+07 | 1.124E+07 | 7.898E+06 | 5.552E+06 | 3.903E+06 | 1.929E+06 | 4.710E+05 | 5.684E+04 | 1.388E+04 | 3.389E+03 | 4.935E+01 | 7.186E-01 |
| 51 SB 122 | 1.567E+05 | 1.559E+05 | 1.550E+05 | 1.542E+05 | 1.534E+05 | 1.517E+05 | 1.485E+05 | 1.438E+05 | 1.408E+05 | 1.378E+05 | 1.293E+05 | 1.212E+05 |
| 51 SB 124 | 9.211E+04 | 9.209E+04 | 9.206E+04 | 9.204E+04 | 9.202E+04 | 9.198E+04 | 9.189E+04 | 9.176E+04 | 9.167E+04 | 9.158E+04 | 9.132E+04 | 9.105E+04 |
| 51 SB 125 | 9.944E+05 | 9.944E+05 | 9.944E+05 | 9.944E+05 | 9.945E+05 | 9.945E+05 | 9.945E+05 | 9.945E+05 | 9.945E+05 | 9.945E+05 | 9.946E+05 | 9.946E+05 |
| 51 SB 126 | 9.985E+04 | 9.973E+04 | 9.962E+04 | 9.950E+04 | 9.939E+04 | 9.916E+04 | 9.870E+04 | 9.801E+04 | 9.755E+04 | 9.710E+04 | 9.575E+04 | 9.442E+04 |
| 51 SB 127 | 1.049E+07 | 1.048E+07 | 1.046E+07 | 1.044E+07 | 1.041E+07 | 1.036E+07 | 1.023E+07 | 1.002E+07 | 9.875E+06 | 9.731E+06 | 9.305E+06 | 8.895E+06 |
| 51 SB 128 | 1.419E+06 | 1.365E+06 | 1.314E+06 | 1.264E+06 | 1.217E+06 | 1.126E+06 | 9.659E+05 | 7.668E+05 | 6.575E+05 | 5.637E+05 | 3.553E+05 | 2.240E+05 |
| 51 SB 128M | 1.734E+07 | 1.336E+07 | 9.551E+06 | 6.735E+06 | 4.738E+06 | 2.341E+06 | 5.726E+05 | 6.900E+04 | 1.687E+04 | 4.120E+03 | 5.991E+01 | 8.724E-01 |
| 51 SB 129 | 3.129E+07 | 2.926E+07 | 2.702E+07 | 2.494E+07 | 2.302E+07 | 1.961E+07 | 1.422E+07 | 8.789E+06 | 6.376E+06 | 4.626E+06 | 1.766E+06 | 6.743E+05 |
| 51 SB 130 | 1.017E+07 | 6.045E+06 | 3.594E+06 | 2.137E+06 | 1.271E+06 | 4.493E+05 | 5.616E+04 | 2.482E+03 | 3.102E+02 | 3.878E+01 | 7.574E-02 | 1.479E-04 |
| 51 SB 131 | 8.115E+07 | 3.344E+07 | 1.354E+07 | 5.483E+06 | 2.220E+06 | 3.640E+05 | 9.783E+03 | 4.311E+01 | 1.159E+00 | 3.115E-02 | 6.049E-07 | 1.175E-11 |
| 52 TE 127 | 1.027E+07 | 1.027E+07 | 1.027E+07 | 1.027E+07 | 1.027E+07 | 1.026E+07 | 1.024E+07 | 1.018E+07 | 1.013E+07 | 1.006E+07 | 9.828E+06 | 9.549E+06 |
| 52 TE 127M | 1.259E+06 | 1.259E+06 | 1.259E+06 | 1.259E+06 | 1.259E+06 | 1.260E+06 | 1.260E+06 | 1.260E+06 | 1.260E+06 | 1.260E+06 | 1.260E+06 | 1.260E+06 |
| 52 TE 129 | 3.079E+07 | 3.042E+07 | 2.964E+07 | 2.857E+07 | 2.734E+07 | 2.463E+07 | 1.939E+07 | 1.334E+07 | 1.053E+07 | 8.463E+06 | 5.059E+06 | 3.747E+06 |
| 52 TE 129M | 4.598E+06 | 4.598E+06 | 4.597E+06 | 4.597E+06 | 4.596E+06 | 4.594E+06 | 4.590E+06 | 4.582E+06 | 4.576E+06 | 4.569E+06 | 4.548E+06 | 4.525E+06 |
| 52 TE 131 | 8.615E+07 | 6.614E+07 | 4.142E+07 | 2.416E+07 | 1.400E+07 | 5.654E+06 | 2.968E+06 | 2.648E+06 | 2.527E+06 | 2.413E+06 | 2.101E+06 | 1.829E+06 |
| 52 TE 131M | 1.407E+07 | 1.395E+07 | 1.381E+07 | 1.366E+07 | 1.350E+07 | 1.320E+07 | 1.260E+07 | 1.176E+07 | 1.123E+07 | 1.072E+07 | 9.331E+06 | 8.123E+06 |
| 52 TE 132 | 1.383E+08 | 1.377E+08 | 1.371E+08 | 1.365E+08 | 1.359E+08 | 1.347E+08 | 1.323E+08 | 1.289E+08 | 1.266E+08 | 1.244E+08 | 1.179E+08 | 1.118E+08 |
| 52 TE 133 | 1.160E+08 | 3.041E+07 | 9.912E+06 | 4.742E+06 | 2.869E+06 | 1.290E+06 | 2.863E+05 | 3.013E+04 | 6.711E+03 | 1.495E+03 | 1.654E+01 | 1.830E-01 |
| 52 TE 133M | 7.281E+07 | 5.006E+07 | 3.439E+07 | 2.363E+07 | 1.624E+07 | 7.664E+06 | 1.708E+06 | 1.796E+05 | 4.002E+04 | 8.917E+03 | 9.864E+01 | 1.091E+00 |
| 52 TE 134 | 1.640E+08 | 9.979E+07 | 6.068E+07 | 3.690E+07 | 2.244E+07 | 8.296E+06 | 1.134E+06 | 5.733E+04 | 7.837E+03 | 1.071E+03 | 2.737E+00 | 6.994E-03 |
| 53 I 129 | 2.050E+00 | 2.050E+00 | 2.051E+00 | 2.051E+00 | 2.051E+00 | 2.051E+00 | 2.051E+00 | 2.051E+00 | 2.051E+00 | 2.052E+00 | 2.052E+00 | 2.052E+00 |
| 53 I 130 | 2.879E+06 | 2.810E+06 | 2.734E+06 | 2.658E+06 | 2.585E+06 | 2.444E+06 | 2.185E+06 | 1.846E+06 | 1.650E+06 | 1.475E+06 | 1.054E+06 | 7.528E+05 |
| 53 I 131 | 9.730E+07 | 9.729E+07 | 9.723E+07 | 9.713E+07 | 9.701E+07 | 9.673E+07 | 9.614E+07 | 9.524E+07 | 9.464E+07 | 9.404E+07 | 9.225E+07 | 9.047E+07 |
| 53 I 132 | 1.405E+08 | 1.401E+08 | 1.397E+08 | 1.393E+08 | 1.389E+08 | 1.379E+08 | 1.359E+08 | 1.326E+08 | 1.303E+08 | 1.281E+08 | 1.215E+08 | 1.152E+08 |
| 53 I 133 | 1.983E+08 | 1.970E+08 | 1.947E+08 | 1.920E+08 | 1.891E+08 | 1.833E+08 | 1.718E+08 | 1.555E+08 | 1.455E+08 | 1.361E+08 | 1.114E+08 | 9.124E+07 |
| 53 I 134 | 2.175E+08 | 1.891E+08 | 1.526E+08 | 1.181E+08 | 8.889E+07 | 4.759E+07 | 1.200E+07 | 1.308E+06 | 2.843E+05 | 6.057E+04 | 5.527E+02 | 4.876E+00 |
| 53 I 135 | 1.852E+08 | 1.758E+08 | 1.668E+08 | 1.583E+08 | 1.502E+08 | 1.353E+08 | 1.097E+08 | 8.008E+07 | 6.493E+07 | 5.265E+07 | 2.807E+07 | 1.496E+07 |

# SEABROOK STATION
## ORIGEN INVENTORIES (CURIES) AFTER SHUTDOWN
## FROM A TYPICAL FULL POWER OPERATING CYCLE

| NUCLIDE | SHUTDOWN | 0.5 HR | 1.0 HR | 1.5 HR | 2.0 HR | 3.0 HR | 5.0 HR | 8.0 HR | 10.0 HR | 12.0 HR | 18.0 HR | 24.0 HR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 XE 131M | 9.821E+05 | 9.822E+05 | 9.823E+05 | 9.825E+05 | 9.826E+05 | 9.828E+05 | 9.832E+05 | 9.838E+05 | 9.841E+05 | 9.844E+05 | 9.852E+05 | 9.856E+05 |
| 54 XE 133 | 1.981E+08 | 1.981E+08 | 1.981E+08 | 1.981E+08 | 1.981E+08 | 1.980E+08 | 1.978E+08 | 1.973E+08 | 1.968E+08 | 1.962E+08 | 1.939E+08 | 1.909E+08 |
| 54 XE 133M | 6.193E+06 | 6.190E+06 | 6.186E+06 | 6.182E+06 | 6.178E+06 | 6.167E+06 | 6.140E+06 | 6.084E+06 | 6.039E+06 | 5.987E+06 | 5.802E+06 | 5.582E+06 |
| 54 XE 135 | 3.846E+07 | 4.400E+07 | 4.885E+07 | 5.315E+07 | 5.697E+07 | 6.332E+07 | 7.168E+07 | 7.624E+07 | 7.571E+07 | 7.331E+07 | 6.046E+07 | 4.576E+07 |
| 54 XE 135M | 3.887E+07 | 3.052E+07 | 2.733E+07 | 2.551E+07 | 2.410E+07 | 2.167E+07 | 1.757E+07 | 1.283E+07 | 1.040E+07 | 8.433E+06 | 4.496E+06 | 2.397E+06 |
| 54 XE 138 | 1.636E+08 | 3.778E+07 | 8.709E+06 | 2.007E+06 | 4.627E+05 | 2.458E+04 | 6.940E+01 | 1.041E-02 | 2.938E-05 | 8.295E-08 | 1.866E-15 | 4.198E-23 |
| 55 CS 134 | 9.062E+06 | 9.062E+06 | 9.061E+06 | 9.061E+06 | 9.061E+06 | 9.061E+06 | 9.060E+06 | 9.059E+06 | 9.059E+06 | 9.058E+06 | 9.056E+06 | 9.054E+06 |
| 55 CS 134M | 3.872E+06 | 3.436E+06 | 3.049E+06 | 2.705E+06 | 2.401E+06 | 1.890E+06 | 1.172E+06 | 5.721E+05 | 3.547E+05 | 2.199E+05 | 5.241E+04 | 1.249E+04 |
| 55 CS 136 | 3.477E+06 | 3.474E+06 | 3.470E+06 | 3.466E+06 | 3.462E+06 | 3.455E+06 | 3.439E+06 | 3.417E+06 | 3.402E+06 | 3.387E+06 | 3.342E+06 | 3.298E+06 |
| 55 CS 137 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 | 6.944E+06 |
| 55 CS 138 | 1.813E+08 | 1.332E+08 | 7.857E+07 | 4.320E+07 | 2.311E+07 | 6.433E+06 | 4.873E+05 | 1.012E+04 | 7.642E+02 | 5.772E+01 | 2.488E-02 | 1.072E-05 |
| 56 BA 135M | 5.403E+03 | 5.338E+03 | 5.274E+03 | 5.211E+03 | 5.148E+03 | 5.026E+03 | 4.788E+03 | 4.454E+03 | 4.244E+03 | 4.044E+03 | 3.498E+03 | 3.026E+03 |
| 56 BA 139 | 1.771E+08 | 1.533E+08 | 1.209E+08 | 9.421E+07 | 7.329E+07 | 4.433E+07 | 1.621E+07 | 3.586E+06 | 1.312E+06 | 4.798E+05 | 2.348E+04 | 1.149E+03 |
| 56 BA 140 | 1.718E+08 | 1.716E+08 | 1.714E+08 | 1.712E+08 | 1.710E+08 | 1.706E+08 | 1.699E+08 | 1.687E+08 | 1.680E+08 | 1.672E+08 | 1.649E+08 | 1.627E+08 |
| 56 BA 141 | 1.610E+08 | 5.244E+07 | 1.680E+07 | 5.381E+06 | 1.724E+06 | 1.769E+05 | 1.863E+03 | 2.013E+00 | 2.119E-02 | 2.232E-04 | 2.606E-10 | 3.042E-16 |
| 57 LA 140 | 1.761E+08 | 1.760E+08 | 1.760E+08 | 1.760E+08 | 1.759E+08 | 1.758E+08 | 1.757E+08 | 1.753E+08 | 1.751E+08 | 1.748E+08 | 1.740E+08 | 1.733E+08 |
| 57 LA 141 | 1.617E+08 | 1.563E+08 | 1.457E+08 | 1.342E+08 | 1.232E+08 | 1.034E+08 | 7.266E+07 | 4.281E+07 | 3.008E+07 | 2.114E+07 | 7.339E+06 | 2.548E+06 |
| 57 LA 142 | 1.564E+08 | 1.381E+08 | 1.122E+08 | 8.993E+07 | 7.190E+07 | 4.591E+07 | 1.872E+07 | 4.872E+06 | 1.986E+06 | 8.098E+05 | 5.487E+04 | 3.718E+03 |
| 58 CE 141 | 1.641E+08 | 1.641E+08 | 1.641E+08 | 1.641E+08 | 1.640E+08 | 1.640E+08 | 1.639E+08 | 1.636E+08 | 1.634E+08 | 1.631E+08 | 1.623E+08 | 1.615E+08 |
| 58 CE 143 | 1.503E+08 | 1.496E+08 | 1.482E+08 | 1.467E+08 | 1.452E+08 | 1.422E+08 | 1.363E+08 | 1.280E+08 | 1.227E+08 | 1.177E+08 | 1.037E+08 | 9.146E+07 |
| 58 CE 144 | 9.884E+07 | 9.884E+07 | 9.883E+07 | 9.883E+07 | 9.882E+07 | 9.881E+07 | 9.879E+07 | 9.876E+07 | 9.874E+07 | 9.872E+07 | 9.866E+07 | 9.860E+07 |
| 58 CE 146 | 8.144E+07 | 1.898E+07 | 4.389E+06 | 1.015E+06 | 2.346E+05 | 1.254E+04 | 3.585E+01 | 5.479E-03 | 1.566E-05 | 4.476E-08 | 1.045E-15 | 2.440E-23 |
| 59 PR 142 | 5.936E+06 | 5.842E+06 | 5.740E+06 | 5.637E+06 | 5.536E+06 | 5.339E+06 | 4.966E+06 | 4.455E+06 | 4.143E+06 | 3.854E+06 | 3.101E+06 | 2.495E+06 |
| 59 PR 143 | 1.485E+08 | 1.485E+08 | 1.485E+08 | 1.485E+08 | 1.485E+08 | 1.485E+08 | 1.485E+08 | 1.484E+08 | 1.483E+08 | 1.482E+08 | 1.477E+08 | 1.470E+08 |
| 59 PR 144 | 9.998E+07 | 9.918E+07 | 9.894E+07 | 9.886E+07 | 9.884E+07 | 9.882E+07 | 9.870E+07 | 9.884E+07 | 9.865E+07 | 9.863E+07 | 9.867E+07 | 9.861E+07 |
| 59 PR 144M | 1.188E+06 | 1.186E+06 | 1.186E+06 | 1.186E+06 | 1.186E+06 | 1.186E+06 | 1.186E+06 | 1.185E+06 | 1.185E+06 | 1.185E+06 | 1.184E+06 | 1.183E+06 |
| 59 PR 145 | 1.024E+08 | 9.755E+07 | 9.205E+07 | 8.687E+07 | 8.198E+07 | 7.301E+07 | 5.790E+07 | 4.090E+07 | 3.244E+07 | 2.573E+07 | 1.283E+07 | 6.402E+06 |
| 59 PR 146 | 8.176E+07 | 5.703E+07 | 2.933E+07 | 1.362E+07 | 6.045E+06 | 1.126E+06 | 3.673E+04 | 2.121E+02 | 6.821E+00 | 2.194E-01 | 7.295E-06 | 2.426E-10 |
| 60 ND 147 | 6.482E+07 | 6.478E+07 | 6.471E+07 | 6.462E+07 | 6.454E+07 | 6.437E+07 | 6.404E+07 | 6.354E+07 | 6.321E+07 | 6.288E+07 | 6.190E+07 | 6.094E+07 |
| 60 ND 149 | 3.689E+07 | 3.085E+07 | 2.525E+07 | 2.067E+07 | 1.691E+07 | 1.133E+07 | 5.084E+06 | 1.528E+06 | 6.858E+05 | 3.077E+05 | 2.781E+04 | 2.513E+03 |
| 61 PM 147 | 1.068E+07 | 1.068E+07 | 1.068E+07 | 1.068E+07 | 1.068E+07 | 1.069E+07 | 1.069E+07 | 1.069E+07 | 1.070E+07 | 1.070E+07 | 1.071E+07 | 1.072E+07 |
| 61 PM 148 | 2.336E+07 | 2.330E+07 | 2.324E+07 | 2.318E+07 | 2.312E+07 | 2.299E+07 | 2.275E+07 | 2.239E+07 | 2.215E+07 | 2.191E+07 | 2.122E+07 | 2.055E+07 |
| 61 PM 148M | 2.366E+06 | 2.366E+06 | 2.365E+06 | 2.364E+06 | 7.363E+06 | 2.361E+06 | 2.358E+06 | 2.353E+06 | 2.350E+06 | 2.347E+06 | 2.337E+06 | 2.327E+06 |
| 61 PM 149 | 4.324E+07 | 4.318E+07 | 4.308E+07 | 4.295E+07 | 4.279E+07 | 4.242E+07 | 4.153E+07 | 4.005E+07 | 3.904E+07 | 3.805E+07 | 3.519E+07 | 3.254E+07 |
| 61 PM 151 | 1.892E+07 | 1.880E+07 | 1.860E+07 | 1.837E+07 | 1.815E+07 | 1.771E+07 | 1.687E+07 | 1.568E+07 | 1.493E+07 | 1.422E+07 | 1.228E+07 | 1.061E+07 |
| 61 PM 154 | 4.858E+06 | 3.716E+03 | 2.213E+00 | 1.317E-03 | 7.839E-07 | 2.777E-13 | 3.486E-26 | 1.550E-45 | 1.946E-58 | 2.443E-71 | 0. | 0. |
| 62 SM 151 | 2.568E+04 | 2.569E+04 | 2.570E+04 | 2.571E+04 | 2.571E+04 | 2.573E+04 | 2.576E+04 | 2.580E+04 | 2.583E+04 | 2.585E+04 | 2.592E+04 | 2.598E+04 |
| 62 SM 153 | 3.598E+07 | 3.573E+07 | 3.547E+07 | 3.521E+07 | 3.495E+07 | 3.443E+07 | 3.342E+07 | 3.197E+07 | 3.103E+07 | 3.013E+07 | 2.756E+07 | 2.521E+07 |
| 63 EU 154 | 5.946E+05 | 5.946E+05 | 5.946E+05 | 5.946E+05 | 5.946E+05 | 5.946E+05 | 5.946E+05 | 5.946E+05 | 5.945E+05 | 5.945E+05 | 5.945E+05 | 5.945E+05 |
| 63 EU 155 | 3.896E+05 | 3.896E+05 | 3.896E+05 | 3.896E+05 | 3.896E+05 | 3.896E+05 | 3.896E+05 | 3.896E+05 | 3.896E+05 | 3.895E+05 | 3.895E+05 | 3.895E+05 |
| 63 EU 156 | 1.361E+07 | 1.360E+07 | 1.359E+07 | 1.358E+07 | 1.357E+07 | 1.355E+07 | 1.350E+07 | 1.343E+07 | 1.339E+07 | 1.334E+07 | 1.320E+07 | 1.305E+07 |
| 63 EU 156 | 1.361E+07 | 1.360E+07 | 1.359E+07 | 1.358E+07 | 1.357E+07 | 1.355E+07 | 1.350E+07 | 1.343E+07 | 1.339E+07 | 1.334E+07 | 1.320E+07 | 1.305E+07 |
| 64 GD 159 | 5.508E+05 | 5.464E+05 | 5.381E+05 | 5.287E+05 | 5.191E+05 | 5.002E+05 | 4.643E+05 | 4.152E+05 | 3.854E+05 | 3.577E+05 | 2.860E+05 | 2.287E+05 |
| 92 U 239 | 1.991E+09 | 8.228E+08 | 3.401E+08 | 1.405E+08 | 5.809E+07 | 9.921E+06 | 2.894E+05 | 1.442E+03 | 4.208E+01 | 1.228E+00 | 3.049E-05 | 7.570E-10 |
| 93 NP 238 | 2.291E+07 | 2.276E+07 | 2.260E+07 | 2.245E+07 | 2.229E+07 | 2.199E+07 | 2.140E+07 | 2.054E+07 | 1.999E+07 | 1.945E+07 | 1.792E+07 | 1.651E+07 |
| 93 NP 239 | 1.988E+09 | 1.984E+09 | 1.975E+09 | 1.964E+09 | 1.953E+09 | 1.929E+09 | 1.883E+09 | 1.815E+09 | 1.771E+09 | 1.728E+09 | 1.605E+09 | 1.491E+09 |
| 93 NP 240 | 2.495E+06 | 1.812E+06 | 1.316E+06 | 9.557E+05 | 6.941E+05 | 3.660E+05 | 1.018E+05 | 1.493E+04 | 4.153E+03 | 1.155E+03 | 2.485E+01 | 5.348E-01 |
| 94 PU 241 | 8.231E+06 | 8.231E+06 | 8.231E+06 | 8.231E+06 | 8.231E+06 | 8.231E+06 | 8.231E+06 | 8.231E+06 | 8.231E+06 | 8.231E+06 | 8.230E+06 | 8.230E+06 |
| 94 PU 243 | 2.174E+07 | 2.027E+07 | 1.891E+07 | 1.763E+07 | 1.644E+07 | 1.429E+07 | 1.080E+07 | 7.102E+06 | 5.369E+06 | 4.059E+06 | 1.753E+06 | 7.576E+05 |
| 95 AM 244 | 3.231E+05 | 3.122E+05 | 3.016E+05 | 2.915E+05 | 2.816E+05 | 2.630E+05 | 2.292E+05 | 1.866E+05 | 1.626E+05 | 1.418E+05 | 9.393E+04 | 6.223E+04 |
| 96 CM 242 | 2.319E+06 | 2.319E+06 | 2.319E+06 | 2.319E+06 | 2.319E+06 | 2.319E+06 | 2.320E+06 | 2.320E+06 | 2.320E+06 | 2.320E+06 | 2.320E+06 | 2.319E+06 |

SEABROOK STATION
ORIGEN INVENTORIES (CURIES) AFTER SHUTDOWN
FROM A TYPICAL FULL POWER OPERATING CYCLE

| NUCLIDE | 2.0 D | 3.0 D | 5.0 D | 7.0 D | 10.0 D | 15.0 D | 20.0 D | 25.0 D | 30.0 D | 60.0 D | 90.0 D | 180.0 D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 AS 77 | 1.302E+05 | 8.568E+04 | 3.653E+04 | 1.551E+04 | 4.286E+03 | 5.026E+02 | 5.893E+01 | 6.909E+00 | 8.101E-01 | 2.105E-06 | 5.469E-12 | 9.592E-29 |
| 34 SE 83 | 1.405E-32 | 7.619E-52 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 35 BR 82 | 1.545E+05 | 9.646E+04 | 3.759E+04 | 1.465E+04 | 3.564E+03 | 3.378E+02 | 3.203E+01 | 3.037E+00 | 2.879E-01 | 2.090E-07 | 1.518E-13 | 5.809E-32 |
| 35 BR 83 | 1.183E+01 | 1.122E-02 | 1.010E-08 | 9.088E-15 | 7.758E-24 | 5.960E-39 | 4.579E-54 | 3.518E-69 | 2.703E-84 | 0. | 0. | 0. |
| 35 BR 84 | 1.286E-20 | 3.003E-34 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 36 KR 83M | 4.991E+01 | 4.781E-02 | 4.308E-08 | 3.877E-14 | 3.310E-23 | 2.543E-38 | 1.954E-53 | 1.501E-68 | 1.153E-83 | 0. | 0. | 0. |
| 36 KR 85 | 6.499E+05 | 6.498E+05 | 6.496E+05 | 6.494E+05 | 6.490E+05 | 6.484E+05 | 6.479E+05 | 6.473E+05 | 6.467E+05 | 6.433E+05 | 6.399E+05 | 6.298E+05 |
| 36 KR 85M | 1.559E+04 | 3.805E+02 | 2.267E-01 | 1.351E-04 | 1.964E-09 | 1.702E-17 | 1.474E-25 | 1.277E-33 | 1.106E-41 | 0. | 0. | 0. |
| 36 KR 87 | 2.178E-04 | 4.536E-10 | 1.968E-21 | 8.541E-33 | 7.720E-50 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 36 KR 88 | 5.690E+02 | 1.623E+00 | 1.319E-05 | 1.073E-10 | 2.488E-18 | 4.691E-31 | 8.845E-44 | 1.668E-56 | 3.145E-69 | 0. | 0. | 0. |
| 37 RB 86 | 1.282E+05 | 1.235E+05 | 1.147E+05 | 1.065E+05 | 9.525E+04 | 7.910E+04 | 6.569E+04 | 5.456E+04 | 4.531E+04 | 1.486E+04 | 4.876E+03 | 1.722E+02 |
| 37 RB 88 | 6.354E+02 | 1.812E+00 | 1.473E-05 | 1.198E-10 | 2.778E-18 | 5.238E-31 | 9.878E-44 | 1.862E-56 | 3.512E-69 | 0. | 0. | 0. |
| 37 RB 89 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 38 SR 89 | 9.353E+07 | 9.225E+07 | 8.975E+07 | 8.732E+07 | 8.380E+07 | 7.824E+07 | 7.305E+07 | 6.821E+07 | 6.368E+07 | 4.219E+07 | 2.795E+07 | 8.125E+06 |
| 38 SR 90 | 5.019E+06 | 5.018E+06 | 5.018E+06 | 5.017E+06 | 5.016E+06 | 5.014E+06 | 5.013E+06 | 5.011E+06 | 5.010E+06 | 5.000E+06 | 4.990E+06 | 4.961E+06 |
| 38 SR 91 | 3.553E+06 | 6.167E+05 | 1.858E+04 | 5.598E+02 | 2.928E+00 | 4.614E-04 | 7.271E-08 | 1.146E-11 | 1.806E-15 | 0. | 0. | 0. |
| 38 SR 92 | 5.934E+02 | 1.280E+00 | 5.963E-06 | 2.777E-11 | 2.791E-19 | 1.306E-32 | 6.113E-46 | 2.861E-59 | 1.339E-72 | 0. | 0. | 0. |
| 39 Y 91M | 2.257E+06 | 3.916E+05 | 1.181E+04 | 3.557E+02 | 1.861E+00 | 2.932E-04 | 4.620E-08 | 7.281E-12 | 1.147E-15 | 0. | 0. | 0. |
| 39 Y 91 | 1.206E+08 | 1.192E+08 | 1.164E+08 | 1.137E+08 | 1.098E+08 | 1.034E+08 | 9.749E+07 | 9.188E+07 | 8.660E+07 | 6.069E+07 | 4.254E+07 | 1.465E+07 |
| 39 Y 92 | 4.303E+04 | 4.045E+02 | 3.374E-02 | 2.788E-06 | 2.093E-12 | 1.298E-22 | 8.045E-33 | 4.988E-43 | 3.093E-53 | 0. | 0. | 0. |
| 39 Y 93 | 5.541E+06 | 1.067E+06 | 3.959E+04 | 1.469E+03 | 1.050E+01 | 2.783E-03 | 7.376E-07 | 1.955E-10 | 5.184E-14 | 1.799E-35 | 6.245E-57 | 0. |
| 39 Y 94 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 40 ZR 95 | 1.601E+08 | 1.583E+08 | 1.549E+08 | 1.516E+08 | 1.468E+08 | 1.390E+08 | 1.317E+08 | 1.248E+08 | 1.182E+08 | 8.539E+07 | 6.170E+07 | 2.327E+07 |
| 40 ZR 97 | 2.277E+07 | 8.510E+06 | 1.188E+06 | 1.659E+05 | 8.659E+03 | 6.309E+01 | 4.597E-01 | 3.350E-03 | 2.441E-05 | 3.652E-18 | 5.465E-31 | 0. |
| 41 NB 95 | 1.608E+08 | 1.608E+08 | 1.606E+08 | 1.604E+08 | 1.597E+08 | 1.581E+08 | 1.560E+08 | 1.534E+08 | 1.504E+08 | 1.276E+08 | 1.027E+08 | 4.584E+07 |
| 41 NB 95M | 1.163E+06 | 1.154E+06 | 1.136E+06 | 1.115E+06 | 1.084E+06 | 1.029E+06 | 9.763E+05 | 9.252E+05 | 8.766E+05 | 6.335E+05 | 4.577E+05 | 1.726E+05 |
| 41 NB 96 | 7.482E+04 | 3.669E+04 | 8.826E+03 | 2.123E+03 | 2.505E+02 | 7.107E+00 | 2.017E-01 | 5.722E-03 | 1.624E-04 | 8.477E-14 | 4.425E-23 | 0. |
| 41 NB 97 | 2.289E+07 | 8.553E+06 | 1.194E+06 | 1.668E+05 | 8.702E+03 | 6.341E+01 | 4.620E-01 | 3.366E-03 | 2.453E-05 | 3.935E-18 | 5.889E-31 | 0. |
| 41 NB 97M | 2.157E+07 | 8.061E+06 | 1.126E+06 | 1.572E+05 | 8.202E+03 | 5.976E+01 | 4.354E-01 | 3.173E-03 | 2.312E-05 | 3.459E-18 | 5.177E-31 | 0. |
| 41 NB 98M | 2.363E-11 | 9.042E-20 | 1.324E-36 | 1.939E-53 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 42 MO 99 | 1.070E+08 | 8.315E+07 | 5.023E+07 | 3.034E+07 | 1.424E+07 | 4.039E+06 | 1.145E+06 | 3.248E+05 | 9.211E+04 | 4.790E+01 | 2.491E-02 | 3.503E-12 |
| 42 MO 101 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 43 TC 99M | 1.030E+08 | 8.010E+07 | 4.839E+07 | 2.923E+07 | 1.373E+07 | 3.891E+06 | 1.103E+06 | 3.129E+05 | 8.873E+04 | 4.615E+01 | 2.400E-02 | 3.375E-12 |
| 43 TC 101 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 43 TC 104 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 44 RU 103 | 1.426E+08 | 1.401E+08 | 1.352E+08 | 1.306E+08 | 1.238E+08 | 1.134E+08 | 1.038E+08 | 9.503E+07 | 8.701E+07 | 5.125E+07 | 3.018E+07 | 6.167E+06 |
| 44 RU 105 | 5.758E+04 | 1.357E+03 | 7.542E-01 | 4.191E-04 | 5.489E-09 | 3.995E-17 | 2.908E-25 | 2.116E-33 | 1.540E-41 | 0. | 0. | 0. |
| 45 RH 103M | 1.286E+08 | 1.263E+08 | 1.219E+08 | 1.177E+08 | 1.116E+08 | 1.022E+08 | 9.357E+07 | 8.567E+07 | 7.844E+07 | 4.620E+07 | 2.721E+07 | 5.559E+06 |
| 45 RH 105 | 4.122E+07 | 2.575E+07 | 1.005E+07 | 3.923E+06 | 9.564E+05 | 9.101E+04 | 8.660E+03 | 8.241E+02 | 7.841E+01 | 5.821E-05 | 4.322E-11 | 1.768E-29 |
| 45 RH 105M | 1.617E+04 | 3.811E+02 | 2.118E-01 | 1.177E-04 | 1.541E-09 | 1.122E-17 | 8.165E-26 | 5.942E-34 | 4.325E-42 | 0. | 0. | 0. |
| 45 RH 106 | 3.811E+07 | 3.804E+07 | 3.789E+07 | 3.775E+07 | 3.754E+07 | 3.719E+07 | 3.684E+07 | 3.649E+07 | 3.615E+07 | 3.417E+07 | 3.229E+07 | 2.726E+07 |
| 45 RH 106M | 8.480E-01 | 4.410E-04 | 1.193E-10 | 3.225E-17 | 4.536E-27 | 1.725E-43 | 6.562E-60 | 2.496E-76 | 9.493E-93 | 0. | 0. | 0. |
| 45 RH 107 | 7.990E-33 | 8.[illegible]40E-53 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 46 PD 109 | 2.457E+06 | [illegible]39E+05 | 6.029E+04 | 5.091E+03 | 1.249E+02 | 2.589E-01 | 5.365E-04 | 1.112E-06 | 2.304E-09 | 1.824E-25 | 1.445E-41 | 0. |
| 46 PD 111 | 1.629E+02 | 7.911E+00 | 1.867E-02 | 4.404E-05 | 5.048E-09 | 1.365E-15 | 3.692E-22 | 9.985E-29 | 2.700E-35 | 0. | 0. | 0. |
| 46 PD 111M | 2.235E+02 | 1.086E+01 | 2.562E-02 | 6.045E-05 | 6.929E-09 | 1.874E-15 | 5.067E-22 | 1.370E-28 | 3.706E-35 | 0. | 0. | 0. |
| 46 PD 112 | 6.612E+05 | 2.890E+05 | 5.521E+04 | 1.055E+04 | 8.807E+02 | 1.405E+01 | 2.241E-01 | 3.575E-03 | 5.702E-05 | 9.395E-16 | 1.548E-26 | 0. |

SEABROOK STATION

ORIGEN INVENTORIES (CURIES) AFTER SHUTDOWN

FROM A TYPICAL FULL POWER OPERATING CYCLE

| NUCLIDE | 2.0 D | 3.0 D | 5.0 D | 7.0 D | 10.0 D | 15.0 D | 20.0 D | 25.0 D | 30.0 D | 60.0 D | 90.0 D | 180.0 D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 AG 109M | 2.457E+06 | 7.141E+05 | 6.031E+04 | 5.093E+03 | 1.250E+02 | 3.255E-01 | 6.659E-02 | 6.556E-02 | 6.507E-02 | 6.222E-02 | 5.950E-02 | 5.201E-02 |
| 47 AG 110M | 2.531E+05 | 2.524E+05 | 2.510E+05 | 2.496E+05 | 2.475E+05 | 2.441E+05 | 2.408E+05 | 2.374E+05 | 2.342E+05 | 2.155E+05 | 1.983E+05 | 1.545E+05 |
| 47 AG 111 | 5.432E+06 | 4.949E+06 | 4.109E+06 | 3.411E+06 | 2.580E+06 | 1.621E+06 | 1.018E+06 | 6.392E+05 | 4.014E+05 | 2.463E+04 | 1.511E+03 | 3.489E-01 |
| 47 AG 111M | 2.333E+02 | 1.133E+01 | 2.674E-02 | 6.310E-05 | 7.248E-09 | 1.960E-15 | 5.301E-22 | 1.434E-28 | 3.877E-35 | 0. | 0. | 0. |
| 47 AG 112 | 7.832E+05 | 3.423E+05 | 6.540E+04 | 1.249E+04 | 1.043E+03 | 1.664E+01 | 2.654E-01 | 4.234E-03 | 6.754E-05 | 1.113E-15 | 1.833E-26 | 0. |
| 48 CD 115 | 9.732E+05 | 7.130E+05 | 3.827E+05 | 2.054E+05 | 8.078E+04 | 1.705E+04 | 3.599E+03 | 7.597E+02 | 1.604E+02 | 1.418E-02 | 1.254E-06 | 8.677E-19 |
| 48 CD 115M | 1.654E+05 | 1.629E+05 | 1.579E+05 | 1.531E+05 | 1.461E+05 | 1.352E+05 | 1.251E+05 | 1.157E+05 | 1.071E+05 | 6.716E+04 | 4.213E+04 | 1.040E+04 |
| 48 CD 117 | 2.860E+00 | 4.761E-03 | 1.319E-08 | 3.654E-14 | 1.685E-22 | 2.152E-36 | 2.749E-50 | 3.511E-64 | 4.485E-78 | 0. | 0. | 0. |
| 48 CD 117M | 3.146E+01 | 2.360E-01 | 1.328E-05 | 7.468E-10 | 3.151E-16 | 7.480E-27 | 1.775E-37 | 4.214E-48 | 1.000E-58 | 0. | 0. | 0. |
| 49 IN 115M | 1.058E+06 | 7.754E+05 | 4.165E+05 | 2.236E+05 | 8.786E+04 | 1.855E+04 | 3.923E+03 | 8.343E+02 | 1.819E+02 | 4.735E+00 | 2.961E+00 | 7.310E-01 |
| 49 IN 117 | 4.425E+01 | 2.972E-01 | 1.766E-05 | 9.919E-10 | 4.185E-16 | 9.933E-27 | 2.358E-37 | 5.597E-48 | 1.328E-58 | 0. | 0. | 0. |
| 49 IN 117M | 4.461E+01 | 2.677E-01 | 1.365E-05 | 7.654E-10 | 3.229E-16 | 7.664E-27 | 1.819E-37 | 4.318E-48 | 1.025E-58 | 0. | 0. | 0. |
| 49 IN 118 | 9.136E-12 | 2.202E-20 | 1.279E-37 | 7.430E-55 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 SN 123 | 3.244E+05 | 3.226E+05 | 3.192E+05 | 3.158E+05 | 3.107E+05 | 3.025E+05 | 2.945E+05 | 2.867E+05 | 2.791E+05 | 2.376E+05 | 2.023E+05 | 1.248E+05 |
| 50 SN 123M | 3.613E-16 | 5.537E-27 | 1.301E-48 | 3.056E-70 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 50 SN 125 | 1.155E+06 | 1.074E+06 | 9.305E+05 | 8.059E+05 | 6.495E+05 | 4.534E+05 | 3.165E+05 | 2.209E+05 | 1.542E+05 | 1.783E+04 | 2.063E+03 | 3.192E+00 |
| 50 SN 127 | 6.747E-01 | 3.173E-04 | 4.177E-11 | 5.497E-18 | 2.625E-28 | 1.650E-45 | 1.037E-62 | 6.516E-80 | 4.095E-97 | 0. | 0. | 0. |
| 50 SN 128 | 3.231E-08 | 1.453E-15 | 2.936E-30 | 5.936E-45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 51 SB 122 | 9.378E+04 | 7.255E+04 | 4.342E+04 | 2.598E+04 | 1.203E+04 | 3.333E+03 | 9.234E+02 | 2.558E+02 | 7.089E+01 | 3.207E-02 | 1.451E-05 | 1.343E-15 |
| 51 SB 124 | 9.001E+04 | 8.898E+04 | 8.696E+04 | 8.498E+04 | 8.209E+04 | 7.750E+04 | 7.316E+04 | 6.907E+04 | 6.520E+04 | 4.616E+04 | 3.268E+04 | 1.159E+04 |
| 51 SB 125 | 9.948E+05 | 9.949E+05 | 9.949E+05 | 9.947E+05 | 9.941E+05 | 9.926E+05 | 9.905E+05 | 9.880E+05 | 9.853E+05 | 9.665E+05 | 9.470E+05 | 8.904E+05 |
| 51 SB 126 | 8.929E+04 | 8.443E+04 | 7.550E+04 | 6.751E+04 | 5.709E+04 | 4.316E+04 | 3.264E+04 | 2.468E+04 | 1.866E+04 | 3.492E+03 | 6.583E+02 | 1.133E+01 |
| 51 SB 127 | 7.430E+06 | 6.205E+06 | 4.329E+06 | 3.020E+06 | 1.759E+06 | 7.151E+05 | 2.907E+05 | 1.181E+05 | 4.802E+04 | 2.165E+02 | 9.760E-01 | 8.944E-08 |
| 51 SB 128 | 3.535E+04 | 5.581E+03 | 1.390E+02 | 3.465E+00 | 1.363E-02 | 1.335E-06 | 1.309E-10 | 1.282E-14 | 1.257E-18 | 0. | 0. | 0. |
| 51 SB 128M | 3.922E-08 | 1.763E-15 | 3.565E-30 | 7.206E-45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 51 SB 129 | 1.433E+04 | 3.045E+02 | 1.375E-01 | 6.212E-05 | 5.962E-10 | 2.585E-18 | 1.120E-26 | 4.857E-35 | 2.105E-43 | 0. | 0. | 0. |
| 51 SB 130 | 2.153E-15 | 3.133E-26 | 6.634E-48 | 1.405E-69 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 51 SB 131 | 1.670E-30 | 2.375E-49 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 52 TE 127 | 8.312E+06 | 7.167E+06 | 5.369E+06 | 4.107E+06 | 2.883E+06 | 1.851E+06 | 1.410E+06 | 1.210E+06 | 1.109E+06 | 8.787E+05 | 7.260E+05 | 4.096E+05 |
| 52 TE 127M | 1.259E+06 | 1.257E+06 | 1.250E+06 | 1.241E+06 | 1.224E+06 | 1.190E+06 | 1.155E+06 | 1.120E+06 | 1.085E+06 | 8.969E+05 | 7.412E+05 | 4.182E+05 |
| 52 TE 129 | 2.903E+06 | 2.827E+06 | 2.713E+06 | 2.603E+06 | 2.447E+06 | 2.207E+06 | 1.991E+06 | 1.796E+06 | 1.620E+06 | 8.722E+05 | 4.697E+05 | 7.337E+04 |
| 52 TE 129M | 4.433E+06 | 4.343E+06 | 4.167E+06 | 3.999E+06 | 3.759E+06 | 3.391E+06 | 3.058E+06 | 2.758E+06 | 2.488E+06 | 1.340E+06 | 7.216E+05 | 1.137E+05 |
| 52 TE 131 | 1.050E+06 | 6.033E+05 | 1.990E+05 | 6.565E+04 | 1.244E+04 | 7.773E+02 | 4.858E+01 | 3.037E+00 | 1.898E-01 | 1.131E-08 | 6.742E-16 | 1.428E-37 |
| 52 TE 131M | 4.666E+06 | 2.680E+06 | 8.840E+05 | 2.916E+05 | 5.525E+04 | 3.453E+03 | 2.158E+02 | 1.349E+01 | 8.430E-01 | 5.025E-08 | 2.995E-15 | 6.342E-37 |
| 52 TE 132 | 9.039E+07 | 7.307E+07 | 4.775E+07 | 3.120E+07 | 1.648E+07 | 5.689E+06 | 1.964E+06 | 6.777E+05 | 2.339E+05 | 3.956E+02 | 6.690E-01 | 3.236E-09 |
| 52 TE 133 | 2.740E-09 | 4.104E-17 | 9.204E-33 | 2.064E-48 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 52 TE 133M | 1.634E-08 | 2.447E-16 | 5.489E-32 | 1.231E-47 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 52 TE 134 | 2.981E-13 | 1.270E-23 | 2.307E-44 | 4.191E-65 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 53 I 129 | 2.053E+00 | 2.053E+00 | 2.054E+00 | 2.055E+00 | 2.056E+00 | 2.059E+00 | 2.061E+00 | 2.062E+00 | 2.064E+00 | 2.071E+00 | 2.074E+00 | 2.078E+00 |
| 53 I 130 | 1.960E+05 | 5.102E+04 | 3.458E+03 | 2.343E+02 | 4.134E+00 | 4.944E-03 | 5.911E-06 | 7.069E-09 | 8.452E-12 | 2.471E-29 | 7.222E-47 | 0. |
| 53 I 131 | 8.351E+07 | 7.691E+07 | 6.498E+07 | 5.477E+07 | 4.232E+07 | 2.751E+07 | 1.788E+07 | 1.162E+07 | 7.549E+06 | 5.685E+05 | 4.281E+04 | 1.828E+01 |
| 53 I 132 | 9.322E+07 | 7.535E+07 | 4.919E+07 | 3.215E+07 | 1.698E+07 | 5.861E+06 | 2.023E+06 | 6.983E+05 | 2.410E+05 | 4.076E+02 | 6.893E-01 | 3.334E-09 |
| 53 I 133 | 4.100E+07 | 1.843E+07 | 3.722E+06 | 7.518E+05 | 6.825E+04 | 1.251E+03 | 2.294E+01 | 4.207E-01 | 7.713E-03 | 2.931E-13 | 1.114E-23 | 0. |
| 53 I 134 | 2.814E-08 | 1.615E-16 | 5.321E-33 | 1.753E-49 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 53 I 135 | 1.208E+06 | 9.758E+04 | 6.364E+02 | 4.151E+00 | 2.186E-03 | 7.509E-09 | 2.579E-14 | 8.860E-20 | 3.043E-25 | 0. | 0. | 0. |

SEABROOK STATION
ORIGEN INVENTORIES (CURIES) AFTER SHUTDOWN
FROM A TYPICAL FULL POWER OPERATING CYCLE

| NUCLIDE | 2.0 D | 3.0 D | 5.0 D | 7.0 D | 10.0 D | 15.0 D | 20.0 D | 25.0 D | 30.0 D | 60.0 D | 90.0 D | 180.0 D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 XE 131M | 9.844E+05 | 9.790E+05 | 9.577E+05 | 9.251E+05 | 8.624E+05 | 7.399E+05 | 6.150E+05 | 4.999E+05 | 3.998E+05 | 8.690E+04 | 1.644E+04 | 9.165E+01 |
| 54 XE 133 | 1.754E+08 | 1.576E+08 | 1.236E+08 | 9.564E+07 | 6.464E+07 | 3.349E+07 | 1.732E+07 | 8.947E+06 | 4.622E+06 | 8.773E+04 | 1.665E+03 | 1.139E-02 |
| 54 XE 133M | 4.548E+06 | 3.530E+06 | 1.989E+06 | 1.079E+06 | 4.217E+05 | 8.687E+04 | 1.785E+04 | 3.667E+03 | 7.533E+02 | 5.661E-02 | 4.255E-06 | 1.806E-18 |
| 54 XE 135 | 1.053E+07 | 1.945E+06 | 5.503E+04 | 1.448E+03 | 6.011E+00 | 6.381E-04 | 6.768E-08 | 7.177E-12 | 7.612E-16 | 0. | 0. | 0. |
| 54 XE 135M | 1.935E+05 | 1.563E+04 | 1.019E+02 | 6.648E-01 | 3.502E-04 | 1.203E-09 | 4.132E-15 | 1.419E-20 | 4.875E-26 | 0. | 0. | 0. |
| 54 XE 138 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 55 CS 134 | 9.046E+06 | 9.037E+06 | 9.021E+06 | 9.004E+06 | 8.979E+06 | 8.938E+06 | 8.897E+06 | 8.856E+06 | 8.815E+06 | 8.575E+06 | 8.342E+06 | 7.679E+06 |
| 55 CS 134M | 4.030E+01 | 1.300E-01 | 1.354E-06 | 1.409E-11 | 4.732E-19 | 1.655E-31 | 5.784E-44 | 2.022E-56 | 7.070E-69 | 0. | 0. | 0. |
| 55 CS 136 | 3.128E+06 | 2.967E+06 | 2.669E+06 | 2.401E+06 | 2.049E+06 | 1.573E+06 | 1.207E+06 | 9.265E+05 | 7.112E+05 | 1.454E+05 | 2.974E+04 | 2.544E+02 |
| 55 CS 137 | 6.943E+06 | 6.943E+06 | 6.942E+06 | 6.941E+06 | 6.940E+06 | 6.937E+06 | 6.935E+06 | 6.933E+06 | 6.931E+06 | 6.918E+06 | 6.905E+06 | 6.867E+06 |
| 55 CS 138 | 3.699E-19 | 1.276E-32 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 56 BA 135M | 1.695E+03 | 9.491E+02 | 2.977E+02 | 9.337E+01 | 1.640E+01 | 9.035E-01 | 4.978E-02 | 2.742E-03 | 1.511E-04 | 4.225E-12 | 1.181E-19 | 0. |
| 56 BA 139 | 6.585E-03 | 3.775E-08 | 1.241E-18 | 4.078E-29 | 7.683E-45 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 56 BA 140 | 1.541E+08 | 1.460E+08 | 1.310E+08 | 1.176E+08 | 9.991E+07 | 7.620E+07 | 5.811E+07 | 4.432E+07 | 3.380E+07 | 6.649E+06 | 1.308E+06 | 9.960E+03 |
| 56 BA 141 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 57 LA 140 | 1.679E+08 | 1.618E+08 | 1.480E+08 | 1.341E+08 | 1.146E+08 | 8.764E+07 | 6.687E+07 | 5.100E+07 | 3.889E+07 | 7.652E+06 | 1.505E+06 | 1.146E+04 |
| 57 LA 141 | 3.698E+04 | 5.370E+02 | 1.132E-01 | 2.385E-05 | 7.300E-11 | 4.708E-20 | 3.037E-29 | 1.959E-38 | 1.263E-47 | 0. | 0. | 0. |
| 57 LA 142 | 7.836E-02 | 1.651E-06 | 7.337E-16 | 3.259E-25 | 3.052E-39 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 58 CE 141 | 1.581E+08 | 1.547E+08 | 1.483E+08 | 1.421E+08 | 1.333E+08 | 1.198E+08 | 1.077E+08 | 9.681E+07 | 8.702E+07 | 4.590E+07 | 2.421E+07 | 3.554E+06 |
| 58 CE 143 | 5.525E+07 | 3.337E+07 | 1.218E+07 | 4.443E+06 | 9.792E+05 | 7.874E+04 | 6.332E+03 | 5.092E+02 | 4.095E+01 | 1.107E-05 | 2.995E-12 | 5.924E-32 |
| 58 CE 144 | 9.836E+07 | 9.812E+07 | 9.765E+07 | 9.717E+07 | 9.646E+07 | 9.529E+07 | 9.414E+07 | 9.300E+07 | 9.187E+07 | 8.539E+07 | 7.937E+07 | 6.373E+07 |
| 58 CE 146 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 59 PR 142 | 1.046E+06 | 4.383E+05 | 7.699E+04 | 1.352E+04 | 9.958E+02 | 1.288E+01 | 1.666E-01 | 2.155E-03 | 2.787E-05 | 1.305E-16 | 6.108E-28 | 0. |
| 59 PR 143 | 1.433E+08 | 1.383E+08 | 1.269E+08 | 1.153E+08 | 9.924E+07 | 7.694E+07 | 5.960E+07 | 4.616E+07 | 3.576E+07 | 7.719E+06 | 1.667E+06 | 1.677E+04 |
| 59 PR 144 | 9.837E+07 | 9.813E+07 | 9.765E+07 | 9.718E+07 | 9.647E+07 | 9.530E+07 | 9.414E+07 | 9.300E+07 | 9.188E+07 | 8.539E+07 | 7.937E+07 | 6.373E+07 |
| 59 PR 144M | 1.180E+06 | 1.178E+06 | 1.172E+06 | 1.166E+06 | 1.158E+06 | 1.144E+06 | 1.130E+06 | 1.116E+06 | 1.102E+06 | 1.025E+06 | 9.524E+05 | 7.648E+05 |
| 59 PR 145 | 3.966E+05 | 2.456E+04 | 9.423E+01 | 3.615E-01 | 8.591E-05 | 7.832E-11 | 7.140E-17 | 6.509E-23 | 5.934E-29 | 0. | 0. | 0. |
| 59 PR 146 | 2.967E-28 | 3.629E-46 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 60 ND 147 | 5.724E+07 | 5.376E+07 | 4.743E+07 | 4.184E+07 | 3.467E+07 | 2.534E+07 | 1.852E+07 | 1.354E+07 | 9.899E+06 | 1.510E+06 | 2.304E+05 | 8.184E+02 |
| 60 ND 149 | 1.675E-01 | 1.116E-05 | 4.961E-14 | 2.204E-22 | 6.529E-35 | 8.593E-56 | 1.131E-76 | 1.489E-97 | 1.959-118 | 0. | 0. | 0. |
| 61 PM 147 | 1.075E+07 | 1.079E+07 | 1.084E+07 | 1.089E+07 | 1.095E+07 | 1.102E+07 | 1.106E+07 | 1.108E+07 | 1.108E+07 | 1.094E+07 | 1.071E+07 | 1.004E+07 |
| 61 PM 148 | 1.807E+07 | 1.590E+07 | 1.231E+07 | 9.531E+06 | 6.503E+06 | 3.455E+06 | 1.853E+06 | 1.010E+06 | 5.641E+05 | 5.875E+04 | 2.964E+04 | 6.497E+03 |
| 61 PM 148M | 2.288E+06 | 2.250E+06 | 2.176E+06 | 2.104E+06 | 2.001E+06 | 1.840E+06 | 1.692E+06 | 1.555E+06 | 1.430E+06 | 8.644E+05 | 5.224E+05 | 1.153E+05 |
| 61 PM 149 | 2.378E+07 | 1.738E+07 | 9.289E+06 | 4.963E+06 | 1.938E+06 | 4.045E+05 | 8.442E+04 | 1.762E+04 | 3.676E+03 | 3.037E-01 | 2.508E-05 | 1.413E-17 |
| 61 PM 151 | 5.904E+06 | 3.286E+06 | 1.018E+06 | 3.153E+05 | 5.436E+04 | 2.903E+03 | 1.550E+02 | 8.277E+00 | 4.420E-01 | 1.025E-08 | 2.377E-16 | 0. |
| 61 PM 154 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 62 SM 151 | 2.615E+04 | 2.625E+04 | 2.633E+04 | 2.635E+04 | 2.636E+04 | 2.636E+04 | 2.636E+04 | 2.635E+04 | 2.635E+04 | 2.633E+04 | 2.632E+04 | 2.627E+04 |
| 62 SM 153 | 1.765E+07 | 1.236E+07 | 6.063E+06 | 2.973E+06 | 1.021E+06 | 1.720E+05 | 2.896E+04 | 4.878E+03 | 8.215E+02 | 1.875E-02 | 4.278E-07 | 5.083E-21 |
| 63 EU 154 | 5.943E+05 | 5.942E+05 | 5.939E+05 | 5.937E+05 | 5.933E+05 | 5.926E+05 | 5.920E+05 | 5.913E+05 | 5.907E+05 | 5.868E+05 | 5.829E+05 | 5.714E+05 |
| 63 EU 155 | 3.893E+05 | 3.892E+05 | 3.889E+05 | 3.886E+05 | 3.881E+05 | 3.874E+05 | 3.866E+05 | 3.859E+05 | 3.852E+05 | 3.808E+05 | 3.764E+05 | 3.637E+05 |
| 63 EU 156 | 1.248E+07 | 1.192E+07 | 1.088E+07 | 9.934E+06 | 8.663E+06 | 6.895E+06 | 5.488E+06 | 4.368E+06 | 3.477E+06 | 8.840E+05 | 2.248E+05 | 3.695E+03 |
| 64 GD 159 | 9.351E+04 | 3.823E+04 | 6.391E+03 | 1.068E+03 | 7.302E+01 | 8.343E-01 | 9.532E-03 | 1.089E-04 | 1.244E-06 | 2.768E-18 | 6.157E-30 | 0. |
| 92 U 239 | 2.878E-28 | 1.094E-46 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 93 NP 238 | 1.190E+07 | 8.579E+06 | 4.457E+06 | 2.315E+06 | 8.670E+05 | 1.687E+05 | 3.281E+04 | 6.384E+03 | 1.243E+03 | 1.775E+00 | 1.707E+00 | 1.705E+00 |
| 93 NP 239 | 1.111E+09 | 8.279E+08 | 4.596E+08 | 2.551E+08 | 1.055E+08 | 2.423E+07 | 5.563E+06 | 1.278E+06 | 2.941E+05 | 9.829E+02 | 9.400E+02 | 9.398E+02 |
| 93 NP 240 | 1.146E-07 | 2.456E-14 | 1.128E-27 | 5.180E-41 | 5.098E-61 | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 94 PU 241 | 8.229E+06 | 8.228E+06 | 8.226E+06 | 8.224E+06 | 8.220E+06 | 8.215E+06 | 8.209E+06 | 8.204E+06 | 8.199E+06 | 8.166E+06 | 8.134E+06 | 8.038E+06 |
| 94 PU 243 | 2.640E+04 | 9.196E+02 | 1.116E+00 | 1.362E-03 | 6.474E-06 | 6.416E-06 | 6.416E-06 | 6.416E-06 | 6.416E-06 | 6.416E-06 | 6.416E-06 | 6.416E-06 |
| 95 AM 244 | 1.199E+04 | 2.309E+03 | 8.565E+01 | 3.177E+00 | 2.270E-02 | 6.019E-06 | 1.596E-09 | 4.230E-13 | 1.121E-16 | 3.892E-38 | 1.351E-39 | 0. |
| 96 CM 242 | 2.313E+06 | 2.305E+06 | 2.286E+06 | 2.267E+06 | 2.238E+06 | 2.191E+06 | 2.145E+06 | 2.100E+06 | 2.056E+06 | 1.810E+06 | 1.593E+06 | 1.087E+06 |