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Rev. 0

# RESPONSE TO PUBLIC COMMENTS ON THE DRAFT SECTION 3116 DETERMINATION FOR SALT WASTE DISPOSAL AT THE SAVANNAH RIVER SITE

January 2006

**U. S. Department of Energy**
**Office of Environmental Management**

# LIST OF ACRONYMS

| | |
|---|---|
| ARP/MCU | Actinide Removal Process/Modular Modular Caustic Side Solvent Extraction Unit |
| CAB | Savannah River Site Citizens Advisory Board |
| CFR | Code of Federal Regulations |
| CSSX | Caustic Side Solvent Extraction |
| DDA | Deliquification Dissolution and Adjustment |
| DOE | Department of Energy |
| DWPF | Defense Waste Processing Facility |
| EPA | Environmental Protection Agency |
| FFT | Filter Feed Tank |
| HHW | High-Heat Waste |
| LHW | Low-Heat Waste |
| MMES | Martin Marietta Energy Systems, Inc. |
| MST | Monosodium Titanate |
| NRC | Nuclear Regulatory Commission |
| PA | Performance Assessment |
| PODD | Performance Objective Demonstration Document |
| RAI | Request for Additional Information |
| RCRA | Resource Conservation and Recovery Act |
| SA | Special Analysis |
| SCDHEC | South Carolina Department of Health and Environmental Control |
| SDF | Saltstone Disposal Facility |
| SPF | Saltstone Production Facility |
| SRNL | Savannah River National Laboratory |
| SRS | Savannah River Site |
| SWPF | Salt Waste Processing Facility |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TPB | Tetraphenylborate |
| TRU | Transuranic |
| WAC | Waste Acceptance Criteria |
| WSRC | Westinghouse Savannah River Company |

Introduction

Although not required by Section 3116, a Notice of Availability (NOA) of the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site (Salt Waste Determination) was published in the Federal Register on March 31, 2005 (FR Doc. 05-6459). The NOA announced that the Salt Waste Determination was available for public review and comment, both electronically via the internet and in DOE public reading rooms in Washington, DC and Aiken, SC. The deadline for submission of comments was initially May 16, 2005, but was subsequently extended to May 31, 2005.

The Department considered all of the comments that it received. Two messages received by email were not related to the Salt Waste Determination in any way, and so were not considered. Overall, approximately 32 comments were received from seven different entities, including:

- Three Public Interest Groups
- Two private citizens
- One regulatory agency
- One site-specific Citizen's Advisory Board

The comments ranged from detailed technical questions to programmatic questions, general process comments, and opposition to Section 3116 itself. The issues raised in the comments included:

- Removal of Radionuclides
- Tank 48 Waste
- Performance Assessments
- Opposition to Section 3116
- NEPA Coverage

DOE has responded to the comments seeking clarifications and additional information regarding the salt waste, the treatment process, and the disposal of waste by developing and/or providing additional information to the public and the NRC. Individual comments and DOE's responses to them can be found at http://apps.em.doe.gov/swd. The Secretary of Energy has fully considered these comments in the process of deciding to approve the Salt Waste Determination.

**BREDL Comment 1:** According to the proposed salt waste processing plan (see Figure 2.1 from the Draft Section 3116 Determination), about 3 million curies of this waste is to be stored indefinitely at the Saltstone Disposal Facility at SRS. The DOE intends this draft document to encompass the processing of the current waste volume via both the Interim Salt Process, to take place within this decade, and the high-capacity Salt Waste Process, to commence in 2009. However, an additional 41.3 million gallons of salt waste will be generated by the SRS Defense Waste Processing Facility by 2020. This too would be sent to the Salt Waste Processing Facility.

**WD Sections:** Section 2.1

**DOE Response:** As discussed on Section 2.1 of the *3116 Determination* [for] *Salt Waste Disposal* [at the] *Savannah River Site*, the quantities and percentages shown in Figure 2.1 reflect the radioactivity (i.e., curies) in the approximately 33.8 Mgal of salt waste currently stored in underground storage tanks at SRS.

DOE also anticipates processing an additional 41.3 Mgal of future waste which are not included in these estimates. DOE believes the inclusion of this waste will not appreciably affect the total curies to be disposed of in the Saltstone Disposal Facility (SDF). This is because the majority of this future waste is comprised of unconcentrated liquid recycle waste resulting from the operation of the Defense Waste Processing Facility (DWPF). The DWPF recycle waste stream is a generally very low-activity waste stream that consists of condensate from chemical processing and melter operation, waste from decontamination activities, and waste from miscellaneous drains and sumps in DWPF. The remainder of the future waste results from the stabilization of legacy nuclear materials in the H-Canyon Facility. The final curies disposed of in the SDF should be as shown in Figure 2.1.

**BREDL Comment 2:** The processing of salt wastes involves the evaporation of water and volatile liquids from the salt bearing supernate from the high-level nuclear waste tanks. The airborne emission of dangerous radionuclides has had and will continue to have a negative impact on the health of people living in the Central Savannah River Area, especially children and the unborn who are particularly vulnerable to radiation. Additional exposure to the region must be limited to be as low as reasonably achievable (ALARA), not merely to meet state and federal standards.

**WD Sections:** WD, Section 7.2.1

**DOE Response:** This comment asserts that airborne emission of radionuclides has had a negative impact on the health of area residents. Dose from SRS's airborne emissions has consistently been less than 1% of the Clean Air Act standard. SRS's emissions are monitored at their source and at the site boundary by SRS and by independent state agencies. Monitoring data from the various agencies is in agreement with SRS's data. Numerous studies have been conducted by various agencies on possible impacts of SRS on our neighbors' health (Brown et. al. 2002, Mamatey 2004). None of the studies substantiates the assertion made in the comment above.

The projected long-term performance of the Saltstone Disposal Facility (i.e., retardation of radionuclide migration) is documented in the *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility* (MMES 1992) and the *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits* (SA) (Cook et al. 2005). The *Saltstone Performance Objective Demonstration Document* (PODD) (Rosenberger et al. 2005), Section 4.0, uses the disposal limits from the SA (Table 7-2) and the projected radionuclide inventory to calculate the maximum annual dose to a member of the public from all saltstone disposal pathways of 2.3 mrem to the whole body, 4.6 mrem to the thyroid, and 5.3 mrem to any other organ. These doses are less than the Nuclear Regulatory Commission's performance objective limits of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ.

The dose calculated from the air pathway for this 3116 Determination is extremely low due to the relatively low concentrations of H-3 and C-14 in the waste. The Saltstone 2005 SA and the PODD calculate an estimated dose of approximately 0.003 mrem per year at both 1,000 years and 10,000 years after closure of SDF for the air pathway. This dose is included in the all pathways dose to the public noted above.

The use of the solidified saltstone waste form and the SDF vault design work together to reduce releases from SDF to the environment to very low levels as low as reasonably achievable.

**References:**

Brown, K. T., Crase, K. W., and Singh, L. P., 2002, *Summary of Epidemiology Studies or Activities Involving Workers at the Savannah River Site or the Surrounding Public: An Update*, ESH-WHS-2002-00005, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina

Mamatey, A. R., 2004, *Savannah River Site Environmental Report for 2003*, WSRC-TR-2004-00015, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina

Rosenberger, K. H., Rogers, B. C., and Cauthen, R. K., 2005, *Saltstone Performance Objective Demonstration Document*, CBU-PIT-2005-00146, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

**BREDL Comment 3:** The saltstone must remain in place for centuries, during which many earthquakes will have an impact on SRS. Removing salt waste from underground tanks and putting it in concrete vaults but still within an active seismic area simply does not make sense.

**WD Sections:** "Protection of the General Population," Section 7.1.2 and Section 7.2.4

**DOE Response:** The projected long-term performance of the Saltstone Disposal Facility (i.e., retardation of radionuclide migration) is documented in the *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility* (MMES 1992) and the *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits* (SA) (Cook et al. 2005). The SA includes the results of seismic evaluation of Vault 4, including effects of static settlement and earthquakes projected to occur over a period of 10,000 years (Sections A.2.1 and A.4).

The *Saltstone Performance Objective Demonstration Document* (Rosenberger et al. 2005), Section 4.0, uses the disposal limits from the SA (Table 7-2) and the projected radionuclide inventory to calculate the maximum annual dose to a member of the public from all saltstone disposal pathways of 2.3 mrem to the whole body, 4.6 mrem to the thyroid, and 5.3 mrem to any other organ. These doses are less than the Nuclear Regulatory Commission's performance objective limits of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ.

The Saltstone Disposal Facility will be protective of public health and the environment even though earthquakes may occur over the 10,000 year assessment period.

The site for Z-Area was chosen based on considerations of depth to water table, distance to surface water and the public, available surface area, and surface topography. Land within a 5-mile radius of the SDF is entirely within the boundaries of SRS. Historically, two major earthquakes have occurred within 100 miles of SRS. The largest known earthquake to affect SRS was the Charleston earthquake of 1886, with an epicenter approximately 90 miles from SRS and a magnitude of 6.6 on the Richter scale. It is estimated that an earthquake of this magnitude would result in a peak ground acceleration of 0.10 g at SRS. A seismic evaluation of Z-Area shows that the soils beneath Z-Area are not susceptible to significant liquefaction for earthquakes having a peak ground acceleration less than or equal to 0.17 g. The second earth earthquake occurred approximately 90 – 100 miles from SRS, with an estimated magnitude of 4.5.

**References:**

Cook, J. R., Wilhite, E. L, Hiergesell, R. A., and Flach, G. P., 2005, *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits*, WSRC-TR-2005-00074, Westinghouse Savannah River Company, Aiken, South Carolina.

MMES, 1992, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, Martin Marietta Energy Systems, Inc., EG&G Idaho, Westinghouse Hanford Company and Westinghouse Savannah River Company, Westinghouse Savannah River Company, Aiken, South Carolina.

**CAB**
**Comment 1:** SRS CAB remains concerned about the organic compounds (Benzene) in the Tank 48 waste and the safety impacts that could have on DWPF and the reduction of melter life.

**WD Sections:** "DDA Process", Section 2.1

**DOE Response:** This comment was provided to the Department as part of CAB Recommendation 211. The Department of Energy provided a written response to this comment and the other comments included in that recommendation in a memorandum from Jeffrey M. Allison, Manager, DOE-SR to Jean Sulc, Chairperson, SRS CAB (Allison 2005). This response is included in the Attachment.

Additional discussion of the potential impacts of organics from Tank 48 on downstream facilities can be found in DOE's response to the Nuclear Regulatory Commission's *Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (NRC 2005). Specifically, the response to RAI Comments 12, 13, 37, and 57 as attached to this document address this area of concern.

**References:**

Allison, J. M., 2005, *Citizens Advisory Board (CAB) Recommendation 211 Draft Salt Waste Determination*, SPD-05-215, US Department of Energy, Aiken, South Carolina

Citizens Advisory Board Recommendation 211, 2005, *Draft Salt Waste Determination*, Citizens Advisory Board, Aiken, South Carolina

NRC 2005, *Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Scott C. Flanders to Mark A. Gilbertson, Nuclear Regulatory Commission (NRC)

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

**CAB Comment 2:** SRS CAB questions what impacts the organics will have on Saltstone.

**WD Sections:** "Tank 48 Waste", Section 5.2.2.c

**DOE Response:** This comment was provided to the Department as part of CAB Recommendation 211. The Department of Energy provided a written response to this comment and the other comments included in that recommendation in a memorandum from Jeffrey M. Allison, Manager, DOE-SR to Jean Sulc, Chairperson, SRS CAB (Allison 2005). This response is included in the Attachment.

Additional discussion on Tank 48 waste and its impacts on the Saltstone Facility can be found in DOE's response to the Nuclear Regulatory Commission's *Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (NRC 2005). Specifically, the response to RAI Comments 37 and 57 attached (WSRC 2005) to this information. These responses are attached.

**References:**


Allison, J. M., 2005, *Citizens Advisory Board (CAB) Recommendation 211 Draft Salt Waste Determination*, SPD-05-215, US Department of Energy, Aiken, South Carolina

Citizens Advisory Board Recommendation 211, 2005, *Draft Salt Waste Determination*, Citizens Advisory Board, Aiken, South Carolina

NRC 2005, *Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Scott C. Flanders to Mark A. Gilbertson, Nuclear Regulatory Commission (NRC)

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

**CAB**
**Comment 3:** SRS CAB wants more detailed information on the Tank 48 processing strategy.

**WD Sections:** **"**Tank 48 Waste", Section 5.2.2.c

**DOE Response:** This comment was provided to the Department as part of CAB Recommendation 211. The Department of Energy provided a written response to this comment and the other comments included in that recommendation in a memorandum from Jeffrey M. Allison, Manager, DOE-SR to Jean Sulc, Chairperson, SRS CAB (Allison 2005). This response is included in the Attachment. DOE has also briefed the CAB's Waste Management Committee on the plans for Tank 48 subsequent to the submittal of this comment and expects to continue to keep the CAB informed of its plans through routine updates in the future.

Additional discussion on Tank 48 waste processing plans can be found in DOE's response to the Nuclear Regulatory Commission's *Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (NRC 2005). Specifically, the response to RAI Comments 12 and 13 (WSRC 2005) provide this information. These responses are attached.

**References:**


Allison, J. M., 2005, *Citizens Advisory Board (CAB) Recommendation 211 Draft Salt Waste Determination*, SPD-05-215, US Department of Energy, Aiken, South Carolina

Citizens Advisory Board Recommendation 211, 2005, *Draft Salt Waste Determination*, Citizens Advisory Board, Aiken, South Carolina

NRC 2005, *Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Scott C. Flanders to Mark A. Gilbertson, Nuclear Regulatory Commission (NRC)

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

Rosenberger, K.H., Rogers, B.C. & Cauthen, R. K. ., June 2005, *"Saltstone Performance Objective Demonstration Document,"* CBU-PIT-2005-00146, Westinghouse Savannah River Company, Aiken, South Carolina, Revision 0, June 2005.

Department of Energy, 2005 *"Draft Section 3116 Determination Salt Waste Disposal, Savannah River Site"*, DOE-WD-2005-001, February 2005.

**CAB Comment 4:** SRS CAB remains concerned about the uncertainty associated with the ultimate curie content of the waste going to SDF. The current estimate is 3MCi but based upon the uncertainties associated with characterization of the saltcake waste it could be as high as 5 MCi. Of particular concern is that DOE will work with SCDHEC to assure flexibility in operating the Saltstone Disposal Facility to accommodate disposal of between 3 MCi and 5 MCi. The SRS CAB believes that flexibility is needed to allow for this potential fluctuation.

**WD Sections:** "Background", Section 2

**DOE Response:** This comment was provided to the Department as part of CAB Recommendation 211. The Department of Energy provided a written response to this comment and the other comments included in that recommendation in a memorandum from Jeffrey M. Allison, Manager, DOE-SR to Jean Sulc, Chairperson, SRS CAB (Allison 2005). This response is included in the Attachment. Additional discussion may be found in Section 9 of the *Interim Salt Processing Strategy Planning Baseline* (Mahoney and d'Entremont 2004). Section 9 discusses in detail the major assumptions, bases, and risks associated with SRS's interim salt processing strategy. It provides information on the selection of salt tanks for potential treatment by the DDA process, SRS's salt waste characterization processes, and the risks and uncertainties related to these activities.

**References:**


Allison, J. M., 2005, *Citizens Advisory Board (CAB) Recommendation 211 Draft Salt Waste Determination*, SPD-05-215, US Department of Energy, Aiken, South Carolina

Citizens Advisory Board Recommendation 211, 2005, *Draft Salt Waste Determination*, Citizens Advisory Board, Aiken, South Carolina

Mahoney, M. J. and d'Entremont, P. D., 2004, *Interim Salt Processing Strategy Planning Baseline*, CBU-PED-2004-00027, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

**DHEC**
**Comment 1:** Tank 48 waste is not specifically represented in Figures 2.1 and 2.2. It is understood from the text that 0.24 Mgal of 0.8 MCi of salt waste containing TPB from Tank 48 will be sent to SDF. Is Tank 48 waste included in the 3 to 5 MCi estimate?

**WD Sections:** Section 2.1

**DOE Response:** Although not explicitly shown, Figures 2.1 and 2.2 of the *3116 Determination [for] Salt Waste Disposal [at the] Savannah River Site* include the 0.24 Mgal and 0.8 MCi of Tank 48 waste to be disposed at the Saltstone Disposal Facility (SDF) through the Deliquification, Dissolution, and Adjustment (DDA) process. The 3 to 5 MCi estimate includes the 0.8 MCi contribution from the Tank 48 waste.

Additional information on the planned disposal volumes shown in Figure 2.2 may be found in *Decontaminated Salt Solution Volume to Be Transferred to the Saltstone Disposal Facility from Salt Treatment and Disposition Activities* (Rios-Armstrong 2005).

Also, Table 8-1 of the *Interim Salt Processing Strategy Planning Baseline* (Mahoney and d'Entremont 2004) provides a breakdown of the curies that will be sent to the SDF.

**References:**

Mahoney, M. J. and d'Entremont, P. D., 2004, *Interim Salt Processing Strategy Planning Baseline*, CBU-PED-2004-00027, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Rios-Armstrong, M. A., 2005, *Decontaminated Salt Solution Volume To Be Transferred To The Saltstone Disposal Facility From Salt Treatment And Disposition Activities*, CBU-PIT-2005-00031, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

**DHEC Comment 2:** It is stated that Tank 48 waste will be combined with DWPF recycle to ensure the processing limits for allowable organic content at SPF are not exceeded. Waste Tank 48 waste is characteristically hazardous at the time of generation (or is it at present)? If so, will it meet LDR limits for underlying constituents prior to disposal?

**WD Sections:** Section 2.1

**DOE Response:** The current *Waste Acceptance Criteria* (WAC) *for Aqueous Waste Sent to the Z-Area Saltstone Production Facility* (SPF) (Chandler 2004) lists the following criterion:

> The transfer of aqueous waste to the Saltstone Facility that would result in the saltstone being classified as hazardous waste, as designated by South Carolina Hazardous Waste Management regulations or the EPA, is strictly prohibited.

The Saltstone Disposal Facility (SDF) is permitted as a non-hazardous landfill by the State of South Carolina. Thus, only material deemed non-hazardous in accordance with Resource Conservation and Recovery Act (RCRA) regulations may be placed in the disposal vaults. Testing performed to date indicates that the presence of tetraphenylborate (TPB) at concentrations in compliance with the current WAC limits have met the Toxicity Characteristic Leaching Procedure (TCLP) requirements, resulting in the saltstone grout being classified as non-hazardous. These results will be documented in the future as part of the process for demonstrating that waste containing Tank 48 material meets the applicable requirements for disposal as a non-hazardous waste.

However, in order to process the Tank 48 waste consistent with the interim processing strategy, the WAC limits for TPB will have to be increased. Tank 48 currently holds legacy material containing organic TPB compounds from the operation of the In-Tank Precipitation process. Therefore, the TPB levels during processing of Tank 48 waste are expected to be higher than the currently approved permit limits for organics. Any changes to increase the limits for organics will require verification that the non-hazardous nature of the waste form is not changed by the increase in organic limits. Any changes will also require changes to the Saltstone permit tables.

Testing has indicated that if sufficient amounts of the TPB solids are allowed to decompose, the non-hazardous classification of the final saltstone product may be challenged. Therefore, additional testing is ongoing to determine what process limitations or new requirements must be placed on the SPF to process the Tank 48 waste in order to limit the decomposition of the TPB solids. These process limitations and requirements may include such parameters as processing rates to limit temperature in the curing grout, TPB concentration limits in the feed stream, waste stream chemical composition, system flushing requirements, and ventilation requirements. The Tank 48 waste will not be processed and disposed of in the Saltstone Facility until the process limitations are identified that will ensure the non-hazardous classification of the grouted waste and any necessary changes to the Saltstone permits are reviewed and approved by SCDHEC.

**References:**

Chandler, T.E., 2004, *Waste Acceptance Criteria for Aqueous Waste Sent to the Z-Area Saltstone Production Facility*, X-SD-Z-00001, Rev. 2, Westinghouse Savannah River Company, Aiken, South Carolina

**DHEC Comment 3:** Though it is stated in the text that ARP/MCU will process waste that has undergone DDA, Figure 2.1: Salt Processing Pathways does not depict this.

**WD Sections:** Section 2.1

**DOE Response:** Although not explicitly stated, Figure 2.1 depicts the curies removed by a given process that receive no further treatment prior to being processed at the Saltstone Production Facility (SPF). As stated in the text, the saltcake that is to be treated through the ARP/MCU process will have undergone the Deliquification, Dissolution, and Adjustment (DDA) process prior to treatment through ARP/MCU. A footnote will be added to Figure 2.1 to clarify that waste processed through ARP/MCU will also have undergone DDA treatment.

**DHEC Comment 4:** Figure 2.2: Salt Processing Volumes shows the volumes of waste and grout from each process. Do the grout volumes shown going to SDF include the waste volumes shown going to SPF? If so, the ratio of grout to waste appears to be about 1:2. If not, the ratio of grout to waste appears to be about 1.5:1. It is stated in the document that the grout is mixed with the waste in a 1:1 ratio. Please clarify the relationship between the volumes of waste and grout.

**WD Sections:** Section 2.1

**DOE Response:** The reason for the difference between the ratios shown in Figure 2.2 and the 1:1 ratio referred to in the text is that one represents a volume ratio and the other a mass ratio.

In Figure 2.2 of the *3116 Determination [for] Salt Waste Disposal [at the] Savannah River Site*, the grout volumes shown going to the Saltstone Disposal Facility (SDF) include the volume of waste fed to the Saltstone Production Facility (SPF). The grout volumes in Figure 2.2 were calculated using the ratio of 1.564 gallons of grout to the SDF per gallon of salt solution fed to the SPF (Rios-Armstrong 2005). *Radionuclide Concentrations in Saltstone* (d'Entremont and Drumm 2005) contains further information about the derivation of this ratio.

Prior to disposal at the SDF, the salt solution will be mixed with dry chemicals in the approximate mass ratio of 1:1 in the SPF. This ratio is derived from the fact that the saltstone is nominally 47% salt solution by mass. The nominal composition for saltstone grout is as follows (MMES 1992):

| | |
|---|---|
| Portland cement Type II | 3 wt% |
| Fly Ash | 25 wt% |
| Slag | 25 wt% |
| Salt Solution | 47 wt% |

**References:**


d'Entremont, P. D., and Drumm, M. D., 2005, *Radionuclide Concentrations in Saltstone*, CBU-PIT-2005-00013, Revision 3, p. 14, Westinghouse Savannah River Company, Aiken, South Carolina

MMES, 1992, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, p. 2-38, Martin Marietta Energy Systems, Inc., EG&G Idaho, Westinghouse Hanford Company and Westinghouse Savannah River Company, Westinghouse Savannah River Company, Aiken, South Carolina

Rios-Armstrong, M. A., 2005, *Decontaminated Salt Solution Volume to be Transferred to the Saltstone Disposal Facility from Salt Treatment and Disposition Activities*, CBU-PIT-2005-00031, Westinghouse Savannah River Company, Aiken, South Carolina

**DHEC Comment 5:** What are the concentrations of all radionuclides in the salt waste before and after mixing with grout for each process (Tank 48, DDA, ARP/MCU, SWPF)?

**WD Sections:** Section 5.0

**DOE Response:** d'Entremont and Drumm (2005) have calculated the concentrations of radionuclides in the salt waste before and after mixing with grout for each process. Table A-9 of *Radionuclide Concentrations in Saltstone* includes the batch-by-batch radionuclide concentrations in the waste streams projected to be sent to the Saltstone Production Facility (SPF) from the Deliquification, Dissolution, and Adjustment (DDA) process during the Interim Salt Processing phase. In Table A-9, Batches 2 and 3 are the concentrations resulting from the aggregation of waste currently in Tank 48 with recycle from the Defense Waste Processing Facility (DWPF).

The average concentration of the DDA, ARP/MCU, and SWPF waste streams sent to the Saltstone Disposal Facility (SDF) are documented in Table A-12 of d'Entremont and Drumm 2005. In Table A-12, Tank 48 is included in the values for the DDA waste stream.

Tables 3.1 through 3.6 of *Radionuclide Concentrations in Saltstone* depict the estimated concentrations of the radionuclides specified in 10 CFR 61.55 for the solidified waste resulting from the DDA, ARP/MCU, and SWPF processes.

For the radionuclide concentrations not specified in 10 CFR 61.55, the concentrations in the grouted waste can be calculated on a batch-by-batch basis and average basis by dividing the concentrations in Tables A-9 and A-12 of the referenced document by a value of 1.564. This number is the ratio of saltstone grout volume per gallon of salt solution feed (d'Entremont and Drumm 2005). Tables 1 and 2 below show the results of these calculations.

Table 1: Interim Strategy Saltstone Batch Concentrations after Mixing with Grout

| Ci/gal | Batch 0 | Batch 1 | Batch 2 | Batch 3 | Batch 4 | Batch 5 | Batch 6 | Batch 7 | Batch 8 | Batch 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| H-3 | 8.54E-06 | 1.78E-04 | 2.32E-04 | 2.62E-04 | 1.51E-04 | 1.52E-04 | 7.84E-05 | 5.38E-05 | 1.82E-04 | 7.69E-05 |
| C-14 | 2.57E-08 | 4.90E-06 | 4.09E-06 | 4.61E-06 | 4.97E-06 | 4.96E-06 | 4.51E-06 | 5.05E-06 | 3.20E-06 | 5.05E-06 |
| Co-60 | 1.28E-08 | 5.14E-06 | 2.39E-06 | 2.70E-06 | 4.19E-06 | 4.17E-06 | 8.08E-07 | 2.76E-06 | 1.88E-06 | 2.79E-06 |
| Ni-59 | 3.44E-13 | 1.69E-08 | 2.73E-09 | 1.93E-09 | 3.45E-08 | 3.41E-08 | 9.48E-09 | 7.64E-08 | 5.36E-09 | 7.02E-08 |
| Ni-63 | 3.97E-08 | 5.82E-06 | 5.81E-06 | 6.55E-06 | 6.87E-06 | 6.86E-06 | 1.96E-06 | 8.79E-06 | 4.55E-06 | 8.64E-06 |
| Se-79 | 1.28E-11 | 1.04E-07 | 1.01E-07 | 7.15E-08 | 1.03E-07 | 1.02E-07 | 3.51E-07 | 1.45E-08 | 1.99E-07 | 5.84E-08 |
| Sr-90 | 4.00E-09 | 8.41E-04 | 9.32E-05 | 6.58E-05 | 6.36E-04 | 6.28E-04 | 1.10E-04 | 4.10E-04 | 6.23E-05 | 3.84E-04 |
| Y-90 | 4.00E-09 | 8.41E-04 | 9.32E-05 | 6.58E-05 | 6.36E-04 | 6.28E-04 | 1.10E-04 | 4.10E-04 | 6.23E-05 | 3.84E-04 |
| Nb-94 | 1.00E-16 | 2.73E-12 | 7.95E-13 | 5.62E-13 | 2.96E-12 | 2.92E-12 | 2.76E-12 | 3.41E-12 | 1.56E-12 | 3.43E-12 |
| Tc-99 | 4.73E-09 | 3.46E-05 | 3.75E-05 | 2.65E-05 | 3.51E-05 | 3.47E-05 | 1.30E-04 | 3.16E-06 | 7.37E-05 | 1.96E-05 |
| Ru-106 | 3.26E-10 | 2.37E-06 | 2.58E-06 | 1.83E-06 | 2.46E-06 | 2.43E-06 | 8.99E-06 | 3.67E-07 | 5.08E-06 | 1.49E-06 |
| Rh-106 | 3.26E-10 | 2.37E-06 | 2.58E-06 | 1.83E-06 | 2.46E-06 | 2.43E-06 | 8.99E-06 | 3.67E-07 | 5.08E-06 | 1.49E-06 |
| Sb-125 | 1.32E-09 | 1.01E-05 | 1.05E-05 | 7.41E-06 | 1.10E-05 | 1.08E-05 | 3.64E-05 | 3.80E-06 | 2.06E-05 | 8.13E-06 |
| Sn-126 | 6.45E-11 | 4.79E-07 | 5.11E-07 | 3.62E-07 | 4.87E-07 | 4.81E-07 | 1.78E-06 | 5.33E-08 | 1.00E-06 | 2.77E-07 |
| I-129 | 5.20E-09 | 1.87E-08 | 2.14E-08 | 1.58E-08 | 1.92E-08 | 1.90E-08 | 7.05E-08 | 1.96E-09 | 1.33E-08 | 1.10E-08 |
| Cs-134 | 1.56E-08 | 2.37E-04 | 2.58E-04 | 1.83E-04 | 2.41E-04 | 2.39E-04 | 7.48E-05 | 2.10E-05 | 4.23E-05 | 1.35E-04 |
| Cs-135 | 5.30E-08 | 4.03E-07 | 4.39E-07 | 3.10E-07 | 4.10E-07 | 4.05E-07 | 1.27E-07 | 3.58E-08 | 7.19E-08 | 2.29E-07 |
| Cs-137 | 1.62E-05 | 1.18E-01 | 1.29E-01 | 9.11E-02 | 1.20E-01 | 1.19E-01 | 3.73E-02 | 1.05E-02 | 2.11E-02 | 6.71E-02 |
| Ba-137m | 1.54E-05 | 1.12E-01 | 1.22E-01 | 8.62E-02 | 1.14E-01 | 1.12E-01 | 3.53E-02 | 9.93E-03 | 2.00E-02 | 6.35E-02 |
| Ce-144 | 8.50E-13 | 6.21E-09 | 6.73E-09 | 4.77E-09 | 2.90E-08 | 2.86E-08 | 2.34E-08 | 7.43E-08 | 1.32E-08 | 7.01E-08 |
| Pr-144 | 8.50E-13 | 6.21E-09 | 6.73E-09 | 4.76E-09 | 2.90E-08 | 2.86E-08 | 2.34E-08 | 7.43E-08 | 1.32E-08 | 7.01E-08 |
| Pm-147 | 5.50E-10 | 1.69E-05 | 4.36E-06 | 3.08E-06 | 2.81E-05 | 2.78E-05 | 1.51E-05 | 5.38E-05 | 8.57E-06 | 5.05E-05 |
| Eu-154 | 1.30E-10 | 1.42E-05 | 1.03E-06 | 7.31E-07 | 9.66E-06 | 9.55E-06 | 3.59E-06 | 2.80E-06 | 2.03E-06 | 2.99E-06 |
| Th-232 | 1.06E-12 | 4.32E-13 | 5.49E-13 | 6.51E-13 | 3.65E-13 | 3.68E-13 | 1.00E-13 | 1.42E-13 | 2.47E-14 | 1.92E-13 |
| U-232 | 1.22E-16 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 6.44E-12 | 6.36E-12 | 4.88E-16 | 2.09E-11 | 2.05E-15 | 1.89E-11 |
| U-233 | 9.41E-14 | 1.36E-08 | 2.74E-07 | 2.01E-07 | 1.15E-08 | 1.16E-08 | 3.17E-09 | 4.48E-09 | 7.78E-10 | 6.05E-09 |
| U-234 | 1.33E-14 | 3.49E-08 | 8.97E-07 | 6.41E-07 | 2.44E-08 | 2.43E-08 | 3.38E-09 | 4.78E-09 | 8.31E-10 | 6.46E-09 |
| U-235 | 1.75E-10 | 4.67E-10 | 8.83E-10 | 7.64E-10 | 3.53E-10 | 3.53E-10 | 5.37E-11 | 1.36E-10 | 1.32E-11 | 1.57E-10 |
| U-236 | 2.18E-10 | 8.52E-09 | 3.03E-08 | 2.30E-08 | 5.72E-09 | 5.70E-09 | 6.20E-10 | 8.85E-10 | 1.52E-10 | 1.19E-09 |
| U-238 | 9.27E-09 | 1.38E-09 | 2.32E-09 | 2.47E-09 | 3.38E-09 | 3.37E-09 | 3.18E-10 | 7.68E-09 | 7.87E-11 | 7.13E-09 |
| Np-237 | 3.42E-14 | 7.30E-08 | 7.14E-08 | 5.78E-08 | 4.63E-08 | 4.60E-08 | 2.81E-09 | 3.99E-09 | 6.89E-10 | 5.38E-09 |
| Pu-238 | 2.44E-08 | 4.06E-04 | 5.17E-04 | 4.09E-04 | 2.71E-04 | 2.69E-04 | 1.69E-05 | 6.23E-05 | 4.14E-06 | 6.69E-05 |
| Pu-239 | 1.55E-07 | 1.06E-06 | 2.12E-06 | 2.15E-06 | 2.75E-06 | 2.74E-06 | 2.48E-07 | 6.38E-06 | 6.14E-08 | 5.92E-06 |
| Pu-240 | 1.68E-09 | 3.62E-07 | 4.61E-07 | 5.47E-07 | 7.20E-07 | 7.18E-07 | 8.44E-08 | 1.47E-06 | 2.08E-08 | 1.38E-06 |

| Ci/gal | Batch 0 | Batch 1 | Batch 2 | Batch 3 | Batch 4 | Batch 5 | Batch 6 | Batch 7 | Batch 8 | Batch 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pu-241 | 2.46E-11 | 6.36E-06 | 8.09E-06 | 9.60E-06 | 1.51E-05 | 1.51E-05 | 1.48E-06 | 3.38E-05 | 3.67E-07 | 3.15E-05 |
| Pu-242 | 9.28E-16 | 4.06E-11 | 5.16E-11 | 6.13E-11 | 1.17E-10 | 1.16E-10 | 9.45E-12 | 2.82E-10 | 2.35E-12 | 2.60E-10 |
| Am-241 | 9.85E-09 | 1.01E-06 | 4.12E-07 | 2.92E-07 | 1.18E-06 | 1.17E-06 | 1.43E-06 | 1.40E-06 | 8.11E-07 | 1.44E-06 |
| Am-242m | 3.00E-14 | 9.92E-10 | 2.38E-10 | 1.68E-10 | 6.81E-10 | 6.73E-10 | 8.27E-10 | 1.94E-11 | 4.68E-10 | 1.24E-10 |
| Cm-244 | 1.14E-09 | 1.60E-07 | 1.65E-07 | 1.17E-07 | 1.59E-07 | 1.57E-07 | 5.74E-07 | 1.38E-08 | 3.25E-07 | 8.65E-08 |
| Cm-245 | 2.05E-15 | 1.56E-11 | 1.63E-11 | 1.15E-11 | 1.56E-11 | 1.54E-11 | 5.66E-11 | 1.32E-12 | 3.20E-11 | 8.48E-12 |
| Na-22 | 2.90E-10 | 1.66E-05 | 2.30E-06 | 1.63E-06 | 2.10E-05 | 2.07E-05 | 3.36E-05 | 3.36E-05 | 4.52E-06 | 3.14E-05 |
| Al-26 | 1.85E-12 | 6.40E-08 | 1.47E-08 | 1.04E-08 | 7.96E-08 | 7.87E-08 | 1.41E-07 | 1.18E-07 | 2.89E-08 | 1.13E-07 |
| Te-125m | 3.23E-10 | 2.46E-06 | 2.56E-06 | 1.81E-06 | 2.68E-06 | 2.65E-06 | 8.89E-06 | 9.29E-07 | 5.03E-06 | 1.98E-06 |
| Sb-126 | 9.03E-12 | 6.71E-08 | 7.15E-08 | 5.06E-08 | 6.82E-08 | 6.74E-08 | 2.49E-07 | 7.46E-09 | 1.41E-07 | 3.88E-08 |
| Sb-126m | 6.45E-11 | 4.79E-07 | 5.11E-07 | 3.62E-07 | 4.87E-07 | 4.81E-07 | 1.78E-06 | 5.33E-08 | 1.00E-06 | 2.77E-07 |
| Sm-151 | 6.16E-10 | 4.04E-05 | 4.88E-06 | 3.46E-06 | 3.29E-05 | 3.25E-05 | 1.70E-05 | 2.33E-05 | 9.60E-06 | 2.32E-05 |
| Eu-152 | 2.98E-12 | 1.96E-07 | 2.36E-08 | 1.67E-08 | 1.59E-07 | 1.57E-07 | 8.21E-08 | 1.13E-07 | 4.65E-08 | 1.12E-07 |
| Eu-155 | 3.48E-11 | 2.29E-06 | 2.76E-07 | 1.95E-07 | 1.86E-06 | 1.84E-06 | 9.59E-07 | 1.32E-06 | 5.43E-07 | 1.31E-06 |
| Ra-226 | 2.99E-20 | 6.03E-08 | 2.02E-12 | 1.45E-12 | 3.57E-08 | 3.53E-08 | 7.62E-15 | 1.08E-14 | 1.87E-15 | 1.46E-14 |
| Ra-228 | 1.06E-12 | 4.32E-13 | 5.49E-13 | 6.51E-13 | 3.65E-13 | 3.68E-13 | 1.00E-13 | 1.42E-13 | 2.47E-14 | 1.92E-13 |
| Ac-227 | 3.98E-14 | 1.06E-13 | 2.02E-13 | 1.74E-13 | 8.06E-14 | 8.06E-14 | 1.22E-14 | 3.11E-14 | 3.01E-15 | 3.58E-14 |
| Th-229 | 2.68E-16 | 3.87E-11 | 7.78E-10 | 5.72E-10 | 3.27E-11 | 3.30E-11 | 9.02E-12 | 1.27E-11 | 2.21E-12 | 1.72E-11 |
| Th-230 | 3.66E-18 | 1.69E-10 | 2.47E-10 | 1.77E-10 | 1.01E-10 | 9.98E-11 | 9.33E-13 | 1.32E-12 | 2.29E-13 | 1.78E-12 |
| Pa-231 | 1.11E-13 | 2.96E-13 | 5.60E-13 | 4.84E-13 | 2.24E-13 | 2.24E-13 | 3.40E-14 | 8.62E-14 | 8.36E-15 | 9.94E-14 |
| Pu-244 | 2.96E-12 | 1.86E-13 | 2.36E-13 | 2.80E-13 | 5.34E-13 | 5.31E-13 | 4.32E-14 | 1.29E-12 | 1.07E-14 | 1.19E-12 |
| Am-243 | 9.96E-15 | 6.54E-10 | 7.89E-11 | 5.58E-11 | 5.32E-10 | 5.26E-10 | 2.74E-10 | 3.76E-10 | 1.55E-10 | 3.75E-10 |
| Cm-242 | 2.46E-14 | 8.24E-10 | 1.95E-10 | 1.38E-10 | 5.64E-10 | 5.57E-10 | 6.78E-10 | 1.59E-11 | 3.84E-10 | 1.02E-10 |
| Cm-243 | 5.83E-15 | 3.83E-10 | 4.62E-11 | 3.27E-11 | 3.11E-10 | 3.08E-10 | 1.61E-10 | 2.20E-10 | 9.09E-11 | 2.20E-10 |
| Cm-247 | 1.12E-24 | 7.37E-20 | 8.90E-21 | 6.30E-21 | 6.00E-20 | 5.93E-20 | 3.10E-20 | 4.25E-20 | 1.75E-20 | 4.23E-20 |
| Cm-248 | 1.17E-24 | 7.68E-20 | 9.28E-21 | 6.56E-21 | 6.25E-20 | 6.18E-20 | 3.23E-20 | 4.42E-20 | 1.82E-20 | 4.41E-20 |
| Bk-249 | 8.56E-32 | 5.62E-27 | 6.78E-28 | 4.80E-28 | 4.57E-27 | 4.52E-27 | 2.36E-27 | 3.23E-27 | 1.33E-27 | 3.22E-27 |
| Cf-249 | 6.49E-24 | 4.26E-19 | 5.14E-20 | 3.64E-20 | 3.47E-19 | 3.43E-19 | 1.79E-19 | 2.45E-19 | 1.01E-19 | 2.44E-19 |
| Cf-251 | 2.22E-25 | 1.46E-20 | 1.76E-21 | 1.25E-21 | 1.19E-20 | 1.17E-20 | 6.12E-21 | 8.39E-21 | 3.46E-21 | 8.36E-21 |
| Cf-252 | 7.21E-27 | 4.73E-22 | 5.71E-23 | 4.04E-23 | 3.85E-22 | 3.80E-22 | 1.99E-22 | 2.72E-22 | 1.12E-22 | 2.71E-22 |
| Vol (kgal) | 750 | 1,250 | 775 | 1,800 | 1,140 | 1,135 | 1,440 | 1,225 | 1,400 | 1,230 |

Table 2: Average Saltstone Concentrations after Mixing with Grout

| Ci/gal | DDA | ARP/MCU | SWPF | Total |
|---|---|---|---|---|
| H-3 | 1.49E-04 | 1.29E-04 | 4.42E-05 | 5.55E-05 |
| C-14 | 4.44E-06 | 3.87E-06 | 2.91E-06 | 3.07E-06 |
| Co-60 | 3.17E-06 | 1.33E-06 | 3.84E-07 | 6.49E-07 |
| Ni-59 | 3.06E-08 | 7.45E-09 | 1.56E-08 | 1.67E-08 |
| Ni-63 | 6.51E-06 | 3.24E-06 | 9.37E-07 | 1.48E-06 |
| Se-79 | 7.09E-08 | 2.76E-07 | 5.79E-07 | 5.28E-07 |
| Sr-90 | 3.93E-04 | 8.65E-05 | 8.89E-06 | 4.40E-05 |
| Y-90 | 3.93E-04 | 8.65E-05 | 8.89E-06 | 4.40E-05 |
| Nb-94 | 2.16E-12 | 2.17E-12 | 4.55E-12 | 4.28E-12 |
| Tc-99 | 2.45E-05 | 1.02E-04 | 2.15E-04 | 1.95E-04 |
| Ru-106 | 1.73E-06 | 7.06E-06 | 1.48E-05 | 1.35E-05 |
| Rh-106 | 1.73E-06 | 7.06E-06 | 1.48E-05 | 1.35E-05 |
| Sb-125 | 7.90E-06 | 2.86E-05 | 6.01E-05 | 5.47E-05 |
| Sn-126 | 3.39E-07 | 1.40E-06 | 2.93E-06 | 2.67E-06 |
| I-129 | 1.41E-08 | 4.23E-08 | 1.16E-07 | 1.05E-07 |
| Cs-134 | 1.68E-04 | 5.88E-05 | 3.70E-08 | 1.61E-05 |
| Cs-135 | 2.90E-07 | 9.99E-08 | 6.29E-11 | 2.77E-08 |
| Cs-137 | 8.37E-02 | 2.93E-02 | 1.84E-05 | 8.00E-03 |
| Ba-137m | 7.92E-02 | 2.77E-02 | 1.75E-05 | 7.57E-03 |
| Ce-144 | 2.84E-08 | 1.84E-08 | 3.86E-08 | 3.72E-08 |
| Pr-144 | 2.84E-08 | 1.84E-08 | 3.86E-08 | 3.72E-08 |
| Pm-147 | 2.38E-05 | 1.19E-05 | 2.49E-05 | 2.45E-05 |
| Eu-154 | 5.25E-06 | 2.82E-06 | 5.91E-06 | 5.77E-06 |
| Th-232 | 4.48E-13 | 6.31E-14 | 6.93E-10 | 6.15E-10 |
| U-232 | 6.82E-12 | 1.26E-15 | 1.42E-10 | 1.27E-10 |
| U-233 | 6.77E-08 | 1.99E-09 | 8.17E-09 | 1.31E-08 |
| U-234 | 2.11E-07 | 2.12E-09 | 5.56E-09 | 2.32E-08 |
| U-235 | 4.23E-10 | 3.37E-11 | 3.84E-10 | 3.78E-10 |
| U-236 | 9.81E-09 | 3.90E-10 | 1.06E-09 | 1.79E-09 |
| U-238 | 4.38E-09 | 2.00E-10 | 3.34E-08 | 3.00E-08 |
| Np-237 | 3.94E-08 | 1.76E-09 | 1.02E-08 | 1.25E-08 |
| Pu-238 | 2.60E-04 | 1.06E-05 | 6.53E-05 | 8.06E-05 |
| Pu-239 | 3.04E-06 | 1.56E-07 | 4.07E-06 | 3.88E-06 |
| Pu-240 | 7.44E-07 | 5.30E-08 | 1.09E-06 | 1.04E-06 |
| Pu-241 | 1.57E-05 | 9.32E-07 | 4.54E-05 | 4.16E-05 |
| Pu-242 | 1.22E-10 | 5.95E-12 | 1.14E-09 | 1.02E-09 |
| Am-241 | 8.89E-07 | 1.13E-06 | 5.14E-07 | 5.62E-07 |
| Am-242m | 3.70E-10 | 6.50E-10 | 2.96E-10 | 3.12E-10 |
| Cm-244 | 1.10E-07 | 4.51E-07 | 5.57E-07 | 5.16E-07 |
| Cm-245 | 1.08E-11 | 4.45E-11 | 5.49E-11 | 5.08E-11 |
| Na-22 | 1.64E-05 | 1.92E-05 | 3.15E-05 | 2.99E-05 |
| Al-26 | 6.17E-08 | 8.55E-08 | 1.48E-07 | 1.39E-07 |
| Te-125m | 1.93E-06 | 6.99E-06 | 1.47E-05 | 1.34E-05 |
| Sb-126 | 4.75E-08 | 1.95E-07 | 4.10E-07 | 3.73E-07 |
| Sb-126m | 3.39E-07 | 1.40E-06 | 2.93E-06 | 2.67E-06 |

| Ci/gal | DDA | ARP/MCU | SWPF | Total |
|---|---|---|---|---|
| Sm-151 | 2.06E-05 | 1.33E-05 | 2.80E-05 | 2.69E-05 |
| Eu-152 | 9.98E-08 | 6.45E-08 | 1.35E-07 | 1.30E-07 |
| Eu-155 | 1.17E-06 | 7.54E-07 | 1.58E-06 | 1.52E-06 |
| Ra-226 | 1.68E-08 | 4.79E-15 | 8.49E-08 | 7.68E-08 |
| Ra-228 | 4.48E-13 | 6.31E-14 | 6.93E-10 | 6.15E-10 |
| Ac-227 | 9.65E-14 | 7.69E-15 | 1.18E-13 | 1.13E-13 |
| Th-229 | 1.93E-10 | 5.66E-12 | 3.14E-11 | 4.46E-11 |
| Th-230 | 1.02E-10 | 5.86E-13 | 2.26E-10 | 2.09E-10 |
| Pa-231 | 2.68E-13 | 2.14E-14 | 3.28E-13 | 3.15E-13 |
| Pu-244 | 7.94E-13 | 2.72E-14 | 5.24E-12 | 4.72E-12 |
| Am-243 | 3.34E-10 | 2.16E-10 | 9.82E-11 | 1.22E-10 |
| Cm-242 | 3.06E-10 | 5.33E-10 | 6.57E-10 | 6.24E-10 |
| Cm-243 | 1.95E-10 | 1.26E-10 | 1.56E-10 | 1.58E-10 |
| Cm-247 | 3.76E-20 | 2.43E-20 | 3.00E-20 | 3.05E-20 |
| Cm-248 | 3.92E-20 | 2.54E-20 | 3.12E-20 | 3.18E-20 |
| Bk-249 | 2.87E-27 | 1.85E-27 | 3.88E-27 | 3.74E-27 |
| Cf-249 | 2.17E-19 | 1.41E-19 | 2.94E-19 | 2.84E-19 |
| Cf-251 | 7.44E-21 | 4.81E-21 | 1.01E-20 | 9.71E-21 |
| Cf-252 | 2.41E-22 | 1.56E-22 | 3.27E-22 | 3.15E-22 |
| Vol (kgal) | 9,305 | 2,840 | 95,800 | 107,945 |

**References:**

d'Entremont, P. D., and Drumm, M. D., 2005, *Radionuclide Concentrations in Saltstone*, CBU-PIT-2005-00013, Revision 3, Westinghouse Savannah River Company, Aiken, South Carolina

**DHEC**
**Comment 6:** On page 15, it is stated that the actinides and strontium are predominantly insoluble in the salt waste so the settling process is expected to remove a significant portion. What is considered a significant portion? Please provide an estimate of the amount expected to settle. How long will the salt solution be held in the settling tank? What is the relationship between settling time and removal of radionuclides? How will removal of radionuclides be maximized?

**WD Sections:** Section 2.1, Salt Processing Strategy, "DDA Process,"

**DOE Response:** In their review of the *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, the Nuclear Regulatory Commission requested similar information in regard to the settling process. Information on the maximization of insoluble radionuclide removal through settling is provided in DOE's response to the Nuclear Regulatory Commission's *Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (NRC 2005). Specifically, the response to RAI Comment 12 provides the information excerpted below:

> *Maximizing Predominantly Insoluble Radionuclide Removal*
>
> DDA process maximizes insoluble solids removal in two steps: minimizing entrainment during dissolution and clarifying the dissolved salt solution by settling the sludge solids before transferring to the dissolved salt solution to the adjustment tank. The effect of both steps is effective at maximizing the removal of insoluble solids before transfer to the adjustment tank.
>
> *Insoluble Solids Settling*
>
> The portion of solids removed by settling can be controlled by two factors, liquid layer depth to be clarified and time. Time allowed is a function of the settling rate. Settling rate of the entrained solids depends on particle size, particle density, particle density in the liquid phase, liquid density, and liquid viscosity. The liquid phase properties are reasonably known or predictable, but the solid phase properties are unknown primarily because measurements of this type have not been made on dissolved salt solution because historically, there has been very limited dissolution of salt. However, solid phase property measurements exist for sludge solids. Since the sludge solids contain the majority of the fission products and actinides (d'Entremont and Drumm 2005), other solids settling are not as important to the radionuclide removal efficiency.
>
> Effectively, settling in a waste tank can be described in terms of the downward movement of an interface with time. The liquid above the interface is clear of any solids larger than a certain minimum size. The minimum size is picked such that more than 99% of the sludge particles are larger than the minimum.

The liquid above this interface is effectively decontaminated of sludge particles and only the soluble radionuclides remain. The rate of change in the interface level was estimated for the dissolved salt solution from the first dissolution tank. The rate is expected to be similar for subsequent tanks, but a detailed estimate will be made on a tank-by-tank basis before dissolution occurs. The first tank settling rate is estimated in Table 12-3 (Gillam 2005):

**Table 12-3: Sludge Solids Settling Rates**

| Fraction of Solids Removed | Settling Rate, in./day |
|---|---|
| 0 | 37.00 |
| 0.500 | 16.00 |
| 0.667 | 9.00 |
| 0.750 | 6.84 |
| 0.800 | 5.54 |
| 0.900 | 2.95 |
| 0.935 | 2.03 |
| 0.950 | 1.65 |
| 0.964 | 1.28 |
| 0.975 | 1.00 |
| 1 | 0.35 |

For example, in order to remove 0.667 or 66.7% of the entrained solids from a dissolved salt solution batch 300 inches deep (assuming the settled sludge layer is less than 6 inches deep and approximately 2 feet below pump suction if the pump suction is at 30 inches above the tank bottom), the solids must be allowed to settle 33 days at a settling rate of 9 inches per day. The actual settling time is adjusted to allow adequate time to settle solids to meet SPF process requirements and balance the need to create enough working volume in the tank farm to maintain waste process operations. The current baseline case is a 30-day settling period.

*Insoluble Solids Entrainment During Dissolution*

Minimizing the amount of entrained sludge is accomplished by selecting tanks with less than 3,000 gallons of low-heat waste (LHW) sludge[1] for DDA processing and minimizing mixing during dissolution. Sludge entrainment during dissolution could be estimated based on the following parameters: the particle size of the solids, the extent of particle agglomeration or adhesion between particles, the distribution of particle sizes, the distribution of particles within the waste tank, the location of the pump suction relative to the solid

[1] High-Heat Waste (HHW) sludges originating from the first canyon cycle have fission product concentrations three orders of magnitude higher than LHW sludges from the second canyon cycle.

particles, the density and viscosity of the liquid phase, and the velocity pattern of the liquid phase during pumping. Phenomena of entrainment can be described analytically, but values of several parameters are not known, such as, the distribution of solids within the saltcake or the liquid phase during dissolution. Additionally, the distribution of solids within the tank and in the saltcake changes as dissolution progresses. However, experience with salt dissolution at SRS and recent experience at the Hanford Site provides an indication of how the solids will behave during saltcake dissolution. In addition, analysis performed for entrainment of sludge during liquid waste transfers provides an indication of when solids will be entrained during waste transfer. Further, sample data from dissolved salt solutions and some solid saltcake samples provide an indication of how much insoluble/low solubility solids can be entrained.

*Insoluble Solids Behavior in Saltcake Tanks*

A saltcake dissolution method similar to DDA was employed to dissolve Tank 20 saltcake. In this case, the saltcake was not deliquified. Dissolution water was added to and removed from the tank in batches as described in the DDA process. Insoluble and low solubility solids remained as the saltcake was dissolved. The solids settled on top of the saltcake. This layer of solids became progressively thicker until successive dissolution water additions became relatively ineffective at dissolving additional saltcake. Approximately two-thirds of the saltcake was dissolved and the remainder was removed several years later after slurry pumps were installed (Hershey 1982). The slurry pumps provided agitation that displaced the solids from the saltcake surface, which resulted in exposing the saltcake to the dissolution water.

Personnel at the Hanford Site recently completed their first saltcake dissolution and removal from Tank S-112 (Barton 2005). This saltcake was deliquified many years before dissolution. In this case, the total liquid inventory in the tank was limited such that the saltcake was not submerged in liquid until most of the saltcake was removed. The water was added in batches and cascaded through the deliquified saltcake. After a short waiting period, the dissolved salt solution was pumped out via salt well pumping. The wait period progressively increased from 1 to 5 days as dissolution progressed. Photographs/videos from the last 5% or so of the saltcake dissolution show a fine particulate material covering the saltcake. The specific compounds of this apparent low solubility or insoluble material have not yet been identified, but the observations indicate similar behavior of the insoluble solids observed during dissolution of Tank 20.

From these experiences, one can infer that low solubility/insoluble materials, i.e., sludge solids, would tend to settle on top of the saltcake during the DDA process. In addition, the solids layer would become progressively thicker as the saltcake is dissolved, thus, increasing the possibility of entraining more solids during pumping.

However, the pump rates remain relatively low which minimizes the liquid phase velocity and, thus, minimizes entrainment. Analysis of the flow pattern around the pump suction for the evaporator systems shows an effective range for entraining sludge solids of about 12 inches from the suction (SRNL 1997).

Based upon these experiences and the plans to dissolve only a portion of the Tank 41, 25 and 28 material during Interim Processing (Mahoney and d'Entremont 2004), it can reasonably be expected that a significant fraction of the low solubility/insoluble materials currently in these tanks will not be removed by the DDA process and will remain in the portion of these tanks that will be processed following Interim Processing. While this solids removal characteristic of the DDA processes is not credited when determining the decontamination achieved by DDA due to uncertainties associated with the insoluble solids content, it does provide further decontamination of the salt waste stored in the tanks. Note as well, that the settling step for dissolved salt solution is included as an integral element of the DDA process to remove the insoluble solids that are not left behind in the tanks associated with Interim Processing.

*Actual Saltcake and Dissolved Salt Solution Sample Data*

As noted earlier, available sample data of saltcake and dissolved salt solution can provide an indication of the actual content of dissolved salt solution from the dissolution step and after the settling step. Past samples of saltcake and dissolved salt solution show that insoluble solids content can vary widely as shown in Table 12-2. The solid salt samples indicate the total insoluble solids that might transfer with dissolved salt solution without settling or any other solid liquid separation. The dissolved salt samples show that most of the insoluble solids in saltcake are not likely to transfer with dissolved salt solution or will settle out before transferring. Since these results show total solids, sludge solids cannot be separately identified from the available data.

**Table 12-2: Insoluble Solids in Saltcake and Dissolved Salt Solution**

| Tank | Insoluble Solids Concentration in Salt Sample (mg/L) | Approximate insoluble Solids in Equivalent Dissolved Salt Solution (mg/L) |
|---|---|---|
| Tank 38 saltcake (Drumm and Hopkins 2003) | 13,700 | 3,900 |
| Tank 41 saltcake (Drumm and Hopkins 2003) | 13,000 | 4,580 |
| Tank 37 saltcake (Drumm and Hopkins 2003) | 25,800 | 8,720 |
| Tank 24 dissolved salt solution (Fowler 1982) | See Note 1 | 27,300 |
| Tank 24 dissolved salt solution (Walker and Hamm 1983) | See Note 1 | 103 |
| Tank 1 saltcake (Fowler 1981a) | 19,800 | 6,600 |
| Tank 20 dissolved salt solution (Fowler 1981c) | See Note 1 | none detected |
| Tank 19 saltcake (Fowler 1980) | 51,000 | 17,000 |
| Tank 19 dissolved salt solution after Transfer to Tank 18 (Fowler 1981b) | See Note 1 | < 100 |

Note 1: Analysis performed on dissolved salt solution sample, therefore no value for saltcake

From experiences identified and the available sample data for similar conditions, minimal solids are expected to be entrained in the dissolved salt solution. However, the relative amount of insoluble solids in the saltcake show that unexpectedly high entrainment of insoluble solids is possible, thus, requiring a settling step after dissolution until enough dissolution experience shows this step to be unnecessary. Note that the saltcake samples show an equivalent dissolved salt solution concentration of several thousand mg/L. The few samples of dissolved salt solution after transferring to another tank is rather limited, but generally shows that about 100 mg/L can be reasonably achieved. These results show that it is possible to remove more than 90% of the insoluble solids in saltcake by minimizing entrainment followed by settling.

**References:**


Barton, W. B., 2005, *Progress of Retrieval at Hanford*, CH2M-25332-VA, Revision 0, CH2M Hill Hanford Group, Inc. Richland, Washington

d'Entremont, P. D., and Drumm, M. D., 2005, *Radionuclide Concentrations in Saltstone*, CBU-PIT-2005-00013, Revision 3, Westinghouse Savannah River Company, Aiken, South Carolina.

Drumm, M. D., and Hopkins, M. D., 2003, *Feed Basis for Processing Relatively Low Radioactivity Waste Tanks*, WSRC-TR-2001-00559, Revision 3, Westinghouse Savannah River Company, Aiken, South Carolina.

Fowler, J. R., 1980, *Analysis of Tank 19 Salt Cake*, DPST-80-569, Westinghouse Savannah River Company, Aiken, South Carolina

Fowler, J. R., 1982, *Analysis of Tank 24 Dissolved Salt Solution*, DPST-82-871, Westinghouse Savannah River Company, Aiken, South Carolina.

Fowler, J. R., 1981a, Laboratory Notebook DPSTN-3302, page 5 – 13, Westinghouse Savannah River Company, Aiken, South Carolina.

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Fowler, J. R., 1981c, Laboratory Notebook DPSTN-3302, page 22 – 23, Westinghouse Savannah River Company, Aiken, South Carolina.

Gillam, J. M., 2005, *Settling of Insoluble Solids in Supernate from Salt Dissolution*, X-CLC-H-00546, Westinghouse Savannah River Company, Aiken, South Carolina.

Hershey, J. H. to W. L. West, 1982, *Tank 20 Density Driven Salt Removal*, Westinghouse Savannah River Company, Aiken, South Carolina

Mahoney, M. J., and P. D. d'Entremont. 2004. *Interim Salt Processing Strategy Planning Baseline*. CBU-PED-2004-00027, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

NRC 2005, *Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Scott C. Flanders to Mark A. Gilbertson, Nuclear Regulatory Commission (NRC)

SRNL, 1997, *Flow Pattern Calculations for Eductor Flow in Tank 43*, SRT-EDS-970022, Westinghouse Savannah River Company, Aiken, South Carolina.

Walker, D. D., and Hamm, B. A., 1983, *Sample Analyses from the Full Scale In-Tank Demonstration of the Precipitation Process*, DPST-83-695, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

**DHEC Comment 7:** On page 17, it is stated "if sample analyses demonstrate that decontamination of the salt solution to meet Class C concentration limits in the grouted waste form can be achieved without removal of soluble actinides and Sr, then the waste will be transferred without MST treatment from the Tank Farm directly to the FFT for ARP filter-only processing." Since the goal for radionuclide removal is not to simply meet Class C concentration limits, how does this constitute removal of highly radioactive radionuclides to the maximum extent practical?

**WD Sections:** Section 2.1, Salt Processing Strategy, "ARP,"
Section 5.2.2.c, "ARP and MCU"

**DOE Response:** The statement referenced above from the *3116 Determination* [for] *Salt Waste Disposal* [at the] *Savannah River Site* (Salt Waste Determination) no longer accurately reflects the SRS operational plan for the ARP facility. The Department, in the context of the maximum extent practical argument presented in the Draft WD, intends to operate the Actinide Removal Process (ARP) to treat salt waste with monosodium titanate (MST) and filtration for as much of the anticipated waste stream designated for ARP processing as possible. DOE will revise the Salt Waste Determination to more clearly reflect this change.

This comment is essentially the same as a comment provided by the Nuclear Regulatory Commission in their review of the Salt Waste Determination *Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (NRC 2005). This question was raised as part of RAI Comment 14. While this response includes references to meeting tank space objectives, it is DOE's intention that all waste processed via the ARP facility meet performance objectives and be consistent with the maximum extent practical argument presented in the Draft WD. The DOE response to this RAI in its entirety is provided in the Attachment section of this document. The following is excerpted from that response.

Recognizing that the Salt Waste Processing Facility (SWPF) cannot be constructed, permitted, and operated until approximately 2011, the two-part interim processing approach described in the draft Salt Waste Determination accelerates risk reduction through processing the minimal amount of some of the lowest activity salt waste (i.e., minimize the curies sent to the Saltstone Disposition Facility (SDF)) to create the necessary tank space for continued sludge removal and treatment in the Defense Waste Processing Facility (DWPF), and the earliest possible full SWPF operation. (See responses to RAI Comments 10, 11, 12 and 13)

One of the input bases to the development of the two-part interim processing strategy, and to any future revisions, is to remove radionuclides to the maximum extent practical while still creating the necessary tank space for continued risk reduction through sludge removal and vitrification to borosilicate glass, and earliest possible full SWPF operation. ARP/MCU are expected to come online in approximately 2007. ARP/MCU will remove approximately 92% (Campbell 2004) of the Cs-137/Ba-137m while also removing insoluble solids which contain the majority of the Sr-90 and actinides. The ARP facilities will also have the capability to remove soluble Sr-90 and actinides through MST strikes.

The two-part interim processing strategy reflected in the Salt Waste Determination was based on preliminary ARP process flowsheet information. A detailed ARP process flowsheet (Subosits 2004) was recently issued which demonstrates the performance of MST strikes is no longer anticipated to be the processing throughput limiting step. Based on this new flowsheet information, it is now planned that MST strikes will be conducted on all salt solution processed through ARP, even if the salt solution already does not exceed Class C concentration limits, as long as throughput can be maintained, with adequate margin, to support necessary tank space needs. An acceptable operational margin can be determined after some operational experience is obtained from operating the ARP/MCU facilities. This is in alignment of the objective to minimize curies to SDF while still meeting tank space objectives.

This emergent information required revisions to applicable sections of the Salt Waste Determination. In particular, the following sections have been revised.

**On page 17 of the Draft Salt Waste Determination, the following paragraph:**

> If sample analyses indicate that salt waste requires removal of soluble Sr-90 and actinides in order to meet Class C concentrations limits in 10 CFR 61.55 in the grouted waste form, the waste will be received into either of the two MST Strike Tanks. Waste received in MST Strike Tank #1 or #2 will be adjusted with water to approximately 5.6 Molar sodium concentration to provide optimum conditions for sorption of Sr-90 and actinides onto MST. Following the addition of MST to either Strike Tank, the contents will be agitated for a reaction period between 4 and 24 hours based on the curie concentration of the soluble actinides to be removed. The resulting slurry will be transferred from either of the strike tanks into the Filter Feed Tank (FFT). If sample analyses demonstrate that decontamination of the salt solution to meet Class C concentration limits in the grouted waste form can be achieved without removal of soluble actinides and Sr-90, then the waste will be transferred without MST treatment from the Tank Farm directly to the FFT for ARP filter-only processing.

**was revised in the Salt Waste Determination in Section 2.1, <u>ARP</u>, to state the following:**

> Based on current process flowsheet information, MST strikes will be conducted on all salt solution processed through ARP, even if the salt solution already does not exceed Class C concentration limits in 10 CFR 61.55 in the grouted waste form, as long as throughput can be maintained, with adequate margin, to support necessary tank space needs. The waste will be received into either of two MST Strike Tanks. Waste received in MST Strike Tank #1 or #2 will be adjusted with water to 5.6 Molar sodium concentration to provide optimum conditions for sorption of Sr-90 and actinides onto MST.
>
> Following the addition of MST to either Strike Tank, the contents will be agitated for a reaction period between 4 and 24 hours based on the curie concentration of the soluble actinides to be removed. The resulting slurry will be transferred from either of the strike tanks into the Filter Feed Tank (FFT). The ARP facilities will be used to remove soluble Sr-90 and actinides through MST strikes, as long as tank space objectives can be met with appropriate operational margin. If emergent technical or processing information becomes known that indicates that tank space objectives cannot be met AND the soluble actinides in the original salt solution are sufficiently low (i.e., below Class C concentration limits) to achieve the necessary tank space recovery prior to SWPF start-up, the stream will only be filtered prior to being sent to MCU.

**On pages 38 and 39 of the Draft Salt Waste Determination, the following sentences:**

> The ARP facilities will also have the capability to remove soluble Sr-90 and actinides through MST strikes. If the soluble actinides in the original salt solution are sufficiently low (i.e., below Class C concentration limits), to achieve the necessary tank space recovery prior to SWPF start-up, the stream will only be filtered prior to being sent to MCU.

**was revised in the Salt Waste Determination in Section 2.1, <u>ARP</u>, to state the following:**

> The ARP facilities will be used to remove soluble Sr-90 and actinides through MST strikes, as long as tank space objectives can be met with appropriate operational margin. If emergent technical or processing information becomes known that indicates that tank space objectives cannot be met AND the soluble actinides in the original salt solution are sufficiently low (i.e., below Class C concentration limits) to achieve the necessary tank space recovery prior to SWPF start-up, the stream will only be filtered prior to being sent to MCU.

**Footnote 25 on page 39 of the Draft Salt Waste Determination:**

[25] The current Interim Salt Processing Strategy does not generally contemplate MST strikes of the salt solutions that will be batched through ARP/MCU but an 8-hour MST strike will be performed if necessary to meet Class C limits for disposal of DSS in SDF or if throughputs can be maintained at 1.5 Mgal per year even if strikes are not necessary to meet Class C concentration limits.

**was revised in the footnote 36 in the Salt Waste Determination to state the following:**

[36] The duration of the MST strikes of the salt solutions will be dependent on the concentration of the Sr-90 and actinides present, and will range from 4 to 24 hours.

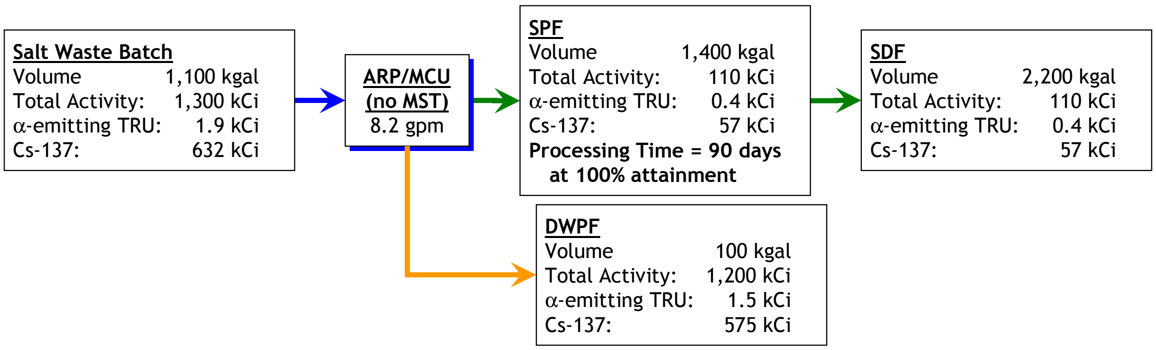
The objective of the two-part interim processing strategy is to run the interim treatment processes available to minimize curies to SDF while still meeting the tank space objectives**.** The processing philosophy of minimizing curies to SDF while still meeting tank space recovery objectives can best be illustrated with the following hypothetical example that demonstrates the logic that will be used in making such an evaluation.

A batch of salt solution feed (Batch 1) is prepared and available for processing through to ARP/MCU for treatment before processing at the SPF. Removal of the total volume from the batch is required by a specific time to meet the tank space objectives to support sludge processing and earliest possible full SWPF operation. Processing Plans A and B have Batch 1 being processed through ARP/MCU with no MST strike and with a 24-hour MST strike, respectively. Note that the Total Activity curie numbers shown below include daughter products of Cs-137 and Sr-90.

*Processing Plan A (No MST Strike):*

Assuming:

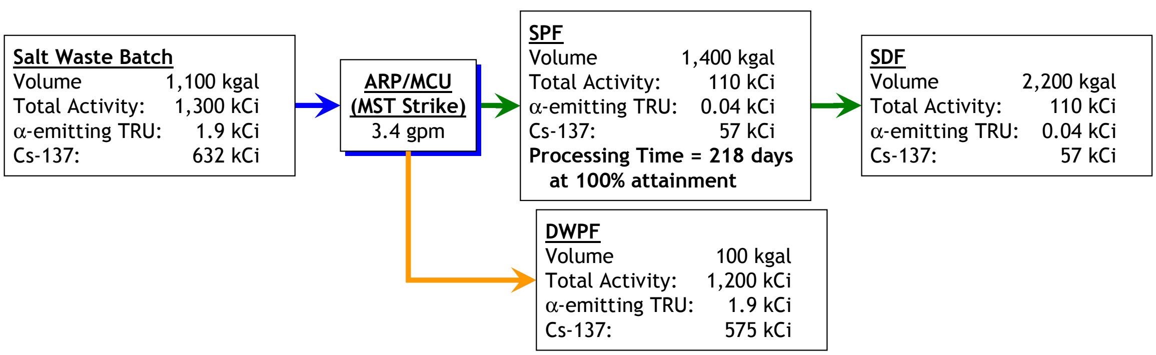
- Processing rate through ARP/MCU is 8.2 gpm




*Processing Plan B (24-Hour MST Strike):*

Assuming:

- Processing rate through ARP/MCU is 3.4 gpm




A comparison of the two cases in the example shown above reveals that even though both processing plans do not exceed Class C concentration limits for disposition to SDF, Processing Plan B results in less alpha emitting transuranic (TRU) curies [40 Ci for Plan B (~98% removal of transuranics) versus 400 Ci (~78% removal of transuranics) for Plan A] being sent to the SDF. However, the total curies, which include the daughter products for Cs-137 and Sr-90, are the same for both cases (~110 kCi – when rounded to the nearest kCi). From a processing duration perspective, it takes ~140% longer (~218 processing days at 100% attainment versus ~90 processing days) to fully disposition the volume in Batch 1. If the processing duration for either case meets the tank space objectives, then Processing Plan B would be implemented since it results in fewer curies being sent to SDF. However, if emergent technical or processing information indicates that tank space objectives cannot be met due to the longer processing duration of Processing Plan B, then Processing Plan A would be implemented.

The analyses performed and reported in the Performance Objective Demonstration Document (PODD) to demonstrate compliance with the Performance Objectives in 10 CFR 61 assumed that no MST strikes were performed in the ARP process (i.e., that none of the soluble Sr-90 or the actinides were removed by the ARP process). This same assumption was used in demonstrating compliance with Class C concentration limits. Therefore, if any such evaluation as that described above was performed with a subsequent decision made not to strike, it would not impact the analyses performed to support this waste determination.

In summary, the plan is that MST strikes will be conducted on all salt solution processed through ARP, even if the salt solution already does not exceed Class C concentration limits, as long as throughput can be maintained, with adequate margin, to support necessary tank space needs. An acceptable operational margin can be determined after some operational experience is obtained from operating the ARP/MCU facilities. This is in alignment of the objective to minimize curies to SDF while still meeting tank space objectives.

**References**:

Campbell, S. G., 2004, *Preliminary Material Balance for the Modular CSSX Unit*, CBU-SPT-2004-00059, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina

NRC 2005, *Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Scott C. Flanders to Mark A. Gilbertson, May 26, 2005

Subosits, S. G., 2004, *Actinide Removal Process Material Balance with Low Curie Salt Feed*, X-CLC-S-00113, Rev. 0, Westinghouse Savannah River Company, Aiken, South Carolina

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina

**DHEC Comment 8:** On page 39, it is stated that DDA will be used to process approximately 6.0 Mgal of the lowest curie salt solution and will result in 1.7 MCi disposed in SDF streams. On page 12, it is shown that DDA will contribute 2.5 MCi to SDF. It is also stated that DDA will continue to be used alone even after ARP/MCU are online. Does the estimated 1.7 MCi include the continued use of DDA or does the continued use amount to the extra 0.8 MCi? Please clarify the derivation of these estimated volumes and activities. How does the use of DDA alone even after ARP/MCU are online assure removal of highly radioactive radionuclides to the maximum extent practical. Also, provide volume, time, or activity limits for the continued use of DDA.

**WD Sections:** Section 5.2.2.c, "DDA, ARP, and MCU"

**DOE Response:** The values shown in Figure 2.1 of the *3116 Determination* [for] *Salt Waste Disposal* [at the] *Savannah River Site* (Salt WD) represent the total curies to be disposed of at the Saltstone Disposal Facility (SDF) for each of the treatment processes (DDA, ARP/MCU, and SWPF). Although not explicitly stated in Figure 2.1, approximately 2.5 million Curies (MCi) from the Deliquification, Dissolution, and Adjustment (DDA) process include approximately 0.8 MCi from the salt waste in Tank 48.

The remainder of those curies, approximately 1.7 MCi, are attributed to the salt solution resulting from all other material processed by DDA prior to the start up of the Salt Waste Processing Facility (SWPF), including the DDA batches that occur after ARP/MCU are online. Approximately 1.7 MCi of the Salt WD does not include the materials in Tank 48. It is the Tank 48 material that makes up the difference of approximately 0.8 MCi.

The estimated volume, time, and activity levels for all of the DDA batches, as well as all ARP/MCU batches, are described in the *Interim Salt Processing Strategy Planning Baseline* (Mahoney and d'Entremont 2004). Table 8-1 of the referenced document shows approximate volumes and approximate activity levels for all of the batches being sent to the Saltstone Disposal Facility during the Interim Salt Processing phase. Of the nine batches planned, two of the batches, Batch 7 and Batch 9, are DDA batches processed after ARP/MCU are online. Figure 2 in the *Interim Salt Processing Strategy Planning Baseline* provides a schedule of when the batches are planned to be processed. The details of the two batches are shown in the table below:

| Batch Number | Approximate Volume (kgal.) | Approximate Total Curies (kCi) | Approximate Processing Dates |
|---|---|---|---|
| 7 | 1225 | 45 | 11/2007 thru 7/2008 |
| 9 | 1230 | 259 | 9/2008 thru 1/2009 |

Recognizing that the Salt Waste Processing Facility (SWPF) cannot be constructed, permitted, and operated until approximately 2011, DOE believes that proceeding with the two-part interim processing approach described in the Salt WD, which includes the continued use of DDA after ARP/MCU are online, to remove radionuclides from and process a minimal amount of some of the lowest activity salt waste so that it can dispose of these salt wastes at SDF is the better course rather than wait until SWPF becomes available. Proceeding with this interim strategy will allow DOE to create the tank space necessary to continue cleanup of the sludge and operate SWPF effectively once that facility has been constructed. The continued processing of some salt waste through DDA, in addition to the salt waste being processed through ARP/MCU, is needed to provide the necessary tank space during this interim processing period. In DOE's view, use of these interim technologies is the proper course of action because the public health, safety, and environmental risks and disadvantages that would result from waiting until SWPF is available and significantly delaying further sludge removal and full-scale operation of SWPF once it has been constructed plainly outweigh the negligible public health, safety, and environmental disadvantages from proceeding with disposal of this waste after using the interim technologies to remove those radionuclides that can be removed now. Accordingly, use of these interim technologies accelerates risk reduction through processing the minimal amount of the lowest activity salt waste to create the necessary tank space for continued removal of the high-activity sludge and earlier full SWPF operation, resulting in removal of highly radioactive radionuclides to the maximum extent practical during that timeframe.

The Nuclear Regulatory Commission (NRC) raised similar questions in the NRC's *Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (NRC 2005). In the *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (WSRC 2005), DOE has provided additional information to demonstrate that the two-part interim processing approach described in the Salt WD will remove highly radioactive radionuclides to the maximum extent practical. This additional information is included in the responses to RAI Comments 10, 11, 12, 13, and 14 and Action Item 3. These responses may be found in the Attachment Section of this document.

**References:**

Mahoney, M. J. and d'Entremont, P. D., 2004, *Interim Salt Processing Strategy Planning Baseline*, CBU-PED-2004-00027, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

NRC 2005, *Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Scott C. Flanders to Mark A. Gilbertson, May 26, 2005.

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

**DHEC**
**Comment 9:** Describe the sampling method used during waste characterization.

**WD Sections:** Section 6.0

**DOE Response:** Waste characterization sampling to support salt processing is performed in three main steps to satisfy two objectives: waste characterization to support disposition planning and characterization to confirm compliance with regulatory requirements. The first step is saltcake and supernate sampling and analysis; the second is pre-aggregation sampling of salt solution; and the third is periodic post-aggregation sampling in Tank 50. The method and reasons for obtaining each of these samples are different and are described below.

Saltcake sampling has historically been performed at SRS using a simple "hammer and pipe" method. The purpose of these samples is to obtain estimates of post-dissolution concentrations of important constituents. Since dissolving the saltcake increases the waste volume by a factor of approximately three, saltcake sampling is performed to increase the confidence that the dissolved salt solution will meet downstream processing requirements prior to dissolution of the saltcake. To obtain these samples, a 1" I.D. (inner diameter) stainless steel pipe with a carbide cutting edge is driven into the saltcake using a variety of impacting tools. This method has been used to obtain saltcake core samples up to 3 feet in length. An example of the analytical methods used and results obtained from this type of sample are found in *Tank 41H Drained Saltcake Core Sample Analysis* (Martino and Nichols 2003). Recently, equipment has been procured that will enable full length core samples to be obtained from salt tanks. The first tank that will be sampled using the new equipment is Tank 25. The methodology for analyzing the Tank 25 core sample is described in *Task Technical and Quality Assurance Plan for the Characterization of Tank 25F Saltcake Core Samples* (Martino et. al., 2004).

Supernate sampling has been performed to support safe storage requirements as well as characterization objectives. The most common type of supernate sample is a 100 ml dip sample obtained from the surface of the supernate. These samples primarily support the waste tank Corrosion Control Program and are analyzed for nitrate, nitrite, and free hydroxide concentrations as well as for total gamma. The abundance of total gamma sample results was an instrumental tool in the tank selection process for DDA and ARP/MCU. Less frequently, supernate samples are taken from waste tanks for characterization purposes. The most recent effort was conducted in 2003 and 2004 where seven waste tanks were sampled and extensively analyzed. The analytical methods used and the results obtained are contained in *Characterization of Supernate Samples from High Level Waste Tanks 13H, 30H, 37H, 39H, 45F, 46F and 49H* (Stallings et. al., 2005)

Pre-aggregation sampling is performed to obtain sufficient information to perform blending calculations to determine the proper ratios of chemical and radiological constituents needed to produce a final composition that meets Saltstone Processing Facility Waste Acceptance Criteria (WAC). Pre-aggregation samples are usually obtained from unmixed waste tanks where it is not desirable to suspend settled solids prior to transfer to Tank 50, the feed tank for the Saltstone Facility. For example, a composite WAC sample, consisting of a total of 2 liters, was taken in Tank 23. The samples were taken at different elevations at the middle of the tank and at the transfer pump suction. From each level, a total volume of one liter of supernate was taken. The sample was analyzed for chemical and radioactive constituents at the Savannah River National Laboratory (SRNL). The analytical methods used and the results obtained are contained in *Characterization of Tank 23 Supernate per Saltstone Waste Acceptance Criteria Analysis Requirements-2005* (Oji and Blume 2005). In another example, a set of three 200 ml samples were obtained from Tank 49 after the receipt of dissolved salt solution from Tank 41. The samples were obtained from 3 different elevations: 20 inches from the tank bottom, 95 inches from the tank bottom, and 165 inches from the tank bottom. These samples were analyzed and the results are reported in *Analysis of Tank 49H Samples (HTF-064-066) for Saltstone Waste Acceptance Criteria Constituents* (Martino 2005). The analytical methods being used and the constituents of interest are described in *Task Technical and Quality Assurance Plan for the Characterization of Tank 49H Dissolved Saltcake Samples* (Martino et. al., 2005). Samples are obtained from different tank elevations to confirm that the tank's contents are not stratified. If the sample results from the different elevations are significantly different, additional samples may be obtained and analyzed. An appropriate margin is included within the blending calculation to account for any uncertainty resulting from stratification as a consequence of sampling an unmixed tank.

Lastly, as was previously discussed with SCDHEC and which was submitted to SCDHEC for approval in the following documents: Saltstone Grout Sampling, ESH-EPG-2004-00318, K. Liner (WSRC) to J. Gilbo (SCDHEC), 12/7/04; Saltstone Production Facility Modification, ESH-EPG-2004-00289, G. Laska (WSRC) to B. Mullinax (SCDHEC), 11/17/04; and the Sampling and Analysis Plan for the Z-Area Industrial Solid Waste Landfill Disposal Facility during Interim Salt Processing, ESH-WPG-2005-00039, K. Liner (WSRC) to J. Gilbo (SCDHEC), 5/26/05, samples will be periodically taken from the post-aggregation mixture in Tank 50 for the purpose of demonstrating compliance with SCDHEC permits, for performing grout formulation tests, and for confirming the accuracy of the Tank 50 blending calculations. These samples will be nominally 200 ml to 3 liters in size and will be obtained from Tank 50 after it has been well mixed using large mixing devices (slurry pumps). The tank is mixed to ensure that a homogeneous, representative sample is obtained. In 2003 a statistical evaluation of DWPF feed batches was performed to determine if slurry pump mixing of Tank 40 (DWPF feed tank) produced statistically similar batches. The report concluded that the results provided “no indication of substantial inhomogeneity during MB1 [Macrobatch 1] processing” (Edwards 2003, page 22).

Based on this study it was concluded that slurry pump mixing of the waste tank produces a relatively homogeneous mixture in the waste tank. Since DWPF feed is a thick sludge and, therefore, harder to mix, slurry pump mixing of lighter salt solution in Tank 50 is expected to produce a homogeneous mixture within the tank. The sampling strategy for Tank 50 is shown in Table 1 below (Ketusky 2005). Note that the initial “DDA” Grouping sample that was used for Vault Classification, TCLP verification, and Grout qualification/formulation has already been completed for the DDA stream using a 4 liter sample of dissolved salt obtained from Tank 41. The subsequent groupings, labeled “Grout” and “Ops” in Table 1, will be performed routinely during salt processing activities.

Table 1. Tank 50 Samples

| PULL SAMPLE | | | | | SUB SAMPLE | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Grouping[1]** | **Size[2]** | **Freq** | **Time** | **Status** | **Requirement/ Intent** | **Freq/Pull** | **Size[2]** | **Rationale** | **Status** |
| **DDA** (Complete) | 4 Liters | 1 per 5 yr | Prior To Permit | Pulled, Repacked & Shipped ( For this report considered complete) | DDA Vault Classification | 1/1 | 1 Liter | Required For New Waste Stream Permit. Evaluates Landfill Requirements & Effects On Groundwater | Analyses Complete & Documented |
| | | | | | DDA TCLP | 1/1 | 100 ml | Initial Verification of Non-Hazardous Nature of Grout | Analyses Complete & Documented |
| | | | | | DDA Grout Qualification & Formulation | 1/1 | 2.9 Liters | Initial Verification That Grout Will Meet the Quality and Processing Requirements | Analyses Complete & Documented |
| **GROUT[3]** | 1 Liter per Tank for Pre-Qual; Otherwise, 3 Liters then every quarter switching between 3 & 2 Liters | 4 per yr | 1/Quarter & as Specified By SRNL | Ongoing | Grout Qualification & Formulation | 1/Quarter & as Specified By SRNL | 2.9 Liter for Pre-Qual, Otherwise 2.9 or 1.9 Liters | Verification That The Grout Will Meet the Quality and Processing Requirements (For Pre-Quals, Samples Of Other Tanks Feeding Tank 50 To Be Combined Prior To Analysis) | Ongoing |
| | | | | | TCLP | 1/Quarter | 100 ml/ Tank | Quarterly Verification of Non-Hazardous Nature of Grout (For Pre-Quals, Samples of Other Tanks Feeding Tank 50 To Be Combined Prior To Analysis) | Ongoing |
| **OPS** | 400 ml if chem. and rad, 200 ml is chem. | 4 per yr | 1/Quarter | Ongoing | Chemistry | 4/4 | 200 ml | Compliance of Liquid/Solid Chemistry | Ongoing |
| | | | | | Radiological | 2/4 | 200 ml | Compliance of Liquid/Solid Radiological Contents | Ongoing |

Notes: [1]Grouping used in this report are for the purpose of this report only, and should not be confused with HLW Sample ID#s
[2]Size refers to nominal material size
[3]GROUT Variations include: P-GROUT= prequalification sample, 3-GROUT=3 liter sample, or 2-GROUT=2 liter sample

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**DHEC**
**Comment 10:** A waste characterization document should be provided that lists all radionuclides in the waste and their concentrations.

**WD Sections:** Section 6.0

**DOE Response:** *Tank Radionuclide Inventori*es (Tran 2005) provides a complete list of the tank radionuclide inventories for all of the Savannah River Site (SRS) waste storage tanks. In the referenced report, tank sludge inventories are found in Table 4, saltcake inventories in Table 5, and supernate inventories in Table 6. These tables are reproduced on the following pages.

## Table 4: Dry Sludge Radioisotope Inventory by Tank

| Tank | Sludge Volume, gal | H-3 (Ci) | C-14 (Ci) | Co-60 (Ci) | Ni-59 (Ci) | Ni-63 (Ci) | Se-79 (Ci) | Sr-90 (Ci) | Y-90 (Ci) | Nb-94 (Ci) | Tc-99 (Ci) | Ru-106 (Ci) | Rh-106 (Ci) | Sb-125 (Ci) | Sn-126 (Ci) | I-129 (Ci) | Cs-134 (Ci) | Cs-135 (Ci) | Cs-137 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 7.05E+03 | - | 1.20E-02 | 1.87E+02 | 2.16E+01 | 1.77E+03 | 1.50E+01 | 5.20E+05 | 5.20E+05 | 1.13E-02 | 2.60E+02 | 4.48E-06 | 4.48E-06 | 1.14E+01 | 2.80E+01 | 1.24E-03 | 1.07E-02 | 1.74E-01 | 3.68E+04 |
| **2** | 4.07E+03 | - | 2.86E-03 | 1.36E+01 | 3.37E+00 | 2.68E+02 | 2.31E+00 | 7.11E+04 | 7.11E+04 | 1.73E-03 | 3.99E+01 | 3.09E-09 | 3.09E-09 | 3.34E-01 | 4.29E+00 | 1.90E-04 | 1.60E-04 | 2.67E-02 | 5.07E+03 |
| **3** | 4.07E+03 | - | 2.40E-03 | 1.50E+01 | 2.82E+00 | 2.27E+02 | 1.93E+00 | 6.24E+04 | 6.24E+04 | 1.45E-03 | 3.34E+01 | 2.04E-08 | 2.04E-08 | 5.01E-01 | 3.59E+00 | 1.59E-04 | 3.03E-04 | 2.24E-02 | 4.44E+03 |
| **4** | 1.27E+05 | - | 3.34E-03 | 4.21E+03 | 1.00E+02 | 8.77E+03 | 7.16E+01 | 3.16E+06 | 3.16E+06 | 5.37E-02 | 1.24E+03 | 2.09E-01 | 2.09E-01 | 1.41E+03 | 1.33E+02 | 5.90E-03 | 4.22E+00 | 8.29E-01 | 2.21E+05 |
| **5** | 3.06E+04 | - | 4.43E-02 | 1.34E+03 | 9.82E+01 | 8.23E+03 | 6.86E+01 | 2.58E+06 | 2.58E+06 | 5.14E-02 | 1.19E+03 | 2.10E-04 | 2.10E-04 | 1.25E+02 | 1.28E+02 | 5.66E-03 | 1.56E-01 | 7.95E-01 | 1.82E+05 |
| **6** | 2.49E+04 | - | - | 2.00E+03 | 9.30E+01 | 8.01E+03 | 6.66E+01 | 2.74E+06 | 2.74E+06 | 4.99E-02 | 1.15E+03 | 1.30E-03 | 1.30E-03 | 2.54E+02 | 1.24E+02 | 5.49E-03 | 3.88E-01 | 7.71E-01 | 1.93E+05 |
| **7** | 1.97E+04 | - | 5.39E-02 | 1.13E+02 | 9.73E+00 | 8.22E+02 | 4.96E+00 | 1.84E+05 | 1.84E+05 | 3.66E-03 | 8.58E+01 | 6.44E-04 | 6.44E-04 | 1.81E+01 | 9.23E+00 | 4.09E-04 | 3.62E-02 | 5.74E-02 | 1.30E+04 |
| **8** | 4.10E+03 | - | 1.96E-03 | 2.80E+01 | 1.03E+00 | 8.98E+01 | 6.62E-01 | 2.84E+04 | 2.84E+04 | 4.94E-04 | 1.14E+01 | 2.18E-04 | 2.18E-04 | 5.56E+00 | 1.23E+00 | 5.45E-05 | 1.17E-02 | 7.66E-03 | 1.99E+03 |
| **9** | 2.71E+03 | - | 3.09E-03 | 1.46E+01 | 3.64E+00 | 2.89E+02 | 2.49E+00 | 7.66E+04 | 7.66E+04 | 1.86E-03 | 4.31E+01 | 3.27E-09 | 3.27E-09 | 3.58E-01 | 4.63E+00 | 2.05E-04 | 1.71E-04 | 2.88E-02 | 5.47E+03 |
| **10** | 2.71E+03 | - | 3.16E-04 | 1.65E+00 | 3.72E-01 | 2.97E+01 | 2.55E-01 | 7.98E+03 | 7.98E+03 | 1.91E-04 | 4.41E+00 | 6.20E-10 | 6.20E-10 | 4.46E-02 | 4.74E-01 | 2.10E-05 | 2.28E-05 | 2.95E-03 | 5.69E+02 |
| **11** | 1.98E+04 | - | 2.00E-02 | 1.30E+03 | 2.24E+01 | 1.98E+03 | 1.24E+01 | 7.00E+05 | 7.00E+05 | 3.14E-03 | 2.10E+02 | 3.28E-03 | 3.28E-03 | 5.62E+01 | 1.14E+01 | 7.28E-04 | 2.60E+00 | 1.41E-01 | 3.86E+04 |
| **12** | 1.43E+05 | - | 2.51E-01 | 9.26E+03 | 2.78E+02 | 2.39E+04 | 1.56E+02 | 7.77E+06 | 7.77E+06 | 4.89E-02 | 2.66E+03 | 1.05E-03 | 1.05E-03 | 2.32E+02 | 1.61E+02 | 9.61E-03 | 7.06E+00 | 1.78E+00 | 4.40E+05 |
| **13** | 2.52E+05 | - | 1.74E-01 | 5.07E+03 | 2.60E+02 | 2.17E+04 | 1.65E+02 | 6.92E+06 | 6.92E+06 | 7.56E-02 | 2.82E+03 | 5.26E-04 | 5.26E-04 | 1.24E+02 | 2.19E+02 | 1.14E-02 | 3.27E+00 | 1.89E+00 | 4.19E+05 |
| **14** | 2.80E+04 | - | 1.17E-03 | 5.56E+01 | 7.35E+00 | 5.96E+02 | 5.05E+00 | 1.76E+05 | 1.76E+05 | 3.38E-03 | 8.72E+01 | 7.17E-08 | 7.17E-08 | 1.45E+00 | 8.64E+00 | 3.97E-04 | 3.93E-03 | 5.83E-02 | 1.19E+04 |
| **15** | 3.12E+05 | - | 2.25E-01 | 6.96E+03 | 2.50E+02 | 2.13E+04 | 1.38E+02 | 6.79E+06 | 6.79E+06 | 3.51E-02 | 2.35E+03 | 1.67E-03 | 1.67E-03 | 1.50E+02 | 1.27E+02 | 8.12E-03 | 4.45E+00 | 1.57E+00 | 3.77E+05 |
| **16** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **21** | 6.09E+03 | - | 3.01E-03 | 1.35E+02 | 1.03E+00 | 9.45E+01 | 7.79E-01 | 5.43E+04 | 5.43E+04 | 1.44E-04 | 1.34E+01 | 2.17E-01 | 2.17E-01 | 1.28E+01 | 7.13E-01 | 4.81E-05 | 1.28E+00 | 8.81E-03 | 3.07E+03 |
| **22** | 9.98E+03 | - | - | 2.61E+02 | 2.13E+00 | 1.96E+02 | 1.66E+00 | 1.06E+05 | 1.06E+05 | 2.97E-04 | 2.80E+01 | 2.47E-03 | 2.47E-03 | 2.21E+01 | 1.51E+00 | 9.70E-05 | 1.29E+00 | 1.87E-02 | 5.80E+03 |
| **23** | 5.61E+04 | - | - | 3.72E-01 | - | - | - | - | - | - | - | - | - | - | - | - | 1.12E-02 | - | 4.23E+02 |
| **24** | 3.54E+03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **25** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **26** | 2.59E+05 | - | 5.46E-01 | 9.31E+02 | 3.21E+01 | 3.14E+03 | 2.66E+00 | 1.72E+05 | 1.72E+05 | 1.41E-03 | 4.61E+01 | 6.59E+01 | 6.59E+01 | 1.24E+03 | 4.93E+00 | 2.19E-04 | 9.94E+00 | 3.08E-02 | 1.18E+04 |
| **27** | 3.86E+03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **28** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **29** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **30** | 6.32E+02 | - | 7.80E-04 | 3.20E+02 | 8.56E-01 | 8.41E+01 | 4.71E-01 | 3.81E+04 | 3.81E+04 | 1.20E-04 | 7.98E+00 | 1.93E-01 | 1.93E-01 | 6.23E+01 | 4.31E-01 | 2.76E-05 | 7.26E+00 | 5.33E-03 | 2.06E+03 |
| **31** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **32** | 9.85E+04 | - | 2.45E-01 | 3.51E+04 | 2.70E+02 | 2.48E+04 | 1.49E+02 | 9.56E+06 | 9.56E+06 | 3.79E-02 | 2.53E+03 | 1.22E+01 | 1.22E+01 | 4.19E+03 | 1.36E+02 | 8.74E-03 | 4.30E+02 | 1.69E+00 | 5.23E+05 |
| **33** | 8.42E+04 | - | 1.25E-01 | 5.00E+04 | 1.65E+02 | 1.63E+04 | 1.13E+02 | 7.62E+06 | 7.62E+06 | 8.47E-02 | 1.96E+03 | 3.94E+03 | 3.94E+03 | 8.24E+04 | 2.10E+02 | 9.32E-03 | 7.22E+02 | 1.31E+00 | 5.20E+05 |
| **34** | 2.02E+04 | - | - | 3.26E+04 | 1.66E+02 | 1.61E+04 | 1.19E+02 | 7.37E+06 | 7.37E+06 | 8.92E-02 | 2.06E+03 | 2.22E+02 | 2.22E+02 | 3.23E+04 | 2.21E+02 | 9.80E-03 | 1.97E+02 | 1.38E+00 | 5.06E+05 |
| **35** | 6.32E+04 | - | 2.03E-01 | 3.99E+04 | 2.23E+02 | 2.10E+04 | 1.23E+02 | 8.55E+06 | 8.55E+06 | 3.12E-02 | 2.08E+03 | 1.41E+01 | 1.41E+01 | 4.82E+03 | 1.12E+02 | 7.18E-03 | 4.67E+02 | 1.39E+00 | 4.65E+05 |
| **36** | 1.86E+02 | - | 2.34E-04 | 3.42E+01 | 2.57E-01 | 2.39E+01 | 1.41E-01 | 9.45E+03 | 9.45E+03 | 3.60E-05 | 2.39E+00 | 2.82E-04 | 2.82E-04 | 2.56E+00 | 1.29E-01 | 8.28E-06 | 1.57E-01 | 1.60E-03 | 5.16E+02 |
| **37** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **38** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **39** | 1.04E+05 | - | 2.40E-01 | 1.24E+05 | 2.64E+02 | 2.60E+04 | 1.46E+02 | 1.20E+07 | 1.20E+07 | 3.70E-02 | 2.47E+03 | 2.48E+03 | 2.48E+03 | 4.10E+04 | 1.33E+02 | 8.54E-03 | 7.75E+03 | 1.65E+00 | 6.46E+05 |
| **40** | 4.39E+05 | - | 5.26E-01 | 2.39E+03 | 1.46E+02 | 1.23E+04 | 8.35E+01 | 3.28E+06 | 3.23E+06 | 5.77E-02 | 1.44E+03 | 2.15E+00 | 1.31E-02 | 3.11E+02 | 1.47E+02 | 6.68E-03 | 2.50E+00 | 9.64E-01 | 2.25E+05 |
| **41** | 2.67E+03 | - | - | 4.78E+01 | 2.07E-01 | 1.97E+01 | 1.61E-01 | 1.17E+04 | 1.17E+04 | 2.89E-05 | 2.72E+00 | 3.10E-03 | 3.10E-03 | 6.80E+00 | 1.47E-01 | 9.43E-06 | 5.49E-01 | 1.82E-03 | 6.33E+02 |
| **42** | 1.76E+04 | - | 1.96E-02 | 3.33E+02 | 1.07E+01 | 9.20E+02 | 5.74E+00 | 2.87E+05 | 2.87E+05 | 1.44E-03 | 9.72E+01 | 1.05E-03 | 1.05E-03 | 1.24E+01 | 5.30E+00 | 3.38E-04 | 5.51E-01 | 6.50E-02 | 1.59E+04 |
| **43** | 2.42E+05 | - | 1.95E-02 | 1.85E+04 | 3.43E+01 | 3.41E+03 | 2.18E+01 | 1.84E+06 | 1.84E+06 | 4.80E-03 | 3.69E+02 | 9.73E+01 | 9.73E+01 | 5.63E+03 | 1.99E+01 | 1.28E-03 | 8.81E+02 | 2.47E-01 | 9.90E+04 |
| **44** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **45** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **46** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **47** | 2.48E+05 | - | 4.32E-01 | 5.43E+02 | 2.54E+01 | 2.45E+03 | 2.10E+00 | 1.30E+05 | 1.30E+05 | 1.11E-03 | 3.65E+01 | 1.18E+00 | 1.18E+00 | 4.63E+02 | 3.90E+00 | 1.73E-04 | 2.44E+00 | 2.43E-02 | 8.91E+03 |
| **48** | 1.81E+04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **49** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **50** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **51** | 1.39E+05 | - | 1.54E-01 | 8.68E+03 | 1.48E+02 | 5.69E+03 | 8.22E+01 | 4.60E+06 | 4.60E+06 | 1.03E-02 | 1.39E+03 | 1.52E-01 | 2.67E-02 | 3.91E+02 | 7.78E+01 | 4.88E-03 | 1.86E+01 | 9.32E-01 | 2.55E+05 |
| **Phase Totals** | 2.80E+06 | - | 3.31E+00 | 3.44E+05 | 2.64E+03 | 2.30E+05 | 1.56E+03 | 8.74E+07 | 8.74E+07 | 6.99E-01 | 2.67E+04 | 6.83E+03 | 6.83E+03 | 1.75E+05 | 2.04E+03 | 1.07E-01 | 1.05E+04 | 1.79E+01 | 5.24E+06 |

## Table 4: Dry Sludge Radioisotope Inventory by Tank, continued

| Tank | Sludge Volume, gal | Ba-137m (Ci) | Ce-144 (Ci) | Pr-144 (Ci) | Pm-147 (Ci) | Eu-154 (Ci) | Th-232 (Ci) | U-232 (Ci) | U-233 (Ci) | U-234 (Ci) | U-235 (Ci) | U-236 (Ci) | U-238 (Ci) | Np-237 (Ci) | Pu-238 (Ci) | Pu-239 (Ci) | Pu-240 (Ci) | Pu-241 (Ci) | Pu-242 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 7.05E+03 | 3.48E+04 | 4.72E-09 | 4.72E-09 | 1.58E+02 | 8.69E+02 | - | 1.14E-02 | - | - | 1.76E-02 | - | 4.39E-01 | 6.41E-01 | 4.97E+02 | 1.33E+02 | 2.97E+01 | 1.63E+02 | 6.12E-03 |
| **2** | 4.07E+03 | 4.80E+03 | 4.35E-13 | 4.35E-13 | 4.27E+00 | 8.82E+01 | - | 1.69E-03 | - | - | 8.12E-04 | - | 2.02E-02 | 2.12E-01 | 1.38E+02 | 1.98E+01 | 4.42E+00 | 1.85E+01 | 9.08E-04 |
| **3** | 4.07E+03 | 4.20E+03 | 7.13E-12 | 7.13E-12 | 6.59E+00 | 8.64E+01 | - | 1.44E-03 | - | - | 2.03E-03 | - | 5.06E-02 | 3.78E-01 | 1.66E+02 | 2.38E+01 | 5.31E+00 | 2.69E+01 | 1.09E-03 |
| **4** | 1.27E+05 | 2.09E+05 | 3.76E-03 | 3.76E-03 | 2.27E+04 | 9.86E+03 | - | 5.92E-02 | - | - | 7.77E-02 | - | 3.34E+00 | 2.98E+00 | 6.05E+02 | 5.98E+02 | 1.34E+02 | 1.13E+03 | 2.75E-02 |
| **5** | 3.06E+04 | 1.72E+05 | 4.13E-07 | 4.13E-07 | 1.79E+03 | 5.20E+03 | - | 5.38E-02 | - | - | 1.05E-01 | - | 2.48E+00 | 4.19E+00 | 2.89E+03 | 4.82E+02 | 1.15E+02 | 7.71E+02 | 3.40E-02 |
| **6** | 2.49E+04 | 1.82E+05 | 4.73E-06 | 4.73E-06 | 3.75E+03 | 6.64E+03 | - | 5.38E-02 | - | - | 6.65E-02 | - | 2.49E+00 | 8.63E-01 | - | 2.55E+02 | 8.84E+01 | 9.93E+02 | 1.74E-01 |
| **7** | 1.97E+04 | 1.23E+04 | 1.03E-05 | 1.03E-05 | 2.75E+02 | 3.85E+02 | - | 4.36E-03 | - | - | 2.04E-02 | - | 7.06E-01 | 3.51E-01 | 1.72E+03 | 3.10E+02 | 7.61E+01 | 7.28E+02 | 7.05E-02 |
| **8** | 4.10E+03 | 1.88E+03 | 3.62E-06 | 3.62E-06 | 8.53E+01 | 7.86E+01 | - | 5.63E-04 | - | - | 1.49E-03 | - | 6.84E-02 | 3.11E-02 | 8.90E+01 | 1.95E+01 | 4.60E+00 | 4.38E+01 | 5.80E-03 |
| **9** | 2.71E+03 | 5.17E+03 | 4.56E-13 | 4.56E-13 | 4.58E+00 | 9.49E+01 | - | 1.82E-03 | - | - | 1.18E-03 | - | 2.94E-02 | 2.01E-01 | 4.37E+01 | 6.24E+00 | 1.39E+00 | 5.79E+00 | 2.87E-04 |
| **10** | 2.71E+03 | 5.38E+02 | 1.13E-13 | 1.13E-13 | 5.75E-01 | 1.03E+01 | - | 1.87E-04 | - | - | 2.28E-04 | - | 5.69E-03 | 4.35E-02 | 2.21E+01 | 3.16E+00 | 7.06E-01 | 3.14E+00 | 1.45E-04 |
| **11** | 1.98E+04 | 3.65E+04 | 2.93E-04 | 2.93E-04 | 1.43E+03 | 6.73E+03 | 2.00E-03 | - | 2.85E-01 | 2.34E-01 | 4.41E-03 | 3.61E-02 | 8.17E-03 | 1.54E-01 | 2.09E+04 | 2.07E+02 | 1.30E+02 | 7.46E+03 | 2.77E-01 |
| **12** | 1.43E+05 | 4.16E+05 | 1.87E-05 | 1.87E-05 | 5.57E+03 | 5.78E+04 | 1.36E+00 | 1.37E-02 | 3.83E+01 | 3.58E+00 | 6.74E-02 | 2.84E-01 | 6.79E-01 | 7.94E+00 | 1.38E+05 | 2.32E+03 | 1.28E+03 | 3.25E+04 | 1.85E+00 |
| **13** | 2.52E+05 | 3.97E+05 | 1.06E-05 | 1.06E-05 | 2.82E+03 | 3.66E+04 | 1.98E-01 | 5.27E-02 | 4.06E+01 | 5.73E+00 | 1.57E-01 | 5.91E-01 | 1.83E+00 | 1.47E+01 | 5.39E+04 | 1.46E+03 | 6.03E+02 | 1.06E+04 | 4.00E-01 |
| **14** | 2.80E+04 | 1.13E+04 | 1.33E-10 | 1.33E-10 | 2.09E+01 | 3.92E+02 | 1.06E-02 | 3.14E-03 | 3.74E-01 | 5.13E-02 | 4.15E-03 | 4.41E-03 | 7.91E-02 | 5.48E-01 | 2.45E+02 | 6.04E+01 | 1.95E+01 | 9.88E+01 | 3.57E-03 |
| **15** | 3.12E+05 | 3.57E+05 | 1.29E-04 | 1.29E-04 | 3.60E+03 | 4.79E+04 | 1.13E+00 | - | 1.39E+01 | 3.79E+00 | 6.12E-02 | 3.59E-01 | 1.40E-03 | 3.55E+00 | 5.70E+04 | 1.22E+03 | 5.90E+02 | 1.22E+04 | 4.45E-01 |
| **16** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **21** | 6.09E+03 | 2.90E+03 | 3.09E-01 | 1.89E-04 | 3.60E+03 | 6.61E+02 | 5.67E-06 | - | 1.79E-01 | 1.91E-01 | 3.03E-03 | 3.50E-02 | 1.79E-02 | 1.58E-01 | 9.51E+02 | 1.40E+01 | 4.76E+00 | 8.35E+01 | 5.33E-04 |
| **22** | 9.98E+03 | 5.49E+03 | 1.99E-04 | 1.99E-04 | 5.78E+02 | 1.34E+03 | - | - | 1.07E+00 | 3.86E-01 | 5.91E-03 | 6.36E-02 | 1.31E-01 | 2.35E-01 | 1.59E+03 | - | - | - | - |
| **23** | 5.61E+04 | 4.00E+02 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **24** | 3.54E+03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **25** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **26** | 2.59E+05 | 1.11E+04 | 3.11E+01 | 3.11E+01 | 2.25E+04 | 1.14E+03 | - | 8.82E-03 | 2.69E-08 | 8.57E-08 | 2.54E-02 | 3.27E-03 | 3.04E+00 | 7.85E-03 | 1.62E+04 | 2.54E+03 | 5.68E+02 | 1.34E+04 | 1.13E-01 |
| **27** | 3.86E+03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **28** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **29** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **30** | 6.32E+02 | 1.95E+03 | 6.72E-02 | 6.72E-02 | 1.78E+03 | 7.98E+02 | - | - | - | 1.83E-02 | 3.25E-04 | 3.37E-03 | 1.20E-05 | 8.25E-03 | 3.52E+03 | 3.06E+01 | 2.20E+01 | 2.26E+03 | 5.26E-02 |
| **31** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **32** | 9.85E+04 | 4.94E+05 | 4.96E+00 | 4.96E+00 | 1.17E+05 | 1.26E+05 | - | - | - | 2.77E+00 | 3.97E-02 | 6.22E-01 | 1.86E-02 | 1.15E+00 | 4.02E+05 | 3.53E+03 | 2.62E+03 | 1.80E+05 | 5.53E+00 |
| **33** | 8.42E+04 | 4.92E+05 | 1.32E+03 | 1.32E+03 | 1.51E+06 | 5.59E+04 | - | 1.12E-01 | 5.39E-07 | 1.11E-02 | 2.09E-01 | 1.16E-01 | 3.02E+01 | 9.48E+00 | 1.55E+04 | 8.44E+03 | 1.48E+03 | 4.40E+04 | 8.57E-02 |
| **34** | 2.02E+04 | 4.78E+05 | 2.95E+01 | 2.95E+01 | 5.68E+05 | 4.46E+04 | - | 1.13E-01 | - | - | 1.14E-01 | - | 8.05E+00 | 6.22E+00 | - | 1.30E+03 | 2.91E+02 | 6.01E+03 | 6.03E-02 |
| **35** | 6.32E+04 | 4.40E+05 | 7.21E+00 | 7.21E+00 | 1.34E+05 | 1.31E+05 | - | - | - | 2.72E+00 | 4.72E-02 | 8.02E-01 | 2.79E-02 | 9.83E-01 | 4.07E+05 | 3.29E+03 | 2.52E+03 | 1.96E+05 | 5.66E+00 |
| **36** | 1.86E+02 | 4.88E+02 | 1.91E-05 | 1.91E-05 | 6.76E+01 | 1.29E+02 | - | - | - | 7.26E-03 | 1.41E-04 | 2.56E-03 | 4.60E-05 | 2.03E-03 | 6.29E+02 | 4.90E+00 | 3.90E+00 | 2.55E+02 | 8.42E-03 |
| **37** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **38** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **39** | 1.04E+05 | 6.11E+05 | 4.44E+03 | 4.44E+03 | 1.24E+06 | 2.71E+05 | - | - | - | 1.12E+01 | 1.62E-01 | 1.93E+00 | 3.42E-02 | 7.05E+00 | 6.25E+05 | 7.78E+03 | 4.83E+03 | 5.55E+05 | 1.03E+01 |
| **40** | 4.39E+05 | 2.10E+05 | 9.04E-01 | 4.22E-04 | 5.05E+03 | 1.29E+04 | 5.67E-02 | 6.30E-02 | 1.61E+00 | 1.55E+00 | 2.93E-01 | 3.87E-01 | 9.17E+00 | 3.20E+01 | 2.93E+04 | 9.45E+03 | 3.58E+03 | 5.03E+04 | 1.81E+00 |
| **41** | 2.67E+03 | 5.99E+02 | 4.25E-04 | 4.25E-04 | 1.86E+02 | 1.92E+02 | - | - | - | 1.23E-02 | 1.43E-04 | 3.54E-03 | 9.78E-06 | 3.69E-02 | 2.02E+02 | - | - | - | - |
| **42** | 1.76E+04 | 1.51E+04 | 9.41E-05 | 9.41E-05 | 3.06E+02 | 2.15E+03 | 4.36E-02 | 1.54E-04 | 6.14E-01 | 2.26E-01 | 5.33E-03 | 3.02E-02 | 9.35E-02 | 1.86E-01 | 2.94E+03 | 1.05E+02 | 3.76E+01 | 6.43E+02 | 3.44E-02 |
| **43** | 2.42E+05 | 9.37E+04 | 8.95E+01 | 8.95E+01 | 1.67E+05 | 4.32E+04 | - | - | - | 3.41E+00 | 4.70E-02 | 6.49E-01 | 3.82E-03 | 3.63E+00 | 8.26E+04 | 3.26E+02 | 2.75E+02 | 7.07E+04 | 4.06E+00 |
| **44** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **45** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **46** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **47** | 2.48E+05 | 8.43E+03 | 8.35E-02 | 8.35E-02 | 8.00E+03 | 7.67E+02 | - | 6.86E-03 | - | - | 1.86E-02 | - | 1.48E+00 | - | 1.58E+04 | 2.26E+03 | 5.06E+02 | 9.84E+03 | 1.04E-01 |
| **48** | 1.81E+04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **49** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **50** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **51** | 1.39E+05 | 2.41E+05 | 5.57E-02 | 2.60E-03 | 9.94E+03 | 4.44E+04 | 1.52E-02 | 2.22E-03 | 1.84E+00 | 1.53E+00 | 3.99E-02 | 2.48E-01 | 3.64E-01 | 1.24E+00 | 1.34E+05 | 1.79E+03 | 1.01E+03 | 5.07E+04 | 1.83E+00 |
| **Phase Totals** | 2.80E+06 | 4.95E+06 | 5.92E+03 | 5.92E+03 | 3.83E+06 | 9.09E+05 | 2.82E+00 | 5.64E-01 | 9.87E+01 | 3.75E+01 | 1.60E+00 | 6.17E+00 | 6.49E+01 | 9.92E+01 | 2.01E+06 | 4.80E+04 | 2.08E+04 | 1.25E+06 | 3.29E+01 |

## Table 4: Dry Sludge Radioisotope Inventory by Tank, continued

| Tank | Sludge Volume, gal | Am-241 (Ci) | Am-242m (Ci) | Cm-244 (Ci) | Cm-245 (Ci) | Na-22 (Ci) | Al-26 (Ci) | Te-125m (Ci) | Sb-126 (Ci) | Sb-126m (Ci) | Sm-151 (Ci) | Eu-152 (Ci) | Eu-155 (Ci) | Ra-226 (Ci) | Ra-228 (Ci) | Ac-227 (Ci) | Th-229 (Ci) | Th-230 (Ci) | Pa-231 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 7.05E+03 | 1.98E+03 | 2.43E+00 | 3.51E-01 | 4.27E-07 | 7.83E-02 | 4.13E-02 | 2.78E+00 | 3.91E+00 | 2.80E+01 | 3.02E+04 | 1.46E+02 | 1.71E+03 | - | - | 4.03E-06 | - | - | 1.12E-05 |
| **2** | 4.07E+03 | 3.01E+02 | 3.64E-01 | 4.47E-02 | 6.55E-08 | 1.08E-02 | 5.69E-03 | 8.16E-02 | 6.01E-01 | 4.29E+00 | 4.16E+03 | 2.01E+01 | 2.35E+02 | - | - | 1.85E-07 | - | - | 5.15E-07 |
| **3** | 4.07E+03 | 2.55E+02 | 3.08E-01 | 4.03E-02 | 5.49E-08 | 9.43E-03 | 4.98E-03 | 1.22E-01 | 5.03E-01 | 3.59E+00 | 3.64E+03 | 1.76E+01 | 2.06E+02 | - | - | 4.63E-07 | - | - | 1.29E-06 |
| **4** | 1.27E+05 | 1.00E+04 | 1.21E+01 | 1.59E+04 | 6.90E-01 | 4.69E-01 | 2.48E-01 | 3.45E+02 | 1.86E+01 | 1.33E+02 | 1.81E+05 | 8.75E+02 | 1.02E+04 | - | - | 1.77E-05 | - | - | 4.92E-05 |
| **5** | 3.06E+04 | 9.10E+03 | 1.13E+01 | 1.83E+00 | 1.95E-06 | 3.87E-01 | 2.04E-01 | 3.04E+01 | 1.79E+01 | 1.28E+02 | 1.49E+05 | 7.22E+02 | 8.44E+03 | - | - | 2.39E-05 | - | - | 6.64E-05 |
| **6** | 2.49E+04 | 8.96E+03 | 1.12E+01 | 1.38E+03 | 1.89E-06 | 4.09E-01 | 2.16E-01 | 6.21E+01 | 1.73E+01 | 1.24E+02 | 1.58E+05 | 7.64E+02 | 8.93E+03 | - | - | 1.52E-05 | - | - | 4.21E-05 |
| **7** | 1.97E+04 | 7.38E+02 | 7.70E-01 | 1.01E+03 | 8.89E-03 | 2.76E-02 | 1.46E-02 | 4.41E+00 | 1.29E+00 | 9.23E+00 | 1.06E+04 | 5.15E+01 | 6.01E+02 | - | - | 4.65E-06 | - | - | 1.29E-05 |
| **8** | 4.10E+03 | 1.02E+02 | 1.10E-01 | 1.83E+02 | 3.35E-03 | 4.22E-03 | 2.23E-03 | 1.36E+00 | 1.72E-01 | 1.23E+00 | 1.63E+03 | 7.89E+00 | 9.21E+01 | - | - | 3.39E-07 | - | - | 9.42E-07 |
| **9** | 2.71E+03 | 3.20E+02 | 3.93E-01 | 4.82E-02 | 7.07E-08 | 1.16E-02 | 6.14E-03 | 8.75E-02 | 6.48E-01 | 4.63E+00 | 4.48E+03 | 2.17E+01 | 2.53E+02 | - | - | 2.69E-07 | - | - | 7.47E-07 |
| **10** | 2.71E+03 | 3.36E+01 | 4.04E-02 | 5.07E-03 | 7.24E-09 | 1.21E-03 | 6.39E-04 | 1.09E-02 | 6.63E-02 | 4.74E-01 | 4.67E+02 | 2.26E+00 | 2.64E+01 | - | - | 5.21E-08 | - | - | 1.45E-07 |
| **11** | 1.98E+04 | 1.84E+03 | 1.15E+00 | 1.17E+02 | 7.47E-04 | 8.20E-02 | 4.33E-02 | 1.37E+01 | 1.59E+00 | 1.14E+01 | 3.16E+04 | 1.53E+02 | 1.79E+03 | 5.26E-07 | 2.00E-03 | 1.01E-06 | 8.09E-04 | 6.44E-05 | 2.79E-06 |
| **12** | 1.43E+05 | 1.78E+04 | 1.56E+01 | 2.16E+03 | 8.29E-03 | 9.34E-01 | 4.93E-01 | 5.67E+01 | 2.25E+01 | 1.61E+02 | 3.60E+05 | 1.74E+03 | 2.04E+04 | 8.08E-06 | 1.36E+00 | 1.54E-05 | 1.09E-01 | 9.89E-04 | 4.27E-05 |
| **13** | 2.52E+05 | 1.83E+04 | 1.93E+01 | 2.56E+03 | 5.61E-03 | 8.91E-01 | 4.71E-01 | 3.03E+01 | 3.06E+01 | 2.19E+02 | 3.44E+05 | 1.66E+03 | 1.94E+04 | 1.29E-05 | 1.98E-01 | 3.57E-05 | 1.15E-01 | 1.58E-03 | 9.93E-05 |
| **14** | 2.80E+04 | 6.34E+02 | 7.52E-01 | 3.57E-01 | 4.88E-05 | 2.54E-02 | 1.34E-02 | 3.54E-01 | 1.21E+00 | 8.64E+00 | 9.78E+03 | 4.73E+01 | 5.53E+02 | 1.16E-07 | 1.06E-02 | 9.47E-07 | 1.06E-03 | 1.41E-05 | 2.63E-06 |
| **15** | 3.12E+05 | 1.34E+04 | 1.25E+01 | 8.80E+02 | 8.32E-03 | 8.01E-01 | 4.23E-01 | 3.67E+01 | 1.77E+01 | 1.27E+02 | 3.09E+05 | 1.50E+03 | 1.75E+04 | 8.55E-06 | 1.13E+00 | 1.40E-05 | 3.95E-02 | 1.05E-03 | 3.88E-05 |
| **16** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **21** | 6.09E+03 | 5.92E+01 | 3.98E-01 | 1.38E+02 | 1.81E-02 | 6.52E-03 | 3.44E-03 | 3.12E+00 | 9.98E-02 | 7.13E-01 | 2.52E+03 | 1.22E+01 | 1.42E+02 | 4.30E-07 | 5.67E-06 | 6.91E-07 | 5.09E-04 | 5.26E-05 | 1.92E-06 |
| **22** | 9.98E+03 | 9.36E+01 | 1.12E-01 | 9.91E-01 | 9.94E-05 | 1.23E-02 | 6.52E-03 | 5.39E+00 | 2.12E-01 | 1.51E+00 | 4.76E+03 | 2.30E+01 | 2.69E+02 | 8.71E-07 | - | 1.35E-06 | 3.06E-03 | 1.07E-04 | 3.74E-06 |
| **23** | 5.61E+04 | - | - | - | - | 8.99E-04 | 4.75E-04 | - | - | - | 3.47E+02 | 1.68E+00 | 1.96E+01 | - | - | - | - | - | - |
| **24** | 3.54E+03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **25** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **26** | 2.59E+05 | 5.74E+02 | - | 1.64E-01 | 7.62E-08 | 2.50E-02 | 1.32E-02 | 3.04E+02 | 6.91E-01 | 4.93E+00 | 9.64E+03 | 4.66E+01 | 5.45E+02 | 1.93E-13 | - | 5.79E-06 | 7.64E-11 | 2.36E-11 | 1.61E-05 |
| **27** | 3.86E+03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **28** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **29** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **30** | 6.32E+02 | 1.48E+02 | 4.70E-02 | 4.05E-01 | 2.83E-05 | 4.37E-03 | 2.31E-03 | 1.52E+01 | 6.03E-02 | 4.31E-01 | 1.69E+03 | 8.17E+00 | 9.54E+01 | 4.12E-08 | - | 7.41E-08 | - | 5.04E-06 | 2.06E-07 |
| **31** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **32** | 9.85E+04 | 2.69E+04 | 1.42E+01 | 8.95E+01 | 8.96E-03 | 1.11E+00 | 5.87E-01 | 1.02E+03 | 1.91E+01 | 1.36E+02 | 4.29E+05 | 2.07E+03 | 2.42E+04 | 6.25E-06 | - | 9.05E-06 | - | 7.65E-04 | 2.51E-05 |
| **33** | 8.42E+04 | 1.58E+04 | 2.07E+01 | 7.53E+00 | 3.21E-06 | 1.11E+00 | 5.84E-01 | 2.01E+04 | 2.95E+01 | 2.10E+02 | 4.27E+05 | 2.06E+03 | 2.41E+04 | 2.50E-08 | - | 4.76E-05 | 1.53E-09 | 3.06E-06 | 1.32E-04 |
| **34** | 2.02E+04 | 1.50E+05 | 2.15E+01 | 6.94E+00 | 3.38E-06 | 1.07E+00 | 5.68E-01 | 7.90E+03 | 3.10E+01 | 2.21E+02 | 4.15E+05 | 2.01E+03 | 2.34E+04 | - | - | 2.60E-05 | - | - | 7.23E-05 |
| **35** | 6.32E+04 | 2.44E+04 | 1.19E+01 | 8.37E+01 | 7.36E-03 | 9.89E-01 | 5.22E-01 | 1.18E+03 | 1.57E+01 | 1.12E+02 | 3.82E+05 | 1.85E+03 | 2.16E+04 | 6.13E-06 | - | 1.08E-05 | - | 7.50E-04 | 2.99E-05 |
| **36** | 1.86E+02 | 3.32E+01 | 1.36E-02 | 9.01E-02 | 8.49E-06 | 1.10E-03 | 5.79E-04 | 6.25E-01 | 1.81E-02 | 1.29E-01 | 4.23E+02 | 2.05E+00 | 2.39E+01 | 1.64E-08 | - | 3.21E-08 | - | 2.00E-06 | 8.91E-08 |
| **37** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **38** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **39** | 1.04E+05 | 3.29E+04 | 1.45E+01 | 1.29E+02 | 8.75E-03 | 1.37E+00 | 7.26E-01 | 1.00E+04 | 1.87E+01 | 1.33E+02 | 5.30E+05 | 2.56E+03 | 3.00E+04 | 2.53E-05 | - | 3.70E-05 | - | 3.10E-03 | 1.03E-04 |
| **40** | 4.39E+05 | 1.26E+04 | 2.65E+01 | 1.14E+05 | 1.28E+01 | 4.78E-01 | 2.53E-01 | 7.60E+01 | 2.06E+01 | 1.47E+02 | 1.85E+05 | 8.93E+02 | 1.04E+04 | 3.50E-06 | 5.67E-02 | 6.68E-05 | 4.58E-03 | 4.28E-04 | 1.85E-04 |
| **41** | 2.67E+03 | 9.18E+00 | 1.12E-02 | 1.17E-01 | 9.66E-06 | 1.35E-03 | 7.11E-04 | 1.66E+00 | 2.06E-02 | 1.47E-01 | 5.19E+02 | 2.51E+00 | 2.93E+01 | 2.78E-08 | - | 3.26E-08 | - | 3.40E-06 | 9.05E-08 |
| **42** | 1.76E+04 | 5.59E+02 | 5.06E-01 | 2.41E+02 | 3.42E-04 | 3.39E-02 | 1.79E-02 | 3.03E+00 | 7.42E-01 | 5.30E+00 | 1.31E+04 | 6.32E+01 | 7.39E+02 | 5.09E-07 | 4.36E-02 | 1.22E-06 | 1.75E-03 | 6.23E-05 | 3.38E-06 |
| **43** | 2.42E+05 | 2.60E+03 | 1.90E+00 | 2.01E+01 | 1.31E-03 | 2.11E-01 | 1.11E-01 | 1.37E+03 | 2.79E+00 | 1.99E+01 | 8.12E+04 | 3.93E+02 | 4.59E+03 | 7.68E-06 | - | 1.07E-05 | - | 9.40E-04 | 2.98E-05 |
| **44** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **45** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **46** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **47** | 2.48E+05 | 5.67E+02 | - | 1.21E-01 | 6.03E-08 | 1.89E-02 | 1.00E-02 | 1.13E+02 | 5.47E-01 | 3.90E+00 | 7.31E+03 | 3.53E+01 | 4.13E+02 | - | - | 4.25E-06 | - | - | 1.18E-05 |
| **48** | 1.81E+04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **49** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **50** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **51** | 1.39E+05 | 1.21E+04 | 8.59E+00 | 6.83E+03 | 7.48E-01 | 5.42E-01 | 2.86E-01 | 9.55E+01 | 1.09E+01 | 7.78E+01 | 2.09E+05 | 1.01E+03 | 1.18E+04 | 3.45E-06 | 1.52E-02 | 9.11E-06 | 5.25E-03 | 4.22E-04 | 2.53E-05 |
| **Phase Totals** | 2.80E+06 | 3.63E+05 | 2.09E+02 | 1.45E+05 | 1.43E+01 | 1.11E+01 | 5.88E+00 | 4.28E+04 | 2.85E+02 | 2.04E+03 | 4.30E+06 | 2.08E+04 | 2.43E+05 | 8.44E-05 | 2.82E+00 | 3.64E-04 | 2.81E-01 | 1.03E-02 | 1.01E-03 |

## Table 4: Dry Sludge Radioisotope Inventory by Tank, continued

| Tank | Sludge Volume, gal | Pu-244 (Ci) | Am-243 (Ci) | Cm-242 (Ci) | Cm-243 (Ci) | Cm-247 (Ci) | Cm-248 (Ci) | Bk-249 (Ci) | Cf-249 (Ci) | Cf-251 (Ci) | Cf-252 (Ci) | DrySludge Transferred Mass (Kg) | Sludge Interstitial Fraction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.05E+03 | 2.80E-05 | 4.88E-01 | 2.02E+00 | 2.86E-01 | 5.51E-11 | 5.74E-11 | 4.19E-18 | 3.18E-10 | 1.09E-11 | 3.53E-13 | 1.13E+04 | 0.70 |
| 2 | 4.07E+03 | 4.15E-06 | 6.72E-02 | 3.02E-01 | 3.94E-02 | 7.58E-12 | 7.90E-12 | 5.77E-19 | 4.38E-11 | 1.50E-12 | 4.86E-14 | 1.58E+03 | 0.70 |
| 3 | 4.07E+03 | 5.00E-06 | 5.88E-02 | 2.55E-01 | 3.44E-02 | 6.63E-12 | 6.91E-12 | 5.05E-19 | 3.83E-11 | 1.31E-12 | 4.26E-14 | 3.06E+03 | 0.70 |
| 4 | 1.27E+05 | 1.26E-04 | 2.92E+00 | 1.01E+01 | 1.71E+00 | 3.30E-10 | 3.44E-10 | 2.51E-17 | 1.91E-09 | 6.52E-11 | 2.12E-12 | 6.55E+04 | 0.70 |
| 5 | 3.06E+04 | 1.55E-04 | 2.41E+00 | 9.36E+00 | 1.41E+00 | 2.72E-10 | 2.84E-10 | 2.07E-17 | 1.57E-09 | 5.38E-11 | 1.75E-12 | 5.76E+04 | 0.56 |
| 6 | 2.49E+04 | 7.96E-04 | 2.55E+00 | 9.26E+00 | 1.49E+00 | 2.88E-10 | 3.00E-10 | 2.19E-17 | 1.66E-09 | 5.69E-11 | 1.85E-12 | 3.87E+04 | 0.70 |
| 7 | 1.97E+04 | 3.22E-04 | 1.72E-01 | 6.39E-01 | 1.01E-01 | 1.94E-11 | 2.02E-11 | 1.48E-18 | 1.12E-10 | 3.84E-12 | 1.24E-13 | 4.09E+04 | 0.70 |
| 8 | 4.10E+03 | 2.65E-05 | 2.63E-02 | 9.13E-02 | 1.54E-02 | 2.97E-12 | 3.10E-12 | 2.26E-19 | 1.72E-11 | 5.88E-13 | 1.91E-14 | 1.80E+03 | 0.70 |
| 9 | 2.71E+03 | 1.31E-06 | 7.25E-02 | 3.26E-01 | 4.24E-02 | 8.17E-12 | 8.52E-12 | 6.22E-19 | 4.72E-11 | 1.62E-12 | 5.24E-14 | 1.52E+03 | 0.70 |
| 10 | 2.71E+03 | 6.64E-07 | 7.54E-03 | 3.35E-02 | 4.42E-03 | 8.51E-13 | 8.87E-13 | 6.48E-20 | 4.92E-12 | 1.68E-13 | 5.46E-15 | 3.14E+02 | 0.70 |
| 11 | 1.98E+04 | 1.27E-03 | 5.11E-01 | 9.53E-01 | 2.99E-01 | 5.77E-11 | 6.01E-11 | 4.39E-18 | 3.33E-10 | 1.14E-11 | 3.70E-13 | 1.73E+04 | 0.70 |
| 12 | 1.43E+05 | 8.45E-03 | 5.83E+00 | 1.30E+01 | 3.41E+00 | 6.57E-10 | 6.85E-10 | 5.01E-17 | 3.80E-09 | 1.30E-10 | 4.22E-12 | 1.90E+05 | 0.53 |
| 13 | 2.52E+05 | 1.83E-03 | 5.56E+00 | 1.60E+01 | 3.25E+00 | 6.27E-10 | 6.53E-10 | 4.77E-17 | 3.62E-09 | 1.24E-10 | 4.02E-12 | 4.18E+05 | 0.70 |
| 14 | 2.80E+04 | 1.63E-05 | 1.58E-01 | 6.24E-01 | 9.26E-02 | 1.78E-11 | 1.86E-11 | 1.36E-18 | 1.03E-10 | 3.53E-12 | 1.14E-13 | 4.12E+03 | 0.70 |
| 15 | 3.12E+05 | 2.03E-03 | 5.00E+00 | 1.04E+01 | 2.93E+00 | 5.64E-10 | 5.87E-10 | 4.29E-17 | 3.26E-09 | 1.11E-10 | 3.62E-12 | 1.66E+05 | 0.48 |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 21 | 6.09E+03 | 2.44E-06 | 4.07E-02 | 3.30E-01 | 2.38E-02 | 4.59E-12 | 4.78E-12 | 3.49E-19 | 2.65E-11 | 9.07E-13 | 2.94E-14 | 6.39E+03 | 0.70 |
| 22 | 9.98E+03 | - | 7.69E-02 | 9.32E-02 | 4.51E-02 | 8.68E-12 | 9.05E-12 | 6.61E-19 | 5.02E-11 | 1.72E-12 | 5.57E-14 | 1.70E+04 | 0.70 |
| 23 | 5.61E+04 | - | 5.61E-03 | - | 3.28E-03 | 6.33E-13 | 6.59E-13 | 4.82E-20 | 3.66E-12 | 1.25E-13 | 4.06E-15 | 4.03E+04 | 0.70 |
| 24 | 3.54E+03 | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 26 | 2.59E+05 | 5.17E-04 | 1.56E-01 | - | 9.13E-02 | 1.76E-11 | 1.83E-11 | 1.34E-18 | 1.02E-10 | 3.48E-12 | 1.13E-13 | 1.59E+05 | 0.70 |
| 27 | 3.86E+03 | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 30 | 6.32E+02 | 2.41E-04 | 2.73E-02 | 3.90E-02 | 1.60E-02 | 3.08E-12 | 3.21E-12 | 2.34E-19 | 1.78E-11 | 6.09E-13 | 1.97E-14 | 5.44E+02 | 0.70 |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 32 | 9.85E+04 | 2.53E-02 | 6.93E+00 | 1.18E+01 | 4.06E+00 | 7.82E-10 | 8.14E-10 | 5.95E-17 | 4.52E-09 | 1.55E-10 | 5.01E-12 | 1.96E+05 | 0.70 |
| 33 | 8.42E+04 | 3.92E-04 | 6.90E+00 | 1.72E+01 | 4.04E+00 | 7.78E-10 | 8.11E-10 | 5.93E-17 | 4.50E-09 | 1.54E-10 | 4.99E-12 | 2.42E+05 | 0.70 |
| 34 | 2.02E+04 | 2.76E-04 | 6.70E+00 | 1.79E+01 | 3.93E+00 | 7.56E-10 | 7.88E-10 | 5.76E-17 | 4.37E-09 | 1.50E-10 | 4.85E-12 | 7.71E+04 | 0.70 |
| 35 | 6.32E+04 | 2.59E-02 | 6.17E+00 | 9.87E+00 | 3.61E+00 | 6.96E-10 | 7.25E-10 | 5.30E-17 | 4.02E-09 | 1.38E-10 | 4.46E-12 | 1.39E+05 | 0.70 |
| 36 | 1.86E+02 | 3.85E-05 | 6.84E-03 | 1.13E-02 | 4.00E-03 | 7.71E-13 | 8.04E-13 | 5.87E-20 | 4.46E-12 | 1.52E-13 | 4.95E-15 | 1.63E+02 | 0.70 |
| 37 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 38 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 39 | 1.04E+05 | 4.71E-02 | 8.57E+00 | 1.21E+01 | 5.02E+00 | 9.66E-10 | 1.01E-09 | 7.36E-17 | 5.58E-09 | 1.91E-10 | 6.20E-12 | 1.17E+05 | 0.70 |
| 40 | 4.39E+05 | 8.26E-03 | 2.98E+00 | 2.20E+01 | 1.75E+00 | 3.37E-10 | 3.51E-10 | 2.56E-17 | 1.94E-09 | 6.65E-11 | 2.16E-12 | 4.04E+05 | 0.70 |
| 41 | 2.67E+03 | - | 8.39E-03 | 9.28E-03 | 4.92E-03 | 9.47E-13 | 9.87E-13 | 7.21E-20 | 5.47E-12 | 1.87E-13 | 6.08E-15 | 2.36E+03 | 0.70 |
| 42 | 1.76E+04 | 1.57E-04 | 2.11E-01 | 4.20E-01 | 1.24E-01 | 2.38E-11 | 2.48E-11 | 1.81E-18 | 1.38E-10 | 4.71E-12 | 1.53E-13 | 1.80E+04 | 0.80 |
| 43 | 2.42E+05 | 1.86E-02 | 1.31E+00 | 1.58E+00 | 7.69E-01 | 1.48E-10 | 1.54E-10 | 1.13E-17 | 8.56E-10 | 2.93E-11 | 9.50E-13 | 9.21E+04 | 0.70 |
| 44 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 45 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 46 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 47 | 2.48E+05 | 4.76E-04 | 1.18E-01 | - | 6.92E-02 | 1.33E-11 | 1.39E-11 | 1.01E-18 | 7.70E-11 | 2.63E-12 | 8.55E-14 | 1.38E+05 | 0.70 |
| 48 | 1.81E+04 | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 49 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 |
| 51 | 1.39E+05 | 8.37E-03 | 3.38E+00 | 7.13E+00 | 1.98E+00 | 3.81E-10 | 3.97E-10 | 2.90E-17 | 2.20E-09 | 7.54E-11 | 2.45E-12 | 1.24E+05 | 0.80 |
| Phase Totals | 2.80E+06 | 1.51E-01 | 6.94E+01 | 1.74E+02 | 4.07E+01 | 7.83E-09 | 8.16E-09 | 5.96E-16 | 4.53E-08 | 1.55E-09 | 5.02E-11 | 2.79E+06 | - |

## Table 5: Insoluble Salt Radionuclide Inventory by Tank

| Tank | Salt Volume, gal | H-3 (Ci) | C-14 (Ci) | Sr-90 (Ci) | Y-90 (Ci) | Cs-137 (Ci) | Ba-137m (Ci) | U-235 (Ci) | U-238 (Ci) | Pu-238 (Ci) | Pu-239 (Ci) | Na-22 (Ci) | Al-26 (Ci) | Ac-227 (Ci) | Pa-231 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.80E+05 | - | 1.10E+01 | 1.71E+05 | 1.71E+05 | 7.63E+03 | 7.22E+03 | 6.72E-03 | 1.51E-01 | 2.18E+03 | 7.27E+01 | 8.96E+01 | 3.13E-01 | 1.53E-06 | 4.26E-06 |
| 2 | 5.36E+05 | - | 1.23E+01 | 1.91E+05 | 1.91E+05 | 8.52E+03 | 8.06E+03 | 7.51E-03 | 1.68E-01 | 2.43E+03 | 8.12E+01 | 1.00E+02 | 3.50E-01 | 1.71E-06 | 4.76E-06 |
| 3 | 5.36E+05 | - | 1.23E+01 | 1.91E+05 | 1.91E+05 | 8.52E+03 | 8.06E+03 | 7.51E-03 | 1.68E-01 | 2.43E+03 | 8.12E+01 | 1.00E+02 | 3.50E-01 | 1.71E-06 | 4.76E-06 |
| 4 | 3.39E+04 | - | 7.75E-01 | 1.21E+04 | 1.21E+04 | 5.39E+02 | 5.09E+02 | 4.74E-04 | 1.06E-02 | 1.54E+02 | 5.13E+00 | 6.32E+00 | 2.21E-02 | 1.08E-07 | 3.01E-07 |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | 5.34E+05 | - | 1.22E+01 | 1.90E+05 | 1.90E+05 | 8.49E+03 | 8.03E+03 | 7.48E-03 | 1.68E-01 | 2.43E+03 | 8.08E+01 | 9.97E+01 | 3.49E-01 | 1.71E-06 | 4.74E-06 |
| 10 | 2.11E+05 | - | 4.83E+00 | 7.52E+04 | 7.52E+04 | 3.36E+03 | 3.18E+03 | 2.96E-03 | 6.64E-02 | 9.60E+02 | 3.20E+01 | 3.95E+01 | 1.38E-01 | 6.76E-07 | 1.88E-06 |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | 6.00E+04 | - | 1.37E+00 | 2.13E+04 | 2.13E+04 | 9.54E+02 | 9.02E+02 | 8.40E-04 | 1.89E-02 | 2.73E+02 | 9.08E+00 | 1.12E+01 | 3.92E-02 | 1.92E-07 | 5.33E-07 |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | 1.30E+05 | - | 2.96E+00 | 4.61E+04 | 4.61E+04 | 2.06E+03 | 1.95E+03 | 1.81E-03 | 4.07E-02 | 5.88E+02 | 1.96E+01 | 2.42E+01 | 8.45E-02 | 4.14E-07 | 1.15E-06 |
| 15 | 1.50E+05 | - | 3.42E+00 | 5.32E+04 | 5.32E+04 | 2.38E+03 | 2.25E+03 | 2.09E-03 | 4.70E-02 | 6.79E+02 | 2.26E+01 | 2.79E+01 | 9.76E-02 | 4.78E-07 | 1.33E-06 |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | 1.10E+06 | - | 2.51E+01 | 3.91E+05 | 3.91E+05 | 1.75E+04 | 1.65E+04 | 1.54E-02 | 3.45E-01 | 4.99E+03 | 1.66E+02 | 2.05E+02 | 7.17E-01 | 3.51E-06 | 9.75E-06 |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | 6.00E+05 | - | 1.37E+01 | 2.14E+05 | 2.14E+05 | 9.54E+03 | 9.03E+03 | 8.41E-03 | 1.89E-01 | 2.73E+03 | 9.09E+01 | 1.12E+02 | 3.92E-01 | 1.92E-06 | 5.33E-06 |
| 28 | 1.03E+06 | - | 2.35E+01 | 3.66E+05 | 3.66E+05 | 1.64E+04 | 1.55E+04 | 1.44E-02 | 3.24E-01 | 4.68E+03 | 1.56E+02 | 1.92E+02 | 6.72E-01 | 3.29E-06 | 9.14E-06 |
| 29 | 1.02E+06 | - | 2.34E+01 | 3.64E+05 | 3.64E+05 | 1.63E+04 | 1.54E+04 | 1.43E-02 | 3.21E-01 | 4.65E+03 | 1.55E+02 | 1.91E+02 | 6.68E-01 | 3.27E-06 | 9.08E-06 |
| 30 | 2.50E+05 | - | 5.71E+00 | 8.88E+04 | 8.88E+04 | 3.97E+03 | 3.75E+03 | 3.50E-03 | 7.84E-02 | 1.13E+03 | 3.78E+01 | 4.66E+01 | 1.63E-01 | 7.98E-07 | 2.22E-06 |
| 31 | 1.15E+06 | - | 2.62E+01 | 4.08E+05 | 4.08E+05 | 1.82E+04 | 1.72E+04 | 1.61E-02 | 3.60E-01 | 5.21E+03 | 1.74E+02 | 2.14E+02 | 7.49E-01 | 3.66E-06 | 1.02E-05 |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | 2.94E+05 | - | 6.72E+00 | 1.05E+05 | 1.05E+05 | 4.67E+03 | 4.42E+03 | 4.11E-03 | 9.23E-02 | 1.33E+03 | 4.45E+01 | 5.49E+01 | 1.92E-01 | 9.39E-07 | 2.61E-06 |
| 34 | 1.91E+05 | - | 4.37E+00 | 6.81E+04 | 6.81E+04 | 3.04E+03 | 2.88E+03 | 2.68E-03 | 6.01E-02 | 8.69E+02 | 2.90E+01 | 3.57E+01 | 1.25E-01 | 6.11E-07 | 1.70E-06 |
| 35 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 36 | 1.04E+06 | - | 2.37E+01 | 3.68E+05 | 3.68E+05 | 1.65E+04 | 1.56E+04 | 1.45E-02 | 3.25E-01 | 4.70E+03 | 1.57E+02 | 1.93E+02 | 6.76E-01 | 3.31E-06 | 9.19E-06 |
| 37 | 1.14E+06 | - | 2.62E+01 | 4.07E+05 | 4.07E+05 | 1.82E+04 | 1.72E+04 | 1.60E-02 | 3.60E-01 | 5.20E+03 | 1.73E+02 | 2.14E+02 | 7.47E-01 | 3.66E-06 | 1.02E-05 |
| 38 | 8.28E+05 | - | 1.89E+01 | 2.95E+05 | 2.95E+05 | 1.32E+04 | 1.25E+04 | 1.16E-02 | 2.60E-01 | 3.76E+03 | 1.25E+02 | 1.55E+02 | 5.41E-01 | 2.65E-06 | 7.35E-06 |
| 39 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 40 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 41 | 1.09E+06 | - | 2.50E+01 | 3.89E+05 | 3.89E+05 | 1.74E+04 | 1.64E+04 | 1.53E-02 | 3.43E-01 | 4.96E+03 | 1.65E+02 | 2.04E+02 | 7.13E-01 | 3.49E-06 | 9.70E-06 |
| 42 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 43 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 44 | 1.00E+06 | - | 2.29E+01 | 3.57E+05 | 3.57E+05 | 1.59E+04 | 1.51E+04 | 1.40E-02 | 3.15E-01 | 4.56E+03 | 1.52E+02 | 1.87E+02 | 6.55E-01 | 3.21E-06 | 8.90E-06 |
| 45 | 1.10E+06 | - | 2.53E+01 | 3.93E+05 | 3.93E+05 | 1.76E+04 | 1.66E+04 | 1.55E-02 | 3.47E-01 | 5.02E+03 | 1.67E+02 | 2.06E+02 | 7.21E-01 | 3.53E-06 | 9.81E-06 |
| 46 | 8.65E+05 | - | 1.98E+01 | 3.08E+05 | 3.08E+05 | 1.38E+04 | 1.30E+04 | 1.21E-02 | 2.72E-01 | 3.93E+03 | 1.31E+02 | 1.62E+02 | 5.65E-01 | 2.76E-06 | 7.68E-06 |
| 47 | 8.35E+05 | - | 1.91E+01 | 2.97E+05 | 2.97E+05 | 1.33E+04 | 1.26E+04 | 1.17E-02 | 2.62E-01 | 3.79E+03 | 1.26E+02 | 1.56E+02 | 5.45E-01 | 2.67E-06 | 7.41E-06 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 2.99E+02 | - | 6.84E-03 | 1.06E+02 | 1.06E+02 | 4.75E+00 | 4.50E+00 | 4.19E-06 | 9.39E-05 | 1.36E+00 | 4.53E-02 | 5.58E-02 | 1.95E-04 | 9.56E-10 | 2.65E-09 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Phase Totals** | 1.62E+07 | - | 3.71E+02 | 5.77E+06 | 5.77E+06 | 2.58E+05 | 2.44E+05 | 2.27E-01 | 5.09E+00 | 7.36E+04 | 2.45E+03 | 3.03E+03 | 1.06E+01 | 5.18E-05 | 1.44E-04 |

## Table 6: Soluble Radionuclide Inventory by Tank

| Tank | Total Supernate Volume, gal | H-3 (Ci) | C-14 (Ci) | Co-60 (Ci) | Ni-59 (Ci) | Ni-63 (Ci) | Se-79 (Ci) | Sr-90 (Ci) | Y-90 (Ci) | Nb-94 (Ci) | Tc-99 (Ci) | Ru-106 (Ci) | Rh-106 (Ci) | Sb-125 (Ci) | Sn-126 (Ci) | I-129 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.66E+05 | 6.28E+01 | 1.11E+00 | 6.47E-01 | 6.97E-02 | 1.57E+00 | 2.58E+00 | 8.09E+02 | 8.09E+02 | 2.03E-05 | 9.58E+02 | 6.61E+01 | 6.61E+01 | 2.68E+02 | 1.31E+01 | 5.17E-01 |
| 2 | 1.64E+05 | 6.20E+01 | 1.09E+00 | 6.38E-01 | 2.55E-02 | 1.55E+00 | 9.45E-01 | 2.96E+02 | 2.96E+02 | 7.43E-06 | 3.50E+02 | 2.42E+01 | 2.42E+01 | 9.80E+01 | 4.78E+00 | 1.89E-01 |
| 3 | 1.64E+05 | 6.20E+01 | 1.09E+00 | 6.38E-01 | 2.59E-02 | 1.55E+00 | 9.58E-01 | 3.00E+02 | 3.00E+02 | 7.53E-06 | 3.55E+02 | 2.45E+01 | 2.45E+01 | 9.93E+01 | 4.84E+00 | 1.92E-01 |
| 4 | 3.99E+05 | 1.51E+02 | 2.66E+00 | 1.55E+00 | 7.43E-02 | 3.77E+00 | 2.75E+00 | 8.62E+02 | 8.62E+02 | 2.16E-05 | 1.02E+03 | 7.04E+01 | 7.04E+01 | 2.85E+02 | 1.39E+01 | 5.50E-01 |
| 5 | 1.71E+04 | 6.49E+00 | 1.14E-01 | 6.69E-02 | 6.55E-04 | 1.62E-01 | 2.43E-02 | 7.60E+00 | 7.60E+00 | 1.91E-07 | 9.00E+00 | 6.21E-01 | 6.21E-01 | 2.52E+00 | 1.23E-01 | 4.85E-03 |
| 6 | 2.71E+05 | 7.23E+02 | 1.81E+00 | 1.06E+00 | 2.12E-03 | 2.57E+00 | 7.87E-02 | 2.47E+01 | 2.47E+01 | 6.19E-07 | 2.92E+01 | 2.01E+00 | 2.01E+00 | 8.16E+00 | 3.98E-01 | 1.57E-02 |
| 7 | 2.90E+05 | 1.19E+02 | 1.93E+00 | 1.13E+00 | 1.06E-02 | 2.75E+00 | 3.92E-01 | 1.11E+02 | 1.11E+02 | 3.09E-06 | 1.45E+02 | 1.00E+01 | 1.00E+01 | 4.07E+01 | 1.98E+00 | 7.84E-02 |
| 8 | 1.02E+04 | 2.34E+02 | 6.76E-02 | 3.96E-02 | 1.50E-04 | 9.61E-02 | 5.54E-03 | 1.74E+00 | 1.74E+00 | 4.36E-08 | 2.05E+00 | 1.42E-01 | 1.42E-01 | 5.74E-01 | 2.80E-02 | 1.11E-03 |
| 9 | 1.75E+05 | 6.63E+01 | 1.17E+00 | 6.83E-01 | 2.67E-02 | 1.66E+00 | 9.91E-01 | 3.10E+02 | 3.10E+02 | 7.79E-06 | 3.67E+02 | 2.54E+01 | 2.53E+01 | 1.03E+02 | 5.01E+00 | 1.98E-01 |
| 10 | 6.53E+04 | 2.47E+01 | 4.35E-01 | 2.55E-01 | 1.74E-03 | 6.18E-01 | 6.45E-02 | 2.02E+01 | 2.02E+01 | 5.07E-07 | 2.39E+01 | 1.65E+00 | 1.65E+00 | 6.69E+00 | 3.26E-01 | 1.29E-02 |
| 11 | 1.56E+05 | 5.89E+01 | 1.04E+00 | 6.07E-01 | 9.94E-07 | 1.47E+00 | 3.68E-05 | 1.04E-02 | 1.04E-02 | 2.90E-10 | 1.37E-02 | 9.42E-04 | 9.42E-04 | 3.82E-03 | 1.86E-04 | 7.36E-06 |
| 12 | 1.18E+05 | 4.48E+01 | 7.89E-01 | 4.62E-01 | 2.61E-03 | 1.12E+00 | 9.66E-02 | 3.02E+01 | 3.02E+01 | 7.59E-07 | 3.58E+01 | 2.47E+00 | 2.47E+00 | 1.00E+01 | 4.88E-01 | 1.93E-02 |
| 13 | 7.54E+05 | 2.85E+02 | 5.02E+00 | 2.94E+00 | 2.49E-01 | 7.13E+00 | 9.24E+00 | 2.89E+03 | 2.89E+03 | 7.27E-05 | 3.43E+03 | 2.36E+02 | 2.36E+02 | 9.58E+02 | 4.67E+01 | 1.85E+00 |
| 14 | 5.95E+04 | 2.25E+01 | 3.96E-01 | 2.32E-01 | 2.11E-02 | 5.63E-01 | 7.81E-01 | 2.45E+02 | 2.45E+02 | 6.14E-06 | 2.89E+02 | 2.00E+01 | 2.00E+01 | 8.09E+01 | 3.95E+00 | 1.56E-01 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 1.18E+06 | 4.47E+02 | 7.86E+00 | 4.60E+00 | 3.32E-05 | 1.12E+01 | 1.23E-03 | 3.85E-01 | 3.85E-01 | 9.69E-09 | 4.57E-01 | 3.15E-02 | 3.15E-02 | 1.28E-01 | 6.23E-03 | 2.94E-03 |
| 22 | 1.18E+06 | 4.45E+02 | 7.84E+00 | 4.59E+00 | 3.61E-05 | 1.11E+01 | 1.34E-03 | 4.16E-01 | 4.16E-01 | 1.05E-08 | 4.97E-01 | 3.43E-02 | 3.42E-02 | 1.39E-01 | 6.77E-03 | 2.93E-03 |
| 23 | 1.30E+06 | 5.06E+00 | 2.02E-01 | 4.22E-03 | 5.56E-06 | 1.84E-01 | 2.06E-04 | 1.57E+00 | 1.57E+00 | 1.62E-09 | 3.29E-01 | 5.27E-03 | 5.26E-03 | 2.13E-02 | 1.04E-03 | 2.84E-03 |
| 24 | 8.53E+05 | 3.23E+02 | 5.69E+00 | 3.33E+00 | 1.00E-02 | 8.08E+00 | 3.71E-01 | 1.16E+02 | 1.16E+02 | 2.92E-06 | 1.38E+02 | 9.50E+00 | 9.50E+00 | 3.85E+01 | 1.88E+00 | 2.47E-02 |
| 25 | 3.66E+05 | 1.39E+02 | 2.44E+00 | 1.43E+00 | 2.93E-02 | 3.47E+00 | 1.08E+00 | 3.40E+02 | 3.40E+02 | 8.52E-06 | 4.02E+02 | 2.77E+01 | 2.77E+01 | 1.12E+02 | 5.48E+00 | 2.17E-01 |
| 26 | 7.01E+05 | 2.65E+02 | 4.67E+00 | 2.73E+00 | 1.06E-01 | 6.63E+00 | 3.92E+00 | 1.28E+03 | 1.28E+03 | 3.08E-05 | 1.45E+03 | 1.00E+02 | 1.00E+02 | 4.06E+02 | 1.98E+01 | 7.83E-01 |
| 27 | 7.83E+05 | 2.96E+02 | 5.22E+00 | 3.05E+00 | 1.34E-01 | 7.41E+00 | 4.97E+00 | 1.54E+03 | 1.54E+03 | 3.91E-05 | 1.84E+03 | 1.27E+02 | 1.27E+02 | 5.16E+02 | 2.52E+01 | 9.95E-01 |
| 28 | 4.94E+05 | 1.87E+02 | 3.29E+00 | 1.93E+00 | 4.68E-02 | 4.68E+00 | 1.73E+00 | 5.43E+02 | 5.43E+02 | 1.36E-05 | 6.43E+02 | 4.44E+01 | 4.44E+01 | 1.80E+02 | 8.77E+00 | 3.47E-01 |
| 29 | 4.74E+05 | 1.79E+02 | 3.16E+00 | 1.85E+00 | 1.00E-02 | 4.49E+00 | 3.71E-01 | 1.16E+02 | 1.16E+02 | 2.92E-06 | 1.38E+02 | 9.49E+00 | 9.49E+00 | 3.85E+01 | 1.88E+00 | 7.42E-02 |
| 30 | 9.90E+05 | 3.75E+02 | 6.60E+00 | 3.86E+00 | 2.25E-01 | 9.37E+00 | 8.33E+00 | 2.61E+03 | 2.61E+03 | 6.55E-05 | 3.09E+03 | 2.13E+02 | 2.13E+02 | 8.63E+02 | 4.21E+01 | 1.66E+00 |
| 31 | 4.59E+05 | 1.74E+02 | 3.06E+00 | 1.79E+00 | 1.10E-01 | 4.35E+00 | 4.09E+00 | 1.28E+03 | 1.28E+03 | 3.22E-05 | 1.52E+03 | 1.05E+02 | 1.05E+02 | 4.24E+02 | 2.07E+01 | 8.19E-01 |
| 32 | 9.13E+05 | 3.46E+02 | 6.08E+00 | 3.56E+00 | 1.51E-01 | 8.64E+00 | 5.60E+00 | 1.51E+03 | 1.51E+03 | 4.40E-05 | 2.07E+03 | 1.43E+02 | 1.43E+02 | 5.80E+02 | 2.83E+01 | 1.12E+00 |
| 33 | 9.42E+05 | 4.80E+02 | 6.28E+00 | 3.67E+00 | 8.09E-02 | 8.92E+00 | 3.00E+00 | 9.39E+02 | 9.39E+02 | 2.36E-05 | 1.11E+03 | 7.67E+01 | 7.66E+01 | 3.11E+02 | 1.52E+01 | 5.99E-01 |
| 34 | 6.40E+05 | 2.42E+02 | 4.27E+00 | 2.50E+00 | 6.69E-02 | 6.06E+00 | 2.48E+00 | 7.76E+02 | 7.76E+02 | 1.95E-05 | 9.19E+02 | 6.34E+01 | 6.34E+01 | 2.57E+02 | 1.25E+01 | 4.95E-01 |
| 35 | 4.94E+05 | 1.87E+02 | 3.29E+00 | 1.93E+00 | 4.24E-02 | 4.68E+00 | 1.57E+00 | 4.92E+02 | 4.92E+02 | 1.24E-05 | 5.82E+02 | 4.02E+01 | 4.02E+01 | 1.63E+02 | 7.94E+00 | 3.14E-01 |
| 36 | 5.30E+05 | 2.01E+02 | 3.53E+00 | 2.07E+00 | 2.35E-01 | 5.02E+00 | 8.71E+00 | 2.73E+03 | 2.73E+03 | 6.85E-05 | 3.23E+03 | 2.23E+02 | 2.23E+02 | 9.03E+02 | 4.40E+01 | 1.74E+00 |
| 37 | 4.60E+05 | 1.74E+02 | 3.06E+00 | 1.79E+00 | 9.27E-02 | 4.35E+00 | 3.44E+00 | 9.85E+02 | 9.85E+02 | 2.70E-05 | 1.27E+03 | 8.79E+01 | 8.79E+01 | 3.56E+02 | 1.74E+01 | 6.87E-01 |
| 38 | 4.20E+05 | 1.59E+02 | 2.80E+00 | 1.64E+00 | 2.90E-03 | 3.97E+00 | 1.07E-01 | 3.36E+01 | 3.36E+01 | 8.44E-07 | 3.98E+01 | 2.75E+00 | 2.74E+00 | 1.11E+01 | 5.43E-01 | 2.15E-02 |
| 39 | 7.95E+05 | 3.01E+02 | 5.30E+00 | 3.10E+00 | 1.89E-02 | 7.52E+00 | 6.99E-01 | 1.64E+02 | 1.64E+02 | 5.49E-06 | 2.59E+02 | 1.79E+01 | 1.79E+01 | 7.24E+01 | 3.53E+00 | 1.40E-01 |
| 40 | 6.12E+05 | 2.32E+02 | 4.08E+00 | 2.39E+00 | 8.77E-04 | 5.80E+00 | 3.25E-02 | 1.06E+01 | 1.06E+01 | 2.56E-07 | 1.21E+01 | 8.31E-01 | 8.31E-01 | 3.37E+00 | 1.64E-01 | 6.50E-03 |
| 41 | 3.46E+05 | 1.31E+02 | 2.30E+00 | 1.35E+00 | 7.76E-03 | 3.27E+00 | 2.87E-01 | 3.17E+01 | 3.17E+01 | 2.26E-06 | 1.07E+02 | 7.35E+00 | 7.35E+00 | 2.98E+01 | 1.45E+00 | 5.75E-02 |
| 42 | 1.27E+06 | 4.80E+02 | 8.45E+00 | 4.94E+00 | 2.60E-01 | 1.20E+01 | 9.64E+00 | 3.02E+03 | 3.02E+03 | 7.58E-05 | 3.57E+03 | 2.46E+02 | 2.46E+02 | 9.99E+02 | 4.87E+01 | 1.93E+00 |
| 43 | 9.45E+05 | 3.58E+02 | 6.30E+00 | 3.69E+00 | 4.09E-03 | 8.95E+00 | 1.51E-01 | 4.10E+01 | 4.10E+01 | 1.19E-06 | 5.62E+01 | 3.88E+00 | 3.87E+00 | 1.57E+01 | 7.66E-01 | 3.03E-02 |
| 44 | 5.64E+05 | 2.14E+02 | 3.76E+00 | 2.20E+00 | 6.34E-02 | 5.34E+00 | 2.35E+00 | 7.35E+02 | 7.35E+02 | 1.85E-05 | 8.71E+02 | 6.01E+01 | 6.00E+01 | 2.43E+02 | 1.19E+01 | 4.69E-01 |
| 45 | 5.11E+05 | 1.93E+02 | 3.40E+00 | 1.99E+00 | 5.43E-02 | 4.84E+00 | 2.01E+00 | 6.30E+02 | 6.30E+02 | 1.58E-05 | 7.45E+02 | 5.14E+01 | 5.14E+01 | 2.08E+02 | 1.02E+01 | 4.02E-01 |
| 46 | 6.72E+05 | 2.55E+02 | 4.48E+00 | 2.62E+00 | 1.07E-01 | 6.36E+00 | 3.97E+00 | 1.24E+03 | 1.24E+03 | 3.12E-05 | 1.47E+03 | 1.01E+02 | 1.01E+02 | 4.11E+02 | 2.01E+01 | 7.93E-01 |
| 47 | 5.97E+05 | 2.26E+02 | 3.98E+00 | 2.33E+00 | 1.76E-02 | 5.65E+00 | 6.51E-01 | 2.04E+02 | 2.04E+02 | 5.12E-06 | 2.41E+02 | 1.66E+01 | 1.66E+01 | 6.74E+01 | 3.29E+00 | 1.30E-01 |
| 48 | 2.40E+05 | 9.10E+01 | 1.60E+00 | 9.37E-01 | 8.69E-03 | 2.28E+00 | 3.22E-01 | 2.98E+02 | 2.98E+02 | 2.53E-06 | 1.19E+02 | 8.23E+00 | 8.23E+00 | 3.34E+01 | 1.63E+00 | 6.44E-02 |
| 49 | 1.92E+05 | 7.26E+01 | 1.28E+00 | 7.48E-01 | 3.15E-04 | 1.82E+00 | 1.17E-02 | 2.68E+01 | 2.68E+01 | 9.19E-08 | 4.33E+00 | 2.99E-01 | 2.99E-01 | 1.21E+00 | 5.91E-02 | 2.34E-03 |
| 50 | 4.24E+05 | 5.67E+00 | 1.70E-02 | 8.49E-03 | 2.28E-07 | 2.63E-02 | 8.46E-06 | 2.65E-03 | 2.65E-03 | 6.65E-11 | 3.14E-03 | 2.16E-04 | 2.16E-04 | 8.77E-04 | 4.28E-05 | 3.45E-03 |
| 51 | 6.93E+05 | 2.62E+02 | 4.62E+00 | 2.70E+00 | 5.46E-03 | 6.56E+00 | 2.02E-01 | 5.07E+01 | 5.07E+01 | 1.59E-06 | 7.50E+01 | 5.18E+00 | 5.18E+00 | 2.10E+01 | 1.02E+00 | 4.05E-02 |
| Phase Totals | 2.39E+07 | 9.37E+03 | 1.48E+02 | 8.63E+01 | 2.40E+00 | 2.10E+02 | 8.90E+01 | 2.77E+04 | 2.77E+04 | 7.00E-04 | 3.30E+04 | 2.28E+03 | 2.28E+03 | 9.23E+03 | 4.50E+02 | 1.78E+01 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Total Supernate Volume, gal | Cs-134 (Ci) | Cs-135 (Ci) | Cs-137 (Ci) | Ba-137m (Ci) | Ce-144 (Ci) | Pr-144 (Ci) | Pm-147 (Ci) | Eu-154 (Ci) | Th-232 (Ci) | U-232 (Ci) | U-233 (Ci) | U-234 (Ci) | U-235 (Ci) | U-236 (Ci) | U-238 (Ci) | Np-237 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.66E+05 | 6.60E+03 | 1.12E+01 | 3.29E+06 | 3.11E+06 | 1.72E-01 | 1.72E-01 | 1.11E+02 | 2.64E+01 | - | 1.51E-04 | - | - | 2.33E-04 | - | 5.79E-03 | 8.45E-03 |
| 2 | 1.64E+05 | 2.42E+03 | 4.10E+00 | 1.20E+06 | 1.14E+06 | 6.30E-02 | 6.30E-02 | 4.07E+01 | 9.66E+00 | - | 1.25E-04 | - | - | 6.01E-05 | - | 1.50E-03 | 1.57E-02 |
| 3 | 1.64E+05 | 2.45E+03 | 4.16E+00 | 1.22E+06 | 1.15E+06 | 6.38E-02 | 6.38E-02 | 4.13E+01 | 9.79E+00 | - | 1.09E-04 | - | - | 1.54E-04 | - | 3.85E-03 | 2.88E-02 |
| 4 | 3.99E+05 | 7.04E+03 | 1.20E+01 | 3.51E+06 | 3.32E+06 | 1.83E-01 | 1.83E-01 | 1.19E+02 | 2.81E+01 | - | 1.81E-04 | - | - | 2.38E-04 | - | 1.02E-02 | 9.15E-03 |
| 5 | 1.71E+04 | 6.20E+01 | 1.05E-01 | 3.09E+04 | 2.92E+04 | 1.62E-03 | 1.62E-03 | 1.05E+00 | 2.48E-01 | - | 1.54E-05 | - | - | 2.99E-05 | - | 7.09E-04 | 1.20E-03 |
| 6 | 2.71E+05 | 2.01E+02 | 3.42E-01 | 1.00E+05 | 9.49E+04 | 5.25E-03 | 5.25E-03 | 3.39E+00 | 8.05E-01 | - | 2.87E-04 | - | - | 3.54E-04 | - | 1.33E-02 | 4.60E-03 |
| 7 | 2.90E+05 | 1.00E+03 | 1.70E+00 | 5.00E+05 | 4.73E+05 | 2.61E-02 | 2.61E-02 | 1.69E+01 | 4.01E+00 | - | 6.88E-05 | - | - | 3.22E-04 | - | 1.11E-02 | 5.54E-03 |
| 8 | 1.02E+04 | 1.42E+01 | 2.41E-02 | 7.06E+03 | 6.68E+03 | 3.69E-04 | 3.69E-04 | 2.39E-01 | 5.66E-02 | - | 3.02E-06 | - | - | 7.97E-06 | - | 3.67E-04 | 1.67E-04 |
| 9 | 1.75E+05 | 2.53E+03 | 4.30E+00 | 1.26E+06 | 1.19E+06 | 6.60E-02 | 6.60E-02 | 4.27E+01 | 1.01E+01 | - | 1.80E-04 | - | - | 1.17E-04 | - | 2.91E-03 | 1.99E-02 |
| 10 | 6.53E+04 | 1.65E+02 | 2.80E-01 | 8.22E+04 | 7.77E+04 | 4.30E-03 | 4.30E-03 | 2.78E+00 | 6.59E-01 | - | 4.31E-05 | - | - | 5.25E-05 | - | 1.31E-03 | 1.00E-02 |
| 11 | 1.56E+05 | 9.41E-02 | 1.60E-04 | 4.69E+01 | 4.44E+01 | 2.45E-06 | 2.45E-06 | 1.59E-03 | 3.76E-04 | 2.81E-06 | - | 4.01E-04 | 3.29E-04 | 6.22E-06 | 5.09E-05 | 1.15E-05 | 2.18E-04 |
| 12 | 1.18E+05 | 2.47E+02 | 4.19E-01 | 1.23E+05 | 1.16E+05 | 6.43E-03 | 6.43E-03 | 4.16E+00 | 9.87E-01 | 2.09E-04 | 2.11E-06 | 5.89E-03 | 5.51E-04 | 1.04E-05 | 4.37E-05 | 1.04E-04 | 1.22E-03 |
| 13 | 7.54E+05 | 2.36E+04 | 4.01E+01 | 1.18E+07 | 1.11E+07 | 6.16E-01 | 6.16E-01 | 3.98E+02 | 9.44E+01 | 4.08E-04 | 1.09E-04 | 8.37E-02 | 1.18E-02 | 3.23E-04 | 1.22E-03 | 3.77E-03 | 3.04E-02 |
| 14 | 5.95E+04 | 2.00E+03 | 3.39E+00 | 9.94E+05 | 9.40E+05 | 5.20E-02 | 5.20E-02 | 3.37E+01 | 7.98E+00 | 1.38E-04 | 4.08E-05 | 4.86E-03 | 6.67E-04 | 5.39E-05 | 5.73E-05 | 1.03E-03 | 7.12E-03 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 1.18E+06 | 3.15E+00 | 5.35E-03 | 1.57E+03 | 1.48E+03 | 8.21E-05 | 8.20E-05 | 5.31E-02 | 1.26E-02 | 1.20E-06 | - | 3.79E-02 | 4.05E-02 | 6.43E-04 | 7.43E-03 | 3.80E-03 | 3.36E-02 |
| 22 | 1.18E+06 | 3.42E+00 | 5.82E-03 | 1.71E+03 | 1.61E+03 | 8.92E-05 | 8.92E-05 | 5.77E-02 | 1.37E-02 | - | - | 1.57E-01 | 5.65E-02 | 8.64E-04 | 9.30E-03 | 1.92E-02 | 3.43E-02 |
| 23 | 1.30E+06 | 1.36E-02 | 2.01E-02 | 2.62E+02 | 2.48E+02 | 1.37E-05 | 1.37E-05 | 8.88E-03 | 2.10E-03 | 1.78E-07 | - | 1.18E-02 | 1.88E-02 | 1.05E-04 | 4.21E-04 | 3.13E-03 | 8.69E-04 |
| 24 | 8.53E+05 | 9.49E+02 | 1.61E+00 | 4.73E+05 | 4.47E+05 | 2.47E-02 | 2.47E-02 | 1.60E+01 | 3.80E+00 | - | 3.84E-09 | 1.17E-14 | 3.72E-14 | 1.10E-08 | 1.42E-09 | 1.32E-06 | 3.41E-09 |
| 25 | 3.66E+05 | 2.77E+03 | 4.71E+00 | 1.38E+06 | 1.31E+06 | 7.22E-02 | 7.22E-02 | 4.67E+01 | 1.11E+01 | - | 1.65E-09 | 5.01E-15 | 1.60E-14 | 4.73E-09 | 6.11E-10 | 5.68E-07 | 1.47E-09 |
| 26 | 7.01E+05 | 1.00E+04 | 1.70E+01 | 4.99E+06 | 4.72E+06 | 2.61E-01 | 2.61E-01 | 1.69E+02 | 4.00E+01 | - | 2.21E-03 | 6.71E-09 | 2.14E-08 | 6.34E-03 | 8.19E-04 | 7.61E-01 | 1.96E-03 |
| 27 | 7.83E+05 | 1.27E+04 | 2.16E+01 | 6.33E+06 | 5.99E+06 | 3.31E-01 | 3.31E-01 | 2.14E+02 | 5.08E+01 | - | 3.52E-09 | 1.07E-14 | 3.42E-14 | 1.01E-08 | 1.31E-09 | 1.21E-06 | 3.13E-09 |
| 28 | 4.94E+05 | 4.43E+03 | 7.53E+00 | 2.21E+06 | 2.09E+06 | 1.16E-01 | 1.16E-01 | 7.48E+01 | 1.77E+01 | - | 2.22E-09 | 6.76E-15 | 2.16E-14 | 6.38E-09 | 8.24E-10 | 7.66E-07 | 1.98E-09 |
| 29 | 4.74E+05 | 9.48E+02 | 1.61E+00 | 4.73E+05 | 4.47E+05 | 2.47E-02 | 2.47E-02 | 1.60E+01 | 3.79E+00 | - | 9.06E-11 | 6.98E-08 | 9.85E-09 | 2.69E-10 | 1.02E-09 | 3.15E-09 | 2.53E-08 |
| 30 | 9.90E+05 | 2.13E+04 | 3.61E+01 | 1.06E+07 | 1.00E+07 | 5.55E-01 | 5.55E-01 | 3.59E+02 | 8.51E+01 | - | - | - | 3.45E-02 | 6.13E-04 | 6.37E-03 | 2.27E-05 | 1.56E-02 |
| 31 | 4.59E+05 | 1.05E+04 | 1.78E+01 | 5.21E+06 | 4.93E+06 | 2.73E-01 | 2.73E-01 | 1.76E+02 | 4.18E+01 | - | 8.78E-11 | 6.76E-08 | 9.54E-09 | 2.61E-10 | 9.84E-10 | 3.05E-09 | 2.45E-08 |
| 32 | 9.13E+05 | 1.43E+04 | 2.43E+01 | 7.13E+06 | 6.74E+06 | 3.73E-01 | 3.73E-01 | 2.41E+02 | 5.72E+01 | - | - | - | 4.13E-02 | 5.91E-04 | 9.27E-03 | 2.77E-04 | 1.71E-02 |
| 33 | 9.42E+05 | 7.66E+03 | 1.30E+01 | 3.82E+06 | 3.61E+06 | 2.00E-01 | 2.00E-01 | 1.29E+02 | 3.06E+01 | - | 1.82E-02 | 8.74E-08 | 1.80E-03 | 3.38E-02 | 1.88E-02 | 4.90E+00 | 1.54E+00 |
| 34 | 6.40E+05 | 6.33E+03 | 1.08E+01 | 3.16E+06 | 2.99E+06 | 1.65E-01 | 1.65E-01 | 1.07E+02 | 2.53E+01 | - | 3.38E-03 | - | - | 3.42E-03 | - | 2.41E-01 | 1.87E-01 |
| 35 | 4.94E+05 | 4.01E+03 | 6.82E+00 | 2.00E+06 | 1.89E+06 | 1.05E-01 | 1.05E-01 | 6.77E+01 | 1.61E+01 | - | - | - | 2.18E-02 | 3.79E-04 | 6.44E-03 | 2.24E-04 | 7.89E-03 |
| 36 | 5.30E+05 | 2.23E+04 | 3.78E+01 | 1.11E+07 | 1.05E+07 | 5.80E-01 | 5.80E-01 | 3.75E+02 | 8.90E+01 | - | - | - | 4.07E-02 | 7.88E-04 | 1.44E-02 | 2.58E-04 | 1.14E-02 |
| 37 | 4.60E+05 | 8.78E+03 | 1.49E+01 | 4.38E+06 | 4.14E+06 | 2.29E-01 | 2.29E-01 | 1.48E+02 | 3.51E+01 | - | 8.79E-11 | 6.77E-08 | 9.55E-09 | 2.61E-10 | 9.85E-10 | 3.05E-09 | 2.46E-08 |
| 38 | 4.20E+05 | 2.74E+02 | 4.66E-01 | 1.37E+05 | 1.29E+05 | 7.15E-03 | 7.15E-03 | 4.63E+00 | 1.10E+00 | - | - | - | 1.25E-07 | 1.73E-09 | 2.38E-08 | 1.40E-10 | 1.33E-07 |
| 39 | 7.95E+05 | 1.79E+03 | 3.03E+00 | 8.90E+05 | 8.42E+05 | 4.65E-02 | 4.65E-02 | 3.01E+01 | 7.14E+00 | - | - | - | 9.44E-02 | 1.36E-03 | 1.62E-02 | 2.88E-04 | 5.93E-02 |
| 40 | 6.12E+05 | 8.31E+01 | 1.41E-01 | 4.14E+04 | 3.92E+04 | 2.17E-03 | 2.17E-03 | 1.40E+00 | 3.32E-01 | 1.46E-03 | 1.63E-03 | 4.16E-02 | 4.00E-02 | 7.55E-03 | 9.99E-03 | 2.36E-01 | 8.26E-01 |
| 41 | 3.46E+05 | 7.34E+02 | 1.25E+00 | 3.66E+05 | 3.46E+05 | 1.91E-02 | 1.91E-02 | 1.24E+01 | 2.94E+00 | - | - | - | 1.44E-01 | 1.66E-03 | 4.12E-02 | 1.14E-04 | 4.29E-01 |
| 42 | 1.27E+06 | 2.46E+04 | 4.18E+01 | 1.23E+07 | 1.16E+07 | 6.42E-01 | 6.42E-01 | 4.15E+02 | 9.85E+01 | 1.01E-01 | 3.58E-04 | 1.43E+00 | 5.24E-01 | 1.24E-02 | 7.01E-02 | 2.17E-01 | 4.31E-01 |
| 43 | 9.45E+05 | 3.87E+02 | 6.58E-01 | 1.93E+05 | 1.83E+05 | 1.01E-02 | 1.01E-02 | 6.53E+00 | 1.55E+00 | - | - | - | 2.67E-01 | 3.68E-03 | 5.08E-02 | 2.99E-04 | 2.84E-01 |
| 44 | 5.64E+05 | 6.00E+03 | 1.02E+01 | 2.99E+06 | 2.83E+06 | 1.56E-01 | 1.56E-01 | 1.01E+02 | 2.40E+01 | - | 2.54E-09 | 7.72E-15 | 2.46E-14 | 7.29E-09 | 9.41E-10 | 8.75E-07 | 2.26E-09 |
| 45 | 5.11E+05 | 5.14E+03 | 8.73E+00 | 2.56E+06 | 2.42E+06 | 1.34E-01 | 1.34E-01 | 8.67E+01 | 2.05E+01 | - | 2.30E-09 | 6.99E-15 | 2.23E-14 | 6.60E-09 | 8.52E-10 | 7.92E-07 | 2.04E-09 |
| 46 | 6.72E+05 | 1.01E+04 | 1.72E+01 | 5.05E+06 | 4.78E+06 | 2.64E-01 | 2.64E-01 | 1.71E+02 | 4.06E+01 | - | 3.02E-09 | 9.19E-15 | 2.93E-14 | 8.68E-09 | 1.12E-09 | 1.04E-06 | 2.69E-09 |
| 47 | 5.97E+05 | 1.66E+03 | 2.82E+00 | 8.29E+05 | 7.84E+05 | 4.34E-02 | 4.33E-02 | 2.80E+01 | 6.65E+00 | - | 1.52E-03 | - | - | 4.14E-03 | - | 3.28E-01 | - |
| 48 | 2.40E+05 | 8.23E+02 | 1.40E+00 | 4.10E+05 | 3.88E+05 | 2.14E-02 | 2.14E-02 | 1.39E+01 | 3.29E+00 | - | - | 8.21E-01 | 2.81E+00 | 1.89E-03 | 8.62E-02 | 1.86E-03 | 1.80E-01 |
| 49 | 1.92E+05 | 2.99E+01 | 5.07E-02 | 1.49E+04 | 1.41E+04 | 7.79E-04 | 7.78E-04 | 5.04E-01 | 1.19E-01 | - | 3.67E-11 | 2.82E-08 | 3.98E-09 | 1.09E-10 | 4.11E-10 | 1.27E-09 | 1.02E-08 |
| 50 | 4.24E+05 | 1.04E-02 | 3.52E-02 | 1.08E+01 | 1.02E+01 | 5.64E-07 | 5.64E-07 | 3.65E-04 | 8.65E-05 | 7.00E-07 | 8.11E-11 | 6.24E-08 | 8.81E-09 | 1.16E-04 | 1.45E-04 | 6.15E-03 | 2.27E-08 |
| 51 | 6.93E+05 | 5.17E+02 | 8.79E-01 | 2.58E+05 | 2.44E+05 | 1.35E-02 | 1.35E-02 | 8.73E+00 | 2.07E+00 | 4.80E-04 | 7.05E-05 | 5.84E-02 | 4.85E-02 | 1.26E-03 | 7.85E-03 | 1.15E-02 | 3.91E-02 |
| Phase Totals | 2.39E+07 | 2.27E+05 | 3.86E+02 | 1.13E+08 | 1.07E+08 | 5.93E+00 | 5.93E+00 | 3.84E+03 | 9.10E+02 | 1.04E-01 | 2.87E-02 | 2.65E+00 | 4.20E+00 | 8.36E-02 | 3.57E-01 | 6.79E+00 | 4.24E+00 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Total Supernate Volume, gal | Pu-238 (Ci) | Pu-239 (Ci) | Pu-240 (Ci) | Pu-241 (Ci) | Pu-242 (Ci) | Am-241 (Ci) | Am-242m (Ci) | Cm-244 (Ci) | Cm-245 (Ci) | Na-22 (Ci) | Al-26 (Ci) | Te-125m (Ci) | Sb-126 (Ci) | Sb-126m (Ci) | Sm-151 (Ci) | Eu-152 (Ci) | Eu-155 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.66E+05 | 6.55E+00 | 1.75E+00 | 3.92E-01 | 2.15E+00 | 8.06E-05 | 1.05E+01 | 6.08E-03 | 4.22E+00 | 4.16E-04 | 5.87E+01 | 3.76E-01 | 6.54E+01 | 1.83E+00 | 1.31E+01 | 1.25E+02 | 6.04E-01 | 7.06E+00 |
| 2 | 1.64E+05 | 1.02E+01 | 1.46E+00 | 3.27E-01 | 1.37E+00 | 6.73E-05 | 3.86E+00 | 2.22E-03 | 1.54E+00 | 1.52E-04 | 2.15E+01 | 1.37E-01 | 2.39E+01 | 6.69E-01 | 4.78E+00 | 4.57E+01 | 2.21E-01 | 2.58E+00 |
| 3 | 1.64E+05 | 1.27E+01 | 1.81E+00 | 4.05E-01 | 2.04E+00 | 8.32E-05 | 3.91E+00 | 2.25E-03 | 1.57E+00 | 1.54E-04 | 2.18E+01 | 1.39E-01 | 2.42E+01 | 6.78E-01 | 4.84E+00 | 4.63E+01 | 2.24E-01 | 2.62E+00 |
| 4 | 3.99E+05 | 1.86E+00 | 1.83E+00 | 4.09E-01 | 3.46E+00 | 8.42E-05 | 1.12E+01 | 6.48E-03 | 4.50E+00 | 4.43E-04 | 6.26E+01 | 4.00E-01 | 6.97E+01 | 1.95E+00 | 1.39E+01 | 1.33E+02 | 6.43E-01 | 7.52E+00 |
| 5 | 1.71E+04 | 8.26E-01 | 1.38E-01 | 3.29E-02 | 2.21E-01 | 9.72E-06 | 9.91E-02 | 5.71E-05 | 3.97E-02 | 3.91E-06 | 5.52E-01 | 3.53E-03 | 6.14E-01 | 1.72E-02 | 1.23E-01 | 1.17E+00 | 5.67E-03 | 6.63E-02 |
| 6 | 2.71E+05 | - | 1.36E+00 | 4.72E-01 | 5.29E+00 | 9.28E-04 | 3.21E-01 | 1.85E-04 | 1.29E-01 | 1.27E-05 | 1.79E+00 | 1.14E-02 | 1.99E+00 | 5.57E-02 | 3.98E-01 | 3.80E+00 | 1.84E-02 | 2.15E-01 |
| 7 | 2.90E+05 | 2.72E+01 | 4.89E+00 | 1.20E+00 | 1.15E+01 | 1.11E-03 | 1.60E+00 | 9.23E-04 | 6.41E-01 | 6.32E-05 | 8.92E+00 | 5.70E-02 | 9.93E+00 | 2.78E-01 | 1.98E+00 | 1.90E+01 | 9.17E-02 | 1.07E+00 |
| 8 | 1.02E+04 | 4.77E-01 | 1.05E-01 | 2.46E-02 | 2.35E-01 | 3.11E-05 | 2.26E-02 | 1.30E-05 | 9.06E-03 | 8.92E-07 | 1.26E-01 | 8.05E-04 | 1.40E-01 | 3.92E-03 | 2.80E-02 | 2.68E-01 | 1.30E-03 | 1.51E-02 |
| 9 | 1.75E+05 | 4.31E+00 | 6.16E-01 | 1.38E-01 | 5.72E-01 | 2.83E-05 | 4.05E+00 | 2.33E-03 | 1.62E+00 | 1.60E-04 | 2.25E+01 | 1.44E-01 | 2.51E+01 | 7.02E-01 | 5.01E+00 | 4.79E+01 | 2.32E-01 | 2.71E+00 |
| 10 | 6.53E+04 | 5.08E+00 | 7.26E-01 | 1.62E-01 | 7.22E-01 | 3.34E-05 | 2.63E-01 | 1.52E-04 | 1.05E-01 | 1.04E-05 | 1.47E+00 | 9.38E-03 | 1.63E+00 | 4.57E-02 | 3.26E-01 | 3.12E+00 | 1.51E-02 | 1.76E-01 |
| 11 | 1.56E+05 | 2.94E+01 | 2.93E-01 | 1.84E-01 | 1.05E+01 | 3.91E-04 | 1.50E-04 | 8.67E-08 | 6.02E-05 | 5.93E-09 | 8.37E-04 | 5.35E-06 | 9.32E-04 | 2.61E-05 | 1.86E-04 | 1.78E-03 | 8.61E-06 | 1.01E-04 |
| 12 | 1.18E+05 | 2.12E+01 | 3.56E-01 | 1.97E-01 | 5.00E+00 | 2.84E-04 | 3.94E-01 | 2.27E-04 | 1.58E-01 | 1.55E-05 | 2.19E+00 | 1.40E-02 | 2.44E+00 | 6.84E-02 | 4.88E-01 | 4.67E+00 | 2.26E-02 | 2.64E-01 |
| 13 | 7.54E+05 | 1.11E+02 | 3.00E+00 | 1.24E+00 | 2.19E+01 | 8.25E-04 | 3.77E+01 | 2.17E-02 | 1.51E+01 | 1.49E-03 | 2.10E+02 | 1.34E+00 | 2.34E+02 | 6.54E+00 | 4.67E+01 | 4.46E+02 | 2.16E+00 | 2.52E+01 |
| 14 | 5.95E+04 | 3.19E+00 | 7.86E-01 | 2.54E-01 | 1.28E+00 | 4.65E-05 | 3.19E+00 | 1.84E-03 | 1.28E+00 | 1.26E-04 | 1.77E+01 | 1.13E-01 | 1.98E+01 | 5.53E-01 | 3.95E+00 | 3.77E+01 | 1.82E-01 | 2.13E+00 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 1.18E+06 | 2.02E+02 | 2.97E+00 | 1.01E+00 | 1.77E+01 | 1.13E-04 | 5.03E-03 | 2.90E-06 | 2.01E-03 | 1.98E-07 | 2.80E-02 | 1.79E-04 | 3.12E-02 | 8.72E-04 | 6.23E-03 | 5.95E-02 | 2.88E-04 | 3.36E-03 |
| 22 | 1.18E+06 | 2.33E+02 | - | - | - | - | 5.47E-03 | 3.15E-06 | 2.19E-03 | 2.16E-07 | 3.04E-02 | 1.95E-04 | 3.39E-02 | 9.48E-04 | 6.77E-03 | 6.47E-02 | 3.13E-04 | 3.66E-03 |
| 23 | 1.30E+06 | 9.48E-01 | 3.25E-03 | 8.10E-04 | 9.48E-02 | 4.83E-03 | 1.24E-02 | 4.85E-07 | 3.64E-04 | 3.31E-08 | 4.68E-03 | 2.99E-05 | 5.21E-03 | 1.46E-04 | 1.04E-03 | 9.95E-03 | 4.81E-05 | 5.62E-04 |
| 24 | 8.53E+05 | 7.05E-03 | 1.10E-03 | 2.47E-04 | 5.81E-03 | 4.92E-08 | 1.52E+00 | 8.74E-04 | 6.07E-01 | 5.98E-05 | 8.44E+00 | 5.40E-02 | 9.40E+00 | 2.63E-01 | 1.88E+00 | 1.79E+01 | 8.68E-02 | 1.01E+00 |
| 25 | 3.66E+05 | 3.03E-03 | 4.74E-04 | 1.06E-04 | 2.49E-03 | 2.11E-08 | 4.42E+00 | 2.55E-03 | 1.77E+00 | 1.74E-04 | 2.46E+01 | 1.58E-01 | 2.74E+01 | 7.67E-01 | 5.48E+00 | 5.24E+01 | 2.53E-01 | 2.96E+00 |
| 26 | 7.01E+05 | 4.05E+03 | 6.35E+02 | 1.42E+02 | 3.34E+03 | 2.83E-02 | 1.60E+01 | 9.22E-03 | 6.40E+00 | 6.31E-04 | 8.90E+01 | 5.69E-01 | 9.92E+01 | 2.77E+00 | 1.98E+01 | 1.89E+02 | 9.16E-01 | 1.07E+01 |
| 27 | 7.83E+05 | 6.47E-03 | 1.01E-03 | 2.27E-04 | 5.33E-03 | 4.51E-08 | 2.03E+01 | 1.17E-02 | 8.13E+00 | 8.01E-04 | 1.13E+02 | 7.23E-01 | 1.26E+02 | 3.52E+00 | 2.52E+01 | 2.40E+02 | 1.16E+00 | 1.36E+01 |
| 28 | 4.94E+05 | 4.08E-03 | 6.40E-04 | 1.43E-04 | 3.36E-03 | 2.85E-08 | 7.08E+00 | 4.08E-03 | 2.84E+00 | 2.79E-04 | 3.94E+01 | 2.52E-01 | 4.39E+01 | 1.23E+00 | 8.77E+00 | 8.38E+01 | 4.05E-01 | 4.74E+00 |
| 29 | 4.74E+05 | 9.26E-05 | 2.51E-06 | 1.04E-06 | 1.83E-05 | 6.88E-10 | 1.51E+00 | 8.73E-04 | 6.06E-01 | 5.97E-05 | 8.43E+00 | 5.39E-02 | 9.39E+00 | 2.63E-01 | 1.88E+00 | 1.79E+01 | 8.67E-02 | 1.01E+00 |
| 30 | 9.90E+05 | 6.65E+03 | 5.78E+01 | 4.15E+01 | 4.27E+03 | 9.94E-02 | 3.40E+01 | 1.96E-02 | 1.36E+01 | 1.34E-03 | 1.89E+02 | 1.21E+00 | 2.11E+02 | 5.89E+00 | 4.21E+01 | 4.02E+02 | 1.95E+00 | 2.27E+01 |
| 31 | 4.59E+05 | 8.97E-05 | 2.43E-06 | 1.00E-06 | 1.77E-05 | 6.66E-10 | 1.67E+01 | 9.63E-03 | 6.69E+00 | 6.59E-04 | 9.30E+01 | 5.95E-01 | 1.04E+02 | 2.90E+00 | 2.07E+01 | 1.98E+02 | 9.57E-01 | 1.12E+01 |
| 32 | 9.13E+05 | 5.99E+03 | 5.26E+01 | 3.90E+01 | 2.68E+03 | 8.23E-02 | 2.28E+01 | 1.32E-02 | 9.15E+00 | 9.01E-04 | 1.27E+02 | 8.13E-01 | 1.42E+02 | 3.96E+00 | 2.83E+01 | 2.70E+02 | 1.31E+00 | 1.53E+01 |
| 33 | 9.42E+05 | 2.51E+03 | 1.37E+03 | 2.40E+02 | 7.13E+03 | 1.39E-02 | 1.22E+01 | 7.05E-03 | 4.90E+00 | 4.82E-04 | 6.81E+01 | 4.36E-01 | 7.59E+01 | 2.12E+00 | 1.52E+01 | 1.45E+02 | 7.00E-01 | 8.18E+00 |
| 34 | 6.40E+05 | - | 3.90E+01 | 8.72E+00 | 1.80E+02 | 1.81E-03 | 1.01E+01 | 5.83E-03 | 4.05E+00 | 3.99E-04 | 5.63E+01 | 3.60E-01 | 6.27E+01 | 1.75E+00 | 1.25E+01 | 1.20E+02 | 5.79E-01 | 6.77E+00 |
| 35 | 4.94E+05 | 3.27E+03 | 2.64E+01 | 2.02E+01 | 1.57E+03 | 4.54E-02 | 6.41E+00 | 3.70E-03 | 2.57E+00 | 2.53E-04 | 3.57E+01 | 2.28E-01 | 3.98E+01 | 1.11E+00 | 7.94E+00 | 7.59E+01 | 3.67E-01 | 4.29E+00 |
| 36 | 5.30E+05 | 3.53E+03 | 2.75E+01 | 2.19E+01 | 1.43E+03 | 4.72E-02 | 3.55E+01 | 2.05E-02 | 1.42E+01 | 1.40E-03 | 1.98E+02 | 1.27E+00 | 2.20E+02 | 6.16E+00 | 4.40E+01 | 4.21E+02 | 2.04E+00 | 2.38E+01 |
| 37 | 4.60E+05 | 8.98E-05 | 2.43E-06 | 1.01E-06 | 1.77E-05 | 6.67E-10 | 1.40E+01 | 8.09E-03 | 5.62E+00 | 5.53E-04 | 7.81E+01 | 4.99E-01 | 8.70E+01 | 2.43E+00 | 1.74E+01 | 1.66E+02 | 8.03E-01 | 9.38E+00 |
| 38 | 4.20E+05 | 3.03E-03 | 1.20E-05 | 1.01E-05 | 2.60E-03 | 1.49E-07 | 4.38E-01 | 2.53E-04 | 1.75E-01 | 1.73E-05 | 2.44E+00 | 1.56E-02 | 2.72E+00 | 7.60E-02 | 5.43E-01 | 5.19E+00 | 2.51E-02 | 2.93E-01 |
| 39 | 7.95E+05 | 5.26E+03 | 6.54E+01 | 4.07E+01 | 4.67E+03 | 8.67E-02 | 2.85E+00 | 1.64E-03 | 1.14E+00 | 1.12E-04 | 1.59E+01 | 1.02E-01 | 1.77E+01 | 4.94E-01 | 3.53E+00 | 3.38E+01 | 1.63E-01 | 1.91E+00 |
| 40 | 6.12E+05 | 7.55E+02 | 2.44E+02 | 9.22E+01 | 1.30E+03 | 4.66E-02 | 1.33E-01 | 7.65E-05 | 5.31E-02 | 5.23E-06 | 7.39E-01 | 4.72E-03 | 8.23E-01 | 2.30E-02 | 1.64E-01 | 1.57E+00 | 7.60E-03 | 8.87E-02 |
| 41 | 3.46E+05 | 2.35E+03 | - | - | - | - | 1.17E+00 | 6.76E-04 | 4.70E-01 | 4.63E-05 | 6.53E+00 | 4.18E-02 | 7.27E+00 | 2.03E-01 | 1.45E+00 | 1.39E+01 | 6.72E-02 | 7.85E-01 |
| 42 | 1.27E+06 | 6.81E+03 | 2.43E+02 | 8.72E+01 | 1.49E+03 | 7.98E-02 | 3.93E+01 | 2.27E-02 | 1.57E+01 | 1.55E-03 | 2.19E+02 | 1.40E+00 | 2.44E+02 | 6.82E+00 | 4.87E+01 | 4.66E+02 | 2.25E+00 | 2.63E+01 |
| 43 | 9.45E+05 | 6.46E+03 | 2.55E+01 | 2.15E+01 | 5.53E+03 | 3.18E-01 | 6.18E-01 | 3.56E-04 | 2.48E-01 | 2.44E-05 | 3.44E+00 | 2.20E-02 | 3.83E+00 | 1.07E-01 | 7.66E-01 | 7.32E+00 | 3.54E-02 | 4.14E-01 |
| 44 | 5.64E+05 | 4.66E-03 | 7.30E-04 | 1.63E-04 | 3.84E-03 | 3.25E-08 | 9.58E+00 | 5.53E-03 | 3.84E+00 | 3.78E-04 | 5.34E+01 | 3.41E-01 | 5.94E+01 | 1.66E+00 | 1.19E+01 | 1.13E+02 | 5.49E-01 | 6.41E+00 |
| 45 | 5.11E+05 | 4.22E-03 | 6.61E-04 | 1.48E-04 | 3.48E-03 | 2.95E-08 | 8.21E+00 | 4.73E-03 | 3.29E+00 | 3.24E-04 | 4.57E+01 | 2.92E-01 | 5.09E+01 | 1.42E+00 | 1.02E+01 | 9.71E+01 | 4.70E-01 | 5.49E+00 |
| 46 | 6.72E+05 | 5.55E-03 | 8.70E-04 | 1.94E-04 | 4.58E-03 | 3.88E-08 | 1.62E+01 | 9.34E-03 | 6.49E+00 | 6.39E-04 | 9.02E+01 | 5.77E-01 | 1.00E+02 | 2.81E+00 | 2.01E+01 | 1.92E+02 | 9.27E-01 | 1.08E+01 |
| 47 | 5.97E+05 | 3.50E+03 | 5.03E+02 | 1.12E+02 | 2.18E+03 | 2.31E-02 | 2.66E+00 | 1.53E-03 | 1.06E+00 | 1.05E-04 | 1.48E+01 | 9.46E-02 | 1.65E+01 | 4.61E-01 | 3.29E+00 | 3.14E+01 | 1.52E-01 | 1.78E+00 |
| 48 | 2.40E+05 | 1.36E+03 | 2.46E+00 | - | - | - | 1.31E+00 | 7.57E-04 | 5.26E-01 | 5.18E-05 | 7.31E+00 | 4.68E-02 | 8.15E+00 | 2.28E-01 | 1.63E+00 | 1.55E+01 | 7.52E-02 | 8.79E-01 |
| 49 | 1.92E+05 | 3.75E-05 | 1.01E-06 | 4.19E-07 | 7.39E-06 | 2.78E-10 | 4.77E-02 | 2.75E-05 | 1.91E-02 | 1.88E-06 | 2.66E-01 | 1.70E-03 | 2.96E-01 | 8.27E-03 | 5.91E-02 | 5.65E-01 | 2.73E-03 | 3.19E-02 |
| 50 | 4.24E+05 | 1.62E-02 | 1.03E-01 | 1.12E-03 | 1.63E-05 | 6.15E-10 | 6.53E-03 | 1.99E-08 | 7.56E-04 | 1.36E-09 | 1.92E-04 | 1.23E-06 | 2.14E-04 | 5.99E-06 | 4.28E-05 | 4.09E-04 | 1.98E-06 | 2.31E-05 |
| 51 | 6.93E+05 | 4.23E+03 | 5.66E+01 | 3.21E+01 | 1.61E+03 | 5.80E-02 | 8.26E-01 | 4.76E-04 | 3.31E-01 | 3.26E-05 | 4.60E+00 | 2.94E-02 | 5.12E+00 | 1.43E-01 | 1.02E+00 | 9.78E+00 | 4.73E-02 | 5.53E-01 |
| Phase Totals | 2.39E+07 | 5.74E+04 | 3.37E+03 | 9.06E+02 | 3.75E+04 | 9.39E-01 | 3.63E+02 | 2.09E-01 | 1.45E+02 | 1.43E-02 | 2.02E+03 | 1.29E+01 | 2.25E+03 | 6.30E+01 | 4.50E+02 | 4.30E+03 | 2.08E+01 | 2.43E+02 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Total Supernate Volume, gal | Ra-226 (Ci) | Ra-228 (Ci) | Ac-227 (Ci) | Th-229 (Ci) | Th-230 (Ci) | Pa-231 (Ci) | Pu-244 (Ci) | Am-243 (Ci) | Cm-242 (Ci) | Cm-243 (Ci) | Cm-247 (Ci) | Cm-248 (Ci) | Bk-249 (Ci) | Cf-249 (Ci) | Cf-251 (Ci) | Cf-252 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.66E+05 | - | - | 5.31E-08 | - | - | 1.47E-07 | 3.68E-07 | 2.02E-03 | 4.99E-03 | 1.18E-03 | 2.28E-13 | 2.37E-13 | 1.73E-20 | 1.32E-12 | 4.50E-14 | 1.46E-15 |
| 2 | 1.64E+05 | - | - | 1.37E-08 | - | - | 3.81E-08 | 3.07E-07 | 7.38E-04 | 1.82E-03 | 4.32E-04 | 8.32E-14 | 8.67E-14 | 6.34E-21 | 4.81E-13 | 1.65E-14 | 5.34E-16 |
| 3 | 1.64E+05 | - | - | 3.52E-08 | - | - | 9.79E-08 | 3.80E-07 | 7.48E-04 | 1.85E-03 | 4.38E-04 | 8.44E-14 | 8.79E-14 | 6.43E-21 | 4.88E-13 | 1.67E-14 | 5.41E-16 |
| 4 | 3.99E+05 | - | - | 5.43E-08 | - | - | 1.51E-07 | 3.85E-07 | 2.15E-03 | 5.31E-03 | 1.26E-03 | 2.42E-13 | 2.53E-13 | 1.85E-20 | 1.40E-12 | 4.79E-14 | 1.56E-15 |
| 5 | 1.71E+04 | - | - | 6.83E-09 | - | - | 1.90E-08 | 4.44E-08 | 1.90E-05 | 4.68E-05 | 1.11E-05 | 2.14E-15 | 2.23E-15 | 1.63E-22 | 1.24E-14 | 4.23E-16 | 1.37E-17 |
| 6 | 2.71E+05 | - | - | 8.09E-08 | - | - | 2.25E-07 | 4.24E-06 | 6.15E-05 | 1.52E-04 | 3.60E-05 | 6.94E-15 | 7.23E-15 | 5.28E-22 | 4.01E-14 | 1.37E-15 | 4.45E-17 |
| 7 | 2.90E+05 | - | - | 7.34E-08 | - | - | 2.04E-07 | 5.09E-06 | 3.06E-04 | 7.57E-04 | 1.79E-04 | 3.46E-14 | 3.60E-14 | 2.63E-21 | 2.00E-13 | 6.83E-15 | 2.22E-16 |
| 8 | 1.02E+04 | - | - | 1.82E-09 | - | - | 5.05E-09 | 1.42E-07 | 4.33E-06 | 1.07E-05 | 2.53E-06 | 4.88E-16 | 5.09E-16 | 3.72E-23 | 2.82E-15 | 9.65E-17 | 3.13E-18 |
| 9 | 1.75E+05 | - | - | 2.66E-08 | - | - | 7.39E-08 | 1.30E-07 | 7.74E-04 | 1.91E-03 | 4.53E-04 | 8.73E-14 | 9.10E-14 | 6.65E-21 | 5.04E-13 | 1.73E-14 | 5.60E-16 |
| 10 | 6.53E+04 | - | - | 1.20E-08 | - | - | 3.33E-08 | 1.53E-07 | 5.04E-05 | 1.24E-04 | 2.95E-05 | 5.68E-15 | 5.92E-15 | 4.33E-22 | 3.28E-14 | 1.12E-15 | 3.65E-17 |
| 11 | 1.56E+05 | 7.42E-10 | 2.81E-06 | 1.42E-09 | 1.14E-06 | 9.08E-08 | 3.94E-09 | 1.79E-06 | 2.88E-08 | 7.11E-08 | 1.68E-08 | 3.24E-18 | 3.38E-18 | 2.47E-25 | 1.87E-17 | 6.41E-19 | 2.08E-20 |
| 12 | 1.18E+05 | 1.24E-09 | 2.09E-04 | 2.37E-09 | 1.67E-05 | 1.52E-07 | 6.57E-09 | 1.30E-06 | 7.54E-05 | 1.86E-04 | 4.42E-05 | 8.51E-15 | 8.86E-15 | 6.48E-22 | 4.92E-14 | 1.68E-15 | 5.46E-17 |
| 13 | 7.54E+05 | 2.66E-08 | 4.08E-04 | 7.37E-08 | 2.38E-04 | 3.26E-06 | 2.05E-07 | 3.77E-06 | 7.22E-03 | 1.78E-02 | 4.23E-03 | 8.14E-13 | 8.48E-13 | 6.20E-20 | 4.70E-12 | 1.61E-13 | 5.22E-15 |
| 14 | 5.95E+04 | 1.50E-09 | 1.38E-04 | 1.23E-08 | 1.38E-05 | 1.84E-07 | 3.42E-08 | 2.12E-07 | 6.10E-04 | 1.51E-03 | 3.57E-04 | 6.88E-14 | 7.17E-14 | 5.24E-21 | 3.97E-13 | 1.36E-14 | 4.41E-16 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 1.18E+06 | 9.13E-08 | 1.20E-06 | 1.47E-07 | 1.08E-04 | 1.12E-05 | 4.07E-07 | 5.17E-07 | 9.62E-07 | 2.38E-06 | 5.63E-07 | 1.08E-16 | 1.13E-16 | 8.26E-24 | 6.27E-16 | 2.14E-17 | 6.96E-19 |
| 22 | 1.18E+06 | 1.27E-07 | - | 1.97E-07 | 4.47E-04 | 1.56E-05 | 5.48E-07 | - | 1.05E-06 | 2.58E-06 | 6.13E-07 | 1.18E-16 | 1.23E-16 | 8.98E-24 | 6.82E-16 | 2.33E-17 | 7.57E-19 |
| 23 | 1.30E+06 | 1.30E+01 | 1.78E-07 | 2.39E-08 | 3.37E-05 | 3.42E-02 | 6.63E-08 | 4.91E-05 | 1.61E-07 | 3.97E-07 | 9.42E-08 | 1.81E-17 | 1.89E-17 | 1.38E-24 | 1.05E-16 | 3.59E-18 | 1.16E-19 |
| 24 | 8.53E+05 | 8.39E-20 | - | 2.52E-12 | 3.32E-17 | 1.03E-17 | 6.99E-12 | 2.25E-10 | 2.90E-04 | 7.17E-04 | 1.70E-04 | 3.27E-14 | 3.41E-14 | 2.49E-21 | 1.89E-13 | 6.47E-15 | 2.10E-16 |
| 25 | 3.66E+05 | 3.60E-20 | - | 1.08E-12 | 1.43E-17 | 4.41E-18 | 3.00E-12 | 9.65E-11 | 8.46E-04 | 2.09E-03 | 4.96E-04 | 9.55E-14 | 9.95E-14 | 7.27E-21 | 5.52E-13 | 1.89E-14 | 6.13E-16 |
| 26 | 7.01E+05 | 4.83E-14 | - | 1.45E-06 | 1.91E-11 | 5.91E-12 | 4.02E-06 | 1.29E-04 | 3.06E-03 | 7.56E-03 | 1.79E-03 | 3.45E-13 | 3.60E-13 | 2.63E-20 | 1.99E-12 | 6.82E-14 | 2.21E-15 |
| 27 | 7.83E+05 | 7.70E-20 | - | 2.31E-12 | 3.05E-17 | 9.42E-18 | 6.41E-12 | 2.06E-10 | 3.88E-03 | 9.60E-03 | 2.27E-03 | 4.38E-13 | 4.57E-13 | 3.34E-20 | 2.53E-12 | 8.66E-14 | 2.81E-15 |
| 28 | 4.94E+05 | 4.86E-20 | - | 1.46E-12 | 1.92E-17 | 5.95E-18 | 4.05E-12 | 1.30E-10 | 1.35E-03 | 3.35E-03 | 7.93E-04 | 1.53E-13 | 1.59E-13 | 1.16E-20 | 8.83E-13 | 3.02E-14 | 9.80E-16 |
| 29 | 4.74E+05 | 2.22E-14 | - | 6.14E-14 | 1.99E-10 | 2.72E-12 | 1.71E-13 | 3.14E-12 | 2.90E-04 | 7.16E-04 | 1.70E-04 | 3.27E-14 | 3.41E-14 | 2.49E-21 | 1.89E-13 | 6.46E-15 | 2.10E-16 |
| 30 | 9.90E+05 | 7.78E-08 | - | 1.40E-07 | - | 9.52E-06 | 3.88E-07 | 4.54E-04 | 6.50E-03 | 1.61E-02 | 3.81E-03 | 7.33E-13 | 7.64E-13 | 5.58E-20 | 4.24E-12 | 1.45E-13 | 4.71E-15 |
| 31 | 4.59E+05 | 2.15E-14 | - | 5.95E-14 | 1.92E-10 | 2.63E-12 | 1.65E-13 | 3.04E-12 | 3.20E-03 | 7.90E-03 | 1.87E-03 | 3.61E-13 | 3.76E-13 | 2.75E-20 | 2.08E-12 | 7.13E-14 | 2.31E-15 |
| 32 | 9.13E+05 | 9.31E-08 | - | 1.35E-07 | - | 1.14E-05 | 3.74E-07 | 3.76E-04 | 4.37E-03 | 1.08E-02 | 2.56E-03 | 4.93E-13 | 5.14E-13 | 3.75E-20 | 2.85E-12 | 9.75E-14 | 3.16E-15 |
| 33 | 9.42E+05 | 4.06E-09 | - | 7.72E-06 | 2.49E-10 | 4.97E-07 | 2.14E-05 | 6.36E-05 | 2.34E-03 | 5.78E-03 | 1.37E-03 | 2.64E-13 | 2.75E-13 | 2.01E-20 | 1.53E-12 | 5.22E-14 | 1.69E-15 |
| 34 | 6.40E+05 | - | - | 7.80E-07 | - | - | 2.17E-06 | 8.27E-06 | 1.94E-03 | 4.78E-03 | 1.13E-03 | 2.18E-13 | 2.27E-13 | 1.66E-20 | 1.26E-12 | 4.32E-14 | 1.40E-15 |
| 35 | 4.94E+05 | 4.91E-08 | - | 8.65E-08 | - | 6.01E-06 | 2.40E-07 | 2.07E-04 | 1.23E-03 | 3.03E-03 | 7.18E-04 | 1.38E-13 | 1.44E-13 | 1.05E-20 | 7.99E-13 | 2.73E-14 | 8.88E-16 |
| 36 | 5.30E+05 | 9.17E-08 | - | 1.80E-07 | - | 1.12E-05 | 5.00E-07 | 2.16E-04 | 6.80E-03 | 1.68E-02 | 3.98E-03 | 7.67E-13 | 7.99E-13 | 5.84E-20 | 4.43E-12 | 1.52E-13 | 4.92E-15 |
| 37 | 4.60E+05 | 2.15E-14 | - | 5.96E-14 | 1.93E-10 | 2.63E-12 | 1.66E-13 | 3.05E-12 | 2.68E-03 | 6.63E-03 | 1.57E-03 | 3.03E-13 | 3.15E-13 | 2.30E-20 | 1.75E-12 | 5.98E-14 | 1.94E-15 |
| 38 | 4.20E+05 | 2.82E-13 | - | 3.94E-13 | - | 3.45E-11 | 1.09E-12 | 6.82E-10 | 8.38E-05 | 2.07E-04 | 4.91E-05 | 9.45E-15 | 9.85E-15 | 7.20E-22 | 5.46E-14 | 1.87E-15 | 6.07E-17 |
| 39 | 7.95E+05 | 2.13E-07 | - | 3.11E-07 | - | 2.60E-05 | 8.64E-07 | 3.96E-04 | 5.46E-04 | 1.35E-03 | 3.19E-04 | 6.15E-14 | 6.41E-14 | 4.69E-21 | 3.56E-13 | 1.22E-14 | 3.95E-16 |
| 40 | 6.12E+05 | 9.02E-08 | 1.46E-03 | 1.72E-06 | 1.18E-04 | 1.10E-05 | 4.78E-06 | 2.13E-04 | 2.54E-05 | 6.27E-05 | 1.49E-05 | 2.86E-15 | 2.98E-15 | 2.18E-22 | 1.65E-14 | 5.66E-16 | 1.84E-17 |
| 41 | 3.46E+05 | 3.24E-07 | - | 3.79E-07 | - | 3.96E-05 | 1.05E-06 | - | 2.24E-04 | 5.55E-04 | 1.31E-04 | 2.53E-14 | 2.64E-14 | 1.93E-21 | 1.46E-13 | 5.00E-15 | 1.62E-16 |
| 42 | 1.27E+06 | 1.18E-06 | 1.01E-01 | 2.82E-06 | 4.05E-03 | 1.45E-04 | 7.84E-06 | 3.65E-04 | 7.52E-03 | 1.86E-02 | 4.41E-03 | 8.49E-13 | 8.85E-13 | 6.46E-20 | 4.90E-12 | 1.68E-13 | 5.45E-15 |
| 43 | 9.45E+05 | 6.01E-07 | - | 8.39E-07 | - | 7.35E-05 | 2.33E-06 | 1.45E-03 | 1.18E-04 | 2.92E-04 | 6.93E-05 | 1.33E-14 | 1.39E-14 | 1.02E-21 | 7.71E-14 | 2.64E-15 | 8.56E-17 |
| 44 | 5.64E+05 | 5.55E-20 | - | 1.66E-12 | 2.20E-17 | 6.79E-18 | 4.62E-12 | 1.49E-10 | 1.83E-03 | 4.53E-03 | 1.07E-03 | 2.07E-13 | 2.16E-13 | 1.57E-20 | 1.20E-12 | 4.09E-14 | 1.33E-15 |
| 45 | 5.11E+05 | 5.02E-20 | - | 1.51E-12 | 1.99E-17 | 6.15E-18 | 4.18E-12 | 1.35E-10 | 1.57E-03 | 3.88E-03 | 9.19E-04 | 1.77E-13 | 1.85E-13 | 1.35E-20 | 1.02E-12 | 3.50E-14 | 1.14E-15 |
| 46 | 6.72E+05 | 6.61E-20 | - | 1.98E-12 | 2.62E-17 | 8.09E-18 | 5.50E-12 | 1.77E-10 | 3.10E-03 | 7.66E-03 | 1.81E-03 | 3.50E-13 | 3.64E-13 | 2.66E-20 | 2.02E-12 | 6.91E-14 | 2.24E-15 |
| 47 | 5.97E+05 | - | - | 9.45E-07 | - | - | 2.62E-06 | 1.06E-04 | 5.08E-04 | 1.26E-03 | 2.98E-04 | 5.73E-14 | 5.97E-14 | 4.36E-21 | 3.31E-13 | 1.13E-14 | 3.68E-16 |
| 48 | 2.40E+05 | 6.34E-06 | - | 4.31E-07 | 2.33E-03 | 7.76E-04 | 1.20E-06 | - | 2.51E-04 | 6.21E-04 | 1.47E-04 | 2.84E-14 | 2.95E-14 | 2.16E-21 | 1.64E-13 | 5.61E-15 | 1.82E-16 |
| 49 | 1.92E+05 | 8.98E-15 | - | 2.49E-14 | 8.03E-11 | 1.10E-12 | 6.91E-14 | 1.27E-12 | 9.12E-06 | 2.25E-05 | 5.34E-06 | 1.03E-15 | 1.07E-15 | 7.84E-23 | 5.95E-15 | 2.03E-16 | 6.60E-18 |
| 50 | 4.24E+05 | 1.99E-14 | 7.00E-07 | 2.64E-08 | 1.78E-10 | 2.43E-12 | 7.33E-08 | 1.96E-06 | 6.61E-09 | 1.63E-08 | 3.87E-09 | 7.45E-19 | 7.77E-19 | 5.68E-26 | 4.31E-18 | 1.47E-19 | 4.78E-21 |
| 51 | 6.93E+05 | 1.09E-07 | 4.80E-04 | 2.89E-07 | 1.66E-04 | 1.34E-05 | 8.01E-07 | 2.65E-04 | 1.58E-04 | 3.91E-04 | 9.26E-05 | 1.78E-14 | 1.86E-14 | 1.36E-21 | 1.03E-13 | 3.52E-15 | 1.14E-16 |
| Phase Totals | 2.39E+07 | 1.30E+01 | 1.04E-01 | 1.91E-05 | 7.53E-03 | 3.53E-02 | 5.30E-05 | 4.32E-03 | 6.95E-02 | 1.72E-01 | 4.07E-02 | 7.84E-12 | 8.17E-12 | 5.97E-19 | 4.53E-11 | 1.55E-12 | 5.03E-14 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Free Supernate Volume, gal | H-3 (Ci) | C-14 (Ci) | Co-60 (Ci) | Ni-59 (Ci) | Ni-63 (Ci) | Se-79 (Ci) | Sr-90 (Ci) | Y-90 (Ci) | Nb-94 (Ci) | Tc-99 (Ci) | Ru-106 (Ci) | Rh-106 (Ci) | Sb-125 (Ci) | Sn-126 (Ci) | I-129 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.71E+04 | 6.46E+00 | 1.14E-01 | 6.66E-02 | 7.17E-03 | 1.62E-01 | 2.66E-01 | 8.33E+01 | 8.33E+01 | 2.09E-06 | 9.86E+01 | 6.80E+00 | 6.80E+00 | 2.76E+01 | 1.34E+00 | 5.31E-02 |
| 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | 2.99E+05 | 1.13E+02 | 2.00E+00 | 1.17E+00 | 5.58E-02 | 2.83E+00 | 2.07E+00 | 6.48E+02 | 6.48E+02 | 1.63E-05 | 7.67E+02 | 5.29E+01 | 5.29E+01 | 2.14E+02 | 1.05E+01 | 4.14E-01 |
| 5 | 3.64E-12 | 1.38E-15 | 2.42E-17 | 1.42E-17 | 1.39E-19 | 3.44E-17 | 5.15E-18 | 1.61E-15 | 1.61E-15 | 4.05E-23 | 1.91E-15 | 1.32E-16 | 1.32E-16 | 5.34E-16 | 2.60E-17 | 1.03E-18 |
| 6 | 2.54E+05 | 6.76E+02 | 1.69E+00 | 9.90E-01 | 1.99E-03 | 2.40E+00 | 7.37E-02 | 2.31E+01 | 2.31E+01 | 5.79E-07 | 2.73E+01 | 1.88E+00 | 1.88E+00 | 7.64E+00 | 3.72E-01 | 1.47E-02 |
| 7 | 2.76E+05 | 1.13E+02 | 1.84E+00 | 1.08E+00 | 1.01E-02 | 2.62E+00 | 3.74E-01 | 1.05E+02 | 1.05E+02 | 2.94E-06 | 1.39E+02 | 9.56E+00 | 9.56E+00 | 3.87E+01 | 1.89E+00 | 7.47E-02 |
| 8 | 7.28E+03 | 1.68E+02 | 4.85E-02 | 2.84E-02 | 1.07E-04 | 6.89E-02 | 3.97E-03 | 1.25E+00 | 1.25E+00 | 3.13E-08 | 1.47E+00 | 1.02E-01 | 1.02E-01 | 4.12E-01 | 2.01E-02 | 7.95E-04 |
| 9 | 1.30E+04 | 4.92E+00 | 8.67E-02 | 5.07E-02 | 1.99E-03 | 1.23E-01 | 7.36E-02 | 2.31E+01 | 2.31E+01 | 5.79E-07 | 2.73E+01 | 1.88E+00 | 1.88E+00 | 7.63E+00 | 3.72E-01 | 1.47E-02 |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | 1.42E+05 | 5.36E+01 | 9.44E-01 | 5.53E-01 | 9.05E-07 | 1.34E+00 | 3.35E-05 | 9.47E-03 | 9.47E-03 | 2.64E-10 | 1.24E-02 | 8.58E-04 | 8.58E-04 | 3.48E-03 | 1.70E-04 | 6.71E-06 |
| 12 | 2.46E+04 | 9.33E+00 | 1.64E-01 | 9.61E-02 | 5.42E-04 | 2.33E-01 | 2.01E-02 | 6.29E+00 | 6.29E+00 | 1.58E-07 | 7.45E+00 | 5.14E-01 | 5.14E-01 | 2.08E+00 | 1.02E-01 | 4.02E-03 |
| 13 | 5.78E+05 | 2.19E+02 | 3.85E+00 | 2.25E+00 | 1.91E-01 | 5.47E+00 | 7.08E+00 | 2.22E+03 | 2.22E+03 | 5.57E-05 | 2.62E+03 | 1.81E+02 | 1.81E+02 | 7.34E+02 | 3.58E+01 | 1.42E+00 |
| 14 | 1.05E+03 | 3.97E-01 | 7.00E-03 | 4.09E-03 | 3.72E-04 | 9.94E-03 | 1.38E-02 | 4.32E+00 | 4.32E+00 | 1.08E-07 | 5.11E+00 | 3.52E-01 | 3.52E-01 | 1.43E+00 | 6.97E-02 | 2.75E-03 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 1.18E+06 | 4.45E+02 | 7.83E+00 | 4.58E+00 | 3.31E-05 | 1.11E+01 | 1.23E-03 | 3.83E-01 | 3.83E-01 | 9.65E-09 | 4.55E-01 | 3.14E-02 | 3.14E-02 | 1.27E-01 | 6.20E-03 | 2.93E-03 |
| 22 | 1.17E+06 | 4.43E+02 | 7.79E+00 | 4.56E+00 | 3.59E-05 | 1.11E+01 | 1.33E-03 | 4.13E-01 | 4.13E-01 | 1.05E-08 | 4.94E-01 | 3.41E-02 | 3.40E-02 | 1.38E-01 | 6.73E-03 | 2.91E-03 |
| 23 | 1.26E+06 | 4.90E+00 | 1.96E-01 | 4.10E-03 | 5.39E-06 | 1.79E-01 | 2.00E-04 | 1.52E+00 | 1.52E+00 | 1.57E-09 | 3.20E-01 | 5.11E-03 | 5.11E-03 | 2.07E-02 | 1.01E-03 | 2.76E-03 |
| 24 | 8.51E+05 | 3.22E+02 | 5.67E+00 | 3.32E+00 | 9.99E-03 | 8.05E+00 | 3.70E-01 | 1.16E+02 | 1.16E+02 | 2.91E-06 | 1.37E+02 | 9.47E+00 | 9.47E+00 | 3.84E+01 | 1.87E+00 | 2.47E-02 |
| 25 | 3.69E+04 | 1.40E+01 | 2.46E-01 | 1.44E-01 | 2.94E-03 | 3.49E-01 | 1.09E-01 | 3.41E+01 | 3.41E+01 | 8.57E-07 | 4.04E+01 | 2.79E+00 | 2.79E+00 | 1.13E+01 | 5.51E-01 | 2.18E-02 |
| 26 | 5.19E+05 | 1.96E+02 | 3.46E+00 | 2.02E+00 | 7.83E-02 | 4.91E+00 | 2.90E+00 | 9.51E+02 | 9.51E+02 | 2.28E-05 | 1.08E+03 | 7.42E+01 | 7.42E+01 | 3.01E+02 | 1.47E+01 | 5.80E-01 |
| 27 | 6.00E+05 | 2.27E+02 | 4.00E+00 | 2.34E+00 | 1.03E-01 | 5.68E+00 | 3.81E+00 | 1.18E+03 | 1.18E+03 | 3.00E-05 | 1.41E+03 | 9.75E+01 | 9.75E+01 | 3.95E+02 | 1.93E+01 | 7.62E-01 |
| 28 | 1.85E+05 | 7.02E+01 | 1.23E+00 | 7.23E-01 | 1.76E-02 | 1.75E+00 | 6.50E-01 | 2.04E+02 | 2.04E+02 | 5.12E-06 | 2.41E+02 | 1.66E+01 | 1.66E+01 | 6.74E+01 | 3.29E+00 | 1.30E-01 |
| 29 | 1.67E+05 | 6.32E+01 | 1.11E+00 | 6.51E-01 | 3.53E-03 | 1.58E+00 | 1.31E-01 | 4.10E+01 | 4.10E+01 | 1.03E-06 | 4.85E+01 | 3.35E+00 | 3.34E+00 | 1.36E+01 | 6.61E-01 | 2.61E-02 |
| 30 | 9.15E+05 | 3.46E+02 | 6.10E+00 | 3.57E+00 | 2.08E-01 | 8.66E+00 | 7.69E+00 | 2.41E+03 | 2.41E+03 | 6.05E-05 | 2.85E+03 | 1.97E+02 | 1.97E+02 | 7.97E+02 | 3.89E+01 | 1.54E+00 |
| 31 | 1.15E+05 | 4.36E+01 | 7.67E-01 | 4.49E-01 | 2.77E-02 | 1.09E+00 | 1.03E+00 | 3.22E+02 | 3.22E+02 | 8.07E-06 | 3.81E+02 | 2.63E+01 | 2.62E+01 | 1.06E+02 | 5.19E+00 | 2.05E-01 |
| 32 | 8.44E+05 | 3.20E+02 | 5.63E+00 | 3.29E+00 | 1.40E-01 | 7.99E+00 | 5.17E+00 | 1.40E+03 | 1.40E+03 | 4.07E-05 | 1.92E+03 | 1.32E+02 | 1.32E+02 | 5.36E+02 | 2.62E+01 | 1.03E+00 |
| 33 | 7.95E+05 | 4.05E+02 | 5.30E+00 | 3.10E+00 | 6.83E-02 | 7.52E+00 | 2.53E+00 | 7.92E+02 | 7.92E+02 | 1.99E-05 | 9.38E+02 | 6.47E+01 | 6.47E+01 | 2.62E+02 | 1.28E+01 | 5.06E-01 |
| 34 | 5.69E+05 | 2.15E+02 | 3.79E+00 | 2.22E+00 | 5.94E-02 | 5.38E+00 | 2.20E+00 | 6.90E+02 | 6.90E+02 | 1.73E-05 | 8.16E+02 | 5.63E+01 | 5.63E+01 | 2.28E+02 | 1.11E+01 | 4.40E-01 |
| 35 | 4.50E+05 | 1.70E+02 | 3.00E+00 | 1.75E+00 | 3.86E-02 | 4.26E+00 | 1.43E+00 | 4.48E+02 | 4.48E+02 | 1.12E-05 | 5.30E+02 | 3.66E+01 | 3.66E+01 | 1.48E+02 | 7.23E+00 | 2.86E-01 |
| 36 | 2.20E+05 | 8.32E+01 | 1.46E+00 | 8.57E-01 | 9.74E-02 | 2.08E+00 | 3.61E+00 | 1.13E+03 | 1.13E+03 | 2.84E-05 | 1.34E+03 | 9.23E+01 | 9.22E+01 | 3.74E+02 | 1.82E+01 | 7.21E-01 |
| 37 | 1.16E+05 | 4.40E+01 | 7.75E-01 | 4.54E-01 | 2.35E-02 | 1.10E+00 | 8.69E-01 | 2.49E+02 | 2.49E+02 | 6.84E-06 | 3.22E+02 | 2.22E+01 | 2.22E+01 | 9.01E+01 | 4.39E+00 | 1.74E-01 |
| 38 | 1.71E+05 | 6.49E+01 | 1.14E+00 | 6.68E-01 | 1.18E-03 | 1.62E+00 | 4.38E-02 | 1.37E+01 | 1.37E+01 | 3.45E-07 | 1.62E+01 | 1.12E+00 | 1.12E+00 | 4.54E+00 | 2.22E-01 | 8.76E-03 |
| 39 | 7.22E+05 | 2.73E+02 | 4.81E+00 | 2.82E+00 | 1.71E-02 | 6.84E+00 | 6.35E-01 | 1.49E+02 | 1.49E+02 | 4.99E-06 | 2.35E+02 | 1.62E+01 | 1.62E+01 | 6.58E+01 | 3.21E+00 | 1.27E-01 |
| 40 | 3.05E+05 | 1.15E+02 | 2.03E+00 | 1.19E+00 | 4.37E-04 | 2.89E+00 | 1.62E-02 | 5.28E+00 | 5.28E+00 | 1.27E-07 | 6.00E+00 | 4.14E-01 | 4.14E-01 | 1.68E+00 | 8.18E-02 | 3.24E-03 |
| 41 | 1.24E+05 | 4.70E+01 | 8.28E-01 | 4.84E-01 | 2.79E-03 | 1.18E+00 | 1.03E-01 | 1.14E+01 | 1.14E+01 | 8.12E-07 | 3.83E+01 | 2.64E+00 | 2.64E+00 | 1.07E+01 | 5.22E-01 | 2.06E-02 |
| 42 | 1.25E+06 | 4.75E+02 | 8.36E+00 | 4.89E+00 | 2.57E-01 | 1.19E+01 | 9.53E+00 | 2.98E+03 | 2.98E+03 | 7.49E-05 | 3.53E+03 | 2.44E+02 | 2.44E+02 | 9.88E+02 | 4.82E+01 | 1.91E+00 |
| 43 | 7.76E+05 | 2.94E+02 | 5.17E+00 | 3.03E+00 | 3.36E-03 | 7.34E+00 | 1.24E-01 | 3.37E+01 | 3.37E+01 | 9.78E-07 | 4.61E+01 | 3.18E+00 | 3.18E+00 | 1.29E+01 | 6.29E-01 | 2.49E-02 |
| 44 | 2.63E+05 | 9.97E+01 | 1.75E+00 | 1.03E+00 | 2.96E-02 | 2.49E+00 | 1.10E+00 | 3.43E+02 | 3.43E+02 | 8.62E-06 | 4.06E+02 | 2.80E+01 | 2.80E+01 | 1.14E+02 | 5.54E+00 | 2.19E-01 |
| 45 | 1.80E+05 | 6.79E+01 | 1.20E+00 | 7.00E-01 | 1.91E-02 | 1.70E+00 | 7.06E-01 | 2.21E+02 | 2.21E+02 | 5.55E-06 | 2.62E+02 | 1.81E+01 | 1.81E+01 | 7.32E+01 | 3.57E+00 | 1.41E-01 |
| 46 | 4.13E+05 | 1.56E+02 | 2.75E+00 | 1.61E+00 | 6.58E-02 | 3.91E+00 | 2.44E+00 | 7.63E+02 | 7.63E+02 | 1.92E-05 | 9.03E+02 | 6.23E+01 | 6.23E+01 | 2.53E+02 | 1.23E+01 | 4.87E-01 |
| 47 | 1.73E+05 | 6.55E+01 | 1.15E+00 | 6.74E-01 | 5.09E-03 | 1.64E+00 | 1.88E-01 | 5.90E+01 | 5.90E+01 | 1.48E-06 | 6.99E+01 | 4.82E+00 | 4.82E+00 | 1.95E+01 | 9.53E-01 | 3.77E-02 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 1.92E+05 | 7.26E+01 | 1.28E+00 | 7.47E-01 | 3.15E-04 | 1.81E+00 | 1.17E-02 | 2.68E+01 | 2.68E+01 | 9.18E-08 | 4.33E+00 | 2.99E-01 | 2.99E-01 | 1.21E+00 | 5.90E-02 | 2.34E-03 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | 5.82E+05 | 2.20E+02 | 3.88E+00 | 2.27E+00 | 4.59E-03 | 5.51E+00 | 1.70E-01 | 4.25E+01 | 4.25E+01 | 1.34E-06 | 6.30E+01 | 4.35E+00 | 4.35E+00 | 1.76E+01 | 8.59E-01 | 3.40E-02 |
| Phase Totals | 1.66E+07 | 6.73E+03 | 1.03E+02 | 6.04E+01 | 1.55E+00 | 1.47E+02 | 5.75E+01 | 1.77E+04 | 1.77E+04 | 4.53E-04 | 2.13E+04 | 1.47E+03 | 1.47E+03 | 5.96E+03 | 2.91E+02 | 1.15E+01 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Free Supernate Volume, gal | Cs-134 (Ci) | Cs-135 (Ci) | Cs-137 (Ci) | Ba-137m (Ci) | Ce-144 (Ci) | Pr-144 (Ci) | Pm-147 (Ci) | Eu-154 (Ci) | Th-232 (Ci) | U-232 (Ci) | U-233 (Ci) | U-234 (Ci) | U-235 (Ci) | U-236 (Ci) | U-238 (Ci) | Np-237 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.71E+04 | 6.79E+02 | 1.15E+00 | 3.39E+05 | 3.20E+05 | 1.77E-02 | 1.77E-02 | 1.15E+01 | 2.72E+00 | - | 1.55E-05 | - | - | 2.39E-05 | - | 5.96E-04 | 8.69E-04 |
| 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | 2.99E+05 | 5.29E+03 | 8.98E+00 | 2.63E+06 | 2.49E+06 | 1.38E-01 | 1.38E-01 | 8.92E+01 | 2.11E+01 | - | 1.36E-04 | - | - | 1.79E-04 | - | 7.70E-03 | 6.87E-03 |
| 5 | 3.64E-12 | 1.32E-14 | 2.24E-17 | 6.56E-12 | 6.20E-12 | 3.43E-19 | 3.43E-19 | 2.22E-16 | 5.26E-17 | - | 3.27E-21 | - | - | 6.35E-21 | - | 1.50E-19 | 2.54E-19 |
| 6 | 2.54E+05 | 1.88E+02 | 3.20E-01 | 9.38E+04 | 8.88E+04 | 4.91E-03 | 4.91E-03 | 3.18E+00 | 7.53E-01 | - | 2.68E-04 | - | - | 3.32E-04 | - | 1.24E-02 | 4.30E-03 |
| 7 | 2.76E+05 | 9.55E+02 | 1.62E+00 | 4.76E+05 | 4.50E+05 | 2.49E-02 | 2.49E-02 | 1.61E+01 | 3.82E+00 | - | 6.56E-05 | - | - | 3.07E-04 | - | 1.06E-02 | 5.28E-03 |
| 8 | 7.28E+03 | 1.02E+01 | 1.73E-02 | 5.06E+03 | 4.79E+03 | 2.65E-04 | 2.65E-04 | 1.71E-01 | 4.06E-02 | - | 2.16E-06 | - | - | 5.72E-06 | - | 2.63E-04 | 1.19E-04 |
| 9 | 1.30E+04 | 1.88E+02 | 3.20E-01 | 9.38E+04 | 8.87E+04 | 4.91E-03 | 4.91E-03 | 3.17E+00 | 7.53E-01 | - | 1.34E-05 | - | - | 8.66E-06 | - | 2.16E-04 | 1.48E-03 |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | 1.42E+05 | 8.57E-02 | 1.46E-04 | 4.27E+01 | 4.04E+01 | 2.24E-06 | 2.23E-06 | 1.45E-03 | 3.43E-04 | 2.56E-06 | - | 3.66E-04 | 3.00E-04 | 5.66E-06 | 4.64E-05 | 1.05E-05 | 1.98E-04 |
| 12 | 2.46E+04 | 5.13E+01 | 8.72E-02 | 2.56E+04 | 2.42E+04 | 1.34E-03 | 1.34E-03 | 8.66E-01 | 2.05E-01 | 4.35E-05 | 4.38E-07 | 1.22E-03 | 1.15E-04 | 2.16E-06 | 9.09E-06 | 2.17E-05 | 2.54E-04 |
| 13 | 5.78E+05 | 1.81E+04 | 3.07E+01 | 9.01E+06 | 8.53E+06 | 4.72E-01 | 4.72E-01 | 3.05E+02 | 7.23E+01 | 3.13E-04 | 8.32E-05 | 6.41E-02 | 9.05E-03 | 2.47E-04 | 9.33E-04 | 2.89E-03 | 2.33E-02 |
| 14 | 1.05E+03 | 3.52E+01 | 5.98E-02 | 1.75E+04 | 1.66E+04 | 9.18E-04 | 9.18E-04 | 5.94E-01 | 1.41E-01 | 2.43E-06 | 7.20E-07 | 8.57E-05 | 1.18E-05 | 9.52E-07 | 1.01E-06 | 1.82E-05 | 1.26E-04 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 1.18E+06 | 3.14E+00 | 5.33E-03 | 1.56E+03 | 1.48E+03 | 8.18E-05 | 8.18E-05 | 5.29E-02 | 1.25E-02 | 1.20E-06 | - | 3.78E-02 | 4.04E-02 | 6.40E-04 | 7.40E-03 | 3.79E-03 | 3.35E-02 |
| 22 | 1.17E+06 | 3.40E+00 | 5.78E-03 | 1.70E+03 | 1.60E+03 | 8.87E-05 | 8.87E-05 | 5.74E-02 | 1.36E-02 | - | - | 1.56E-01 | 5.62E-02 | 8.59E-04 | 9.25E-03 | 1.91E-02 | 3.41E-02 |
| 23 | 1.26E+06 | 1.32E-02 | 1.95E-02 | 2.54E+02 | 2.41E+02 | 1.33E-05 | 1.33E-05 | 8.61E-03 | 2.04E-03 | 1.72E-07 | - | 1.15E-02 | 1.82E-02 | 1.01E-04 | 4.09E-04 | 3.04E-03 | 8.43E-04 |
| 24 | 8.51E+05 | 9.46E+02 | 1.61E+00 | 4.72E+05 | 4.46E+05 | 2.47E-02 | 2.47E-02 | 1.60E+01 | 3.79E+00 | - | 3.82E-09 | 1.16E-14 | 3.71E-14 | 1.10E-08 | 1.42E-09 | 1.32E-06 | 3.40E-09 |
| 25 | 3.69E+04 | 2.79E+02 | 4.73E-01 | 1.39E+05 | 1.31E+05 | 7.26E-03 | 7.26E-03 | 4.70E+00 | 1.11E+00 | - | 1.66E-10 | 5.04E-16 | 1.61E-15 | 4.76E-10 | 6.15E-11 | 5.71E-08 | 1.47E-10 |
| 26 | 5.19E+05 | 7.42E+03 | 1.26E+01 | 3.70E+06 | 3.50E+06 | 1.93E-01 | 1.93E-01 | 1.25E+02 | 2.97E+01 | - | 1.63E-03 | 4.97E-09 | 1.59E-08 | 4.70E-03 | 6.06E-04 | 5.64E-01 | 1.45E-03 |
| 27 | 6.00E+05 | 9.75E+03 | 1.66E+01 | 4.86E+06 | 4.59E+06 | 2.54E-01 | 2.54E-01 | 1.64E+02 | 3.90E+01 | - | 2.70E-09 | 8.21E-15 | 2.62E-14 | 7.75E-09 | 1.00E-09 | 9.31E-07 | 2.40E-09 |
| 28 | 1.85E+05 | 1.66E+03 | 2.82E+00 | 8.28E+05 | 7.84E+05 | 4.33E-02 | 4.33E-02 | 2.80E+01 | 6.65E+00 | - | 8.33E-10 | 2.53E-15 | 8.09E-15 | 2.39E-09 | 3.09E-10 | 2.87E-07 | 7.41E-10 |
| 29 | 1.67E+05 | 3.34E+02 | 5.68E-01 | 1.67E+05 | 1.58E+05 | 8.71E-03 | 8.71E-03 | 5.64E+00 | 1.34E+00 | - | 3.19E-11 | 2.46E-08 | 3.47E-09 | 9.49E-11 | 3.58E-10 | 1.11E-09 | 8.93E-09 |
| 30 | 9.15E+05 | 1.97E+04 | 3.34E+01 | 9.80E+06 | 9.27E+06 | 5.13E-01 | 5.12E-01 | 3.32E+02 | 7.86E+01 | - | - | - | 3.19E-02 | 5.66E-04 | 5.89E-03 | 2.10E-05 | 1.44E-02 |
| 31 | 1.15E+05 | 2.62E+03 | 4.46E+00 | 1.31E+06 | 1.24E+06 | 6.84E-02 | 6.84E-02 | 4.43E+01 | 1.05E+01 | - | 2.20E-11 | 1.70E-08 | 2.39E-09 | 6.54E-11 | 2.47E-10 | 7.65E-10 | 6.15E-09 |
| 32 | 8.44E+05 | 1.32E+04 | 2.25E+01 | 6.59E+06 | 6.23E+06 | 3.45E-01 | 3.45E-01 | 2.23E+02 | 5.29E+01 | - | - | - | 3.82E-02 | 5.46E-04 | 8.57E-03 | 2.57E-04 | 1.58E-02 |
| 33 | 7.95E+05 | 6.46E+03 | 1.10E+01 | 3.22E+06 | 3.05E+06 | 1.69E-01 | 1.68E-01 | 1.09E+02 | 2.59E+01 | - | 1.54E-02 | 7.38E-08 | 1.52E-03 | 2.85E-02 | 1.58E-02 | 4.13E+00 | 1.30E+00 |
| 34 | 5.69E+05 | 5.63E+03 | 9.56E+00 | 2.80E+06 | 2.65E+06 | 1.47E-01 | 1.47E-01 | 9.49E+01 | 2.25E+01 | - | 3.01E-03 | - | - | 3.04E-03 | - | 2.15E-01 | 1.66E-01 |
| 35 | 4.50E+05 | 3.65E+03 | 6.21E+00 | 1.82E+06 | 1.72E+06 | 9.53E-02 | 9.53E-02 | 6.16E+01 | 1.46E+01 | - | - | - | 1.99E-02 | 3.45E-04 | 5.86E-03 | 2.04E-04 | 7.18E-03 |
| 36 | 2.20E+05 | 9.22E+03 | 1.57E+01 | 4.59E+06 | 4.35E+06 | 2.40E-01 | 2.40E-01 | 1.56E+02 | 3.69E+01 | - | - | - | 1.69E-02 | 3.27E-04 | 5.95E-03 | 1.07E-04 | 4.72E-03 |
| 37 | 1.16E+05 | 2.22E+03 | 3.77E+00 | 1.11E+06 | 1.05E+06 | 5.79E-02 | 5.79E-02 | 3.75E+01 | 8.88E+00 | - | 2.22E-11 | 1.71E-08 | 2.42E-09 | 6.61E-11 | 2.49E-10 | 7.73E-10 | 6.21E-09 |
| 38 | 1.71E+05 | 1.12E+02 | 1.90E-01 | 5.58E+04 | 5.28E+04 | 2.92E-03 | 2.92E-03 | 1.89E+00 | 4.48E-01 | - | - | - | 5.11E-08 | 7.05E-10 | 9.74E-09 | 5.73E-11 | 5.45E-08 |
| 39 | 7.22E+05 | 1.62E+03 | 2.76E+00 | 8.09E+05 | 7.65E+05 | 4.23E-02 | 4.23E-02 | 2.74E+01 | 6.49E+00 | - | - | - | 8.58E-02 | 1.24E-03 | 1.47E-02 | 2.62E-04 | 5.39E-02 |
| 40 | 3.05E+05 | 4.14E+01 | 7.03E-02 | 2.06E+04 | 1.95E+04 | 1.08E-03 | 1.08E-03 | 6.98E-01 | 1.65E-01 | 7.28E-04 | 8.09E-04 | 2.07E-02 | 1.99E-02 | 3.76E-03 | 4.97E-03 | 1.18E-01 | 4.11E-01 |
| 41 | 1.24E+05 | 2.64E+02 | 4.48E-01 | 1.31E+05 | 1.24E+05 | 6.88E-03 | 6.88E-03 | 4.45E+00 | 1.06E+00 | - | - | - | 5.16E-02 | 5.97E-04 | 1.48E-02 | 4.09E-05 | 1.54E-01 |
| 42 | 1.25E+06 | 2.44E+04 | 4.14E+01 | 1.21E+07 | 1.15E+07 | 6.35E-01 | 6.35E-01 | 4.11E+02 | 9.74E+01 | 1.00E-01 | 3.54E-04 | 1.41E+00 | 5.19E-01 | 1.22E-02 | 6.93E-02 | 2.15E-01 | 4.27E-01 |
| 43 | 7.76E+05 | 3.18E+02 | 5.40E-01 | 1.58E+05 | 1.50E+05 | 8.29E-03 | 8.28E-03 | 5.36E+00 | 1.27E+00 | - | - | - | 2.19E-01 | 3.02E-03 | 4.17E-02 | 2.45E-04 | 2.33E-01 |
| 44 | 2.63E+05 | 2.80E+03 | 4.76E+00 | 1.40E+06 | 1.32E+06 | 7.30E-02 | 7.30E-02 | 4.72E+01 | 1.12E+01 | - | 1.18E-09 | 3.60E-15 | 1.15E-14 | 3.40E-09 | 4.39E-10 | 4.08E-07 | 1.05E-09 |
| 45 | 1.80E+05 | 1.81E+03 | 3.07E+00 | 8.99E+05 | 8.51E+05 | 4.71E-02 | 4.70E-02 | 3.04E+01 | 7.22E+00 | - | 8.07E-10 | 2.45E-15 | 7.83E-15 | 2.32E-09 | 2.99E-10 | 2.78E-07 | 7.18E-10 |
| 46 | 4.13E+05 | 6.23E+03 | 1.06E+01 | 3.10E+06 | 2.94E+06 | 1.62E-01 | 1.62E-01 | 1.05E+02 | 2.49E+01 | - | 1.86E-09 | 5.64E-15 | 1.80E-14 | 5.33E-09 | 6.88E-10 | 6.40E-07 | 1.65E-09 |
| 47 | 1.73E+05 | 4.82E+02 | 8.18E-01 | 2.40E+05 | 2.27E+05 | 1.26E-02 | 1.26E-02 | 8.13E+00 | 1.93E+00 | - | 4.41E-04 | - | - | 1.20E-03 | - | 9.50E-02 | - |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 1.92E+05 | 2.98E+01 | 5.07E-02 | 1.49E+04 | 1.41E+04 | 7.78E-04 | 7.78E-04 | 5.03E-01 | 1.19E-01 | - | 3.67E-11 | 2.82E-08 | 3.98E-09 | 1.09E-10 | 4.11E-10 | 1.27E-09 | 1.02E-08 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | 5.82E+05 | 4.34E+02 | 7.38E-01 | 2.16E+05 | 2.05E+05 | 1.13E-02 | 1.13E-02 | 7.33E+00 | 1.74E+00 | 4.03E-04 | 5.91E-05 | 4.91E-02 | 4.07E-02 | 1.06E-03 | 6.59E-03 | 9.69E-03 | 3.29E-02 |
| Phase Totals | 1.66E+07 | 1.47E+05 | 2.50E+02 | 7.33E+07 | 6.93E+07 | 3.83E+00 | 3.83E+00 | 2.48E+03 | 5.88E+02 | 1.02E-01 | 2.23E-02 | 1.75E+00 | 1.17E+00 | 6.39E-02 | 2.13E-01 | 5.41E+00 | 2.93E+00 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Free Supernate Volume, gal | Pu-238 (Ci) | Pu-239 (Ci) | Pu-240 (Ci) | Pu-241 (Ci) | Pu-242 (Ci) | Am-241 (Ci) | Am-242m (Ci) | Cm-244 (Ci) | Cm-245 (Ci) | Na-22 (Ci) | Al-26 (Ci) | Te-125m (Ci) | Sb-126 (Ci) | Sb-126m (Ci) | Sm-151 (Ci) | Eu-152 (Ci) | Eu-155 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.71E+04 | 6.74E-01 | 1.80E-01 | 4.03E-02 | 2.21E-01 | 8.29E-06 | 1.08E+00 | 6.25E-04 | 4.34E-01 | 4.28E-05 | 6.04E+00 | 3.86E-02 | 6.73E+00 | 1.88E-01 | 1.34E+00 | 1.28E+01 | 6.21E-02 | 7.26E-01 |
| 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | 2.99E+05 | 1.39E+00 | 1.38E+00 | 3.08E-01 | 2.60E+00 | 6.33E-05 | 8.44E+00 | 4.87E-03 | 3.38E+00 | 3.33E-04 | 4.70E+01 | 3.01E-01 | 5.24E+01 | 1.46E+00 | 1.05E+01 | 9.99E+01 | 4.83E-01 | 5.65E+00 |
| 5 | 3.64E-12 | 1.75E-16 | 2.92E-17 | 6.99E-18 | 4.68E-17 | 2.06E-21 | 2.10E-17 | 1.21E-20 | 8.42E-18 | 8.29E-22 | 1.17E-16 | 7.48E-19 | 1.30E-16 | 3.64E-18 | 2.60E-17 | 2.49E-16 | 1.20E-18 | 1.41E-17 |
| 6 | 2.54E+05 | - | 1.27E+00 | 4.41E-01 | 4.95E+00 | 8.68E-04 | 3.01E-01 | 1.73E-04 | 1.20E-01 | 1.19E-05 | 1.67E+00 | 1.07E-02 | 1.86E+00 | 5.21E-02 | 3.72E-01 | 3.56E+00 | 1.72E-02 | 2.01E-01 |
| 7 | 2.76E+05 | 2.59E+01 | 4.66E+00 | 1.15E+00 | 1.10E+01 | 1.06E-03 | 1.53E+00 | 8.79E-04 | 6.11E-01 | 6.02E-05 | 8.49E+00 | 5.43E-02 | 9.46E+00 | 2.65E-01 | 1.89E+00 | 1.81E+01 | 8.73E-02 | 1.02E+00 |
| 8 | 7.28E+03 | 3.42E-01 | 7.51E-02 | 1.77E-02 | 1.68E-01 | 2.23E-05 | 1.62E-02 | 9.35E-06 | 6.50E-03 | 6.40E-07 | 9.03E-02 | 5.78E-04 | 1.01E-01 | 2.81E-03 | 2.01E-02 | 1.92E-01 | 9.29E-04 | 1.09E-02 |
| 9 | 1.30E+04 | 3.21E-01 | 4.58E-02 | 1.02E-02 | 4.25E-02 | 2.11E-06 | 3.01E-01 | 1.73E-04 | 1.20E-01 | 1.19E-05 | 1.67E+00 | 1.07E-02 | 1.86E+00 | 5.21E-02 | 3.72E-01 | 3.56E+00 | 1.72E-02 | 2.01E-01 |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | 1.42E+05 | 2.68E+01 | 2.66E-01 | 1.67E-01 | 9.58E+00 | 3.56E-04 | 1.37E-04 | 7.89E-08 | 5.48E-05 | 5.40E-09 | 7.62E-04 | 4.88E-06 | 8.49E-04 | 2.37E-05 | 1.70E-04 | 1.62E-03 | 7.84E-06 | 9.16E-05 |
| 12 | 2.46E+04 | 4.42E+00 | 7.41E-02 | 4.09E-02 | 1.04E+00 | 5.92E-05 | 8.20E-02 | 4.73E-05 | 3.28E-02 | 3.23E-06 | 4.57E-01 | 2.92E-03 | 5.09E-01 | 1.42E-02 | 1.02E-01 | 9.71E-01 | 4.70E-03 | 5.49E-02 |
| 13 | 5.78E+05 | 8.51E+01 | 2.30E+00 | 9.52E-01 | 1.68E+01 | 6.32E-04 | 2.89E+01 | 1.67E-02 | 1.16E+01 | 1.14E-03 | 1.61E+02 | 1.03E+00 | 1.79E+02 | 5.01E+00 | 3.58E+01 | 3.42E+02 | 1.65E+00 | 1.93E+01 |
| 14 | 1.05E+03 | 5.63E-02 | 1.39E-02 | 4.48E-03 | 2.27E-02 | 8.20E-07 | 5.62E-02 | 3.24E-05 | 2.25E-02 | 2.22E-06 | 3.13E-01 | 2.00E-03 | 3.49E-01 | 9.75E-03 | 6.97E-02 | 6.66E-01 | 3.22E-03 | 3.76E-02 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 1.18E+06 | 2.01E+02 | 2.96E+00 | 1.01E+00 | 1.77E+01 | 1.13E-04 | 5.01E-03 | 2.89E-06 | 2.01E-03 | 1.98E-07 | 2.79E-02 | 1.78E-04 | 3.11E-02 | 8.69E-04 | 6.20E-03 | 5.93E-02 | 2.87E-04 | 3.35E-03 |
| 22 | 1.17E+06 | 2.31E+02 | - | - | - | - | 5.43E-03 | 3.13E-06 | 2.18E-03 | 2.14E-07 | 3.03E-02 | 1.94E-04 | 3.37E-02 | 9.42E-04 | 6.73E-03 | 6.43E-02 | 3.11E-04 | 3.64E-03 |
| 23 | 1.26E+06 | 9.19E-01 | 3.15E-03 | 7.86E-04 | 9.19E-02 | 4.68E-03 | 1.20E-02 | 4.70E-07 | 3.53E-04 | 3.21E-08 | 4.54E-03 | 2.90E-05 | 5.05E-03 | 1.41E-04 | 1.01E-03 | 9.65E-03 | 4.67E-05 | 5.45E-04 |
| 24 | 8.51E+05 | 7.03E-03 | 1.10E-03 | 2.46E-04 | 5.79E-03 | 4.91E-08 | 1.51E+00 | 8.71E-04 | 6.05E-01 | 5.96E-05 | 8.42E+00 | 5.38E-02 | 9.37E+00 | 2.62E-01 | 1.87E+00 | 1.79E+01 | 8.65E-02 | 1.01E+00 |
| 25 | 3.69E+04 | 3.04E-04 | 4.77E-05 | 1.07E-05 | 2.51E-04 | 2.12E-09 | 4.45E-01 | 2.57E-04 | 1.78E-01 | 1.76E-05 | 2.48E+00 | 1.58E-02 | 2.76E+00 | 7.72E-02 | 5.51E-01 | 5.27E+00 | 2.55E-02 | 2.98E-01 |
| 26 | 5.19E+05 | 3.00E+03 | 4.71E+02 | 1.05E+02 | 2.48E+03 | 2.10E-02 | 1.18E+01 | 6.83E-03 | 4.74E+00 | 4.67E-04 | 6.60E+01 | 4.22E-01 | 7.35E+01 | 2.05E+00 | 1.47E+01 | 1.40E+02 | 6.78E-01 | 7.92E+00 |
| 27 | 6.00E+05 | 4.96E-03 | 7.77E-04 | 1.74E-04 | 4.09E-03 | 3.46E-08 | 1.56E+01 | 8.97E-03 | 6.23E+00 | 6.14E-04 | 8.67E+01 | 5.54E-01 | 9.65E+01 | 2.70E+00 | 1.93E+01 | 1.84E+02 | 8.91E-01 | 1.04E+01 |
| 28 | 1.85E+05 | 1.53E-03 | 2.40E-04 | 5.36E-05 | 1.26E-03 | 1.07E-08 | 2.65E+00 | 1.53E-03 | 1.06E+00 | 1.05E-04 | 1.48E+01 | 9.45E-02 | 1.65E+01 | 4.60E-01 | 3.29E+00 | 3.14E+01 | 1.52E-01 | 1.78E+00 |
| 29 | 1.67E+05 | 3.26E-05 | 8.83E-07 | 3.65E-07 | 6.44E-06 | 2.42E-10 | 5.34E-01 | 3.08E-04 | 2.14E-01 | 2.11E-05 | 2.97E+00 | 1.90E-02 | 3.31E+00 | 9.26E-02 | 6.61E-01 | 6.32E+00 | 3.06E-02 | 3.57E-01 |
| 30 | 9.15E+05 | 6.15E+03 | 5.34E+01 | 3.84E+01 | 3.95E+03 | 9.18E-02 | 3.14E+01 | 1.81E-02 | 1.26E+01 | 1.24E-03 | 1.75E+02 | 1.12E+00 | 1.95E+02 | 5.45E+00 | 3.89E+01 | 3.72E+02 | 1.80E+00 | 2.10E+01 |
| 31 | 1.15E+05 | 2.25E-05 | 6.09E-07 | 2.52E-07 | 4.44E-06 | 1.67E-10 | 4.19E+00 | 2.42E-03 | 1.68E+00 | 1.65E-04 | 2.33E+01 | 1.49E-01 | 2.60E+01 | 7.27E-01 | 5.19E+00 | 4.96E+01 | 2.40E-01 | 2.80E+00 |
| 32 | 8.44E+05 | 5.54E+03 | 4.86E+01 | 3.61E+01 | 2.47E+03 | 7.61E-02 | 2.11E+01 | 1.22E-02 | 8.46E+00 | 8.33E-04 | 1.18E+02 | 7.52E-01 | 1.31E+02 | 3.66E+00 | 2.62E+01 | 2.50E+02 | 1.21E+00 | 1.41E+01 |
| 33 | 7.95E+05 | 2.12E+03 | 1.16E+03 | 2.03E+02 | 6.02E+03 | 1.17E-02 | 1.03E+01 | 5.95E-03 | 4.13E+00 | 4.07E-04 | 5.75E+01 | 3.68E-01 | 6.40E+01 | 1.79E+00 | 1.28E+01 | 1.22E+02 | 5.91E-01 | 6.91E+00 |
| 34 | 5.69E+05 | - | 3.47E+01 | 7.74E+00 | 1.60E+02 | 1.61E-03 | 8.98E+00 | 5.18E-03 | 3.60E+00 | 3.54E-04 | 5.00E+01 | 3.20E-01 | 5.57E+01 | 1.56E+00 | 1.11E+01 | 1.06E+02 | 5.14E-01 | 6.01E+00 |
| 35 | 4.50E+05 | 2.97E+03 | 2.41E+01 | 1.84E+01 | 1.43E+03 | 4.13E-02 | 5.84E+00 | 3.36E-03 | 2.34E+00 | 2.30E-04 | 3.25E+01 | 2.08E-01 | 3.62E+01 | 1.01E+00 | 7.23E+00 | 6.91E+01 | 3.34E-01 | 3.90E+00 |
| 36 | 2.20E+05 | 1.46E+03 | 1.14E+01 | 9.05E+00 | 5.93E+02 | 1.96E-02 | 1.47E+01 | 8.49E-03 | 5.90E+00 | 5.81E-04 | 8.20E+01 | 5.24E-01 | 9.13E+01 | 2.55E+00 | 1.82E+01 | 1.74E+02 | 8.43E-01 | 9.85E+00 |
| 37 | 1.16E+05 | 2.27E-05 | 6.15E-07 | 2.54E-07 | 4.48E-06 | 1.69E-10 | 3.55E+00 | 2.05E-03 | 1.42E+00 | 1.40E-04 | 1.98E+01 | 1.26E-01 | 2.20E+01 | 6.15E-01 | 4.39E+00 | 4.20E+01 | 2.03E-01 | 2.37E+00 |
| 38 | 1.71E+05 | 1.24E-03 | 4.89E-06 | 4.13E-06 | 1.06E-03 | 6.10E-08 | 1.79E-01 | 1.03E-04 | 7.16E-02 | 7.05E-06 | 9.96E-01 | 6.37E-03 | 1.11E+00 | 3.10E-02 | 2.22E-01 | 2.12E+00 | 1.02E-02 | 1.20E-01 |
| 39 | 7.22E+05 | 4.78E+03 | 5.95E+01 | 3.69E+01 | 4.24E+03 | 7.88E-02 | 2.59E+00 | 1.49E-03 | 1.04E+00 | 1.02E-04 | 1.44E+01 | 9.23E-02 | 1.61E+01 | 4.49E-01 | 3.21E+00 | 3.07E+01 | 1.48E-01 | 1.73E+00 |
| 40 | 3.05E+05 | 3.76E+02 | 1.21E+02 | 4.59E+01 | 6.46E+02 | 2.32E-02 | 6.60E-02 | 3.81E-05 | 2.64E-02 | 2.61E-06 | 3.68E-01 | 2.35E-03 | 4.10E-01 | 1.15E-02 | 8.18E-02 | 7.82E-01 | 3.78E-03 | 4.42E-02 |
| 41 | 1.24E+05 | 8.43E+02 | - | - | - | - | 4.21E-01 | 2.43E-04 | 1.69E-01 | 1.66E-05 | 2.35E+00 | 1.50E-02 | 2.61E+00 | 7.31E-02 | 5.22E-01 | 4.99E+00 | 2.41E-02 | 2.82E-01 |
| 42 | 1.25E+06 | 6.74E+03 | 2.40E+02 | 8.62E+01 | 1.48E+03 | 7.90E-02 | 3.89E+01 | 2.24E-02 | 1.56E+01 | 1.53E-03 | 2.17E+02 | 1.39E+00 | 2.41E+02 | 6.75E+00 | 4.82E+01 | 4.60E+02 | 2.23E+00 | 2.60E+01 |
| 43 | 7.76E+05 | 5.30E+03 | 2.09E+01 | 1.77E+01 | 4.54E+03 | 2.61E-01 | 5.08E-01 | 2.93E-04 | 2.03E-01 | 2.00E-05 | 2.83E+00 | 1.81E-02 | 3.15E+00 | 8.80E-02 | 6.29E-01 | 6.01E+00 | 2.91E-02 | 3.40E-01 |
| 44 | 2.63E+05 | 2.17E-03 | 3.41E-04 | 7.62E-05 | 1.79E-03 | 1.52E-08 | 4.47E+00 | 2.58E-03 | 1.79E+00 | 1.76E-04 | 2.49E+01 | 1.59E-01 | 2.77E+01 | 7.76E-01 | 5.54E+00 | 5.29E+01 | 2.56E-01 | 2.99E+00 |
| 45 | 1.80E+05 | 1.48E-03 | 2.32E-04 | 5.19E-05 | 1.22E-03 | 1.03E-08 | 2.88E+00 | 1.66E-03 | 1.15E+00 | 1.14E-04 | 1.60E+01 | 1.03E-01 | 1.79E+01 | 5.00E-01 | 3.57E+00 | 3.41E+01 | 1.65E-01 | 1.93E+00 |
| 46 | 4.13E+05 | 3.41E-03 | 5.34E-04 | 1.19E-04 | 2.81E-03 | 2.38E-08 | 9.94E+00 | 5.73E-03 | 3.98E+00 | 3.92E-04 | 5.54E+01 | 3.54E-01 | 6.17E+01 | 1.72E+00 | 1.23E+01 | 1.18E+02 | 5.69E-01 | 6.65E+00 |
| 47 | 1.73E+05 | 1.01E+03 | 1.46E+02 | 3.25E+01 | 6.33E+02 | 6.70E-03 | 7.69E-01 | 4.44E-04 | 3.08E-01 | 3.03E-05 | 4.28E+00 | 2.74E-02 | 4.77E+00 | 1.33E-01 | 9.53E-01 | 9.11E+00 | 4.41E-02 | 5.15E-01 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 1.92E+05 | 3.75E-05 | 1.01E-06 | 4.19E-07 | 7.39E-06 | 2.78E-10 | 4.77E-02 | 2.75E-05 | 1.91E-02 | 1.88E-06 | 2.65E-01 | 1.70E-03 | 2.96E-01 | 8.27E-03 | 5.90E-02 | 5.64E-01 | 2.73E-03 | 3.19E-02 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | 5.82E+05 | 3.55E+03 | 4.75E+01 | 2.70E+01 | 1.35E+03 | 4.87E-02 | 6.94E-01 | 4.00E-04 | 2.78E-01 | 2.74E-05 | 3.86E+00 | 2.47E-02 | 4.30E+00 | 1.20E-01 | 8.59E-01 | 8.21E+00 | 3.97E-02 | 4.64E-01 |
| Phase Totals | 1.66E+07 | 4.44E+04 | 2.45E+03 | 6.68E+02 | 3.01E+04 | 7.69E-01 | 2.35E+02 | 1.35E-01 | 9.40E+01 | 9.26E-03 | 1.31E+03 | 8.36E+00 | 1.46E+03 | 4.07E+01 | 2.91E+02 | 2.78E+03 | 1.34E+01 | 1.57E+02 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Free Supernate Volume, gal | Ra-226 (Ci) | Ra-228 (Ci) | Ac-227 (Ci) | Th-229 (Ci) | Th-230 (Ci) | Pa-231 (Ci) | Pu-244 (Ci) | Am-243 (Ci) | Cm-242 (Ci) | Cm-243 (Ci) | Cm-247 (Ci) | Cm-248 (Ci) | Bk-249 (Ci) | Cf-249 (Ci) | Cf-251 (Ci) | Cf-252 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.71E+04 | - | - | 5.46E-09 | - | - | 1.52E-08 | 3.79E-08 | 2.08E-04 | 5.13E-04 | 1.22E-04 | 2.34E-14 | 2.44E-14 | 1.78E-21 | 1.35E-13 | 4.63E-15 | 1.50E-16 |
| 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | 2.99E+05 | - | - | 4.08E-08 | - | - | 1.13E-07 | 2.89E-07 | 1.62E-03 | 3.99E-03 | 9.46E-04 | 1.82E-13 | 1.90E-13 | 1.39E-20 | 1.05E-12 | 3.60E-14 | 1.17E-15 |
| 5 | 3.64E-12 | - | - | 1.45E-24 | - | - | 4.03E-24 | 9.42E-24 | 4.02E-21 | 9.93E-21 | 2.35E-21 | 4.54E-31 | 4.73E-31 | 3.45E-38 | 2.62E-30 | 8.97E-32 | 2.91E-33 |
| 6 | 2.54E+05 | - | - | 7.57E-08 | - | - | 2.10E-07 | 3.97E-06 | 5.75E-05 | 1.42E-04 | 3.37E-05 | 6.49E-15 | 6.76E-15 | 4.94E-22 | 3.75E-14 | 1.28E-15 | 4.16E-17 |
| 7 | 2.76E+05 | - | - | 6.99E-08 | - | - | 1.94E-07 | 4.85E-06 | 2.92E-04 | 7.21E-04 | 1.71E-04 | 3.29E-14 | 3.43E-14 | 2.51E-21 | 1.90E-13 | 6.51E-15 | 2.11E-16 |
| 8 | 7.28E+03 | - | - | 1.30E-09 | - | - | 3.62E-09 | 1.02E-07 | 3.10E-06 | 7.67E-06 | 1.82E-06 | 3.50E-16 | 3.65E-16 | 2.67E-23 | 2.02E-15 | 6.92E-17 | 2.25E-18 |
| 9 | 1.30E+04 | - | - | 1.98E-09 | - | - | 5.49E-09 | 9.63E-09 | 5.75E-05 | 1.42E-04 | 3.37E-05 | 6.49E-15 | 6.76E-15 | 4.94E-22 | 3.75E-14 | 1.28E-15 | 4.16E-17 |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | 1.42E+05 | 6.76E-10 | 2.56E-06 | 1.29E-09 | 1.04E-06 | 8.28E-08 | 3.59E-09 | 1.63E-06 | 2.62E-08 | 6.47E-08 | 1.53E-08 | 2.95E-18 | 3.08E-18 | 2.25E-25 | 1.71E-17 | 5.84E-19 | 1.90E-20 |
| 12 | 2.46E+04 | 2.58E-10 | 4.35E-05 | 4.92E-10 | 3.48E-06 | 3.16E-08 | 1.37E-09 | 2.70E-07 | 1.57E-05 | 3.88E-05 | 9.19E-06 | 1.77E-15 | 1.84E-15 | 1.35E-22 | 1.02E-14 | 3.50E-16 | 1.14E-17 |
| 13 | 5.78E+05 | 2.04E-08 | 3.13E-04 | 5.64E-08 | 1.82E-04 | 2.49E-06 | 1.57E-07 | 2.89E-06 | 5.53E-03 | 1.37E-02 | 3.24E-03 | 6.23E-13 | 6.50E-13 | 4.75E-20 | 3.60E-12 | 1.23E-13 | 4.00E-15 |
| 14 | 1.05E+03 | 2.65E-11 | 2.43E-06 | 2.17E-10 | 2.44E-07 | 3.25E-09 | 6.03E-10 | 3.75E-09 | 1.08E-05 | 2.66E-05 | 6.30E-06 | 1.21E-15 | 1.26E-15 | 9.24E-23 | 7.01E-15 | 2.40E-16 | 7.79E-18 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 1.18E+06 | 9.10E-08 | 1.20E-06 | 1.46E-07 | 1.08E-04 | 1.11E-05 | 4.06E-07 | 5.15E-07 | 9.58E-07 | 2.37E-06 | 5.61E-07 | 1.08E-16 | 1.13E-16 | 8.23E-24 | 6.25E-16 | 2.14E-17 | 6.94E-19 |
| 22 | 1.17E+06 | 1.27E-07 | - | 1.96E-07 | 4.45E-04 | 1.55E-05 | 5.45E-07 | - | 1.04E-06 | 2.57E-06 | 6.09E-07 | 1.17E-16 | 1.22E-16 | 8.93E-24 | 6.78E-16 | 2.32E-17 | 7.52E-19 |
| 23 | 1.26E+06 | 1.26E+01 | 1.72E-07 | 2.31E-08 | 3.26E-05 | 3.31E-02 | 6.43E-08 | 4.76E-05 | 1.56E-07 | 3.85E-07 | 9.13E-08 | 1.76E-17 | 1.83E-17 | 1.34E-24 | 1.02E-16 | 3.48E-18 | 1.13E-19 |
| 24 | 8.51E+05 | 8.37E-20 | - | 2.51E-12 | 3.31E-17 | 1.02E-17 | 6.97E-12 | 2.24E-10 | 2.89E-04 | 7.15E-04 | 1.69E-04 | 3.26E-14 | 3.40E-14 | 2.48E-21 | 1.88E-13 | 6.45E-15 | 2.09E-16 |
| 25 | 3.69E+04 | 3.62E-21 | - | 1.09E-13 | 1.43E-18 | 4.43E-19 | 3.02E-13 | 9.71E-12 | 8.51E-05 | 2.10E-04 | 4.99E-05 | 9.60E-15 | 1.00E-14 | 7.31E-22 | 5.55E-14 | 1.90E-15 | 6.16E-17 |
| 26 | 5.19E+05 | 3.58E-14 | - | 1.07E-06 | 1.41E-11 | 4.38E-12 | 2.98E-06 | 9.58E-05 | 2.27E-03 | 5.60E-03 | 1.33E-03 | 2.56E-13 | 2.66E-13 | 1.95E-20 | 1.48E-12 | 5.05E-14 | 1.64E-15 |
| 27 | 6.00E+05 | 5.90E-20 | - | 1.77E-12 | 2.34E-17 | 7.22E-18 | 4.91E-12 | 1.58E-10 | 2.98E-03 | 7.36E-03 | 1.74E-03 | 3.36E-13 | 3.50E-13 | 2.56E-20 | 1.94E-12 | 6.64E-14 | 2.16E-15 |
| 28 | 1.85E+05 | 1.82E-20 | - | 5.46E-13 | 7.21E-18 | 2.23E-18 | 1.52E-12 | 4.88E-11 | 5.08E-04 | 1.26E-03 | 2.97E-04 | 5.73E-14 | 5.97E-14 | 4.36E-21 | 3.31E-13 | 1.13E-14 | 3.68E-16 |
| 29 | 1.67E+05 | 7.82E-15 | - | 2.17E-14 | 7.00E-11 | 9.57E-13 | 6.02E-14 | 1.11E-12 | 1.02E-04 | 2.52E-04 | 5.98E-05 | 1.15E-14 | 1.20E-14 | 8.77E-22 | 6.66E-14 | 2.28E-15 | 7.39E-17 |
| 30 | 9.15E+05 | 7.19E-08 | - | 1.29E-07 | - | 8.80E-06 | 3.59E-07 | 4.20E-04 | 6.01E-03 | 1.48E-02 | 3.52E-03 | 6.78E-13 | 7.06E-13 | 5.16E-20 | 3.92E-12 | 1.34E-13 | 4.35E-15 |
| 31 | 1.15E+05 | 5.39E-15 | - | 1.49E-14 | 4.82E-11 | 6.60E-13 | 4.15E-14 | 7.64E-13 | 8.02E-04 | 1.98E-03 | 4.69E-04 | 9.04E-14 | 9.42E-14 | 6.89E-21 | 5.22E-13 | 1.79E-14 | 5.80E-16 |
| 32 | 8.44E+05 | 8.60E-08 | - | 1.25E-07 | - | 1.05E-05 | 3.46E-07 | 3.48E-04 | 4.04E-03 | 9.98E-03 | 2.37E-03 | 4.56E-13 | 4.75E-13 | 3.47E-20 | 2.63E-12 | 9.01E-14 | 2.92E-15 |
| 33 | 7.95E+05 | 3.43E-09 | - | 6.51E-06 | 2.10E-10 | 4.19E-07 | 1.81E-05 | 5.36E-05 | 1.97E-03 | 4.88E-03 | 1.16E-03 | 2.23E-13 | 2.32E-13 | 1.70E-20 | 1.29E-12 | 4.40E-14 | 1.43E-15 |
| 34 | 5.69E+05 | - | - | 6.93E-07 | - | - | 1.93E-06 | 7.34E-06 | 1.72E-03 | 4.25E-03 | 1.01E-03 | 1.94E-13 | 2.02E-13 | 1.48E-20 | 1.12E-12 | 3.83E-14 | 1.24E-15 |
| 35 | 4.50E+05 | 4.47E-08 | - | 7.87E-08 | - | 5.48E-06 | 2.19E-07 | 1.89E-04 | 1.12E-03 | 2.76E-03 | 6.54E-04 | 1.26E-13 | 1.31E-13 | 9.59E-21 | 7.28E-13 | 2.49E-14 | 8.08E-16 |
| 36 | 2.20E+05 | 3.80E-08 | - | 7.45E-08 | - | 4.65E-06 | 2.07E-07 | 8.94E-05 | 2.82E-03 | 6.96E-03 | 1.65E-03 | 3.18E-13 | 3.31E-13 | 2.42E-20 | 1.84E-12 | 6.28E-14 | 2.04E-15 |
| 37 | 1.16E+05 | 5.45E-15 | - | 1.51E-14 | 4.87E-11 | 6.66E-13 | 4.19E-14 | 7.71E-13 | 6.79E-04 | 1.68E-03 | 3.97E-04 | 7.66E-14 | 7.98E-14 | 5.83E-21 | 4.42E-13 | 1.51E-14 | 4.91E-16 |
| 38 | 1.71E+05 | 1.15E-13 | - | 1.61E-13 | - | 1.41E-11 | 4.47E-13 | 2.79E-10 | 3.42E-05 | 8.45E-05 | 2.00E-05 | 3.86E-15 | 4.02E-15 | 2.94E-22 | 2.23E-14 | 7.63E-16 | 2.48E-17 |
| 39 | 7.22E+05 | 1.93E-07 | - | 2.83E-07 | - | 2.37E-05 | 7.86E-07 | 3.60E-04 | 4.96E-04 | 1.23E-03 | 2.90E-04 | 5.59E-14 | 5.83E-14 | 4.26E-21 | 3.23E-13 | 1.11E-14 | 3.59E-16 |
| 40 | 3.05E+05 | 4.49E-08 | 7.28E-04 | 8.58E-07 | 5.89E-05 | 5.50E-06 | 2.38E-06 | 1.06E-04 | 1.26E-05 | 3.12E-05 | 7.40E-06 | 1.43E-15 | 1.49E-15 | 1.09E-22 | 8.24E-15 | 2.82E-16 | 9.15E-18 |
| 41 | 1.24E+05 | 1.16E-07 |  | 1.36E-07 | - | 1.42E-05 | 3.78E-07 | - | 8.06E-05 | 1.99E-04 | 4.72E-05 | 9.09E-15 | 9.48E-15 | 6.92E-22 | 5.25E-14 | 1.80E-15 | 5.83E-17 |
| 42 | 1.25E+06 | 1.17E-06 | 1.00E-01 | 2.79E-06 | 4.01E-03 | 1.43E-04 | 7.75E-06 | 3.61E-04 | 7.44E-03 | 1.84E-02 | 4.36E-03 | 8.39E-13 | 8.75E-13 | 6.39E-20 | 4.85E-12 | 1.66E-13 | 5.39E-15 |
| 43 | 7.76E+05 | 4.93E-07 | - | 6.89E-07 | - | 6.04E-05 | 1.91E-06 | 1.19E-03 | 9.71E-05 | 2.40E-04 | 5.69E-05 | 1.10E-14 | 1.14E-14 | 8.34E-22 | 6.33E-14 | 2.17E-15 | 7.03E-17 |
| 44 | 2.63E+05 | 2.59E-20 | - | 7.76E-13 | 1.02E-17 | 3.17E-18 | 2.16E-12 | 6.94E-11 | 8.56E-04 | 2.11E-03 | 5.01E-04 | 9.65E-14 | 1.01E-13 | 7.35E-21 | 5.58E-13 | 1.91E-14 | 6.19E-16 |
| 45 | 1.80E+05 | 1.77E-20 | - | 5.29E-13 | 6.98E-18 | 2.16E-18 | 1.47E-12 | 4.73E-11 | 5.51E-04 | 1.36E-03 | 3.23E-04 | 6.22E-14 | 6.48E-14 | 4.74E-21 | 3.59E-13 | 1.23E-14 | 3.99E-16 |
| 46 | 4.13E+05 | 4.06E-20 | - | 1.22E-12 | 1.61E-17 | 4.97E-18 | 3.38E-12 | 1.09E-10 | 1.90E-03 | 4.70E-03 | 1.11E-03 | 2.15E-13 | 2.24E-13 | 1.63E-20 | 1.24E-12 | 4.24E-14 | 1.38E-15 |
| 47 | 1.73E+05 | - | - | 2.74E-07 | - | - | 7.60E-07 | 3.06E-05 | 1.47E-04 | 3.64E-04 | 8.62E-05 | 1.66E-14 | 1.73E-14 | 1.26E-21 | 9.59E-14 | 3.28E-15 | 1.07E-16 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 1.92E+05 | 8.98E-15 | - | 2.48E-14 | 8.03E-11 | 1.10E-12 | 6.90E-14 | 1.27E-12 | 9.12E-06 | 2.25E-05 | 5.34E-06 | 1.03E-15 | 1.07E-15 | 7.83E-23 | 5.94E-15 | 2.03E-16 | 6.60E-18 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | 5.82E+05 | 9.18E-08 | 4.03E-04 | 2.42E-07 | 1.40E-04 | 1.12E-05 | 6.73E-07 | 2.23E-04 | 1.33E-04 | 3.28E-04 | 7.77E-05 | 1.50E-14 | 1.56E-14 | 1.14E-21 | 8.65E-14 | 2.96E-15 | 9.60E-17 |
| Phase Totals | 1.66E+07 | 1.26E+01 | 1.02E-01 | 1.46E-05 | 4.99E-03 | 3.35E-02 | 4.05E-05 | 3.54E-03 | 4.49E-02 | 1.11E-01 | 2.63E-02 | 5.07E-12 | 5.28E-12 | 3.86E-19 | 2.93E-11 | 1.00E-12 | 3.25E-14 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Sludge IL Volume, gal | H-3 (Ci) | C-14 (Ci) | Co-60 (Ci) | Ni-59 (Ci) | Ni-63 (Ci) | Se-79 (Ci) | Sr-90 (Ci) | Y-90 (Ci) | Nb-94 (Ci) | Tc-99 (Ci) | Ru-106 (Ci) | Rh-106 (Ci) | Sb-125 (Ci) | Sn-126 (Ci) | I-129 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.93E+03 | 1.87E+00 | 3.29E-02 | 1.92E-02 | 2.07E-03 | 4.67E-02 | 7.68E-02 | 2.41E+01 | 2.41E+01 | 6.04E-07 | 2.85E+01 | 1.96E+00 | 1.96E+00 | 7.96E+00 | 3.88E-01 | 1.54E-02 |
| 2 | 2.85E+03 | 1.08E+00 | 1.90E-02 | 1.11E-02 | 4.43E-04 | 2.69E-02 | 1.64E-02 | 5.15E+00 | 5.15E+00 | 1.29E-07 | 6.09E+00 | 4.20E-01 | 4.20E-01 | 1.70E+00 | 8.31E-02 | 3.29E-03 |
| 3 | 2.85E+03 | 1.08E+00 | 1.90E-02 | 1.11E-02 | 4.50E-04 | 2.69E-02 | 1.67E-02 | 5.22E+00 | 5.22E+00 | 1.31E-07 | 6.18E+00 | 4.26E-01 | 4.26E-01 | 1.73E+00 | 8.42E-02 | 3.33E-03 |
| 4 | 8.90E+04 | 3.37E+01 | 5.93E-01 | 3.47E-01 | 1.66E-02 | 8.42E-01 | 6.14E-01 | 1.92E+02 | 1.92E+02 | 4.83E-06 | 2.28E+02 | 1.57E+01 | 1.57E+01 | 6.37E+01 | 3.11E+00 | 1.23E-01 |
| 5 | 1.71E+04 | 6.49E+00 | 1.14E-01 | 6.69E-02 | 6.55E-04 | 1.62E-01 | 2.43E-02 | 7.60E+00 | 7.60E+00 | 1.91E-07 | 9.00E+00 | 6.21E-01 | 6.21E-01 | 2.52E+00 | 1.23E-01 | 4.85E-03 |
| 6 | 1.75E+04 | 4.65E+01 | 1.16E-01 | 6.80E-02 | 1.37E-04 | 1.65E-01 | 5.06E-03 | 1.59E+00 | 1.59E+00 | 3.98E-08 | 1.88E+00 | 1.30E-01 | 1.29E-01 | 5.25E-01 | 2.56E-02 | 1.01E-03 |
| 7 | 1.38E+04 | 5.65E+00 | 9.19E-02 | 5.38E-02 | 5.03E-04 | 1.31E-01 | 1.86E-02 | 5.25E+00 | 5.25E+00 | 1.47E-07 | 6.91E+00 | 4.77E-01 | 4.77E-01 | 1.93E+00 | 9.43E-02 | 3.73E-03 |
| 8 | 2.87E+03 | 6.61E+01 | 1.91E-02 | 1.12E-02 | 4.23E-05 | 2.72E-02 | 1.57E-03 | 4.91E-01 | 4.91E-01 | 1.23E-08 | 5.81E-01 | 4.01E-02 | 4.01E-02 | 1.62E-01 | 7.92E-03 | 3.13E-04 |
| 9 | 1.90E+03 | 7.18E-01 | 1.26E-02 | 7.40E-03 | 2.90E-04 | 1.80E-02 | 1.07E-02 | 3.36E+00 | 3.36E+00 | 8.45E-08 | 3.98E+00 | 2.75E-01 | 2.75E-01 | 1.11E+00 | 5.43E-02 | 2.15E-03 |
| 10 | 1.90E+03 | 7.18E-01 | 1.26E-02 | 7.40E-03 | 5.06E-05 | 1.80E-02 | 1.87E-03 | 5.87E-01 | 5.87E-01 | 1.47E-08 | 6.95E-01 | 4.79E-02 | 4.79E-02 | 1.94E-01 | 9.48E-03 | 3.75E-04 |
| 11 | 1.39E+04 | 5.25E+00 | 9.24E-02 | 5.41E-02 | 8.86E-08 | 1.31E-01 | 3.28E-06 | 9.27E-04 | 9.27E-04 | 2.58E-11 | 1.22E-03 | 8.39E-05 | 8.39E-05 | 3.40E-04 | 1.66E-05 | 6.56E-07 |
| 12 | 7.58E+04 | 2.87E+01 | 5.05E-01 | 2.96E-01 | 1.67E-03 | 7.17E-01 | 6.18E-02 | 1.94E+01 | 1.94E+01 | 4.86E-07 | 2.29E+01 | 1.58E+00 | 1.58E+00 | 6.41E+00 | 3.12E-01 | 1.24E-02 |
| 13 | 1.76E+05 | 6.68E+01 | 1.18E+00 | 6.88E-01 | 5.83E-02 | 1.67E+00 | 2.16E+00 | 6.77E+02 | 6.77E+02 | 1.70E-05 | 8.02E+02 | 5.53E+01 | 5.53E+01 | 2.24E+02 | 1.09E+01 | 4.32E-01 |
| 14 | 1.96E+04 | 7.42E+00 | 1.31E-01 | 7.64E-02 | 6.94E-03 | 1.85E-01 | 2.57E-01 | 8.05E+01 | 8.05E+01 | 2.02E-06 | 9.53E+01 | 6.58E+00 | 6.58E+00 | 2.67E+01 | 1.30E+00 | 5.14E-02 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 4.26E+03 | 1.61E+00 | 2.84E-02 | 1.66E-02 | 1.20E-07 | 4.03E-02 | 4.45E-06 | 1.39E-03 | 1.39E-03 | 3.50E-11 | 1.65E-03 | 1.14E-04 | 1.14E-04 | 4.61E-04 | 2.25E-05 | 1.06E-05 |
| 22 | 6.99E+03 | 2.65E+00 | 4.66E-02 | 2.72E-02 | 2.15E-07 | 6.61E-02 | 7.96E-06 | 2.47E-03 | 2.47E-03 | 6.26E-11 | 2.95E-03 | 2.04E-04 | 2.03E-04 | 8.25E-04 | 4.02E-05 | 1.74E-05 |
| 23 | 3.93E+04 | 1.53E-01 | 6.11E-03 | 1.28E-04 | 1.68E-07 | 5.58E-03 | 6.23E-06 | 4.76E-02 | 4.76E-02 | 4.90E-11 | 9.98E-03 | 1.59E-04 | 1.59E-04 | 6.46E-04 | 3.15E-05 | 8.61E-05 |
| 24 | 2.48E+03 | 9.38E-01 | 1.65E-02 | 9.66E-03 | 2.91E-05 | 2.35E-02 | 1.08E-03 | 3.38E-01 | 3.38E-01 | 8.48E-09 | 4.00E-01 | 2.76E-02 | 2.76E-02 | 1.12E-01 | 5.45E-03 | 7.19E-05 |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | 1.82E+05 | 6.87E+01 | 1.21E+00 | 7.08E-01 | 2.74E-02 | 1.72E+00 | 1.01E+00 | 3.33E+02 | 3.33E+02 | 7.98E-06 | 3.76E+02 | 2.60E+01 | 2.60E+01 | 1.05E+02 | 5.13E+00 | 2.03E-01 |
| 27 | 2.70E+03 | 1.02E+00 | 1.80E-02 | 1.05E-02 | 4.63E-04 | 2.56E-02 | 1.72E-02 | 5.31E+00 | 5.31E+00 | 1.35E-07 | 6.36E+00 | 4.39E-01 | 4.39E-01 | 1.78E+00 | 8.68E-02 | 3.43E-03 |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | 4.42E+02 | 1.67E-01 | 2.95E-03 | 1.72E-03 | 1.00E-04 | 4.19E-03 | 3.72E-03 | 1.16E+00 | 1.16E+00 | 2.92E-08 | 1.38E+00 | 9.51E-02 | 9.51E-02 | 3.85E-01 | 1.88E-02 | 7.43E-04 |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | 6.89E+04 | 2.61E+01 | 4.59E-01 | 2.69E-01 | 1.14E-02 | 6.52E-01 | 4.22E-01 | 1.14E+02 | 1.14E+02 | 3.32E-06 | 1.57E+02 | 1.08E+01 | 1.08E+01 | 4.38E+01 | 2.14E+00 | 8.44E-02 |
| 33 | 5.90E+04 | 3.00E+01 | 3.93E-01 | 2.30E-01 | 5.06E-03 | 5.58E-01 | 1.88E-01 | 5.88E+01 | 5.88E+01 | 1.48E-06 | 6.96E+01 | 4.80E+00 | 4.80E+00 | 1.94E+01 | 9.48E-01 | 3.75E-02 |
| 34 | 1.41E+04 | 5.35E+00 | 9.41E-02 | 5.51E-02 | 1.48E-03 | 1.34E-01 | 5.47E-02 | 1.71E+01 | 1.71E+01 | 4.30E-07 | 2.03E+01 | 1.40E+00 | 1.40E+00 | 5.67E+00 | 2.76E-01 | 1.09E-02 |
| 35 | 4.42E+04 | 1.67E+01 | 2.95E-01 | 1.72E-01 | 3.79E-03 | 4.19E-01 | 1.41E-01 | 4.40E+01 | 4.40E+01 | 1.11E-06 | 5.21E+01 | 3.59E+00 | 3.59E+00 | 1.46E+01 | 7.11E-01 | 2.81E-02 |
| 36 | 1.30E+02 | 4.93E-02 | 8.68E-04 | 5.08E-04 | 5.77E-05 | 1.23E-03 | 2.14E-03 | 6.70E-01 | 6.70E-01 | 1.68E-08 | 7.93E-01 | 5.47E-02 | 5.47E-02 | 2.22E-01 | 1.08E-02 | 4.27E-04 |
| 37 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 38 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 39 | 7.25E+04 | 2.74E+01 | 4.83E-01 | 2.83E-01 | 1.72E-03 | 6.86E-01 | 6.37E-02 | 1.50E+01 | 1.50E+01 | 5.01E-07 | 2.36E+01 | 1.63E+00 | 1.63E+00 | 6.60E+00 | 3.22E-01 | 1.27E-02 |
| 40 | 3.07E+05 | 1.16E+02 | 2.05E+00 | 1.20E+00 | 4.40E-04 | 2.91E+00 | 1.63E-02 | 5.33E+00 | 5.33E+00 | 1.28E-07 | 6.05E+00 | 4.17E-01 | 4.17E-01 | 1.69E+00 | 8.25E-02 | 3.26E-03 |
| 41 | 1.87E+03 | 7.07E-01 | 1.24E-02 | 7.28E-03 | 4.19E-05 | 1.77E-02 | 1.55E-03 | 1.71E-01 | 1.71E-01 | 1.22E-08 | 5.75E-01 | 3.97E-02 | 3.97E-02 | 1.61E-01 | 7.84E-03 | 3.10E-04 |
| 42 | 1.40E+04 | 5.31E+00 | 9.35E-02 | 5.47E-02 | 2.88E-03 | 1.33E-01 | 1.07E-01 | 3.34E+01 | 3.34E+01 | 8.39E-07 | 3.96E+01 | 2.73E+00 | 2.73E+00 | 1.11E+01 | 5.39E-01 | 2.13E-02 |
| 43 | 1.69E+05 | 6.41E+01 | 1.13E+00 | 6.60E-01 | 7.32E-04 | 1.60E+00 | 2.71E-02 | 7.35E+00 | 7.35E+00 | 2.13E-07 | 1.01E+01 | 6.94E-01 | 6.94E-01 | 2.81E+00 | 1.37E-01 | 5.43E-03 |
| 44 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 45 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 46 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 47 | 1.74E+05 | 6.57E+01 | 1.16E+00 | 6.77E-01 | 5.11E-03 | 1.64E+00 | 1.89E-01 | 5.93E+01 | 5.93E+01 | 1.49E-06 | 7.01E+01 | 4.84E+00 | 4.84E+00 | 1.96E+01 | 9.56E-01 | 3.78E-02 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | 1.11E+05 | 4.21E+01 | 7.41E-01 | 4.34E-01 | 8.76E-04 | 1.05E+00 | 3.25E-02 | 8.13E+00 | 8.13E+00 | 2.55E-07 | 1.20E+01 | 8.31E-01 | 8.30E-01 | 3.37E+00 | 1.64E-01 | 6.49E-03 |
| Phase Totals | 1.73E+06 | 7.52E+02 | 1.13E+01 | 6.58E+00 | 1.50E-01 | 1.60E+01 | 5.55E+00 | 1.73E+03 | 1.73E+03 | 4.36E-05 | 2.06E+03 | 1.42E+02 | 1.42E+02 | 5.75E+02 | 2.81E+01 | 1.11E+00 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Sludge IL Volume, gal | Cs-134 (Ci) | Cs-135 (Ci) | Cs-137 (Ci) | Ba-137m (Ci) | Ce-144 (Ci) | Pr-144 (Ci) | Pm-147 (Ci) | Eu-154 (Ci) | Th-232 (Ci) | U-232 (Ci) | U-233 (Ci) | U-234 (Ci) | U-235 (Ci) | U-236 (Ci) | U-238 (Ci) | Np-237 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.93E+03 | 1.96E+02 | 3.33E-01 | 9.78E+04 | 9.25E+04 | 5.12E-03 | 5.12E-03 | 3.31E+00 | 7.85E-01 | - | 4.47E-06 | - | - | 6.91E-06 | - | 1.72E-04 | 2.51E-04 |
| 2 | 2.85E+03 | 4.20E+01 | 7.13E-02 | 2.09E+04 | 1.98E+04 | 1.09E-03 | 1.09E-03 | 7.08E-01 | 1.68E-01 | - | 2.17E-06 | - | - | 1.05E-06 | - | 2.61E-05 | 2.73E-04 |
| 3 | 2.85E+03 | 4.26E+01 | 7.23E-02 | 2.12E+04 | 2.01E+04 | 1.11E-03 | 1.11E-03 | 7.18E-01 | 1.70E-01 | - | 1.90E-06 | - | - | 2.68E-06 | - | 6.70E-05 | 5.00E-04 |
| 4 | 8.90E+04 | 1.57E+03 | 2.67E+00 | 7.83E+05 | 7.40E+05 | 4.09E-02 | 4.09E-02 | 2.65E+01 | 6.28E+00 | - | 4.05E-05 | - | - | 5.31E-05 | - | 2.29E-03 | 2.04E-03 |
| 5 | 1.71E+04 | 6.20E+01 | 1.05E-01 | 3.09E+04 | 2.92E+04 | 1.62E-03 | 1.62E-03 | 1.05E+00 | 2.48E-01 | - | 1.54E-05 | - | - | 2.99E-05 | - | 7.09E-04 | 1.20E-03 |
| 6 | 1.75E+04 | 1.29E+01 | 2.20E-02 | 6.45E+03 | 6.10E+03 | 3.37E-04 | 3.37E-04 | 2.18E-01 | 5.18E-02 | - | 1.84E-05 | - | - | 2.28E-05 | - | 8.52E-04 | 2.96E-04 |
| 7 | 1.38E+04 | 4.77E+01 | 8.10E-02 | 2.37E+04 | 2.25E+04 | 1.24E-03 | 1.24E-03 | 8.04E-01 | 1.91E-01 | - | 3.27E-06 | - | - | 1.53E-05 | - | 5.30E-04 | 2.63E-04 |
| 8 | 2.87E+03 | 4.00E+00 | 6.80E-03 | 2.00E+03 | 1.89E+03 | 1.04E-04 | 1.04E-04 | 6.75E-02 | 1.60E-02 | - | 8.53E-07 | - | - | 2.25E-06 | - | 1.04E-04 | 4.71E-05 |
| 9 | 1.90E+03 | 2.74E+01 | 4.66E-02 | 1.37E+04 | 1.29E+04 | 7.16E-04 | 7.15E-04 | 4.63E-01 | 1.10E-01 | - | 1.95E-06 | - | - | 1.26E-06 | - | 3.15E-05 | 2.15E-04 |
| 10 | 1.90E+03 | 4.79E+00 | 8.14E-03 | 2.39E+03 | 2.26E+03 | 1.25E-04 | 1.25E-04 | 8.08E-02 | 1.92E-02 | - | 1.25E-06 | - | - | 1.52E-06 | - | 3.80E-05 | 2.91E-04 |
| 11 | 1.39E+04 | 8.39E-03 | 1.42E-05 | 4.18E+00 | 3.95E+00 | 2.19E-07 | 2.19E-07 | 1.41E-04 | 3.35E-05 | 2.51E-07 | - | 3.58E-05 | 2.94E-05 | 5.54E-07 | 4.54E-06 | 1.03E-06 | 1.94E-05 |
| 12 | 7.58E+04 | 1.58E+02 | 2.68E-01 | 7.87E+04 | 7.45E+04 | 4.12E-03 | 4.12E-03 | 2.66E+00 | 6.32E-01 | 1.34E-04 | 1.35E-06 | 3.77E-03 | 3.53E-04 | 6.64E-06 | 2.79E-05 | 6.68E-05 | 7.81E-04 |
| 13 | 1.76E+05 | 5.53E+03 | 9.39E+00 | 2.75E+06 | 2.60E+06 | 1.44E-01 | 1.44E-01 | 9.32E+01 | 2.21E+01 | 9.56E-05 | 2.54E-05 | 1.96E-02 | 2.76E-03 | 7.55E-05 | 2.85E-04 | 8.83E-04 | 7.10E-03 |
| 14 | 1.96E+04 | 6.57E+02 | 1.12E+00 | 3.27E+05 | 3.10E+05 | 1.71E-02 | 1.71E-02 | 1.11E+01 | 2.63E+00 | 4.53E-05 | 1.34E-05 | 1.60E-03 | 2.20E-04 | 1.78E-05 | 1.89E-05 | 3.39E-04 | 2.35E-03 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 4.26E+03 | 1.14E-02 | 1.93E-05 | 5.66E+00 | 5.36E+00 | 2.96E-07 | 2.96E-07 | 1.92E-04 | 4.55E-05 | 4.34E-09 | - | 1.37E-04 | 1.46E-04 | 2.32E-06 | 2.68E-05 | 1.37E-05 | 1.21E-04 |
| 22 | 6.99E+03 | 2.03E-02 | 3.46E-05 | 1.01E+01 | 9.59E+00 | 5.30E-07 | 5.30E-07 | 3.43E-04 | 8.13E-05 | - | - | 9.34E-04 | 3.36E-04 | 5.13E-06 | 5.53E-05 | 1.14E-04 | 2.04E-04 |
| 23 | 3.93E+04 | 4.12E-04 | 6.08E-04 | 7.94E+00 | 7.51E+00 | 4.15E-07 | 4.15E-07 | 2.69E-04 | 6.37E-05 | 5.38E-09 | - | 3.58E-04 | 5.68E-04 | 3.17E-06 | 1.28E-05 | 9.49E-05 | 2.63E-05 |
| 24 | 2.48E+03 | 2.76E+00 | 4.68E-03 | 1.37E+03 | 1.30E+03 | 7.19E-05 | 7.18E-05 | 4.65E-02 | 1.10E-02 | - | 1.11E-11 | 3.39E-17 | 1.08E-16 | 3.20E-11 | 4.13E-12 | 3.84E-09 | 9.91E-12 |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | 1.82E+05 | 2.59E+03 | 4.41E+00 | 1.29E+06 | 1.22E+06 | 6.76E-02 | 6.76E-02 | 4.38E+01 | 1.04E+01 | - | 5.72E-04 | 1.74E-09 | 5.55E-09 | 1.64E-03 | 2.12E-04 | 1.97E-01 | 5.09E-04 |
| 27 | 2.70E+03 | 4.39E+01 | 7.45E-02 | 2.19E+04 | 2.07E+04 | 1.14E-03 | 1.14E-03 | 7.40E-01 | 1.75E-01 | - | 1.21E-11 | 3.70E-17 | 1.18E-16 | 3.49E-11 | 4.51E-12 | 4.19E-09 | 1.08E-11 |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | 4.42E+02 | 9.50E+00 | 1.61E-02 | 4.74E+03 | 4.48E+03 | 2.48E-04 | 2.48E-04 | 1.60E-01 | 3.80E-02 | - | - | - | 1.54E-05 | 2.74E-07 | 2.85E-06 | 1.02E-08 | 6.96E-06 |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | 6.89E+04 | 1.08E+03 | 1.83E+00 | 5.38E+05 | 5.09E+05 | 2.81E-02 | 2.81E-02 | 1.82E+01 | 4.32E+00 | - | - | - | 3.12E-03 | 4.46E-05 | 6.99E-04 | 2.09E-05 | 1.29E-03 |
| 33 | 5.90E+04 | 4.79E+02 | 8.14E-01 | 2.39E+05 | 2.26E+05 | 1.25E-02 | 1.25E-02 | 8.09E+00 | 1.92E+00 | - | 1.14E-03 | 5.47E-09 | 1.13E-04 | 2.12E-03 | 1.17E-03 | 3.07E-01 | 9.63E-02 |
| 34 | 1.41E+04 | 1.40E+02 | 2.37E-01 | 6.96E+04 | 6.59E+04 | 3.64E-03 | 3.64E-03 | 2.36E+00 | 5.59E-01 | - | 7.47E-05 | - | - | 7.54E-05 | - | 5.33E-03 | 4.12E-03 |
| 35 | 4.42E+04 | 3.59E+02 | 6.10E-01 | 1.79E+05 | 1.69E+05 | 9.36E-03 | 9.36E-03 | 6.06E+00 | 1.44E+00 | - | - | - | 1.95E-03 | 3.39E-05 | 5.76E-04 | 2.00E-05 | 7.06E-04 |
| 36 | 1.30E+02 | 5.46E+00 | 9.28E-03 | 2.72E+03 | 2.58E+03 | 1.42E-04 | 1.42E-04 | 9.22E-02 | 2.19E-02 | - | - | - | 9.99E-06 | 1.94E-07 | 3.53E-06 | 6.33E-08 | 2.79E-06 |
| 37 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 38 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 39 | 7.25E+04 | 1.63E+02 | 2.77E-01 | 8.11E+04 | 7.67E+04 | 4.24E-03 | 4.24E-03 | 2.75E+00 | 6.51E-01 | - | - | - | 8.61E-03 | 1.24E-04 | 1.48E-03 | 2.63E-05 | 5.40E-03 |
| 40 | 3.07E+05 | 4.17E+01 | 7.08E-02 | 2.08E+04 | 1.97E+04 | 1.09E-03 | 1.09E-03 | 7.03E-01 | 1.67E-01 | 7.34E-04 | 8.16E-04 | 2.09E-02 | 2.01E-02 | 3.79E-03 | 5.01E-03 | 1.19E-01 | 4.15E-01 |
| 41 | 1.87E+03 | 3.96E+00 | 6.74E-03 | 1.98E+03 | 1.87E+03 | 1.03E-04 | 1.03E-04 | 6.69E-02 | 1.59E-02 | - | - | - | 7.76E-04 | 8.97E-06 | 2.23E-04 | 6.14E-07 | 2.32E-03 |
| 42 | 1.40E+04 | 2.73E+02 | 4.63E-01 | 1.36E+05 | 1.29E+05 | 7.11E-03 | 7.11E-03 | 4.60E+00 | 1.09E+00 | 1.12E-03 | 3.97E-06 | 1.58E-02 | 5.81E-03 | 1.37E-04 | 7.76E-04 | 2.40E-03 | 4.78E-03 |
| 43 | 1.69E+05 | 6.94E+01 | 1.18E-01 | 3.46E+04 | 3.27E+04 | 1.81E-03 | 1.81E-03 | 1.17E+00 | 2.77E-01 | - | - | - | 4.78E-02 | 6.59E-04 | 9.10E-03 | 5.35E-05 | 5.09E-02 |
| 44 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 45 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 46 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 47 | 1.74E+05 | 4.83E+02 | 8.21E-01 | 2.41E+05 | 2.28E+05 | 1.26E-02 | 1.26E-02 | 8.15E+00 | 1.93E+00 | - | 4.43E-04 | - | - | 1.20E-03 | - | 9.53E-02 | - |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | 1.11E+05 | 8.30E+01 | 1.41E-01 | 4.14E+04 | 3.91E+04 | 2.16E-03 | 2.16E-03 | 1.40E+00 | 3.32E-01 | 7.71E-05 | 1.13E-05 | 9.38E-03 | 7.78E-03 | 2.03E-04 | 1.26E-03 | 1.85E-03 | 6.28E-03 |
| Phase Totals | 1.73E+06 | 1.42E+04 | 2.41E+01 | 7.07E+06 | 6.69E+06 | 3.70E-01 | 3.70E-01 | 2.39E+02 | 5.67E+01 | 2.21E-03 | 3.19E-03 | 7.38E-02 | 1.01E-01 | 1.03E-02 | 2.10E-02 | 7.35E-01 | 6.03E-01 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Sludge IL Volume, gal | Pu-238 (Ci) | Pu-239 (Ci) | Pu-240 (Ci) | Pu-241 (Ci) | Pu-242 (Ci) | Am-241 (Ci) | Am-242m (Ci) | Cm-244 (Ci) | Cm-245 (Ci) | Na-22 (Ci) | Al-26 (Ci) | Te-125m (Ci) | Sb-126 (Ci) | Sb-126m (Ci) | Sm-151 (Ci) | Eu-152 (Ci) | Eu-155 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.93E+03 | 1.95E-01 | 5.21E-02 | 1.16E-02 | 6.39E-02 | 2.40E-06 | 3.13E-01 | 1.81E-04 | 1.26E-01 | 1.24E-05 | 1.74E+00 | 1.12E-02 | 1.94E+00 | 5.44E-02 | 3.88E-01 | 3.71E+00 | 1.79E-02 | 2.10E-01 |
| 2 | 2.85E+03 | 1.78E-01 | 2.54E-02 | 5.68E-03 | 2.39E-02 | 1.17E-06 | 6.71E-02 | 3.87E-05 | 2.69E-02 | 2.65E-06 | 3.73E-01 | 2.39E-03 | 4.16E-01 | 1.16E-02 | 8.31E-02 | 7.94E-01 | 3.84E-03 | 4.49E-02 |
| 3 | 2.85E+03 | 2.20E-01 | 3.15E-02 | 7.03E-03 | 3.55E-02 | 1.45E-06 | 6.80E-02 | 3.92E-05 | 2.72E-02 | 2.68E-06 | 3.79E-01 | 2.42E-03 | 4.22E-01 | 1.18E-02 | 8.42E-02 | 8.05E-01 | 3.89E-03 | 4.55E-02 |
| 4 | 8.90E+04 | 4.14E-01 | 4.09E-01 | 9.14E-02 | 7.73E-01 | 1.88E-05 | 2.51E+00 | 1.45E-03 | 1.00E+00 | 9.89E-05 | 1.40E+01 | 8.93E-02 | 1.56E+01 | 4.35E-01 | 3.11E+00 | 2.97E+01 | 1.44E-01 | 1.68E+00 |
| 5 | 1.71E+04 | 8.26E-01 | 1.38E-01 | 3.29E-02 | 2.21E-01 | 9.72E-06 | 9.91E-02 | 5.71E-05 | 3.97E-02 | 3.91E-06 | 5.52E-01 | 3.53E-03 | 6.14E-01 | 1.72E-02 | 1.23E-01 | 1.17E+00 | 5.67E-03 | 6.63E-02 |
| 6 | 1.75E+04 | - | 8.73E-02 | 3.03E-02 | 3.40E-01 | 5.97E-05 | 2.07E-02 | 1.19E-05 | 8.28E-03 | 8.15E-07 | 1.15E-01 | 7.36E-04 | 1.28E-01 | 3.58E-03 | 2.56E-02 | 2.45E-01 | 1.18E-03 | 1.38E-02 |
| 7 | 1.38E+04 | 1.29E+00 | 2.33E-01 | 5.72E-02 | 5.46E-01 | 5.29E-05 | 7.61E-02 | 4.39E-05 | 3.05E-02 | 3.00E-06 | 4.24E-01 | 2.71E-03 | 4.72E-01 | 1.32E-02 | 9.43E-02 | 9.01E-01 | 4.36E-03 | 5.09E-02 |
| 8 | 2.87E+03 | 1.35E-01 | 2.96E-02 | 6.97E-03 | 6.63E-02 | 8.79E-06 | 6.39E-03 | 3.69E-06 | 2.56E-03 | 2.52E-07 | 3.56E-02 | 2.28E-04 | 3.97E-02 | 1.11E-03 | 7.92E-03 | 7.57E-02 | 3.66E-04 | 4.28E-03 |
| 9 | 1.90E+03 | 4.68E-02 | 6.68E-03 | 1.49E-03 | 6.20E-03 | 3.07E-07 | 4.38E-02 | 2.53E-05 | 1.76E-02 | 1.73E-06 | 2.44E-01 | 1.56E-03 | 2.72E-01 | 7.60E-03 | 5.43E-02 | 5.19E-01 | 2.51E-03 | 2.93E-02 |
| 10 | 1.90E+03 | 1.48E-01 | 2.11E-02 | 4.71E-03 | 2.10E-02 | 9.70E-07 | 7.65E-03 | 4.41E-06 | 3.06E-03 | 3.02E-07 | 4.26E-02 | 2.72E-04 | 4.74E-02 | 1.33E-03 | 9.48E-03 | 9.05E-02 | 4.38E-04 | 5.12E-03 |
| 11 | 1.39E+04 | 2.62E+00 | 2.61E-02 | 1.64E-02 | 9.38E-01 | 3.49E-05 | 1.34E-05 | 7.72E-09 | 5.36E-06 | 5.28E-10 | 7.46E-05 | 4.77E-07 | 8.31E-05 | 2.32E-06 | 1.66E-05 | 1.59E-04 | 7.67E-07 | 8.96E-06 |
| 12 | 7.58E+04 | 1.36E+01 | 2.28E-01 | 1.26E-01 | 3.20E+00 | 1.82E-04 | 2.52E-01 | 1.45E-04 | 1.01E-01 | 9.95E-06 | 1.40E+00 | 8.98E-03 | 1.56E+00 | 4.37E-02 | 3.12E-01 | 2.99E+00 | 1.44E-02 | 1.69E-01 |
| 13 | 1.76E+05 | 2.60E+01 | 7.03E-01 | 2.91E-01 | 5.12E+00 | 1.93E-04 | 8.82E+00 | 5.09E-03 | 3.53E+00 | 3.48E-04 | 4.91E+01 | 3.14E-01 | 5.47E+01 | 1.53E+00 | 1.09E+01 | 1.04E+02 | 5.05E-01 | 5.90E+00 |
| 14 | 1.96E+04 | 1.05E+00 | 2.59E-01 | 8.36E-02 | 4.23E-01 | 1.53E-05 | 1.05E+00 | 6.05E-04 | 4.20E-01 | 4.14E-05 | 5.84E+00 | 3.74E-02 | 6.51E+00 | 1.82E-01 | 1.30E+00 | 1.24E+01 | 6.01E-02 | 7.02E-01 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 4.26E+03 | 7.29E-01 | 1.07E-02 | 3.65E-03 | 6.40E-02 | 4.08E-07 | 1.82E-05 | 1.05E-08 | 7.27E-06 | 7.16E-10 | 1.01E-04 | 6.46E-07 | 1.13E-04 | 3.15E-06 | 2.25E-05 | 2.15E-04 | 1.04E-06 | 1.21E-05 |
| 22 | 6.99E+03 | 1.38E+00 | - | - | - | - | 3.25E-05 | 1.87E-08 | 1.30E-05 | 1.28E-09 | 1.81E-04 | 1.16E-06 | 2.01E-04 | 5.63E-06 | 4.02E-05 | 3.84E-04 | 1.86E-06 | 2.17E-05 |
| 23 | 3.93E+04 | 2.87E-02 | 9.84E-05 | 2.45E-05 | 2.87E-03 | 1.46E-04 | 3.76E-04 | 1.47E-08 | 1.10E-05 | 1.00E-09 | 1.42E-04 | 9.06E-07 | 1.58E-04 | 4.41E-06 | 3.15E-05 | 3.01E-04 | 1.46E-06 | 1.70E-05 |
| 24 | 2.48E+03 | 2.05E-05 | 3.21E-06 | 7.17E-07 | 1.69E-05 | 1.43E-10 | 4.40E-03 | 2.54E-06 | 1.76E-03 | 1.74E-07 | 2.45E-02 | 1.57E-04 | 2.73E-02 | 7.63E-04 | 5.45E-03 | 5.21E-02 | 2.52E-04 | 2.94E-03 |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | 1.82E+05 | 1.05E+03 | 1.65E+02 | 3.68E+01 | 8.66E+02 | 7.33E-03 | 4.14E+00 | 2.39E-03 | 1.66E+00 | 1.63E-04 | 2.31E+01 | 1.48E-01 | 2.57E+01 | 7.18E-01 | 5.13E+00 | 4.90E+01 | 2.37E-01 | 2.77E+00 |
| 27 | 2.70E+03 | 2.23E-05 | 3.50E-06 | 7.82E-07 | 1.84E-05 | 1.56E-10 | 7.01E-02 | 4.04E-05 | 2.81E-02 | 2.76E-06 | 3.90E-01 | 2.49E-03 | 4.35E-01 | 1.22E-02 | 8.68E-02 | 8.29E-01 | 4.01E-03 | 4.69E-02 |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | 4.42E+02 | 2.97E+00 | 2.58E-02 | 1.85E-02 | 1.91E+00 | 4.44E-05 | 1.52E-02 | 8.75E-06 | 6.08E-03 | 5.99E-07 | 8.45E-02 | 5.40E-04 | 9.41E-02 | 2.63E-03 | 1.88E-02 | 1.80E-01 | 8.69E-04 | 1.02E-02 |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | 6.89E+04 | 4.52E+02 | 3.97E+00 | 2.95E+00 | 2.02E+02 | 6.21E-03 | 1.72E+00 | 9.94E-04 | 6.90E-01 | 6.80E-05 | 9.60E+00 | 6.14E-02 | 1.07E+01 | 2.99E-01 | 2.14E+00 | 2.04E+01 | 9.87E-02 | 1.15E+00 |
| 33 | 5.90E+04 | 1.57E+02 | 8.57E+01 | 1.50E+01 | 4.46E+02 | 8.70E-04 | 7.66E-01 | 4.41E-04 | 3.07E-01 | 3.02E-05 | 4.26E+00 | 2.73E-02 | 4.75E+00 | 1.33E-01 | 9.48E-01 | 9.06E+00 | 4.38E-02 | 5.12E-01 |
| 34 | 1.41E+04 | - | 8.61E-01 | 1.92E-01 | 3.98E+00 | 3.99E-05 | 2.23E-01 | 1.29E-04 | 8.94E-02 | 8.80E-06 | 1.24E+00 | 7.95E-03 | 1.38E+00 | 3.87E-02 | 2.76E-01 | 2.64E+00 | 1.28E-02 | 1.49E-01 |
| 35 | 4.42E+04 | 2.92E+02 | 2.36E+00 | 1.81E+00 | 1.40E+02 | 4.06E-03 | 5.74E-01 | 3.31E-04 | 2.30E-01 | 2.26E-05 | 3.19E+00 | 2.04E-02 | 3.56E+00 | 9.95E-02 | 7.11E-01 | 6.79E+00 | 3.28E-02 | 3.84E-01 |
| 36 | 1.30E+02 | 8.67E-01 | 6.75E-03 | 5.37E-03 | 3.51E-01 | 1.16E-05 | 8.73E-03 | 5.03E-06 | 3.49E-03 | 3.44E-07 | 4.86E-02 | 3.11E-04 | 5.41E-02 | 1.51E-03 | 1.08E-02 | 1.03E-01 | 5.00E-04 | 5.84E-03 |
| 37 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 38 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 39 | 7.25E+04 | 4.80E+02 | 5.97E+00 | 3.71E+00 | 4.26E+02 | 7.90E-03 | 2.60E-01 | 1.50E-04 | 1.04E-01 | 1.03E-05 | 1.45E+00 | 9.26E-03 | 1.61E+00 | 4.51E-02 | 3.22E-01 | 3.08E+00 | 1.49E-02 | 1.74E-01 |
| 40 | 3.07E+05 | 3.79E+02 | 1.22E+02 | 4.63E+01 | 6.52E+02 | 2.34E-02 | 6.66E-02 | 3.84E-05 | 2.67E-02 | 2.63E-06 | 3.71E-01 | 2.37E-03 | 4.13E-01 | 1.16E-02 | 8.25E-02 | 7.88E-01 | 3.81E-03 | 4.46E-02 |
| 41 | 1.87E+03 | 1.27E+01 | - | - | - | - | 6.33E-03 | 3.65E-06 | 2.54E-03 | 2.50E-07 | 3.53E-02 | 2.25E-04 | 3.93E-02 | 1.10E-03 | 7.84E-03 | 7.50E-02 | 3.63E-04 | 4.24E-03 |
| 42 | 1.40E+04 | 7.54E+01 | 2.69E+00 | 9.65E-01 | 1.65E+01 | 8.84E-04 | 4.35E-01 | 2.51E-04 | 1.74E-01 | 1.72E-05 | 2.42E+00 | 1.55E-02 | 2.70E+00 | 7.55E-02 | 5.39E-01 | 5.15E+00 | 2.49E-02 | 2.91E-01 |
| 43 | 1.69E+05 | 1.16E+03 | 4.57E+00 | 3.86E+00 | 9.91E+02 | 5.69E-02 | 1.11E-01 | 6.39E-05 | 4.44E-02 | 4.37E-06 | 6.17E-01 | 3.94E-03 | 6.87E-01 | 1.92E-02 | 1.37E-01 | 1.31E+00 | 6.34E-03 | 7.41E-02 |
| 44 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 45 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 46 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 47 | 1.74E+05 | 1.02E+03 | 1.46E+02 | 3.27E+01 | 6.35E+02 | 6.72E-03 | 7.72E-01 | 4.45E-04 | 3.09E-01 | 3.05E-05 | 4.30E+00 | 2.75E-02 | 4.79E+00 | 1.34E-01 | 9.56E-01 | 9.14E+00 | 4.42E-02 | 5.16E-01 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | 1.11E+05 | 6.79E+02 | 9.08E+00 | 5.15E+00 | 2.58E+02 | 9.31E-03 | 1.33E-01 | 7.64E-05 | 5.31E-02 | 5.23E-06 | 7.38E-01 | 4.72E-03 | 8.22E-01 | 2.30E-02 | 1.64E-01 | 1.57E+00 | 7.59E-03 | 8.87E-02 |
| Phase Totals | 1.73E+06 | 5.81E+03 | 5.51E+02 | 1.50E+02 | 4.66E+03 | 1.25E-01 | 2.26E+01 | 1.31E-02 | 9.07E+00 | 8.93E-04 | 1.26E+02 | 8.07E-01 | 1.40E+02 | 3.93E+00 | 2.81E+01 | 2.68E+02 | 1.30E+00 | 1.52E+01 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Sludge IL Volume, gal | Ra-226 (Ci) | Ra-228 (Ci) | Ac-227 (Ci) | Th-229 (Ci) | Th-230 (Ci) | Pa-231 (Ci) | Pu-244 (Ci) | Am-243 (Ci) | Cm-242 (Ci) | Cm-243 (Ci) | Cm-247 (Ci) | Cm-248 (Ci) | Bk-249 (Ci) | Cf-249 (Ci) | Cf-251 (Ci) | Cf-252 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.93E+03 | - | - | 1.58E-09 | - | - | 4.38E-09 | 1.09E-08 | 6.00E-05 | 1.48E-04 | 3.51E-05 | 6.76E-15 | 7.05E-15 | 5.15E-22 | 3.91E-14 | 1.34E-15 | 4.34E-17 |
| 2 | 2.85E+03 | - | - | 2.39E-10 | - | - | 6.63E-10 | 5.35E-09 | 1.28E-05 | 3.17E-05 | 7.51E-06 | 1.45E-15 | 1.51E-15 | 1.10E-22 | 8.36E-15 | 2.86E-16 | 9.29E-18 |
| 3 | 2.85E+03 | - | - | 6.13E-10 | - | - | 1.70E-09 | 6.62E-09 | 1.30E-05 | 3.21E-05 | 7.62E-06 | 1.47E-15 | 1.53E-15 | 1.12E-22 | 8.48E-15 | 2.90E-16 | 9.41E-18 |
| 4 | 8.90E+04 | - | - | 1.21E-08 | - | - | 3.37E-08 | 8.59E-08 | 4.80E-04 | 1.19E-03 | 2.81E-04 | 5.41E-14 | 5.64E-14 | 4.12E-21 | 3.13E-13 | 1.07E-14 | 3.47E-16 |
| 5 | 1.71E+04 | - | - | 6.83E-09 | - | - | 1.90E-08 | 4.44E-08 | 1.90E-05 | 4.68E-05 | 1.11E-05 | 2.14E-15 | 2.23E-15 | 1.63E-22 | 1.24E-14 | 4.23E-16 | 1.37E-17 |
| 6 | 1.75E+04 | - | - | 5.20E-09 | - | - | 1.44E-08 | 2.73E-07 | 3.95E-06 | 9.77E-06 | 2.32E-06 | 4.46E-16 | 4.65E-16 | 3.40E-23 | 2.58E-15 | 8.82E-17 | 2.86E-18 |
| 7 | 1.38E+04 | - | - | 3.49E-09 | - | - | 9.69E-09 | 2.42E-07 | 1.46E-05 | 3.60E-05 | 8.53E-06 | 1.64E-15 | 1.71E-15 | 1.25E-22 | 9.49E-15 | 3.25E-16 | 1.05E-17 |
| 8 | 2.87E+03 | - | - | 5.14E-10 | - | - | 1.43E-09 | 4.02E-08 | 1.22E-06 | 3.02E-06 | 7.16E-07 | 1.38E-16 | 1.44E-16 | 1.05E-23 | 7.97E-16 | 2.73E-17 | 8.85E-19 |
| 9 | 1.90E+03 | - | - | 2.88E-10 | - | - | 8.00E-10 | 1.40E-09 | 8.39E-06 | 2.07E-05 | 4.91E-06 | 9.46E-16 | 9.86E-16 | 7.20E-23 | 5.47E-15 | 1.87E-16 | 6.07E-18 |
| 10 | 1.90E+03 | - | - | 3.48E-10 | - | - | 9.66E-10 | 4.43E-09 | 1.46E-06 | 3.62E-06 | 8.57E-07 | 1.65E-16 | 1.72E-16 | 1.26E-23 | 9.54E-16 | 3.26E-17 | 1.06E-18 |
| 11 | 1.39E+04 | 6.62E-11 | 2.51E-07 | 1.26E-10 | 1.02E-07 | 8.10E-09 | 3.51E-10 | 1.59E-07 | 2.56E-09 | 6.33E-09 | 1.50E-09 | 2.89E-19 | 3.01E-19 | 2.20E-26 | 1.67E-18 | 5.72E-20 | 1.85E-21 |
| 12 | 7.58E+04 | 7.95E-10 | 1.34E-04 | 1.51E-09 | 1.07E-05 | 9.73E-08 | 4.21E-09 | 8.32E-07 | 4.83E-05 | 1.19E-04 | 2.83E-05 | 5.44E-15 | 5.67E-15 | 4.15E-22 | 3.15E-14 | 1.08E-15 | 3.49E-17 |
| 13 | 1.76E+05 | 6.23E-09 | 9.56E-05 | 1.72E-08 | 5.57E-05 | 7.62E-07 | 4.79E-08 | 8.82E-07 | 1.69E-03 | 4.17E-03 | 9.89E-04 | 1.90E-13 | 1.98E-13 | 1.45E-20 | 1.10E-12 | 3.77E-14 | 1.22E-15 |
| 14 | 1.96E+04 | 4.95E-10 | 4.53E-05 | 4.05E-09 | 4.55E-06 | 6.06E-08 | 1.13E-08 | 7.00E-08 | 2.01E-04 | 4.96E-04 | 1.18E-04 | 2.27E-14 | 2.36E-14 | 1.72E-21 | 1.31E-13 | 4.48E-15 | 1.45E-16 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | 4.26E+03 | 3.30E-10 | 4.34E-09 | 5.30E-10 | 3.90E-07 | 4.03E-08 | 1.47E-09 | 1.87E-09 | 3.47E-09 | 8.58E-09 | 2.03E-09 | 3.92E-19 | 4.08E-19 | 2.98E-26 | 2.26E-18 | 7.75E-20 | 2.51E-21 |
| 22 | 6.99E+03 | 7.57E-10 | - | 1.17E-09 | 2.66E-06 | 9.26E-08 | 3.25E-09 | - | 6.21E-09 | 1.54E-08 | 3.64E-09 | 7.01E-19 | 7.30E-19 | 5.34E-26 | 4.05E-18 | 1.39E-19 | 4.50E-21 |
| 23 | 3.93E+04 | 3.93E-01 | 5.38E-09 | 7.23E-10 | 1.02E-06 | 1.03E-03 | 2.01E-09 | 1.49E-06 | 4.87E-09 | 1.20E-08 | 2.85E-09 | 5.49E-19 | 5.72E-19 | 4.18E-26 | 3.17E-18 | 1.09E-19 | 3.52E-21 |
| 24 | 2.48E+03 | 2.44E-22 | - | 7.30E-15 | 9.64E-20 | 2.98E-20 | 2.03E-14 | 6.53E-13 | 8.42E-07 | 2.08E-06 | 4.93E-07 | 9.50E-17 | 9.90E-17 | 7.23E-24 | 5.49E-16 | 1.88E-17 | 6.09E-19 |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | 1.82E+05 | 1.25E-14 | - | 3.75E-07 | 4.95E-12 | 1.53E-12 | 1.04E-06 | 3.35E-05 | 7.93E-04 | 1.96E-03 | 4.64E-04 | 8.94E-14 | 9.32E-14 | 6.81E-21 | 5.17E-13 | 1.77E-14 | 5.74E-16 |
| 27 | 2.70E+03 | 2.66E-22 | - | 7.96E-15 | 1.05E-19 | 3.25E-20 | 2.21E-14 | 7.12E-13 | 1.34E-05 | 3.31E-05 | 7.85E-06 | 1.51E-15 | 1.58E-15 | 1.15E-22 | 8.74E-15 | 2.99E-16 | 9.70E-18 |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | 4.42E+02 | 3.47E-11 | - | 6.25E-11 | - | 4.25E-09 | 1.73E-10 | 2.03E-07 | 2.90E-06 | 7.17E-06 | 1.70E-06 | 3.28E-16 | 3.41E-16 | 2.49E-23 | 1.89E-15 | 6.48E-17 | 2.10E-18 |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | 6.89E+04 | 7.02E-09 | - | 1.02E-08 | - | 8.59E-07 | 2.83E-08 | 2.84E-05 | 3.30E-04 | 8.15E-04 | 1.93E-04 | 3.72E-14 | 3.88E-14 | 2.83E-21 | 2.15E-13 | 7.35E-15 | 2.39E-16 |
| 33 | 5.90E+04 | 2.54E-10 | - | 4.83E-07 | 1.56E-11 | 3.11E-08 | 1.34E-06 | 3.98E-06 | 1.46E-04 | 3.62E-04 | 8.58E-05 | 1.65E-14 | 1.72E-14 | 1.26E-21 | 9.55E-14 | 3.27E-15 | 1.06E-16 |
| 34 | 1.41E+04 | - | - | 1.72E-08 | - | - | 4.78E-08 | 1.82E-07 | 4.27E-05 | 1.06E-04 | 2.50E-05 | 4.82E-15 | 5.02E-15 | 3.67E-22 | 2.78E-14 | 9.52E-16 | 3.09E-17 |
| 35 | 4.42E+04 | 4.40E-09 | - | 7.74E-09 | - | 5.38E-07 | 2.15E-08 | 1.86E-05 | 1.10E-04 | 2.71E-04 | 6.43E-05 | 1.24E-14 | 1.29E-14 | 9.43E-22 | 7.15E-14 | 2.45E-15 | 7.94E-17 |
| 36 | 1.30E+02 | 2.25E-11 | - | 4.42E-11 | - | 2.76E-09 | 1.23E-10 | 5.30E-08 | 1.67E-06 | 4.13E-06 | 9.78E-07 | 1.88E-16 | 1.96E-16 | 1.43E-23 | 1.09E-15 | 3.72E-17 | 1.21E-18 |
| 37 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 38 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 39 | 7.25E+04 | 1.94E-08 | - | 2.84E-08 | - | 2.37E-06 | 7.88E-08 | 3.61E-05 | 4.97E-05 | 1.23E-04 | 2.91E-05 | 5.61E-15 | 5.85E-15 | 4.27E-22 | 3.24E-14 | 1.11E-15 | 3.60E-17 |
| 40 | 3.07E+05 | 4.53E-08 | 7.34E-04 | 8.65E-07 | 5.94E-05 | 5.54E-06 | 2.40E-06 | 1.07E-04 | 1.27E-05 | 3.15E-05 | 7.46E-06 | 1.44E-15 | 1.50E-15 | 1.09E-22 | 8.31E-15 | 2.84E-16 | 9.22E-18 |
| 41 | 1.87E+03 | 1.75E-09 | - | 2.05E-09 | - | 2.14E-07 | 5.69E-09 | - | 1.21E-06 | 2.99E-06 | 7.09E-07 | 1.37E-16 | 1.42E-16 | 1.04E-23 | 7.90E-16 | 2.70E-17 | 8.77E-19 |
| 42 | 1.40E+04 | 1.31E-08 | 1.12E-03 | 3.12E-08 | 4.49E-05 | 1.60E-06 | 8.68E-08 | 4.04E-06 | 8.33E-05 | 2.06E-04 | 4.88E-05 | 9.40E-15 | 9.79E-15 | 7.16E-22 | 5.43E-14 | 1.86E-15 | 6.03E-17 |
| 43 | 1.69E+05 | 1.08E-07 | - | 1.50E-07 | - | 1.32E-05 | 4.17E-07 | 2.60E-04 | 2.12E-05 | 5.24E-05 | 1.24E-05 | 2.39E-15 | 2.49E-15 | 1.82E-22 | 1.38E-14 | 4.73E-16 | 1.53E-17 |
| 44 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 45 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 46 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 47 | 1.74E+05 | - | - | 2.75E-07 | - | - | 7.63E-07 | 3.07E-05 | 1.48E-04 | 3.65E-04 | 8.65E-05 | 1.67E-14 | 1.74E-14 | 1.27E-21 | 9.63E-14 | 3.29E-15 | 1.07E-16 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | 1.11E+05 | 1.75E-08 | 7.71E-05 | 4.63E-08 | 2.67E-05 | 2.15E-06 | 1.29E-07 | 4.26E-05 | 2.54E-05 | 6.27E-05 | 1.49E-05 | 2.86E-15 | 2.98E-15 | 2.18E-22 | 1.65E-14 | 5.66E-16 | 1.84E-17 |
| Phase Totals | 1.73E+06 | 3.93E-01 | 2.21E-03 | 2.35E-06 | 2.10E-04 | 1.06E-03 | 6.53E-06 | 5.73E-04 | 4.33E-03 | 1.07E-02 | 2.54E-03 | 4.89E-13 | 5.09E-13 | 3.72E-20 | 2.82E-12 | 9.66E-14 | 3.14E-15 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Salt IL Volume, gal | H-3 (Ci) | C-14 (Ci) | Co-60 (Ci) | Ni-59 (Ci) | Ni-63 (Ci) | Se-79 (Ci) | Sr-90 (Ci) | Y-90 (Ci) | Nb-94 (Ci) | Tc-99 (Ci) | Ru-106 (Ci) | Rh-106 (Ci) | Sb-125 (Ci) | Sn-126 (Ci) | I-129 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.44E+05 | 5.45E+01 | 9.59E-01 | 5.61E-01 | 6.05E-02 | 1.36E+00 | 2.24E+00 | 7.02E+02 | 7.02E+02 | 1.76E-05 | 8.31E+02 | 5.73E+01 | 5.73E+01 | 2.32E+02 | 1.13E+01 | 4.48E-01 |
| 2 | 1.61E+05 | 6.09E+01 | 1.07E+00 | 6.27E-01 | 2.51E-02 | 1.52E+00 | 9.29E-01 | 2.91E+02 | 2.91E+02 | 7.30E-06 | 3.44E+02 | 2.38E+01 | 2.37E+01 | 9.63E+01 | 4.70E+00 | 1.86E-01 |
| 3 | 1.61E+05 | 6.09E+01 | 1.07E+00 | 6.27E-01 | 2.54E-02 | 1.52E+00 | 9.41E-01 | 2.95E+02 | 2.95E+02 | 7.40E-06 | 3.49E+02 | 2.41E+01 | 2.41E+01 | 9.76E+01 | 4.76E+00 | 1.88E-01 |
| 4 | 1.02E+04 | 3.85E+00 | 6.77E-02 | 3.96E-02 | 1.89E-03 | 9.62E-02 | 7.02E-02 | 2.20E+01 | 2.20E+01 | 5.52E-07 | 2.60E+01 | 1.80E+00 | 1.79E+00 | 7.28E+00 | 3.55E-01 | 1.40E-02 |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | 1.60E+05 | 6.06E+01 | 1.07E+00 | 6.24E-01 | 2.45E-02 | 1.52E+00 | 9.07E-01 | 2.84E+02 | 2.84E+02 | 7.13E-06 | 3.36E+02 | 2.32E+01 | 2.32E+01 | 9.40E+01 | 4.58E+00 | 1.81E-01 |
| 10 | 6.34E+04 | 2.40E+01 | 4.22E-01 | 2.47E-01 | 1.69E-03 | 6.00E-01 | 6.26E-02 | 1.96E+01 | 1.96E+01 | 4.93E-07 | 2.32E+01 | 1.60E+00 | 1.60E+00 | 6.49E+00 | 3.17E-01 | 1.25E-02 |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | 1.80E+04 | 6.81E+00 | 1.20E-01 | 7.02E-02 | 3.96E-04 | 1.70E-01 | 1.47E-02 | 4.60E+00 | 4.60E+00 | 1.15E-07 | 5.44E+00 | 3.75E-01 | 3.75E-01 | 1.52E+00 | 7.42E-02 | 2.93E-03 |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | 3.89E+04 | 1.47E+01 | 2.59E-01 | 1.51E-01 | 1.38E-02 | 3.68E-01 | 5.10E-01 | 1.60E+02 | 1.60E+02 | 4.01E-06 | 1.89E+02 | 1.30E+01 | 1.30E+01 | 5.28E+01 | 2.58E+00 | 1.02E-01 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | 3.30E+05 | 1.25E+02 | 2.20E+00 | 1.29E+00 | 2.63E-02 | 3.12E+00 | 9.75E-01 | 3.05E+02 | 3.05E+02 | 7.67E-06 | 3.61E+02 | 2.49E+01 | 2.49E+01 | 1.01E+02 | 4.93E+00 | 1.95E-01 |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | 1.80E+05 | 6.82E+01 | 1.20E+00 | 7.02E-01 | 3.09E-02 | 1.70E+00 | 1.14E+00 | 3.54E+02 | 3.54E+02 | 9.00E-06 | 4.24E+02 | 2.93E+01 | 2.92E+01 | 1.19E+02 | 5.78E+00 | 2.29E-01 |
| 28 | 3.09E+05 | 1.17E+02 | 2.06E+00 | 1.20E+00 | 2.93E-02 | 2.92E+00 | 1.08E+00 | 3.40E+02 | 3.40E+02 | 8.53E-06 | 4.02E+02 | 2.77E+01 | 2.77E+01 | 1.12E+02 | 5.48E+00 | 2.17E-01 |
| 29 | 3.07E+05 | 1.16E+02 | 2.05E+00 | 1.20E+00 | 6.48E-03 | 2.90E+00 | 2.40E-01 | 7.53E+01 | 7.53E+01 | 1.89E-06 | 8.91E+01 | 6.15E+00 | 6.14E+00 | 2.49E+01 | 1.21E+00 | 4.80E-02 |
| 30 | 7.49E+04 | 2.83E+01 | 4.99E-01 | 2.92E-01 | 1.70E-02 | 7.09E-01 | 6.30E-01 | 1.97E+02 | 1.97E+02 | 4.95E-06 | 2.33E+02 | 1.61E+01 | 1.61E+01 | 6.53E+01 | 3.18E+00 | 1.26E-01 |
| 31 | 3.44E+05 | 1.30E+02 | 2.29E+00 | 1.34E+00 | 8.28E-02 | 3.26E+00 | 3.07E+00 | 9.61E+02 | 9.61E+02 | 2.41E-05 | 1.14E+03 | 7.85E+01 | 7.84E+01 | 3.18E+02 | 1.55E+01 | 6.13E-01 |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | 8.81E+04 | 4.49E+01 | 5.87E-01 | 3.44E-01 | 7.57E-03 | 8.34E-01 | 2.80E-01 | 8.78E+01 | 8.78E+01 | 2.20E-06 | 1.04E+02 | 7.17E+00 | 7.17E+00 | 2.91E+01 | 1.42E+00 | 5.61E-02 |
| 34 | 5.74E+04 | 2.17E+01 | 3.82E-01 | 2.24E-01 | 5.99E-03 | 5.43E-01 | 2.22E-01 | 6.96E+01 | 6.96E+01 | 1.75E-06 | 8.24E+01 | 5.68E+00 | 5.68E+00 | 2.30E+01 | 1.12E+00 | 4.44E-02 |
| 35 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 36 | 3.11E+05 | 1.18E+02 | 2.07E+00 | 1.21E+00 | 1.38E-01 | 2.94E+00 | 5.10E+00 | 1.60E+03 | 1.60E+03 | 4.01E-05 | 1.89E+03 | 1.30E+02 | 1.30E+02 | 5.29E+02 | 2.58E+01 | 1.02E+00 |
| 37 | 3.43E+05 | 1.30E+02 | 2.29E+00 | 1.34E+00 | 6.93E-02 | 3.25E+00 | 2.57E+00 | 7.36E+02 | 7.36E+02 | 2.02E-05 | 9.52E+02 | 6.57E+01 | 6.56E+01 | 2.66E+02 | 1.30E+01 | 5.13E-01 |
| 38 | 2.48E+05 | 9.40E+01 | 1.65E+00 | 9.69E-01 | 1.71E-03 | 2.35E+00 | 6.35E-02 | 1.99E+01 | 1.99E+01 | 4.99E-07 | 2.35E+01 | 1.62E+00 | 1.62E+00 | 6.58E+00 | 3.21E-01 | 1.27E-02 |
| 39 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 40 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 41 | 2.20E+05 | 8.32E+01 | 1.46E+00 | 8.57E-01 | 4.93E-03 | 2.08E+00 | 1.83E-01 | 2.02E+01 | 2.02E+01 | 1.44E-06 | 6.77E+01 | 4.67E+00 | 4.67E+00 | 1.89E+01 | 9.23E-01 | 3.65E-02 |
| 42 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 43 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 44 | 3.01E+05 | 1.14E+02 | 2.00E+00 | 1.17E+00 | 3.38E-02 | 2.85E+00 | 1.25E+00 | 3.92E+02 | 3.92E+02 | 9.85E-06 | 4.64E+02 | 3.20E+01 | 3.20E+01 | 1.30E+02 | 6.33E+00 | 2.50E-01 |
| 45 | 3.31E+05 | 1.25E+02 | 2.21E+00 | 1.29E+00 | 3.52E-02 | 3.14E+00 | 1.30E+00 | 4.08E+02 | 4.08E+02 | 1.03E-05 | 4.84E+02 | 3.34E+01 | 3.33E+01 | 1.35E+02 | 6.59E+00 | 2.61E-01 |
| 46 | 2.60E+05 | 9.83E+01 | 1.73E+00 | 1.01E+00 | 4.13E-02 | 2.46E+00 | 1.53E+00 | 4.80E+02 | 4.80E+02 | 1.20E-05 | 5.68E+02 | 3.92E+01 | 3.92E+01 | 1.59E+02 | 7.75E+00 | 3.06E-01 |
| 47 | 2.50E+05 | 9.48E+01 | 1.67E+00 | 9.77E-01 | 7.37E-03 | 2.37E+00 | 2.73E-01 | 8.55E+01 | 8.55E+01 | 2.15E-06 | 1.01E+02 | 6.98E+00 | 6.98E+00 | 2.83E+01 | 1.38E+00 | 5.46E-02 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 8.97E+01 | 3.40E-02 | 5.98E-04 | 3.50E-04 | 1.47E-07 | 8.49E-04 | 5.46E-06 | 1.25E-02 | 1.25E-02 | 4.30E-11 | 2.03E-03 | 1.40E-04 | 1.40E-04 | 5.66E-04 | 2.76E-05 | 1.09E-06 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phase Totals | 4.71E+06 | 1.79E+03 | 3.14E+01 | 1.84E+01 | 6.91E-01 | 4.46E+01 | 2.56E+01 | 7.91E+03 | 7.91E+03 | 2.01E-04 | 9.49E+03 | 6.55E+02 | 6.54E+02 | 2.65E+03 | 1.29E+02 | 5.12E+00 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Salt IL Volume, gal | Cs-134 (Ci) | Cs-135 (Ci) | Cs-137 (Ci) | Ba-137m (Ci) | Ce-144 (Ci) | Pr-144 (Ci) | Pm-147 (Ci) | Eu-154 (Ci) | Th-232 (Ci) | U-232 (Ci) | U-233 (Ci) | U-234 (Ci) | U-235 (Ci) | U-236 (Ci) | U-238 (Ci) | Np-237 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.44E+05 | 5.73E+03 | 9.73E+00 | 2.85E+06 | 2.70E+06 | 1.49E-01 | 1.49E-01 | 9.66E+01 | 2.29E+01 | - | 1.31E-04 | - | - | 2.02E-04 | - | 5.02E-03 | 7.33E-03 |
| 2 | 1.61E+05 | 2.37E+03 | 4.03E+00 | 1.18E+06 | 1.12E+06 | 6.19E-02 | 6.19E-02 | 4.00E+01 | 9.49E+00 | - | 1.23E-04 | - | - | 5.91E-05 | - | 1.47E-03 | 1.54E-02 |
| 3 | 1.61E+05 | 2.41E+03 | 4.09E+00 | 1.20E+06 | 1.13E+06 | 6.27E-02 | 6.27E-02 | 4.06E+01 | 9.62E+00 | - | 1.08E-04 | - | - | 1.52E-04 | - | 3.78E-03 | 2.83E-02 |
| 4 | 1.02E+04 | 1.79E+02 | 3.05E-01 | 8.94E+04 | 8.46E+04 | 4.68E-03 | 4.68E-03 | 3.03E+00 | 7.17E-01 | - | 4.63E-06 | - | - | 6.07E-06 | - | 2.61E-04 | 2.33E-04 |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | 1.60E+05 | 2.32E+03 | 3.94E+00 | 1.15E+06 | 1.09E+06 | 6.04E-02 | 6.04E-02 | 3.91E+01 | 9.27E+00 | - | 1.64E-04 | - | - | 1.07E-04 | - | 2.66E-03 | 1.82E-02 |
| 10 | 6.34E+04 | 1.60E+02 | 2.72E-01 | 7.98E+04 | 7.55E+04 | 4.17E-03 | 4.17E-03 | 2.70E+00 | 6.40E-01 | - | 4.18E-05 | - | - | 5.10E-05 | - | 1.27E-03 | 9.72E-03 |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | 1.80E+04 | 3.75E+01 | 6.37E-02 | 1.87E+04 | 1.77E+04 | 9.78E-04 | 9.78E-04 | 6.33E-01 | 1.50E-01 | 3.18E-05 | 3.20E-07 | 8.95E-04 | 8.38E-05 | 1.58E-06 | 6.64E-06 | 1.59E-05 | 1.85E-04 |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | 3.89E+04 | 1.30E+03 | 2.21E+00 | 6.49E+05 | 6.14E+05 | 3.40E-02 | 3.40E-02 | 2.20E+01 | 5.21E+00 | 8.99E-05 | 2.67E-05 | 3.17E-03 | 4.35E-04 | 3.52E-05 | 3.74E-05 | 6.72E-04 | 4.65E-03 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | 3.30E+05 | 2.49E+03 | 4.23E+00 | 1.24E+06 | 1.17E+06 | 6.50E-02 | 6.49E-02 | 4.20E+01 | 9.96E+00 | - | 1.48E-09 | 4.51E-15 | 1.44E-14 | 4.26E-09 | 5.50E-10 | 5.11E-07 | 1.32E-09 |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | 1.80E+05 | 2.92E+03 | 4.97E+00 | 1.46E+06 | 1.38E+06 | 7.62E-02 | 7.62E-02 | 4.93E+01 | 1.17E+01 | - | 8.09E-10 | 2.46E-15 | 7.86E-15 | 2.33E-09 | 3.00E-10 | 2.79E-07 | 7.20E-10 |
| 28 | 3.09E+05 | 2.77E+03 | 4.71E+00 | 1.38E+06 | 1.31E+06 | 7.23E-02 | 7.22E-02 | 4.67E+01 | 1.11E+01 | - | 1.39E-09 | 4.22E-15 | 1.35E-14 | 3.99E-09 | 5.15E-10 | 4.79E-07 | 1.24E-09 |
| 29 | 3.07E+05 | 6.14E+02 | 1.04E+00 | 3.06E+05 | 2.89E+05 | 1.60E-02 | 1.60E-02 | 1.04E+01 | 2.46E+00 | - | 5.87E-11 | 4.52E-08 | 6.38E-09 | 1.74E-10 | 6.58E-10 | 2.04E-09 | 1.64E-08 |
| 30 | 7.49E+04 | 1.61E+03 | 2.73E+00 | 8.02E+05 | 7.58E+05 | 4.20E-02 | 4.19E-02 | 2.71E+01 | 6.44E+00 | - | - | - | 2.61E-03 | 4.64E-05 | 4.82E-04 | 1.72E-06 | 1.18E-03 |
| 31 | 3.44E+05 | 7.84E+03 | 1.33E+01 | 3.91E+06 | 3.70E+06 | 2.04E-01 | 2.04E-01 | 1.32E+02 | 3.14E+01 | - | 6.58E-11 | 5.07E-08 | 7.15E-09 | 1.95E-10 | 7.37E-10 | 2.28E-09 | 1.84E-08 |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | 8.81E+04 | 7.17E+02 | 1.22E+00 | 3.57E+05 | 3.38E+05 | 1.87E-02 | 1.87E-02 | 1.21E+01 | 2.87E+00 | - | 1.71E-03 | 8.18E-09 | 1.69E-04 | 3.16E-03 | 1.75E-03 | 4.58E-01 | 1.44E-01 |
| 34 | 5.74E+04 | 5.68E+02 | 9.64E-01 | 2.83E+05 | 2.68E+05 | 1.48E-02 | 1.48E-02 | 9.57E+00 | 2.27E+00 | - | 3.03E-04 | - | - | 3.06E-04 | - | 2.16E-02 | 1.67E-02 |
| 35 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 36 | 3.11E+05 | 1.30E+04 | 2.21E+01 | 6.49E+06 | 6.14E+06 | 3.40E-01 | 3.40E-01 | 2.20E+02 | 5.21E+01 | - | - | - | 2.38E-02 | 4.62E-04 | 8.41E-03 | 1.51E-04 | 6.67E-03 |
| 37 | 3.43E+05 | 6.56E+03 | 1.11E+01 | 3.27E+06 | 3.09E+06 | 1.71E-01 | 1.71E-01 | 1.11E+02 | 2.62E+01 | - | 6.57E-11 | 5.06E-08 | 7.14E-09 | 1.95E-10 | 7.36E-10 | 2.28E-09 | 1.84E-08 |
| 38 | 2.48E+05 | 1.62E+02 | 2.76E-01 | 8.09E+04 | 7.65E+04 | 4.23E-03 | 4.23E-03 | 2.74E+00 | 6.49E-01 | - | - | - | 7.41E-08 | 1.02E-09 | 1.41E-08 | 8.30E-11 | 7.89E-08 |
| 39 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 40 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 41 | 2.20E+05 | 4.67E+02 | 7.93E-01 | 2.33E+05 | 2.20E+05 | 1.22E-02 | 1.22E-02 | 7.87E+00 | 1.87E+00 | - | - | - | 9.13E-02 | 1.06E-03 | 2.62E-02 | 7.23E-05 | 2.73E-01 |
| 42 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 43 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 44 | 3.01E+05 | 3.20E+03 | 5.44E+00 | 1.59E+06 | 1.51E+06 | 8.34E-02 | 8.34E-02 | 5.40E+01 | 1.28E+01 | - | 1.35E-09 | 4.11E-15 | 1.31E-14 | 3.89E-09 | 5.02E-10 | 4.66E-07 | 1.20E-09 |
| 45 | 3.31E+05 | 3.33E+03 | 5.66E+00 | 1.66E+06 | 1.57E+06 | 8.69E-02 | 8.69E-02 | 5.62E+01 | 1.33E+01 | - | 1.49E-09 | 4.53E-15 | 1.45E-14 | 4.28E-09 | 5.53E-10 | 5.14E-07 | 1.33E-09 |
| 46 | 2.60E+05 | 3.92E+03 | 6.65E+00 | 1.95E+06 | 1.85E+06 | 1.02E-01 | 1.02E-01 | 6.60E+01 | 1.57E+01 | - | 1.17E-09 | 3.55E-15 | 1.13E-14 | 3.35E-09 | 4.33E-10 | 4.02E-07 | 1.04E-09 |
| 47 | 2.50E+05 | 6.98E+02 | 1.19E+00 | 3.48E+05 | 3.29E+05 | 1.82E-02 | 1.82E-02 | 1.18E+01 | 2.79E+00 | - | 6.39E-04 | - | - | 1.74E-03 | - | 1.38E-01 | - |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 8.97E+01 | 1.40E-02 | 2.37E-05 | 6.96E+00 | 6.58E+00 | 3.64E-07 | 3.64E-07 | 2.36E-04 | 5.59E-05 | - | 1.72E-14 | 1.32E-11 | 1.86E-12 | 5.10E-14 | 1.92E-13 | 5.96E-13 | 4.79E-12 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phase Totals | 4.71E+06 | 6.54E+04 | 1.11E+02 | 3.26E+07 | 3.08E+07 | 1.71E+00 | 1.70E+00 | 1.10E+03 | 2.62E+02 | 1.22E-04 | 3.25E-03 | 4.07E-03 | 1.18E-01 | 7.39E-03 | 3.69E-02 | 6.33E-01 | 5.25E-01 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Salt IL Volume, gal | Pu-238 (Ci) | Pu-239 (Ci) | Pu-240 (Ci) | Pu-241 (Ci) | Pu-242 (Ci) | Am-241 (Ci) | Am-242m (Ci) | Cm-244 (Ci) | Cm-245 (Ci) | Na-22 (Ci) | Al-26 (Ci) | Te-125m (Ci) | Sb-126 (Ci) | Sb-126m (Ci) | Sm-151 (Ci) | Eu-152 (Ci) | Eu-155 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.44E+05 | 5.68E+00 | 1.52E+00 | 3.40E-01 | 1.87E+00 | 6.99E-05 | 9.15E+00 | 5.27E-03 | 3.66E+00 | 3.61E-04 | 5.09E+01 | 3.26E-01 | 5.67E+01 | 1.59E+00 | 1.13E+01 | 1.08E+02 | 5.24E-01 | 6.12E+00 |
| 2 | 1.61E+05 | 1.01E+01 | 1.44E+00 | 3.21E-01 | 1.35E+00 | 6.61E-05 | 3.79E+00 | 2.19E-03 | 1.52E+00 | 1.49E-04 | 2.11E+01 | 1.35E-01 | 2.35E+01 | 6.57E-01 | 4.70E+00 | 4.49E+01 | 2.17E-01 | 2.54E+00 |
| 3 | 1.61E+05 | 1.25E+01 | 1.78E+00 | 3.98E-01 | 2.01E+00 | 8.18E-05 | 3.84E+00 | 2.22E-03 | 1.54E+00 | 1.52E-04 | 2.14E+01 | 1.37E-01 | 2.38E+01 | 6.66E-01 | 4.76E+00 | 4.55E+01 | 2.20E-01 | 2.57E+00 |
| 4 | 1.02E+04 | 4.73E-02 | 4.67E-02 | 1.04E-02 | 8.83E-02 | 2.15E-06 | 2.86E-01 | 1.65E-04 | 1.15E-01 | 1.13E-05 | 1.59E+00 | 1.02E-02 | 1.78E+00 | 4.97E-02 | 3.55E-01 | 3.39E+00 | 1.64E-02 | 1.92E-01 |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | 1.60E+05 | 3.95E+00 | 5.64E-01 | 1.26E-01 | 5.23E-01 | 2.59E-05 | 3.70E+00 | 2.13E-03 | 1.48E+00 | 1.46E-04 | 2.06E+01 | 1.32E-01 | 2.30E+01 | 6.42E-01 | 4.58E+00 | 4.38E+01 | 2.12E-01 | 2.48E+00 |
| 10 | 6.34E+04 | 4.94E+00 | 7.05E-01 | 1.58E-01 | 7.01E-01 | 3.24E-05 | 2.56E-01 | 1.47E-04 | 1.02E-01 | 1.01E-05 | 1.42E+00 | 9.11E-03 | 1.59E+00 | 4.43E-02 | 3.17E-01 | 3.03E+00 | 1.46E-02 | 1.71E-01 |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | 1.80E+04 | 3.23E+00 | 5.41E-02 | 2.99E-02 | 7.59E-01 | 4.32E-05 | 5.99E-02 | 3.45E-05 | 2.40E-02 | 2.36E-06 | 3.34E-01 | 2.13E-03 | 3.72E-01 | 1.04E-02 | 7.42E-02 | 7.09E-01 | 3.43E-03 | 4.01E-02 |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | 3.89E+04 | 2.08E+00 | 5.13E-01 | 1.66E-01 | 8.38E-01 | 3.03E-05 | 2.08E+00 | 1.20E-03 | 8.33E-01 | 8.21E-05 | 1.16E+01 | 7.41E-02 | 1.29E+01 | 3.61E-01 | 2.58E+00 | 2.46E+01 | 1.19E-01 | 1.39E+00 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | 3.30E+05 | 2.72E-03 | 4.26E-04 | 9.53E-05 | 2.24E-03 | 1.90E-08 | 3.98E+00 | 2.29E-03 | 1.59E+00 | 1.57E-04 | 2.22E+01 | 1.42E-01 | 2.47E+01 | 6.90E-01 | 4.93E+00 | 4.71E+01 | 2.28E-01 | 2.66E+00 |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | 1.80E+05 | 1.49E-03 | 2.33E-04 | 5.21E-05 | 1.23E-03 | 1.04E-08 | 4.67E+00 | 2.69E-03 | 1.87E+00 | 1.84E-04 | 2.60E+01 | 1.66E-01 | 2.90E+01 | 8.10E-01 | 5.78E+00 | 5.53E+01 | 2.67E-01 | 3.12E+00 |
| 28 | 3.09E+05 | 2.55E-03 | 4.00E-04 | 8.94E-05 | 2.10E-03 | 1.78E-08 | 4.43E+00 | 2.55E-03 | 1.77E+00 | 1.75E-04 | 2.46E+01 | 1.58E-01 | 2.74E+01 | 7.68E-01 | 5.48E+00 | 5.24E+01 | 2.53E-01 | 2.96E+00 |
| 29 | 3.07E+05 | 6.00E-05 | 1.62E-06 | 6.71E-07 | 1.18E-05 | 4.45E-10 | 9.81E-01 | 5.65E-04 | 3.93E-01 | 3.87E-05 | 5.46E+00 | 3.49E-02 | 6.08E+00 | 1.70E-01 | 1.21E+00 | 1.16E+01 | 5.62E-02 | 6.56E-01 |
| 30 | 7.49E+04 | 5.03E+02 | 4.37E+00 | 3.14E+00 | 3.23E+02 | 7.52E-03 | 2.57E+00 | 1.48E-03 | 1.03E+00 | 1.01E-04 | 1.43E+01 | 9.15E-02 | 1.59E+01 | 4.46E-01 | 3.18E+00 | 3.04E+01 | 1.47E-01 | 1.72E+00 |
| 31 | 3.44E+05 | 6.72E-05 | 1.82E-06 | 7.52E-07 | 1.33E-05 | 4.99E-10 | 1.25E+01 | 7.22E-03 | 5.01E+00 | 4.94E-04 | 6.97E+01 | 4.46E-01 | 7.76E+01 | 2.17E+00 | 1.55E+01 | 1.48E+02 | 7.17E-01 | 8.37E+00 |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | 8.81E+04 | 2.35E+02 | 1.28E+02 | 2.25E+01 | 6.67E+02 | 1.30E-03 | 1.14E+00 | 6.60E-04 | 4.58E-01 | 4.51E-05 | 6.37E+00 | 4.08E-02 | 7.10E+00 | 1.98E-01 | 1.42E+00 | 1.35E+01 | 6.55E-02 | 7.66E-01 |
| 34 | 5.74E+04 | - | 3.50E+00 | 7.81E-01 | 1.62E+01 | 1.62E-04 | 9.07E-01 | 5.23E-04 | 3.63E-01 | 3.58E-05 | 5.05E+00 | 3.23E-02 | 5.62E+00 | 1.57E-01 | 1.12E+00 | 1.07E+01 | 5.19E-02 | 6.06E-01 |
| 35 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 36 | 3.11E+05 | 2.07E+03 | 1.61E+01 | 1.28E+01 | 8.38E+02 | 2.77E-02 | 2.08E+01 | 1.20E-02 | 8.33E+00 | 8.21E-04 | 1.16E+02 | 7.41E-01 | 1.29E+02 | 3.61E+00 | 2.58E+01 | 2.46E+02 | 1.19E+00 | 1.39E+01 |
| 37 | 3.43E+05 | 6.71E-05 | 1.82E-06 | 7.51E-07 | 1.32E-05 | 4.98E-10 | 1.05E+01 | 6.04E-03 | 4.20E+00 | 4.13E-04 | 5.83E+01 | 3.73E-01 | 6.50E+01 | 1.82E+00 | 1.30E+01 | 1.24E+02 | 6.00E-01 | 7.01E+00 |
| 38 | 2.48E+05 | 1.80E-03 | 7.09E-06 | 5.99E-06 | 1.54E-03 | 8.83E-08 | 2.59E-01 | 1.49E-04 | 1.04E-01 | 1.02E-05 | 1.44E+00 | 9.23E-03 | 1.61E+00 | 4.50E-02 | 3.21E-01 | 3.07E+00 | 1.48E-02 | 1.73E-01 |
| 39 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 40 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 41 | 2.20E+05 | 1.49E+03 | - | - | - | - | 7.45E-01 | 4.30E-04 | 2.98E-01 | 2.94E-05 | 4.15E+00 | 2.65E-02 | 4.62E+00 | 1.29E-01 | 9.23E-01 | 8.82E+00 | 4.27E-02 | 4.99E-01 |
| 42 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 43 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 44 | 3.01E+05 | 2.48E-03 | 3.89E-04 | 8.70E-05 | 2.05E-03 | 1.73E-08 | 5.11E+00 | 2.95E-03 | 2.05E+00 | 2.02E-04 | 2.85E+01 | 1.82E-01 | 3.17E+01 | 8.86E-01 | 6.33E+00 | 6.05E+01 | 2.93E-01 | 3.42E+00 |
| 45 | 3.31E+05 | 2.74E-03 | 4.29E-04 | 9.59E-05 | 2.26E-03 | 1.91E-08 | 5.32E+00 | 3.07E-03 | 2.13E+00 | 2.10E-04 | 2.96E+01 | 1.90E-01 | 3.30E+01 | 9.23E-01 | 6.59E+00 | 6.30E+01 | 3.05E-01 | 3.56E+00 |
| 46 | 2.60E+05 | 2.14E-03 | 3.36E-04 | 7.51E-05 | 1.77E-03 | 1.50E-08 | 6.25E+00 | 3.60E-03 | 2.50E+00 | 2.47E-04 | 3.48E+01 | 2.23E-01 | 3.88E+01 | 1.08E+00 | 7.75E+00 | 7.40E+01 | 3.58E-01 | 4.18E+00 |
| 47 | 2.50E+05 | 1.47E+03 | 2.11E+02 | 4.71E+01 | 9.16E+02 | 9.70E-03 | 1.11E+00 | 6.42E-04 | 4.46E-01 | 4.39E-05 | 6.20E+00 | 3.97E-02 | 6.91E+00 | 1.93E-01 | 1.38E+00 | 1.32E+01 | 6.38E-02 | 7.45E-01 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 8.97E+01 | 1.75E-08 | 4.74E-10 | 1.96E-10 | 3.46E-09 | 1.30E-13 | 2.23E-05 | 1.29E-08 | 8.93E-06 | 8.80E-10 | 1.24E-04 | 7.94E-07 | 1.38E-04 | 3.87E-06 | 2.76E-05 | 2.64E-04 | 1.28E-06 | 1.49E-05 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phase Totals | 4.71E+06 | 5.81E+03 | 3.70E+02 | 8.79E+01 | 2.77E+03 | 4.67E-02 | 1.04E+02 | 6.02E-02 | 4.18E+01 | 4.12E-03 | 5.82E+02 | 3.72E+00 | 6.48E+02 | 1.81E+01 | 1.29E+02 | 1.24E+03 | 5.98E+00 | 6.99E+01 |

## Table 6: Soluble Radionuclide Inventory by Tank, continued

| Tank | Salt IL Volume, gal | Ra-226 (Ci) | Ra-228 (Ci) | Ac-227 (Ci) | Th-229 (Ci) | Th-230 (Ci) | Pa-231 (Ci) | Pu-244 (Ci) | Am-243 (Ci) | Cm-242 (Ci) | Cm-243 (Ci) | Cm-247 (Ci) | Cm-248 (Ci) | Bk-249 (Ci) | Cf-249 (Ci) | Cf-251 (Ci) | Cf-252 (Ci) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.44E+05 | - | - | 4.60E-08 | - | - | 1.28E-07 | 3.20E-07 | 1.75E-03 | 4.33E-03 | 1.03E-03 | 1.97E-13 | 2.06E-13 | 1.50E-20 | 1.14E-12 | 3.90E-14 | 1.27E-15 |
| 2 | 1.61E+05 | - | - | 1.35E-08 | - | - | 3.74E-08 | 3.02E-07 | 7.25E-04 | 1.79E-03 | 4.25E-04 | 8.18E-14 | 8.52E-14 | 6.23E-21 | 4.73E-13 | 1.62E-14 | 5.25E-16 |
| 3 | 1.61E+05 | - | - | 3.46E-08 | - | - | 9.62E-08 | 3.74E-07 | 7.35E-04 | 1.82E-03 | 4.30E-04 | 8.29E-14 | 8.64E-14 | 6.31E-21 | 4.79E-13 | 1.64E-14 | 5.32E-16 |
| 4 | 1.02E+04 | - | - | 1.39E-09 | - | - | 3.85E-09 | 9.82E-09 | 5.48E-05 | 1.35E-04 | 3.21E-05 | 6.18E-15 | 6.44E-15 | 4.71E-22 | 3.57E-14 | 1.22E-15 | 3.97E-17 |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | 1.60E+05 | - | - | 2.43E-08 | - | - | 6.76E-08 | 1.19E-07 | 7.08E-04 | 1.75E-03 | 4.15E-04 | 7.99E-14 | 8.32E-14 | 6.08E-21 | 4.61E-13 | 1.58E-14 | 5.12E-16 |
| 10 | 6.34E+04 | - | - | 1.16E-08 | - | - | 3.23E-08 | 1.48E-07 | 4.89E-05 | 1.21E-04 | 2.86E-05 | 5.52E-15 | 5.75E-15 | 4.20E-22 | 3.19E-14 | 1.09E-15 | 3.54E-17 |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | 1.80E+04 | 1.89E-10 | 3.18E-05 | 3.60E-10 | 2.54E-06 | 2.31E-08 | 9.99E-10 | 1.98E-07 | 1.15E-05 | 2.83E-05 | 6.71E-06 | 1.29E-15 | 1.35E-15 | 9.84E-23 | 7.47E-15 | 2.56E-16 | 8.29E-18 |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | 3.89E+04 | 9.81E-10 | 8.99E-05 | 8.04E-09 | 9.02E-06 | 1.20E-07 | 2.23E-08 | 1.39E-07 | 3.98E-04 | 9.84E-04 | 2.33E-04 | 4.49E-14 | 4.68E-14 | 3.42E-21 | 2.59E-13 | 8.88E-15 | 2.88E-16 |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | 3.30E+05 | 3.24E-20 | - | 9.71E-13 | 1.28E-17 | 3.97E-18 | 2.70E-12 | 8.68E-11 | 7.61E-04 | 1.88E-03 | 4.46E-04 | 8.59E-14 | 8.95E-14 | 6.54E-21 | 4.96E-13 | 1.70E-14 | 5.51E-16 |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | 1.80E+05 | 1.77E-20 | - | 5.31E-13 | 7.01E-18 | 2.17E-18 | 1.47E-12 | 4.74E-11 | 8.93E-04 | 2.21E-03 | 5.23E-04 | 1.01E-13 | 1.05E-13 | 7.67E-21 | 5.82E-13 | 1.99E-14 | 6.46E-16 |
| 28 | 3.09E+05 | 3.04E-20 | - | 9.10E-13 | 1.20E-17 | 3.72E-18 | 2.53E-12 | 8.14E-11 | 8.47E-04 | 2.09E-03 | 4.96E-04 | 9.55E-14 | 9.95E-14 | 7.27E-21 | 5.52E-13 | 1.89E-14 | 6.13E-16 |
| 29 | 3.07E+05 | 1.44E-14 | - | 3.98E-14 | 1.29E-10 | 1.76E-12 | 1.11E-13 | 2.04E-12 | 1.88E-04 | 4.64E-04 | 1.10E-04 | 2.12E-14 | 2.21E-14 | 1.61E-21 | 1.22E-13 | 4.18E-15 | 1.36E-16 |
| 30 | 7.49E+04 | 5.88E-09 | - | 1.06E-08 | - | 7.20E-07 | 2.94E-08 | 3.44E-05 | 4.92E-04 | 1.21E-03 | 2.88E-04 | 5.55E-14 | 5.78E-14 | 4.22E-21 | 3.20E-13 | 1.10E-14 | 3.56E-16 |
| 31 | 3.44E+05 | 1.61E-14 | - | 4.46E-14 | 1.44E-10 | 1.97E-12 | 1.24E-13 | 2.28E-12 | 2.40E-03 | 5.92E-03 | 1.40E-03 | 2.70E-13 | 2.82E-13 | 2.06E-20 | 1.56E-12 | 5.34E-14 | 1.73E-15 |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | 8.81E+04 | 3.80E-10 | - | 7.22E-07 | 2.33E-11 | 4.65E-08 | 2.01E-06 | 5.95E-06 | 2.19E-04 | 5.41E-04 | 1.28E-04 | 2.47E-14 | 2.57E-14 | 1.88E-21 | 1.43E-13 | 4.88E-15 | 1.58E-16 |
| 34 | 5.74E+04 | - | - | 6.99E-08 | - | - | 1.94E-07 | 7.41E-07 | 1.73E-04 | 4.29E-04 | 1.02E-04 | 1.96E-14 | 2.04E-14 | 1.49E-21 | 1.13E-13 | 3.87E-15 | 1.26E-16 |
| 35 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 36 | 3.11E+05 | 5.37E-08 | - | 1.05E-07 | - | 6.57E-06 | 2.93E-07 | 1.26E-04 | 3.98E-03 | 9.84E-03 | 2.33E-03 | 4.49E-13 | 4.68E-13 | 3.42E-20 | 2.60E-12 | 8.88E-14 | 2.88E-15 |
| 37 | 3.43E+05 | 1.61E-14 | - | 4.45E-14 | 1.44E-10 | 1.97E-12 | 1.24E-13 | 2.28E-12 | 2.00E-03 | 4.95E-03 | 1.17E-03 | 2.26E-13 | 2.36E-13 | 1.72E-20 | 1.31E-12 | 4.47E-14 | 1.45E-15 |
| 38 | 2.48E+05 | 1.67E-13 | - | 2.33E-13 | - | 2.04E-11 | 6.48E-13 | 4.04E-10 | 4.96E-05 | 1.23E-04 | 2.90E-05 | 5.59E-15 | 5.83E-15 | 4.26E-22 | 3.23E-14 | 1.11E-15 | 3.59E-17 |
| 39 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 40 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 41 | 2.20E+05 | 2.06E-07 | - | 2.41E-07 | - | 2.52E-05 | 6.69E-07 | - | 1.43E-04 | 3.52E-04 | 8.35E-05 | 1.61E-14 | 1.68E-14 | 1.22E-21 | 9.29E-14 | 3.18E-15 | 1.03E-16 |
| 42 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 43 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 44 | 3.01E+05 | 2.96E-20 | - | 8.87E-13 | 1.17E-17 | 3.62E-18 | 2.46E-12 | 7.93E-11 | 9.78E-04 | 2.42E-03 | 5.73E-04 | 1.10E-13 | 1.15E-13 | 8.40E-21 | 6.37E-13 | 2.18E-14 | 7.08E-16 |
| 45 | 3.31E+05 | 3.26E-20 | - | 9.77E-13 | 1.29E-17 | 3.99E-18 | 2.71E-12 | 8.73E-11 | 1.02E-03 | 2.52E-03 | 5.96E-04 | 1.15E-13 | 1.20E-13 | 8.75E-21 | 6.64E-13 | 2.27E-14 | 7.37E-16 |
| 46 | 2.60E+05 | 2.55E-20 | - | 7.65E-13 | 1.01E-17 | 3.12E-18 | 2.12E-12 | 6.84E-11 | 1.20E-03 | 2.96E-03 | 7.00E-04 | 1.35E-13 | 1.41E-13 | 1.03E-20 | 7.80E-13 | 2.67E-14 | 8.66E-16 |
| 47 | 2.50E+05 | - | - | 3.96E-07 | - | - | 1.10E-06 | 4.43E-05 | 2.13E-04 | 5.27E-04 | 1.25E-04 | 2.40E-14 | 2.51E-14 | 1.83E-21 | 1.39E-13 | 4.75E-15 | 1.54E-16 |
| 48 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 49 | 8.97E+01 | 4.20E-18 | - | 1.16E-17 | 3.76E-14 | 5.14E-16 | 3.23E-17 | 5.95E-16 | 4.27E-09 | 1.05E-08 | 2.50E-09 | 4.81E-19 | 5.02E-19 | 3.67E-26 | 2.78E-18 | 9.52E-20 | 3.09E-21 |
| 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 51 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phase Totals | 4.71E+06 | 2.67E-07 | 1.22E-04 | 1.69E-06 | 1.16E-05 | 3.27E-05 | 4.68E-06 | 2.13E-04 | 2.00E-02 | 4.94E-02 | 1.17E-02 | 2.25E-12 | 2.35E-12 | 1.72E-19 | 1.30E-11 | 4.46E-13 | 1.45E-14 |

A discussion of the radionuclide concentrations for the waste streams to be disposed at the Saltstone Disposal Facility is included in the response to SCDHEC Public Comment 5**.**

**References:**

Tran, H. Q., 2005, *Tank Radionuclide Inventories*, CBU-PIT-2005-00138, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina

**DHEC**
**Comment 11:** It is stated that the grout is mixed in a one-to-one ratio for all salt waste streams treated through interim processing. Does this include Tank 48 waste? How was the ratio of grout to waste determined for all salt waste streams? What ratio of grout is needed for stabilization? How will achievement of homogeneity be determined?

**WD Sections:** Section 6.0

**DOE Response:** The one-to-one ratio discussed in the *3116 Determination [for] Salt Waste Disposal [at the] Savannah River Site* is an approximation of the actual weight ratio used to produce grout. The nominal weight ratio of dry premix material and salt solution is 53% dry material-to-47% liquid salt solution. In other words, on average in the Saltstone Production Facility (SPF), 47 grams of salt solution are mixed with 53 grams of dry premix to produce 100 grams of grout. The actual dry material-to-liquid ratio is adjusted up or down by one or two percent to compensate for changes in the salt chemical (i.e., nitrates, carbonates, etc…) and organic content of the solution, as well as for changes in the premix materials (cement, furnace slag, and fly ash). The actual dry material-to-liquid ratio is determined in the laboratory, where various ratios are tested to determine which mixture best meets the following processibility restraints:

- Gel Time – in order to safely process the grout through the SPF, the grout must retain the ability to be poured for at least 20 minutes
- Bleed Water – the grout cannot have excessive bleed water rise to the surface as it cures
- Set Time – the grout must set to a hardened material within 72 hours
- Toxicity Characteristic Leaching Procedure (TCLP) – the grout must resist leaching of hazardous materials.

Years of testing and facility operation have proven that as long as the physical and chemical criteria specified in the *Waste Acceptance Criteria* (WAC) *for Aqueous Waste Sent to the Z-Area Saltstone Production Facility* (Chandler 2004) are met, a viable grout formulation using approximately 53% dry material-to-47% liquid salt waste can be obtained. Traditionally, as more and more organic material is added to the feed stream, set retardants must be added to the grout to ensure that the minimum gel time requirements are met. In addition, organics in the salt solution sometimes cause the grout to foam. In these instances, an anti-foam agent is also added to the grout. Testing to date has indicated that a viable grout formulation can be developed for processing the Tank 48 waste.

Homogeneity of the salt solution feed to the SPF is accomplished using several slurry pumps on Tank 50H. The requirement for a homogeneous and consistent feed to the SPF is documented in the Saltstone Facility WAC.

Given homogeneity of the salt solution, homogeneity of the grouted waste will be accomplished by using air blenders to pre-mix the dry grout materials and then mixing the dry grout materials with the salt solution.

**References:**

Chandler, T. E., 2004, *Waste Acceptance Criteria for Aqueous Waste Sent to the Z-Area Saltstone Production Facility*, X-SD-Z-00001, Rev. 2, Westinghouse Savannah River Company, Aiken, South Carolina

**DHEC**
**Comment 12:** What is the waste classification for Tank 48 after mixing with grout?

**WD Sections:** Section 6.0

**DOE Response:** After the waste from Tank 48 is aggregated with recycle from the Defense Waste Processing Facility (DWPF) and the aggregate is mixed into grout, the waste stream classification will be non-hazardous, as the Saltstone Disposal Facility is permitted as a non-hazardous landfill by the State of South Carolina. The Tank 48 waste will not be processed and disposed of in the Saltstone Facility until required laboratory studies and associated analyses that address both the short-term and long-term impacts to the health and safety of occupational workers, the public and the environment are complete. Also ensure the non-hazardous classification of the grouted waste and any necessary changes to the Saltstone permits are reviewed and approved by SCDHEC. Radiologically, the aggregated Tank 48 waste stream after mixing with grout will meet Class C concentration limits per 10 CFR 61.55. As stated in the *3116 Determination* [for] *Salt Waste Disposal* [at the] *Savannah River Site* (Salt WD), the solidified waste will be below Class C concentration limits. DOE's responses to NRC RAI's 37 and 57 (see attachment) provide additional information on DOE's plans for the Tank 48 material.

As further discussed in the response to DHEC Public Comment 5, d'Entremont and Drumm (2005) have calculated the batch-by-batch radionuclide concentrations in the waste streams to be sent to the Saltstone Processing Facility (SPF) from the Deliquification, Dissolution, and Adjustment (DDA) process during the Interim Salt Processing phase. In Table A-9 of *Radionuclide Concentrations in Saltstone*, Batches 2 and 3 are the expected concentrations resulting from the aggregation of waste currently in Tank 48 with recycle from the Defense Waste Processing Facility (DWPF).

These Tank 48 waste streams are factored into the average DDA waste stream comparison to 10 CFR 61.55 shown in Tables 6.3 and 6.4 of the Salt WD. Based on the results documented in *Radionuclide Concentrations in Saltstone* for Batches 2 and 3, the Tank 48 waste streams can be compared to the 10 CFR 61.55 concentration limits. The following tables show these specific results for the Tank 48 waste.

## Table 1: Tank 48 Waste Stream Comparison to 10 CFR 61.55 Table 1

| **Radionuclides (Long-lived)** | **10 CFR 61.55 Limit (Ci/m³)** | **Estimated Average Concentration (Ci/m³)** | **% of 10 CFR 61.55 Class C Limit** |
|---|---|---|---|
| **$^{14}C$** | 8 | 0.001 | 0.01% |
| **$^{14}C$ in activated metal** | 80 | *(1)* | *(1)* |
| **$^{59}Ni$ in activated metal** | 220 | *(1)* | *(1)* |
| **$^{94}Nb$ in activated metal** | 0.2 | *(1)* | *(1)* |
| **$^{99}Tc$** | 3 | 0.008 | 0.26% |
| **$^{129}I$** | 0.08 | 0.000005 | 0.01% |
| **Alpha Emitting Transuranic (TRU) nuclides with half-life greater than 5 years** | 100*(2)* | 69(2) | 69% |
| **$^{241}Pu$** | 3,500*(2)* | 1(2) | 0.04% |
| **$^{242}Cm$** | 20,000*(2)* | 0.00002(2) | 0.0000001% |

1 Not present in the grouted salt waste in the Saltstone Disposal Facility.
2 Units are in nanocuries per gram.

## Table 2: Tank 48 Waste Stream Comparison to 10 CFR 61.55 Table 2

| **Radionuclides (Short-lived)** | **10 CFR 61.55 Limit (Ci/m³) Column 3** | **Estimated Average Concentration (Ci/m³)** | **% of 10 CFR 61.55 Class C Limit** |
|---|---|---|---|
| **Total of all nuclides with less than 5 year half-life** | *(1)* | *(1)* | *(1)* |
| **$^{3}H$** | *(1)* | *(1)* | *(1)* |
| **$^{60}Co$** | *(1)* | *(1)* | *(1)* |
| **$^{63}Ni$** | 700 | 0.002 | 0.0002% |
| **$^{63}Ni$ in activated metal** | 7000 | *(2)* | *(2)* |
| **$^{90}Sr$** | 7000 | 0.02 | 0.0003% |
| **$^{137}Cs$** | 4600 | 27 | 0.6% |

1 There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in the table determine the waste to be Class C independent of these nuclides. Because the Saltstone Disposal Facility is a low level waste disposal facility, the grouted salt waste must meet or be lower than the concentration limits for Class C.
2 Not present in the grouted salt waste in the Saltstone Disposal Facility.

**References:**

d'Entremont, P. D., and Drumm, M. D., 2005, *Radionuclide Concentrations in Saltstone*, CBU-PIT-2005-00013, Revision 3, Westinghouse Savannah River Company, Aiken, South Carolina

**DHEC Comment 13:** It is stated that the engineered grout and the SDF vaults are designed to retard migration of the radionuclides from the grout waste form. Please provide a discussion about the physical and chemical properties of the grout and how it stabilizes the waste. Provide a copy of the waste form technical evaluation.

**WD Sections:** Section 7.0

**DOE Response:** The projected long-term performance of the Saltstone Disposal Facility (i.e., retardation of radionuclide migration) is documented in the *Radiological Performance Assessment* [PA] *for the Z-Area Saltstone Disposal Facility* (MMES 1992) and the *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits* (SA) (Cook et al. 2005).

The physical and chemical characteristics of the saltstone are discussed in Sections 2.4.2 and 2.4.3 of the PA, which are excerpted below. The primary characteristics of the saltstone that are important in retarding migration of contaminants are its low permeability and diffusivity and its chemically reducing characteristics.

The hydraulic conductivities of the materials simulated in the SA, including the saltstone, are listed in Table A-4, which is attached. The diffusivities of the materials simulated are listed in Table A-9 of the SA, which also is attached. The chemically reducing nature of saltstone is reflected in the distribution coefficient, $K_d$, that was used for technetium; a value of 1,000 was used. The $K_d$ values used in the SA are presented in Section A.2.5 and Table A-4 of the SA, which are attached.

Further information on the physical and chemical nature of saltstone is provided in the *Response to Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* resulting from the NRC's review of the Saltstone PA (WSRC 2005). Specifically, the responses to RAI Comments 33 and 34 present and discuss the measurements for hydraulic conductivity; the response to RAI Comment 38 discusses the physical properties of saltstone made from a range of compositions; the response to RAI Comment 43 presents the impacts of a variety of degradation mechanisms on saltstone; the responses to RAI Comments 50, 51, and 54 discuss the sorption of radionuclides on saltstone (i.e., $K_d$ values) and the effect of the reducing environment provided by the presence of slag in saltstone on technetium, and the response to RAI Comment 55 discusses the persistence over a long time (i.e., 10,000 years) of the reducing characteristics of saltstone.

Additionally, the response to RAI Comment 19 provides results of twenty sensitivity cases exploring the impact of changes in saltstone properties and infiltration.

The all-pathways dose results of these cases range from 0.02 mrem/year to 95.4 mrem/year. The 95.4 mrem/year dose is from a case in which the $K_d$ for technetium is set to zero throughout the vault and saltstone for the entire 10,000-year simulation. This sensitivity case, in essence, ignores the presence of slag in both the vault and saltstone and models unretarded movement of the Tc in the environment. This is not a credible case given the slag content in both the vault itself and the saltstone and was modeled merely to understand the model's sensitivity to variations of the $K_d$ factor.

Information excerpted from the Saltstone PA (MMES 1992)

**2.4.2 Physical Characteristics of Saltstone**

For this performance assessment a composition containing 47 wt% salt solution, 25 wt% slag, 25 wt% fly ash, and 3 wt% cement is used to represent the average projected composition of the saltstone that will be sent to the SDF for disposal. When first prepared, the saltstone grout has the consistency and flow characteristics of buttermilk or latex paint and is readily pumped from the SPF to a cell in a disposal vault. The saltstone grout self-levels in the vault and gels in 30 to 60 min. The saltstone hardens in 12 to 18 h with no evidence of bleed water on the upper surface. After setting, the saltstone is self-supporting with a 28-day compressive strength in excess of $1.4 \times 10^6$ Pa. The specific gravity of both the saltstone grout and the solidified saltstone ranges from 1.6 to 1.8. A bulk density of $1.7 \times 10^3$ kg/m$^3$ was used in this assessment to establish the projected inventory and concentration of species in the waste.

The effective diffusivity of saltstone, defined as the product of the molecular diffusivity and tortuosity of the matrix, was estimated from the results of nitrate leach tests on 250 cc blocks of saltstone (Langton 1986). An average value of the apparent diffusion coefficient, which for nitrate is equivalent to the effective diffusion coefficient, was determined to be $5 \times 10^{-9}$ cm$^2$/s.

**2.4.3 Chemical Composition**

After the saltstone solidifies, it can best be described as a porous solid that contains a solution of salts in the pores of the solid. The composition on mixing (i.e., the Saltstone grout composition) is first described in Sect. 2.4.2.1. As a first approximation, the grout composition also describes the solid saltstone. However, pertinent reactions during curing can strongly influence long-term performance of the final waste form, and can alter the composition of the pore solution. Chemical interactions during mixing and curing will change the salt solution composition in the pores, when compared to the solution initially used to prepare the saltstone.

**2.4.3.1 Chemical Composition of Saltstone Grout**

The projected composition for saltstone grout is described in terms of the components used to make the grout. The composition shown in Table 2.4-2 is the projected saltstone grout composition from ETF wastewater, ITP wastewater, and the NB composition of wastewater. For each of these compositions, the same NB of dry materials is used. These compositions assume a grout mixture containing 47 wt% of a salt solution and 53 wt% dry blend comprised of 47.17 wt% slag, 47.17 wt% fly ash and 5.66 wt% cement. This ratio yields a mixture containing 25 wt% slag, 25 wt% fly ash, 3 wt% cement, and 47 wt% salt solution.

These compositions provide a reasonable representation of the range of saltstone grout produced from the two projected waste stream compositions, and it also provides a nominal blend for the purpose of estimating the composition of the saltstone waste form.

#### 2.4.3.2 Chemical Composition of Solid Saltstone

As noted above, chemical reactions between components in the salt solution and the dry blend will change the composition of the saltstone when compared to the starting materials. Chromium (VI) species, technetium (VII) species, and salt solution contaminants that form sparingly soluble sulfides (Hg, Co, Ni, Zn, Tc, Ru, Rh, Sb, Sn) will react with components of the slag to form insoluble species that are not readily leached from the saltstone waste form. Water and soluble aluminum (III), calcium (II), barium (II), and strontium (II) species are incorporated into the cement matrix as the dry materials hydrate and the saltstone sets. Pertinent chemical reactions that can directly impact the long-term radiological performance are discussed in detail in Appendix D.

Based on chemical equilibrium calculations, Tc (VII) will react with components of the slag to form $Tc_2S_7$, while chromate in the solution will be reduced to a lower oxidation state and precipitate as Chromium (III) hydroxide. Strontium and barium are incorporated as aluminosilicates within the calcium aluminosilicate structure of the cement paste. These less soluble forms effectively fix these contaminants, thus reducing their potential impact on long-term performance through groundwater pathways.

Information Excerpted from the Vault 4 SA (Cook et al. 2005)

**Table A-4. Saturated Hydraulic Conductivities (cm/sec)**

| | TI01 | TI02 | TI03 | TI04 | TI05 | TI06 | TI07 | TI08 |
|---|---|---|---|---|---|---|---|---|
| | | | Horizontal conductivity: | | | | | |
| Nati/Back | 1.00E-04 | 1.00E-04 | 1.00E-04 | 1.00E-04 | 1.00E-04 | 1.00E-04 | 1.00E-04 | 1.00E-04 |
| Drain Bot | 1.00E-01 | 9.99E-02 | 9.97E-02 | 9.90E-02 | 9.71E-02 | 9.30E-02 | 8.63E-02 | 7.46E-02 |
| Drain Ver | 1.00E-01 | 1.00E-01 | 1.00E-01 | 1.00E-01 | 1.00E-01 | 1.00E-01 | 1.00E-01 | 1.00E-01 |
| Drain Top | 1.00E-01 | 9.99E-02 | 9.93E-02 | 9.75E-02 | 9.28E-02 | 8.25E-02 | 6.58E-02 | 3.66E-02 |
| Concrete | 1.00E-12 | 5.20E-12 | 1.29E-11 | 3.16E-11 | 7.64E-11 | 1.98E-10 | 4.19E-10 | 1.00E-09 |
| Saltstone | 1.00E-11 | 3.00E-11 | 5.50E-11 | 1.00E-10 | 1.80E-10 | 3.40E-10 | 5.60E-10 | 1.00E-09 |
| | | | Vertical conductivity: | | | | | |
| Drain Bot | 9.52E-02 | 6.45E-02 | 2.70E-02 | 8.94E-03 | 3.34E-03 | 1.41E-03 | 7.25E-04 | 3.93E-04 |
| Drain Top | 8.89E-02 | 4.21E-02 | 1.29E-02 | 3.78E-03 | 1.36E-03 | 5.69E-04 | 2.91E-04 | 1.57E-04 |

**Table A-9. Molecular Diffusion Coefficients**

| Porous Media | Molecular Diffusion Coefficients $Cm^2/sec$ | $Cm^2/year$ |
|---|---|---|
| Native/Backfill Soil | 5.E-05 | 1.58E+02 |
| Drainage Layer | 5.E-05 | 1.58E+02 |
| Saltstone | 5.E-09 | 1.58E-01 |
| Concrete | 1.E-08 | 3.15E-01 |

### A.2.5 Distribution Coefficient

The distribution coefficients ($K_d$) of all contaminants and daughters used for this study are summarized in Table A-8. The values for clay are used for the saturated-zone models. Various plutonium isotopes of different oxidation states are lumped into two pseudo components: Pu- for Pu (III, IV) and Pu5- for Pu (V, VI). For soil, drain and clay, $K_d$ in Pu (III, IV) is significantly higher than Pu (V, VI).

**Table A-8. Distribution Coefficients ($K_d$ in $cm^3/g$)**

| Nuclides | Soil | Drain | Clay | Saltstone | Concrete |
|---|---|---|---|---|---|
| NO3 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Al-26 | 4.00E+01 | 4.00E+01 | 0.00E+00 | 2.00E+01 | 2.00E+01 |
| Am-243 | 1.90E+03 | 1.90E+03 | 8.40E+03 | 5.00E+03 | 5.00E+03 |
| Np-239 | 5.00E+00 | 5.00E+00 | 5.50E+01 | 5.00E+03 | 5.00E+03 |
| Pu-239 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-239 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| Bi-210 | 4.50E+02 | 4.50E+02 | 1.20E+04 | 5.00E+03 | 5.00E+03 |
| Po-210 | 1.50E+02 | 1.50E+02 | 3.00E+03 | 5.00E+02 | 5.00E+02 |
| C-14 | 2.00E+00 | 2.00E+00 | 1.00E+00 | 5.00E+03 | 5.00E+03 |
| Cf-249 | 5.10E+02 | 5.10E+02 | 8.40E+03 | 5.00E+03 | 5.00E+03 |
| Cm-245 | 4.00E+03 | 4.00E+03 | 6.00E+03 | 5.00E+03 | 5.00E+03 |
| Pu-241 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-241 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| Am-241 | 1.90E+03 | 1.90E+03 | 8.40E+03 | 5.00E+03 | 5.00E+03 |
| Np-237 | 5.00E+00 | 5.00E+00 | 5.50E+01 | 5.00E+03 | 5.00E+03 |
| Cl-36 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 5.00E+03 | 5.00E+03 |
| Cm-245 | 4.00E+03 | 4.00E+03 | 6.00E+03 | 5.00E+03 | 5.00E+03 |
| Pu-241 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-241 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| Am-241 | 1.90E+03 | 1.90E+03 | 8.40E+03 | 5.00E+03 | 5.00E+03 |
| Np-237 | 5.00E+00 | 5.00E+00 | 5.50E+01 | 5.00E+03 | 5.00E+03 |
| Cm-246 | 4.00E+03 | 4.00E+03 | 6.00E+03 | 5.00E+03 | 5.00E+03 |
| Cm-247 | 4.00E+03 | 4.00E+03 | 6.00E+03 | 5.00E+03 | 5.00E+03 |
| Am-243 | 1.90E+03 | 1.90E+03 | 8.40E+03 | 5.00E+03 | 5.00E+03 |
| Np-239 | 5.00E+00 | 5.00E+00 | 5.50E+01 | 5.00E+03 | 5.00E+03 |
| Pu-239 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-239 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| Cm-248 | 4.00E+03 | 4.00E+03 | 6.00E+03 | 5.00E+03 | 5.00E+03 |
| Pu-244 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-244 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| Cs-135 | 3.30E+02 | 3.30E+02 | 1.90E+03 | 2.00E+01 | 2.00E+01 |
| Cs-137 | 3.30E+02 | 3.30E+02 | 1.90E+03 | 2.00E+01 | 2.00E+01 |
| H-3 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| I-129 | 6.00E-01 | 6.00E-01 | 1.00E+00 | 2.00E+00 | 2.00E+00 |
| K-40 | 3.00E+00 | 3.00E+00 | 5.00E+00 | 2.00E+00 | 2.00E+00 |
| Mo-93 | 3.00E+00 | 3.00E+00 | 1.30E+01 | 1.00E+00 | 1.00E+00 |
| Nb-93m | 1.60E+02 | 1.60E+02 | 9.00E+02 | 5.00E+02 | 5.00E+02 |
| Nb-94 | 1.60E+02 | 1.60E+02 | 9.00E+02 | 5.00E+02 | 5.00E+02 |
| Nb-95m | 1.60E+02 | 1.60E+02 | 9.00E+02 | 5.00E+02 | 5.00E+02 |
| Nb-95 | 1.60E+02 | 1.60E+02 | 9.00E+02 | 5.00E+02 | 5.00E+02 |
| Ni-59 | 4.00E+02 | 4.00E+02 | 6.50E+02 | 1.00E+02 | 1.00E+02 |
| Np-237 | 5.00E+00 | 5.00E+00 | 5.50E+01 | 5.00E+03 | 5.00E+03 |
| Pd-107 | 5.50E+01 | 5.50E+01 | 2.70E+02 | 1.00E+02 | 1.00E+02 |
| Pu-238 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-238 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| U-234 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Pu-239 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-239 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| U-235 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Pu-240 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-240 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| U-236 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Pu-241 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-241 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| Am-241 | 1.90E+03 | 1.90E+03 | 8.40E+03 | 5.00E+03 | 5.00E+03 |
| Np-237 | 5.00E+00 | 5.00E+00 | 5.50E+01 | 5.00E+03 | 5.00E+03 |
| Pu-242 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-242 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |

| | | | | | |
|---|---|---|---|---|---|
| U-238 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Pu-244 | 3.70E+02 | 3.70E+02 | 6.50E+03 | 5.00E+03 | 5.00E+03 |
| Pu5-244 | 1.50E+01 | 1.50E+01 | 5.00E+01 | 5.00E+03 | 5.00E+03 |
| Ra-226 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| Rb-87 | 5.50E+01 | 5.50E+01 | 2.70E+02 | 5.50E+01 | 5.50E+01 |
| Se-79 | 3.60E+01 | 3.60E+01 | 7.60E+01 | 1.00E-01 | 1.00E-01 |
| Sn-126 | 1.30E+02 | 1.30E+02 | 6.70E+02 | 1.00E+03 | 1.00E+03 |
| Sr-90 | 1.00E+01 | 1.00E+01 | 1.10E+02 | 1.00E+00 | 1.00E+00 |
| Tc-99 | 1.00E-01 | 1.00E-01 | 1.00E-01 | 1.00E+03 | 1.00E+03 |
| Th-228 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-224 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| Th-229 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-225 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| Ac-225 | 4.50E+02 | 4.50E+02 | 2.40E+03 | 5.00E+03 | 5.00E+03 |
| Th-230 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-226 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| Pb-210 | 2.70E+02 | 2.70E+02 | 5.50E+02 | 5.00E+02 | 5.00E+02 |
| Po-210 | 1.50E+02 | 1.50E+02 | 3.00E+03 | 5.00E+02 | 5.00E+02 |
| Th-232 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-228 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| Th-228 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-224 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| U-232 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Th-228 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-224 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| U-233 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Th-229 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-225 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| U-234 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Th-230 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-226 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| Pb-210 | 2.70E+02 | 2.70E+02 | 5.50E+02 | 5.00E+02 | 5.00E+02 |
| Po-210 | 1.50E+02 | 1.50E+02 | 3.00E+03 | 5.00E+02 | 5.00E+02 |
| U-235 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Pa-231 | 5.50E+02 | 5.50E+02 | 2.70E+03 | 5.00E+03 | 5.00E+03 |
| Ac-227 | 4.50E+02 | 4.50E+02 | 2.40E+03 | 5.00E+03 | 5.00E+03 |
| Th-227 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| Ra-223 | 5.00E+02 | 5.00E+02 | 9.10E+03 | 5.00E+01 | 5.00E+01 |
| U-236 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| U-238 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Th-234 | 3.20E+03 | 3.20E+03 | 5.80E+03 | 5.00E+03 | 5.00E+03 |
| U-234 | 8.00E+02 | 8.00E+02 | 1.60E+03 | 2.00E+03 | 2.00E+03 |
| Zr-93 | 6.00E+02 | 6.00E+02 | 3.30E+03 | 5.00E+03 | 5.00E+03 |
| Nb-93m | 1.60E+02 | 1.60E+02 | 9.00E+02 | 5.00E+02 | 5.00E+02 |
| Zr-95 | 6.00E+02 | 6.00E+02 | 3.30E+03 | 5.00E+03 | 5.00E+03 |
| Nb-95 | 1.60E+02 | 1.60E+02 | 9.00E+02 | 5.00E+02 | 5.00E+02 |

**References:**


Cook, J. R., Wilhite, E. L, Hiergesell, R. A., and Flach, G. P., 2005, *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits*, WSRC-TR-2005-00074, Westinghouse Savannah River Company, Aiken, South Carolina

MMES, 1992, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, Martin Marietta Energy Systems, Inc., EG&G Idaho, Westinghouse Hanford Company and Westinghouse Savannah River Company, Westinghouse Savannah River Company, Aiken, South Carolina

WSRC, 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Westinghouse Savannah River Company, Aiken, South Carolina

**GANE**
**Comment 1:** Concerned about the sheer volume of waste that needs to be processed at SRS and the level of radioactivity involved. DOE's intent to vitrify 98% of the radioactivity sounds pretty good until one realizes that it would mean more than 90 million curies of radioactivity that would be placed into the less stable medium of concrete grout which would undoubtedly begin to mobilize into the environment in 50 to 75 years.

**WD Sections:** N/A

**DOE Response:** The salt processing strategy that is described in the *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* is expected to result in removal and vitrification through the Defense Waste Processing Facility (DWPF) of approximately 97.8% to 98.7% of the total curies originally contained in the salt waste (approximately 218 to 220 million curies (MCi) of the 223 MCi total curies in salt waste). The total curies being disposed of in the Saltstone Disposal Facility (SDF) in the form of a solidified grout mixture will be approximately 3 to 5 MCi (1.3 to 2.2%), not 90 MCi as stated in the Comment. A description of the salt processing pathways and associated curie distribution are shown in Figure 2.1 of the Salt WD.

The *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility* (MMES 1992) and the recent *Special Analysis: Revision of Saltstone Vault 4 Disposal Limit* (Cook et al. 2005) calculate the extent of migration of radionuclides from the disposed saltstone over time. The calculation includes the amount of water that could infiltrate the disposal system, the solubility of radionuclides in the saltstone, the sorption of radionuclides on saltstone, concrete and soil as well as the degradation of the engineered system over time, including effects of earthquakes. The resulting concentrations of radionuclides in groundwater over 10,000 years are very low, and the resulting doses to a hypothetical person using groundwater from a well near the disposal facility are well within Department of Energy and Nuclear Regulatory Commission performance objectives.

**References:**

Cook, J. R., Wilhite, E. L, Hiergesell, R. A., and Flach, G. P., 2005, *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits*, WSRC-TR-2005-00074, Westinghouse Savannah River Company, Aiken, South Carolina

MMES 1992, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, Martin Marietta Energy Systems, Inc., EG&G Idaho, Westinghouse Hanford Company and Westinghouse Savannah River Company, Westinghouse Savannah River Company, Aiken, South Carolina

**GANE**
**Comment 2**: GANE is adamantly opposed to Section 3116 and therefore objects to this initial determination under Section 3116.

**WD Sections:** General

**Response:** Section 3116 of the 2005 National Defense Authorization Act authorizes the Secretary of Energy, in consultation with the Nuclear Regulatory Commission, to make determinations that waste meeting specific requirements is not high level waste. The Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site documents DOE's evaluation of the salt waste at SRS against these criteria.

**References:**

DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005.

**GANE**
**Comment 3**: If DOE persists with this Section 3116 Determination, however, GANE believes that the new proposal must be analyzed in a supplemental environmental impact statement to satisfy NEPA.

**WD Sections:** Section 7.2

**Response:** As discussed in Section 2.0 of the Draft Section 3116 Determination, the proposed salt waste treatment and disposal action is addressed by the Salt Processing Alternatives Supplemental Environmental Impact Statement of 2001. A supplement analysis has been prepared that documents this and concludes that no changes to NEPA documentation are required. The ROD for the SPA SEIS has been amended to clarify DOE's intent with respect to salt waste treatment and disposal at SRS and to document the conclusions of the Supplement Analysis.

**References:**

DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005

DOE 2001, *Salt Processing Alternatives Supplemental Environmental Impact Statement*, DOE/EIS-0082-S2, July, 2001

**GANE**

**Comment 4:** GANE is opposed to the two-phase, three part process proposed to gain tank space while waiting for the SWPF to come on-line in 2009.

**WD Sections:** Section 2.1

**Response:** As demonstrated in the Section 3116 Determination, the Department believes that its two-phase, three-part approach to treating and disposing of salt waste is the best available strategy for minimizing the risk associated with the cleanup and closure of the high level waste system at SRS.

**References:**

DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005.

**NRDC**
**Comment 1**: The Interim Phase Processing places undue risks on future generations and inappropriately abandons millions of curies of radioactivity in South Carolina.

**WD Sections:** Section 5

**Response:** The purpose of the 3116 Determination is to evaluate a proposed disposal action against the requirements of Section 3116. The Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site concludes that the proposed disposal action meets all of the requirements specified in Section 3116. Risks to future generations from the disposal of salt waste are addressed in Section 5 of the WD wherein exposure to a member of the public via various scenarios is analyzed. Based on current planned processing the majority of the curies proposed for disposal in the Saltstone vaults is cesium. The majority of cesium will decay in approximately 300 years. Within that time frame, it is reasonable to assume that the Department of Energy and/or its successor agencies will maintain institutional control over the closed Saltstone vaults. This will likely provide additional protection to the citizen's of South Carolina. The Salt Processing Alternatives Supplemental Environmental Impact Statement also evaluated the risks associated with treatment and disposal of salt waste at SRS. The risks associated with implementing a number of treatment options were found to be small and acceptable. DOE has prepared a Supplement Analysis that further concludes that the planned treatment strategy is bounded by the SEIS.

Section 5 of the WD discusses the removal of radionuclides to the maximum extent practical. Section 6 of the WD discusses how the proposed disposal action will be within NRC Class C limits. Section 7 of the WD demonstrates how the proposed disposal action will meet performance objectives. The interim phase will leave Cs-137 that will decay after 300 years. Taken as a whole, the Department believes that the draft Section 3116 Determination clearly demonstrates that the proposed disposal of salt waste at SRS meets the applicable requirements of Section 3116 for the Secretary of Energy to determine that the waste is not high level waste.

**References**:

DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005

DOE 2001, *"Salt Processing Alternatives Final Supplemental Environmental Impact Statement"*, DOE/EIS-0082-S2, June 2001

DOE 2005, *"Supplement Analysis: Salt Processing Alternatives at the Savannah River Site"* DOE/EIS-0082-S2-SA, December 2005

**NRDC**

**Comment 1.1:** The assertion that the DDA process will treat minimal low-activity waste has no basis.

**WD Sections:** Section 1.0 and 2.1

**Response:** Selection of the waste storage tanks and associated salt waste volumes to undergo the Deliquification, Dissolution, and Adjustment (DDA) process during the Interim Salt Processing phase at the Savannah River Site (SRS) is discussed in DOE's response to the Nuclear Regulatory Commission's *Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (NRC 2005).

Data and discourse demonstrating that the lowest-activity tanks have been selected to undergo the DDA process are included in the response to RAI Comment 12 (Attached).

Contained in the response to RAI Comment 10 (Attached) and the SRS *Interim Salt Processing Strategy Planning Baseline* (Mahoney and d'Entremont 2004) are data and discourse demonstrating that the planned total volume of waste to be processed through DDA is the minimal amount required to maintain enough tank space for continual waste processing.

**References:**


Mahoney, M. J. and d'Entremont, P. D., 2004, *Interim Salt Processing Strategy Planning Baseline*, CBU-PED-2004-00027, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

NRC 2005, *Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Scott C. Flanders to Mark A. Gilbertson, May 26, 2005.

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

**NRDC**
**Comment 2:** The draft Section 3116 Determination violates fundamental tenets of health physics.

**WD Sections:** Section 2.1

**Response:** The purpose of the Section 3116 Determination is to evaluate a proposed disposal action against the requirements of Section 3116. The Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site (DOE 2005) concludes that the proposed disposal action meets the requirements specified in Section 3116. Section 5 discusses the identification of highly radioactive radionuclides and their removal to the maximum extent practical. Section 6 of the WD discusses how the proposed disposal action will be within NRC Class C concentration limits. Section 7 of the WD demonstrates how the proposed disposal action will meet performance objectives. Taken as a whole, the Department believes that the Section 3116 Determination clearly demonstrates that the proposed disposal of salt waste at SRS meets the applicable requirements of Section 3116 for the Secretary of Energy to determine that the waste is not high level waste.

In support of the analyses contained in the Salt WD, DOE has prepared a Performance Assessment (MMES 1992), a Special Analysis (Cook et al. 2005), and a Performance Objectives Demonstration Document (PODD) (Rosenberger et al. 2005) in accordance with applicable DOE and NRC guidance. The PODD specifically compares the planned disposal action against the NRC's performance objectives including: 1) 10 CFR 61.41, All Pathways Analysis; 2) 10 CFR 61.42, Inadvertent Intruder Analysis; 3) 10 CFR 61.43, Protection of Individuals during Operations; and 4) 10 CFR 61.44, Long-Term Stability of the Disposal Site. Throughout the PODD's evaluation of compliance with the various performance objectives, DOE demonstrates sound, logical application of fundamental health physics principles; including a comprehensive all-pathways analysis to ensure an accurate projection of dose, application of 10 CFR 20 and 10 CFR 835 limits for doses to workers and the public, an "as low as reasonably achievable" or ALARA program, and an overall radiation protection program.

**References:**


DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005

MMES, 1992, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, p. 2-38, Martin Marietta Energy Systems, Inc., EG&G Idaho, Westinghouse Hanford Company and Westinghouse Savannah River Company, Westinghouse Savannah River Company, Aiken, South Carolina

Cook, J. R., Wilhite, E. L, Hiergesell, R. A., and Flach, G. P., 2005, *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits*, WSRC-TR-2005-00074, Westinghouse Savannah River Company, Aiken, South Carolina

Rosenberger, K. H., Rogers, B. C., and Cauthen, R. K., 2005, *Saltstone Performance Objective Demonstration Document*, CBU-PIT-2005-00146, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina

**NRDC Comment 3:** Dilution and pollution is no longer an acceptable waste management and disposal practice.

**WD Sections**: Section 2.1

**Response:** The salt waste treatment and disposal strategies discussed in detail in the Section 3116 Determination do not rely upon dilution to treat and dispose of salt waste. The salt waste treated via the DDA process is combined with other waste from within the tank farm (e.g., DWPF recycle waste) to adjust the sodium molarity and other non-radioactive parameters so that the waste can be processed and disposed of at the Saltstone Facility. In the case of Tank 48 waste, the organic component of the waste drives the amount of recycle waste or inhibited water that must be combined with the salt waste from Tank 48 for safe processing and disposal.

**References:**

DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005

**NRDC**
**Comment 4:** Draft Section 3116 conflicts with NEPA and prior DOE decisions

**WD Sections:** Section 2.0

**Response:** As discussed in Section 2.0 of the Draft Section 3116 Determination, the proposed salt waste treatment and disposal action is addressed by the Salt Processing Alternatives Supplemental Environmental Impact Statement of 2001. A supplement analysis has been prepared that documents this and concludes that no changes to NEPA documentation are required. The ROD for the SPA SEIS has been amended to clarify DOE's intent with respect to salt waste treatment and disposal at SRS and to document the conclusions of the Supplement Analysis.

**References:**

DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005

DOE 2001, *Salt Processing Alternatives Supplemental Environmental Impact Statement*, DOE/EIS-0082-S2, July, 2001

**NRDC**
**Comment 5:** The regulatory performance requirements are obsolete.

**WD Sections:** Section 7

**Response:** Section 3116 requires demonstration of compliance with specific requirements promulgated by the Nuclear Regulatory Commission. This comment is not within the Department's purview.

**References:**

DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005

**Hooker**
**Comment 1:** Lack of trust.

**WD Sections:** General

**Response:** The Draft Section 3116 Determination evaluates a proposed disposal action against the requirements of Section 3116 which were selected to ensure protection of the health and safety of the public and the environment. The NRC and the State of South Carolina will monitor the Department's actions associated with implementation of this waste disposal activity and will identify any non-compliances.

Further, the Department has an extensive public involvement program that allows citizens the opportunity to learn about SRS activities and to express concerns regarding those activities.

**References:**

DOE 2005, *Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, DOE-WD-2005-001, February, 2005

**WHET Comment 1:** No factor of safety used in the Performance Assessment calculations. No field tests have been performed for the plan to grout 3 to 5 million curies of cesium and dispose of it in the Saltstone Disposal Facility.

**WD Sections:** Section 7.0

**DOE Response:** Although factors of safety are routinely employed in engineering calculations, they are not generally used in Performance Assessments (PA). In the PA, input parameters and assumptions are selected to provide a reasonable yet conservative representation of the system being analyzed.

The projected long-term performance of the Saltstone Disposal Facility (i.e., retardation of radionuclide migration) is documented in the *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility* (MMES 1992) and the *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits* (SA) (Cook et al. 2005).

The results of the SA are expressed in terms of radionuclide disposal limits (i.e., the total number of curies of each radionuclide that can be disposed without exceeding any of the performance measures; see Table 7-2 of the SA). These limits are compared with the expected inventory of radionuclides to be disposed in Vault 4 to obtain the projected impacts for the entire facility.

The *Saltstone Performance Objective Demonstration Document* (Rosenberger et al. 2005), Section 4.0, uses those disposal limits and the projected radionuclide inventory to calculate the maximum annual dose to a member of the public from all saltstone disposal pathways of 2.3 mrem to the whole body, 4.6 mrem to the thyroid, and 5.3 mrem to any other organ. These doses are factors of eleven, sixteen, and five, respectively, less than the NRC performance objective for all-pathways annual exposure to a member of the general public (i.e., 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ). The projected dose to a hypothetical inadvertent intruder is 21.7 mrem/year, which is 4% of the NRC performance objective of 500 mrem/year. These results provide a reasonable expectation that the performance objectives will not be exceeded.

A field test of saltstone disposal was conducted at SRS (McIntyre and Wilhite 1987). The results of this test were used in DOE's response to the Nuclear Regulatory Commission's *Request for Additional Information* [RAI] *on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* (NRC 2005). Specifically, the response to RAI Comment 31 (Attached) compares a simulation of the lysimeter test using the PA model with the test results (WSRC 2005).

**References:**


Cook, J. R., Wilhite, E. L, Hiergesell, R. A., and Flach, G. P., 2005, *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits*, WSRC-TR-2005-00074, Westinghouse Savannah River Company, Aiken, South Carolina

McIntyre, P. F., and Wilhite, E. L, 1987, *Slag Saltstone Lysimeter: Monitoring During the First Two Years*, DPST-87-523, Savannah River Laboratory, Westinghouse Savannah River Company, Aiken, South Carolina

MMES 1992, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, Martin Marietta Energy Systems, Inc., EG&G Idaho, Westinghouse Hanford Company and Westinghouse Savannah River Company, Westinghouse Savannah River Company, Aiken, South Carolina

NRC 2005, *Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Scott C. Flanders to Mark A. Gilbertson, Nuclear Regulatory Commission (NRC)

Rosenberger, K. H., Rogers, B. C., and Cauthen, R. K., 2005, *Saltstone Performance Objective Demonstration Document*, CBU-PIT-2005-00146, Westinghouse Savannah River Company, Aiken, South Carolina

WSRC 2005, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, CBU-PIT-2005-00131, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

# ATTACHMENTS

During the consultation process with the Nuclear Regulatory Commission (NRC) on the Draft Section 3116 Determination, a Request for Additional Information (RAI's) was generated by the NRC. DOE prepared responses to 68 specific RAI's and some of those key responses are reproduced here verbatim to ensure consistency in responding to the public's comments. In addition, during later meetings with the NRC, certain action items were identified that DOE again prepared responses to. One of those responses is included verbatim in this attachment as well to ensure a consistent response to the public comments. The full text of both the RAI responses and the AI responses can be found in CBU-PIT-2005-00131, *Response to Request for Additional Information on the Draft Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Rev. 1, July 2005 and CBU-PIT-2005-00203, Rev. 1, *Response to Action Items from Public Meetings Between NRC and DOE to Discuss RAI for the Savannah River Site*. Because these were developed prior to completing the consultation process with the NRC and preparation of the final Salt Waste Determination, the proposed changes to the Salt Waste Determination identified in these responses are not necessarily identical to those actually incorporated in the final document.

The following are included in this attachment:

DOE Response to NRC Comment 10

DOE Response to NRC Comment 11

DOE Response to NRC Comment 12

DOE Response to NRC Comment 13

DOE Response to NRC Comment 14

DOE Response to NRC Comment 31

DOE Response to NRC Comment 37

DOE Response to NRC Comment 57

DOE Response to NRC Action Item 3 (7/27/05)

Letter, Jeffrey M. Allison to Jean Sulc, Chairperson, Savannah River Site Citizen's Advisory Board, SPD-05-215, June 28, 2005

**NRC Comment 10**: Additional information is needed to support the conclusion that use of interim treatment measures before the completion of the SWPF is consistent with removal of highly radioactive radionuclides to the maximum extent practical.

**Basis:** The NRC agrees with the conclusion in Reference 4 that the determination of whether highly radioactive radionuclides have been removed to the maximum extent practical can include a wide variety of considerations. However, it is expected that any factors included in the determination will be supported by a technical basis and, when possible, quantitative comparisons.

For example, although it is stated that risk to the public is reduced by continuing sludge processing at the Defense Waste Processing Facility (DWPF) [4], no information is presented to support the amount of risk reduction achieved by continuing waste processing prior to completion of construction of the SWPF. Furthermore, insufficient information is presented to enable a comparison between the increased risks associated with disposing of Deliquification, Dissolution and Adjustment (DDA) and Actinide Removal Process (ARP)/MCU waste in saltstone with the risks associated with postponing treatment until all of the waste can be treated at the SWPF.

Similarly, although it is stated that it is necessary to treat waste with interim procedures prior to the completion of the SWPF because shutdown of the DWPF due to tank space limitations will be economically impractical, a comparison between the costs of shutting down and restarting the DWPF with the costs of implementing the proposed interim treatment procedures and disposing of higher activity waste in the SDF has not been provided. Although it was estimated that it would cost $1 billion to halt and restart waste processing with the DWPF [4], no basis for that estimate was given.

**Path Forward:** Provide a detailed cost/benefit analysis supporting a comparison of the proposed alternative with alternative treatment plans. The response should address the quantitative and qualitative costs and benefits of treating waste with the SWPF alone as well as the costs and benefits of treating waste with both the ARP/MCU and the SWPF. The response should include:
1) A comparison between the risks to the general public, workers, and inadvertent intruders associated with the proposed treatment plan and the two alternatives (e.g., treating waste with the SWPF alone or treating waste with the ARP/MCU and SWPF). The response should also include an estimate of the risk the tanks currently pose to the public as well as the number of tank-years of waste storage in old style tanks that would be avoided by treating waste with DDA and ARP/MCU instead of waiting to treat waste with the SWPF (e.g., percent reduction). Consideration should be given to the fact that the wastes that have been proposed to be removed are the lowest activity wastes [4].

2) A comparison of the costs associated with at least three alternatives (i.e., the proposed alternative, treating waste at the SWPF alone, and treating waste with the ARP/MCU and SWPF).

The response should address the costs associated with construction and operation of interim procedures and the costs associated with disposing of a higher activity waste on site, as well as the costs of ceasing and restarting sludge processing.

Additional alternatives, such as slowing down the throughput of the DWPF or creating new interim tank storage, should be considered. The comparison should also consider factors other than economic cost (e.g., schedule) and the factors should be converted into a comparable metric (e.g., cost and risk) to the extent practical.

The analysis should reflect uncertainties in the timing of when sludge processing would need to cease due to lack of tank space and the uncertainty in the availability of the ARP, MCU, and SWPF treatment facilities.

**SRS Response:** This response evaluates and compares costs and benefits associated with three different cases and demonstrates that the salt waste disposition strategy described in the Draft Section 3116 Determination Salt Waste Disposal Savannah River Site, DOE-WD-2005-001, (WD) is the most cost effective case and the case that will provide the lowest overall risk to the site worker and to the general public. Additional details concerning the evaluation performed in response to this RAI comment can be found in "Cost and Benefit Evaluation for Three Salt Waste Treatment Cases at SRS" (d'Entremont et al. 2005).

The following three interim salt strategy cases were evaluated and compared in this response:

Case #1: Baseline Case - The Interim Salt Treatment Strategy is described in the WD and involves initial salt waste disposition using Deliquification, Dissolution, and Adjustment (DDA) followed by Actinide Removal Process (ARP) and Modular CSSX (Caustic Side Solvent Extraction) Unit (MCU) in combination with DDA until the Salt Waste Processing Facility (SWPF) becomes operational. Once the SWPF facility becomes operational, all salt waste streams will be treated using the SWPF.

Case #2: Limited Interim Processing (LIP) Case – This case does not begin initial salt waste disposition until the ARP and MCU facilities begin operation in 2007. No salt waste is processed using the DDA process. Upon start-up of SWPF, ARP/ MCU operations cease and all salt waste is processed using the SWPF.

Case #3: No Interim Processing (NIP) Case – This case does not begin initial salt waste disposition until the SWPF is ready to begin operation in 2009. No salt waste is processed using the DDA process nor with the ARP/MCU facilities. Using this case, all salt waste is processed using the SWPF.

Note that the Baseline Case is the case that was described in the WD and that the other two cases were requested for evaluation in the RAI. These other two cases evaluated herein, namely LIP and NIP, represent scenarios for evaluation only and do not represent detailed plans that have been accepted by either the DOE or by the facilities involved. When these three cases were evaluated, the following fundamental differences were noted between the cases:

Completion of High Level Waste (HLW) System Operations: The Baseline Case resulted in the completion of HLW System operations in 2019. The salt waste dispositioned to SPF/SDF by DDA and ARP/MCU created compliant tank space in the HLW Tank Farms that permitted Defense Waste Processing Facility (DWPF) operations to continue without interruption and permitted SWPF operations to commence processing at forecast production rates. The LIP Case required 3+ years longer to complete HLW system operations than the Baseline Case. The delay in mission completion resulted from the reduced processing rates through SWPF and DWPF caused by the limited compliant tank space available to prepare the salt and sludge waste streams for processing during initial years of SWPF operation. DWPF production rates are impacted because of the limited compliant tank space prevents sludge washing which is required prior to processing sludge waste at DWPF. The NIP Case required approximately 5+ years longer to complete HLW system operations than the Baseline Case. The causes for the delay in mission completion were the same as those above. However, since the time required to recover adequate compliant tank space was longer for this case as compared to the LIP case, the extension of HLW System operations was longer for the NIP case. Note that for both the LIP Case and the NIP Case, DWPF operations were slowed, but the DWPF was not shut down.

Risk: The doses (exposures) associated with each of the three cases were compared as well as the material/facilities at risk. Dose was further broken down in terms of dose to the facility worker, dose to the public from both ongoing operations and from material dispositioned to the SDF, and dose to the inadvertent intruder from the SDF. In order to appropriately characterize the risks from ongoing operations, the differences between the cases in terms of old style Tank Years and Tank Farm waste disposition rate were also evaluated and expressed in Curie Years. The evaluation showed the following:

**Table 10-1 Summary of Dose, Tank Years and Curie Year Impacts**

| Case | Total Dose - All Workers (rem) | Public Dose (mrem/yr) | Average SDF Intruder Dose (mrem/year) | SDF Dose - All Pathways (mrem/yr) | Old Style Tank Years* | Tank Farm Curie Years** |
|---|---|---|---|---|---|---|
| Baseline | 890 | 0.19 | 9*** | 2.3 | 240 | 3.7E+09 |
| LIP Case<br><br>*(change from Baseline)* | 1100<br><br>*(+24%)* | 0.19<br><br>*(0.0%)* | 0 | 2.3<br><br>*(0.0%)* | 300<br><br>*(+25%)* | 4.7E+09<br><br>*(+25%)* |
| NIP Case<br><br>*(change from Baseline)* | 1200<br><br>*(+35%)* | 0.19<br><br>*(0.0%)* | 0 | 2.3<br><br>*(0.0%)* | 340<br><br>*(+42%)* | 5.3E+09<br><br>*(+42%)* |

* Total number of years all old style tanks are in service, e.g., 20 tanks in service for 2 years = 40 Tank- Years

** Total number of years a curie is in the Tank Farms, e.g., 30 MCi in the tank farm for three years = 90M Curie- Years

*** The baseline intruder dose of 9 mrem/year equates to an increase of only 2.5% over the natural background dose of 360 mrem/year

It can be seen from Table 10-1 that the Baseline Case results in significantly lower worker dose (approximately 200 rem less than LIP Case and 300 rem less than NIP case) and significantly shorter time that radioactive material remains in the old style tanks. Intruder doses are higher for the Baseline Case, but the difference (average 9 mrem/year for the maximum 100 year intruder dose) is not significant when compared to average exposure from natural sources of radiation (360 mrem/year (NCRP 1987)). The LIP and NIP Cases show significant increases from the Baseline Case for worker exposure and time that radioactive material remains in the Tank Farm. Thus, using the Interim Salt Processing Baseline Case provides the lowest risk to facility workers from radiation exposure and the shortest time that radionuclides remain in tanks that do not meet secondary containment requirements.

Financial Cost: The Baseline Case is the most cost effective case. The primary reason that the Baseline Case is the most cost effective is the difference in lifecycle costs associated with extending the HLW system (Tank Farms, DWPF, SWPF, Saltstone Production Facility (SPF), Saltstone Disposal Facility (SDF), etc.) operations by 3+ years for the LIP Case and 5+ years for the NIP Case. This results in an additional cost for operation of approximately $1B and $1.5B respectively (unescalated). Since the sunk costs (costs already incurred for the project that are not recoverable) for MCU/ARP construction are high relative to the total project cost, and since the life cycle costs for the HLW system are much higher than the project construction and D&D (decontamination and decommissioning) costs, the life cycle costs dominate the cost comparison. As a result of the significant differences (approximately one order of magnitude) between the project costs remaining for ARP/MCU and the life cycle cost increases for extending facility lifecycles, the case that results in the shortest life cycle will have the lowest financial cost.

Other aspects of the facility operations that were reviewed as a part of this evaluation included consideration of slowing down DWPF rather than shutting down DWPF due to feed streams (sludge batches) to DWPF being unavailable. The slowdown avoids a shutdown of DWPF and subsequent restart. The evaluation shows that slowing down DWPF is preferred over shutdown from a cost perspective and cost comparisons utilized this basis when DWPF operation was evaluated. For the analysis of both the LIP Case and the NIP Case, DWPF operations are maintained at a reduced level to avoid the cost impacts a shutdown and restart.

Qualitative Discussion

These additional factors were considered in the comparative evaluation of the Baseline Case, the LIP Case and the NIP Case. The evaluation of these factors is described below. This evaluation is qualitative since it was not possible to provide a quantitative evaluation of these factors.

Sensitivity to facility start-up delays: Since the primary influence on cost and risk associated with these cases is life cycle, delays in facility start-up will have a significant impact on both risk and cost. The evaluation assumes that the dates projected for facility start-up will be achieved and that throughput rates will be as forecasted. Delays in facility start-up and reductions in throughput rates would extend the duration of facility operation with associated increases in cost and a decrease in the rate of risk reductions.

The primary influence on cost and risk associated with these cases is the duration of facility operation. The evaluation assumes that the dates projected for facility start-up will be achieved and that throughput rates will be as forecasted. Delays in facility start-up and reductions in throughput rates would extend the duration of facility operation with associated increases in cost and a decrease in benefits. It should be noted that this extension in facility operation is likely greater than a day for day match with a delay in facility start-up. Delays in facility start-up will result in less tank space available for salt batch and sludge batch preparation. It would take years of operation at reduced rates to recover the "lost" tank space. In the cases analyzed, it took 4+ years after SWPF start-up for the LIP Case and 7+ years for the NIP Case for SWPF to achieve forecast processing rates. Attaining these forecast processing rates was limited by the availability of compliant tank space to prepare salt batches to feed SWPF at a rate of seven million gallons of salt waste solution per year.

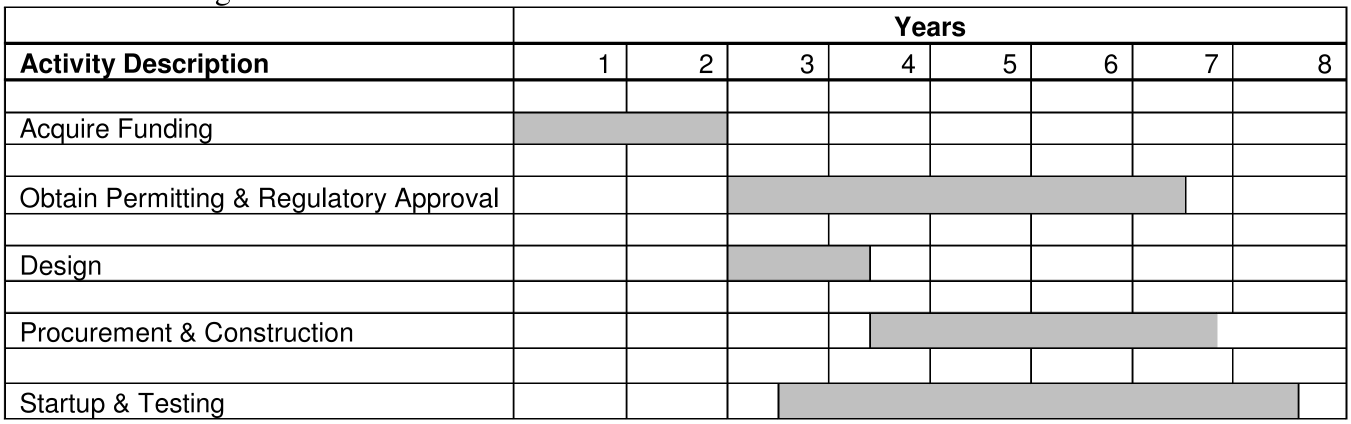
Construction of new HLW storage tanks: In 2001, the cost of new tank construction at Hanford was estimated to be $75 Million assuming that at least four tanks were built (Boyles 2001). The breakdown of the costs supporting this total is shown in Table 10-2. In order to support SWPF start-up at full capacity, four new tanks would need to be constructed for staging dissolved salt solution. Therefore, a total of $300 Million would be required to construct adequate tank space. Since the cost of new tank construction was more than twice the lifecycle cost for ARP/MCU facility (less sunk costs), this was not considered to be cost effective. Hanford also estimated an overall schedule of approximately seven years, the details of which are shown in Figure 10-1. This schedule is not within the timeframe required to support SWPF start-up assumptions. One further note: The construction of new tank space does not support DOE's and the State of South Carolina's overall objective of risk reduction.

Table 10-2. Cost Estimate for Construction of New Double-Shell Tanks
(Based on Each One of at Least Four Tanks)

| **Activity Description** | **Cost ($K)** |
|---|---|
| Obtain Permitting and Regulatory Approval | 1,000 |
| Design | 7,000 |
| Procurement and Construction | 66,000 |
| Start-up and Testing | 1,000 |
| **Total** | **$75,000** |

Source: V. C. Boyles, et al. RPP-7702 Tank Space Options, RPP-7702, CH2 M Hill Hanford Group, Rev. 0., April 4, 2001. (page 4-53, Table 4-25)

Figure 10-1. Schedule for Construction of New Double-Shell Tanks




Source: V. C. Boyles, et al. RPP-7702 Tank Space Options, RPP-7702, CH2 M Hill Hanford Group, Rev. 0., April 4, 2001. (page 4-55, Figure 4-8)

Aging Infrastructure: A critical element to the discussion on material at risk (expressed in terms of Curie Years and Tank Years) is the consequence of materials leaked from the aging noncompliant tanks and related infrastructure (pipes, valves, secondary containment structures, etc.). While the sections of Reference 1 that address worker dose and life cycle costs clearly show the expected increases to exposure and cost associated with lifecycle extensions, they cannot accurately quantify the risk associated with the continued use of the aging tank farms during the period of lifecycle extension. Clearly the risk of leaks increases proportionally with the increase in facility lifecycle associated directly with the increase in years of operation, e.g. a ten percent increase in lifecycle is a ten percent increase in risk of an incident. The probability of leaks also increases as a result of the fact that tanks and transfer infrastructure continue to degrade due to the corrosive environment and radiation associated with the storage and processing of HLW. No attempt is made to quantify the probability of failure of the degrading infrastructure, but the increased probability is clear. Likewise, no attempt is made to quantify the impact of the contamination to the environment or to quantify the worker/public dose associated with such a leak. The quantity and type of material, the location of the leak, duration of the leak, proximity of workers, proximity of transport media, environmental conditions, etc. all effect the impact of such an occurrence. While SRS has robust systems for preventing and/or mitigating such an occurrence through tank inspections, corrosion control programs, solution chemistry management, secondary containment, leak detection systems, etc., the probability of occurrence of a leak increases with facility lifecycle extensions. The quantification of Tank Years and curie years is directly related to this increase in risk and demonstrates the exigencies associated with implementation of salt waste stabilization utilizing the Interim Salt Processing Strategy described in the Salt WD.

Summary: Taken as a whole, the above fundamental differences in the cases evaluated demonstrate that the Baseline Case is the most cost effective option and provides the lowest worker dose. Inadvertent intruder doses are marginally higher with the Baseline Case, but this dose is not significant when compared to exposure from natural sources of radiation. The Baseline Case also reduces radioactive material at risk the most quickly because it facilitates stabilization of radioactive material in the Tank Farms more quickly than in the other cases, as well as permitting closure of old style tanks per the enforceable Federal Facility Agreement (FFA) schedule (WSRC 1993). For these reasons, the Baseline Case provides the greatest overall benefit at the lowest cost.

**References:**

d'Entremont, P. D., Hill, P. J., Ketusky, E. T., Sheppard, R. E., *Cost and Benefit Evaluation for Three Salt Waste Treatment Cases at SRS*, CBU-PIT-2005-00150, Revision 1, July 7, 2005.

WSRC, 1993, *Federal Facility Agreement for the Savannah River Site*, Administrative Document Number 89005-FF, WSRC-OS-94-42, Effective Date: August 16, 1993.

V. C. Boyles et al., 2001, *RPP-7702 Tank Space Options*, RPP-7702, CH2 M Hill Hanford Group, Rev. 0., April 4, 2001.

National Council on Radiation Protection, 1987, *Ionizing Radiation Exposure of the Population of the United States*, NCRP Report No.93, 1987.

**NRC Comment 11:** Predicted removal efficiencies and the bases for predicted removal efficiencies for many of the highly radioactive radionuclides are not provided for each of the treatment schemes (i.e., DDA, ARP, MCU, SWPF). Predicted removal efficiencies and the bases for those removal efficiencies are necessary to support the conclusion that highly radioactive radionuclides have been removed to the maximum extent practical. It should be noted that NRC staff believes that "highly radioactive radionuclides" are those radionuclides that contribute most significantly to risk to the public, workers, and the environment.

**Basis:** DOE has identified several radionuclides, including I-129, Tc-99, Sn-126, Se-79, Cs-137, Sr-90, Pu-isotopes, U-isotopes, and Np-237/Am-241, as radionuclides that are important to the Saltstone Disposal Facility (SDF) performance [1, 3, 5]. However, the expected removal of all of these radionuclides by the DDA, ARP, MCU, and SWPF treatments are not provided. Predicted removal efficiencies, with the technical bases for the predicted efficiencies, are necessary to support an evaluation of whether the proposed treatment plan is consistent with the removal of highly radioactive radionuclides to the maximum extent practical. Removal efficiencies for unit processes within each of the treatment processes (e.g., cross flow filtration, monosodium titanate (MST) strikes, and solid washing operations) are needed to support the predicted removal efficiencies for each treatment process. Estimated uncertainties in predicted removal efficiencies are necessary to allow a meaningful comparison of the predicted performance of each process and to support an analysis of the source term as part of a performance assessment.

For example, the concentration of several highly radioactive radionuclides in the waste from the SWPF will be higher than the concentrations resulting from the ARP/MCU treatment (Table 3-1 of [5]). Based on the information in Reference 4 and supporting documents, it is difficult to determine if the SWPF waste has higher concentrations of some radionuclides than the ARP/MCU waste because of differences in the predicted radionuclide concentrations in influent waste streams, or because the SWPF will have lower decontamination factors for some radionuclides than the ARP/MCU treatment.

**Path Forward:** Provide a list of radionuclides that are determined to be highly radioactive radionuclides with respect to waste disposal at the SDF. The response should include technical bases to support the selections. The determination of which radionuclides are highly radioactive with respect to waste disposal at the SDF should address the predicted contributions of each radionuclide to the risk to the public, workers, and the environment under expected conditions and under less favorable conditions (e.g., in cases with significant degradation of the cap, erosion barrier, or waste form).

Provide predicted removal efficiencies for highly radioactive radionuclides for the DDA, ARP, MCU, and SWPF treatment processes, as well as unit processes within each treatment process. The response should include flowcharts showing removal efficiencies for highly radioactive radionuclides. The response also should include estimated uncertainties in the predicted removal efficiencies.

**SRS Response:** Based on consultations with the NRC, DOE views "highly radioactive radionuclides" in the context of Section 3116 to be those radionuclides, which, using a risk-informed approach, contribute most significantly to radiological risk to the workers, the public, and the environment. Table 11-1, below, lists these radionuclides for the salt waste at the Savannah River Site. This list takes into account scientific and health physics principles, knowledge and expertise. The scientific rationale for this list is explained in the *Draft Section 3116 Determination* (pp. 29-30) and the additional information discussed below.

Strontium-90, Cs-137, and the alpha-emitting transuranic (TRU) nuclides (alpha-emitting isotopes of Pu, Am, Np and Cm which constitute the majority of the actinides) are the radionuclides for salt waste disposal at Savannah River Site that, on the basis of a risk-informed approach, contribute most significantly to radiological risk to the workers, the public, and the environment. The significance of the contribution of any particular radionuclide to radiological risk and potential dose depends on the concentration and availability of the radionuclide at the time of potential exposure, as recognized by the NRC. See 10 CFR 61.55(a)(1). DOE has compared the risk contributions of the radionuclides to various existing indicators of radiological risk to workers, the public, and the environment. Specifically, the inventories of radionuclides in solidified salt waste (if solidified without use of DDA, ARP/MCU, or SWPF treatment) were compared against NRC Class A concentration limits, and the dose limits for radiation protection in the performance objectives at 10 CFR 61 Subpart C each serving as a quantitative aid in validating which radionuclides are "highly radioactive." In this analytical process, four results are noted[1]. First, note that Sr-90, Cs-137, and the alpha-emitting TRU nuclides (alpha-emitting isotopes of Pu, Am, Np and Cm) are the only radionuclides in this waste that have total inventories in solidified salt waste (if solidified without use of DDA, ARP/MCU, or SWPF treatment) which would result in a dose exceeding the NRC Class A concentration limits (10 CFR 61.55).[2] Second, note that no radionuclides have average inventories in solidified salt waste (if solidified without use of DDA, ARP/MCU, or SWPF treatment) exceeding 10%[3] of the allowable annual public dose of 25 mrem (*See* 10 CFR 61.41)**.** Third, note that Cs-137 is the only radionuclide with an average inventory in solidified salt waste (if solidified without use of DDA, ARP/MCU, or SWPF treatment) in an SDF vault which would result in a dose that exceeds 10% of a allowable annual intruder dose of

[1] For the comparisons to 10 CFR 61.55 Class A concentration limits, 10 CFR 61.41, 10 CFR 61.42 and 10 CFR 61.43, the comparisons were made as if the waste was solidified as grout, using the grout quantity and grout composition which will be used in the SDF, but without first treating the salt waste through DDA, ARP/MCU or SWPF. The solidified waste form was used in this analysis because the solidified waste form will affect the availability of the radionuclides to the environment, human intruder and the public after disposal. As NRC has recognized, the contribution of any particular radionuclide to radiological risk depends on the availability of the radionuclide at the time of exposure as well as its concentration.

[2] Reference to Class A limits is intended only as a tool to assist in screening nuclides for consideration as "highly radioactive." It does not mean that all nuclides that exceed Class A are highly radioactive radionuclides, *per se*.

[3] Use of 10% in this context is not inconsistent with the position adopted by the NRC in another context (decommissioning). Specifically, in that context, the NRC has stated: "NRC staff considers radionuclides and exposure pathways that contribute no greater than 10 percent of the dose criteria to be insignificant contributors" (NUREG 1757, *Consolidated NMSS Decommissioning Guidance*, Vol. 2, Sec. 3.3, p. 3-4).

500 mrem (*See* 10 CFR 61.42). Fourth, note that Cs-137 is the only radionuclide with a total inventory in solidified salt waste (if solidified without use of DDA, ARP/MCU, or SWPF treatment) which would result in a dose that exceeds 10% of a allowable annual worker gamma dose of 5.0 rem (*See* 10 CFR 61.43). Additionally, note that Sr-90, Cs-137, and the alpha-emitting TRU nuclides are the only radionuclides driving worker inhalation dose.

In summary, comparison of SRS salt characterization data with the four health and environmental indicators given above suggests Sr-90, Cs-137, and the alpha-emitting TRU nuclides (alpha-emitting isotopes of Pu, Am, Np and Cm) are the radionuclides in solidified salt waste (if solidified without use of DDA, ARP/MCU, or SWPF treatment) to be considered highly radioactive radionuclides to be removed to the maximum extent practical (Reboul 2005). Identification of these nuclides is based on the specific facts of this salt waste, and does not necessarily apply to other wastes or to other 3116 waste determinations. DOE's two-phased, three-part salt processing plan provides for removal of these nuclides using a combination of the following five treatment processes: 1) deliquification, dissolution, and adjustment (DDA); 2) actinide removal process (ARP) without monosodium titanate (MST) sorption; 3) ARP with MST sorption; 4) modular caustic side solvent extraction unit (MCU); and 5) Salt Waste Processing Facility (SWPF) treatments. Nominal, lower bounding, and upper bounding removal efficiencies for each of the planned treatment processes are identified in Table 11-1 below (Reboul 2005).

Table 11-1

| Treatment Process | Removal Efficiency, % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sr-90 | | | Cs-137 | | | α-emitting TRU | | |
| | Nom | Low | High | Nom | Low | High | Nom | Low | High |
| DDA | 66 | 46 | 86 | 50 | 30 | 70 | 63 | 43 | 83 |
| ARP w/o MST | 99.6 | 98.0 | 99.9 | ~ 0 | ~ 0 | ~ 0 | 78 | 50 | 93 |
| ARP w/ MST | 99.997 | 99.4 | 99.999 | ~ 0 | ~ 0 | ~ 0 | 98 | 90 | 99.9 |
| MCU | 0 | 0 | 0 | 91 | 90 | 92 | 0 | 0 | 0 |
| SWPF | 99.98 | 99.4 | 99.999 | 99.998 | 99.99 | 99.998 | 96 | 90 | 99.5 |

Selenium-79, Tc-99, Sn-126, I-129, and uranium isotopes were identified in the *Draft Section 3116 Determination,* as having been considered in detail due to their long radiological lives and high potential for mobility in the environment.[4] However, those radionuclides are in such low concentrations in the salt waste that they do not present a significant risk to the workers, the public or the environment. For those contained in Tables 1 and 2 of 10 CFR 61.55, the radionuclides individually and in combination are well below the concentration limits for Class A waste even if these radionuclides were solidified without treatment (Reboul 2005, Table 2).

[4] Although discussed in the draft waste determination, these radionuclides may not be those discussed for other waste forms or other sites.

Subsequent to the development of the Draft Section 3116 Determination, DOE prepared an updated Special Analysis for the Saltstone Facility (Cook et al. 2005) using improved analytical models and additional sensitivity analyses that more accurately depicted the potential dose impacts of salt waste disposal. This analysis demonstrates that Se-79, Tc-99, Sn-126, I-129, and uranium were found not to exceed any of the indicators discussed above.

The results of the SA as well as conclusions reached using the above analytical process pertaining to radionuclide inventories in the solidified salt waste (if solidified without use of DDA, ARP/MCU, or SWPF treatment) indicate these radionuclides have an insignificant impact on risk and therefore are not necessarily highly radioactive radionuclides for the SRS salt waste. In fact, inventories of all other radionuclides in the solidified salt waste (if solidified without use of DDA, ARP/MCU, or SWPF treatment) are two or more orders of magnitude below the dose-based limits of the performance objectives discussed above (*See* 10 CFR 61.41-43). As an example, Table 11-2 below demonstrates this for Se-79, Tc-99, Sn-126, I-129, and the uranium isotopes for the all-pathways public dose (10 CFR 61.41).

Table 11-2

| Radionuclide | Dose from Average Untreated Solidified Inventories in Vault 4 Volume, mrem/yr | Fraction of 25 mrem/yr Dose |
|---|---|---|
| Se-79 | 3.3E-01 | 1.3E-2 |
| Tc-99 | 4.5E-13 | 1.8E-14 |
| Sn-126 | 3.0E-17 | 1.2E-18 |
| I-129 | 6.3E-03 | 2.5E-4 |
| U-232 | < 1.1E-21 | < 4.3E-23 |
| U-233 | < 1.6E-19 | < 6.3E-21 |
| U-234 | < 1.1E-19 | < 4.2E-21 |
| U-235 | < 3.0E-21 | < 1.2E-22 |
| U-236 | < 1.3E-20 | < 5.0E-22 |
| U-238 | < 1.7E-19 | < 6.9E-21 |

(Data derived from Reboul 2005, Table 3).

Thus, these other radionuclides (Se-79, Tc-99, Sn-126, I-129 and uranium isotopes) both individually and in combination would result in doses which are clearly below 10% of the limits set forth in performance objectives in 10 CFR 61.41, 10 CFR 61.42 and 10 CFR 61.43 and therefore do not contribute significantly to the risk to workers, the public, and the environment. Because of the very low concentrations of these radionuclides and low associated risks as shown above, these radionuclides are not targeted for removal. In this regard, the "maximum extent practical" removal standard in Section 3116 of the NDAA contemplates, among other things, the exercise of expert judgment and consideration of the sensibleness and reasonableness of further removal of radionuclides. For the SRS salt waste streams, the concentrations of Se-79, Tc-99, I-

129, Sn-126, and uranium isotopes and the associated risks are so low that it would not be sensible or reasonable to further remove those radionuclides. Nevertheless, DOE notes that additional incidental removal of the radionuclides will likely occur.[5]

With respect to the planned treatment processes, all flowcharts and assumptions are provided in CBU-PIT-2005-00141 (Reboul 2005).

Degradation of the waste cap, erosion barrier, and waste form were included in the analysis quantifying the radionuclide inventory limits for Vault 4 of the SDF (Cook et al. 2005). These limits were the bases for evaluating public and intruder doses in determining highly radioactive radionuclides (Reboul 2005). Consequently, the effects of waste degradation have been taken into account.

**References:**


Reboul, S. H., 2005. *Removal of Highly Radioactive Nuclides from SRS Salt Waste*, CBU-PIT-2005-00141, Westinghouse Savannah River Company, Closure Business Unit, Aiken, South Carolina. June, 2005.

DOE, February 28, 2005. *Draft Section 3116 Determination Salt Waste Disposal Savannah River Site.* DOE-WD-2005-001.

Cook, J. R., Wilhite, E. L., Hiergesell, R. A., and Flach, G. P. 2005. *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits*, WSRC-TR-2005-00074, Revision 0, May 2005.

NRC, September, 2003. *Consolidated NMSS Decommissioning Guidance*, Vol. 2. NUREG 1757.


[5] During the filtration steps at ARP and SWPF, a majority of the insoluble fractions of these radionuclides will be removed. Additional incidental removal occurs during DDA due to settling.

**NRC**
**Comment 12**: Additional information about the selection and optimization of treatment steps in the DDA treatment process and the selection of waste for DDA processing is necessary to support the conclusion that highly radioactive radionuclides have been removed to the maximum extent practical.

**Basis:** Results of both DOE and independent NRC analyses indicate that several radionuclides (e.g., I-129, Tc-99, Sn-126, Se-79, Cs-137, Sr-90, Pu-isotopes, Np-237/Am-241) are important to SDF performance. Significant fractions of the inventory of most of these radionuclides at the SDF will be attributable to the DDA waste [5]. However, processes to minimize the concentration of many of these radionuclides in the DDA waste are not discussed in the waste determination or supporting documents. For example, attempts to minimize the amount of Sn-126 or actinides in DDA waste might include steps to minimize the amount of sludge entrained in the waste during the DDA process; however, the waste determination does not include a description of the variables that affect the amount of sludge that is entrained or any steps that could be taken to minimize the amount of entrained sludge.

Similarly, although the waste determination indicates that settling is expected to remove a "significant portion" of the insoluble radionuclides (pg. 15 of [4]), it is unclear what removal efficiencies are expected, what data there is to support the expected removal efficiencies, and how the process has been optimized. Because the expected removal efficiencies and factors affecting the removal efficiencies are not discussed, it is unclear whether additional treatment steps, such as filtration, would be practical or if currently planned treatment steps, such as settling, could be improved.

In Reference 4 it is indicated that the lowest activity waste will be selected for DDA processing; however, a comparison of the radionuclide concentrations of the wastes prior to processing is not provided.

**Path Forward:** Provide information to support the conclusion that the lowest activity waste will be selected for processing in the DDA. Provide information about the selection and optimization of treatment steps to minimize the concentration of highly radioactive radionuclides in DDA waste. The response should include a description of:

1) Factors that affect the amount of sludge entrained in the DDA waste, and efforts to optimize the process to minimize the amount of entrained sludge.

2) Alternative deliquification technologies that were evaluated and the expected removal efficiencies of highly radioactive radionuclides by those technologies. The response should address whether any technologies, such as vacuum techniques, that have been employed with some success at other sites (e.g., Hanford) were considered.

This response also should address the potential effects of differences in the porosity and pore structure of saltcake in different tanks and the potential effects of these differences on the success of the deliquification processes.

3) Alternative filtration technologies that were evaluated and the expected removal efficiencies of highly radioactive radionuclides by those technologies.

In addition, a detailed cost-benefit analysis of the alternative treatment technologies should be provided to support a determination of whether the proposed DDA process is consistent with the removal of highly radioactive radionuclides to the maximum extent practical.

**SRS Response:** The Deliquification, Dissolution, and Adjustment (DDA) process is described in Section 2, pages 12 – 16, of the Draft 3116 Determination [for] Salt Waste Disposal [at the] Savannah River Site (Salt WD). The response to the questions in this NRC Comment are addressed through discussion of the following topics.

- Saltcake composition considered for DDA;
- Technologies explored;
- Parameters important to optimizing DDA treatment of predominantly soluble Radionuclides;
- Parameters important to optimizing DDA treatment of predominantly insoluble Radionuclides;
- Selection of DDA tanks.

### *Saltcake Composition Considered for DDA*

Most of the waste in the Tank Farms was generated from the chemical separation processes in F- and H-Canyons. This waste contained a strongly acidic solution of nitric acid and metal oxides. Before transferring to the Tank Farms, chemicals (sodium hydroxide) were added to adjust the waste to an alkaline state to prevent corrosion of the carbon steel waste tanks. This chemical adjustment resulted in the precipitation of metal oxides, including strontium (Sr) and actinides (e.g., plutonium (Pu)). These solids settled to the bottom of the waste tanks forming a layer that is commonly referred to as sludge. Since the early 1960s, DOE concentrated the decanted supernate with the Tank Farm evaporator systems to reduce the overall volume of the waste. During the evaporation process, the salt waste was concentrated and formed two distinct phases – concentrated supernate solution and solid saltcake.
By decanting the liquid above the sludge layer, the quantity of entrained solids within the salt phases was minimized. The concentrated supernate and interstitial liquid within the saltcake waste contain the soluble fractions of Cs-137, I-129, Tc-99, Sn-126 and Se-79. The relative portions of the specific isotopes of interest, i.e., Cs-137, I-129, Tc-99, Sn-126, and Se-79, in the supernate phase of the salt waste are noted in Table 12-1.

**Table 12-1: Salt Waste Radionuclides (Reboul 2005)**

| Isotope | Total Inventory in Salt Waste (supernate and saltcake), Ci | Portion of Total Salt Waste Inventory in Supernate |
|---|---|---|
| Cs-137 | 1.1E+8 | 99+% |
| I-129 | 1.8E+1 | 99+% |
| Tc-99 | 3.5E+4 | 94% |
| Sn-126 | 6.2E+2 | 73% |
| Se-79 | 2.2E+2 | 40% |

The solid saltcake is composed predominantly of nitrate, carbonate, aluminate, and sulfate salts and contains relatively small quantities of radioactive material (Drumm and Tran 2004). The radioactive constituents within the solid saltcake are determined predominantly by the quantity of entrained insoluble solids that was carried over during the evaporation process. The insoluble solids entrained in the saltcake include strontium and actinides, as well as the insoluble fractions of Tc-99, Sn-126, and Se-79.

As discussed on page 14 of the Salt WD, the DDA process effectively removes approximately 50% of the soluble nuclides, e.g., Cs-137, I-129, Tc-99, Sn-126, and Se-79, during the deliquification phase and insoluble nuclides, e.g., Sr-90, Pu-isotopes, and Np-237/Am-241 during settling before disposal at Saltstone Disposal Facility (SDF). Optimizing the amount of liquid removed during deliquification optimizes the removal of the soluble nuclides. Likewise, minimizing the amount of entrained insoluble solids during dissolution and optimizing the settling step will minimize the amount of Sr and actinides that are disposed of in the SDF. Optimization of both soluble and insoluble activity is discussed in detail later in this response. A discussion on entrained sludge is found in the response to NRC Comment 15. It should be noted that, because DDA removes a large fraction of the soluble radionuclides from the saltcake prior to dissolution, and because the selected treatment processes target the removal of Cs-137, Sr-90, and the actinides, the DDA stream disposed of in the SDF is actually lower in concentration for I-129, Tc-99, Sn-126, and Se-79, than the ARP/MCU or SWPF streams (d'Entremont and Drumm 2005).

## *Technologies Explored*

The salt treatment technologies explored were not restricted to exclusively to the DDA processing steps, but rather included many alternative processes for treating salt wastes. The DDA process has origins as a proposal to supplement or enhance the now defunct In-Tank Precipitation (ITP) process. When ITP was shut down, an equivalent process to DDA, then referred to as Low Curie Salt, was considered as part of more than 150 process alternatives evaluated for technical viability and effectiveness and for cost for replacing the ITP process (WSRC 1998).

The DDA was rejected as a process incapable of treating **all** saltcake wastes. However, the National Research Council of the National Academy of Sciences (NAS) recommended that SRS consider "tailoring the processing operations to tank waste contents". The NAS recommendation further states (National Research Council 2000):

> "instead of blending tank wastes to produce a feed that might allow all tank contents to be treated by a single process, as is now planned, would it be advantageous to tailor processing based on chemical and radionuclide contents of individual tanks? For example, could tank wastes with little or no cesium be processed only to remove strontium and actinides … ? Alternatively, could tank wastes with low strontium and actinide concentrations be processed only to remove cesium? Indeed, could tank wastes with low actinide, strontium, and cesium concentrations be sent directly to the Saltstone Facility after minor waste conditioning (e.g., filtration)?"

Based on this recommendation, the waste processing strategy changed to include multiple processes to treat the salt waste based on composition. DDA was developed as a viable process for a portion of the salt waste tanks. By recognizing that there are some saltcakes with lower concentrations of highly radioactive radionuclides, decontaminated dissolved salt solutions can be readily produced that meet the process requirements. This is accomplished by removal of the liquid phase of the salt waste containing the soluble nuclides. This liquid is stored in other waste tanks for future processing through SWPF. The low-activity saltcake remaining is then dissolved and transferred to another tank to separate the liquid phase from the solid phase by allowing the solid phase to settle to the tank bottom. Further partitioning of this low-curie content waste by decanting produces a waste stream that can be disposed of prior to the construction of enhanced processing facilities. The result of this effort is that waste tanks can be emptied and closed earlier than originally planned, and thereby expediting the elimination of the risk associated with storing legacy radioactive liquid waste.

An additional evaluation of potential process alternatives was performed in 2003. This evaluation included several hundred variations of options for methods of removal of salt waste from the waste tanks and disposal of the final waste. The treatment processes were primarily the same as those previously considered in reference WSRC 1998, but varied considerably in physical size, form, and potential location of the processes because the intent of this evaluation was to identify any possible process that could create and maintain adequate operating space in the Tank Farms prior to startup of the SWPF. The treatment process technologies considered include ion exchange, solvent extraction, crystallization, vitrification, reformation, precipitation, geological and electrochemical technologies as well as various methods to physically extract saltcake from a waste tank such as robotic mining, vacuum mining, and sluicing. The evaluation supported the currently planned DDA and ARP/MCU interim salt waste disposition processes.

The response to NRC Comment 10 provides an evaluation of the Interim Processing Plan (Baseline Case), and two other cases suggested for comparison by the NRC. These cases were a limited interim processing case where only the ARP/MCU processes were run before SWPF start-up (no DDA processing) and a no interim processing case where no salt waste was processed until SWPF started up (no DDA or ARP/MCU processing). The fundamental differences in the cases evaluated demonstrate that the Baseline Case is the most cost-effective option and provides the lowest worker dose. Public doses (including inadvertent intruder doses) are marginally higher with the Baseline Case, but this dose is not significant when compared to exposure from natural sources of radiation (360 mrem/year). The Baseline Case also reduces radioactive material at risk the most quickly because it facilitates stabilization of radioactive material in the Tank Farms more quickly than in the other cases, allowing closure of old style tanks per the Federal Facility Agreement (FFA) schedule. For these reasons, the Baseline Case provides the greatest overall benefit at the lowest cost.

Some alternatives to each DDA process step were evaluated in order to optimize the radionuclide removal effectiveness. DDA can be divided into an initial liquid-solid separation step where the liquid phase is separated from the saltcake and a second liquid-solid separation where insoluble solids are separated from the dissolved salt solution. Key to the liquid phase separation from the saltcake is the deliquification step. The development of the deliquification step considered alternative variations to produce the best possible separation of liquid from solid saltcake. Given the large size of the waste tank, hydrogeology principles were applied to determine favorable configurations for the best separation. Evaluations included one or two pump wells, up to four deliquification cycles, liquid injection on top of saltcake (both in one injection well or in two injection wells), and liquid covering saltcake or not covering saltcake (Staheli and Peters 1998). Initial development lacked SRS saltcake specific physical properties, but experience with deliquifying Hanford saltcakes provided some initial design guidance (Kirk 1980, Handy 1975, Simmons 1995). Cost was not considered as a factor for designing the deliquification step.

Several possible unit operations were considered for the separation of dissolved salt solution from the insoluble solids. The options considered include settling, cross-flow filtration, and dead-end filtration (Norton et al. 2003, Seufert and Norton 2003). The set of options considered follows from site experience and past alternative evaluations for filtering sludge slurries (Poirier 2000, Van Pelt 2000, McCabe 1995, Poirier et al. 2001). Settling was selected since significant reduction in insoluble solids results by using this process and any filtering options would require the design and construction of new facilities. These filtration facilities could not be constructed and placed on-line within the time period needed for initiation of salt waste removal. If the filtration alternative must be pursued due to the time constraints associated with settling unit operation cycle time, there will be schedule impact and life-cycle cost impact associated with the programmatic delays. Additional discussion of the lifecycle cost impacts of programmatic delays is provided in the response to NRC Comment 10.

As an example, 50% of the solids can be removed by settling for less than 19 days for a 300-inch deep batch in the settling tank. The Baseline Case for DDA is to settle for a minimum of 30 days which results in the removal of approximately two-thirds of the radioactive solids through settling (Gillam 2005).

### ***Parameters Important to Optimizing DDA Treatment of Predominantly Soluble Radionuclides***

In the deliquification step of DDA, the free supernate is removed from the tank and is stored in another Type III tank for future processing at SWPF. Therefore, the radionuclides associated with the free supernate (e.g., Cs-137, I-129, Tc-99, Sn-126, and Se-79) are removed and stored for future processing through the Salt Waste Processing Facility (SWPF). The second part of the deliquification process involves the removal of the interstitial liquid from the saltcake and storage of this liquid for future processing at the SWPF.

The key to success of the DDA process is the quality of the liquid-solid separation, which is determined by the quantity of liquid residual in the saltcake after deliquification. The key properties that determine residual are intrinsic saltcake permeability, pump out rate, and liquid retention curve. Saltcake porosity primarily identifies the total quantity of the starting liquid phase and is not important to the success of the separation. However, the porosity will affect the total time required to complete the deliquification step.

The intrinsic permeability affects the rate of liquid removal and, thus, the amount of time required to remove the liquid from the saltcake. The higher the permeability, the less time required; the lower the permeability, the greater the time required. If permeability is so low that effective liquid removal would take several years, the process would be impractical to implement.

Information about the potential effects of variations in saltcake properties is continuing to be developed with each SRS waste tank deliquified. When SRS began development of the DDA process, no physical property data on real SRS saltcake was available. Considerable data on Hanford saltcakes was available from their experiences with performing saltcake deliquification operations since the 1970s (Kirk 1980, Handy 1975). Data from simulated SRS saltcake was available for comparison (Wiersma 1996, Kiser 1979, Churnetski 1981, Goodlett 1968). As such, the initial development included simulations that included a large range of variability and heterogeneity in saltcake properties to determine the magnitude of the effect.

The initial range of permeability analyzed included 1.0E-3 to 1.0E-7 cm/sec, a very high to very low permeability and a variation over 10,000 times the lowest value. These initial simulations started with 22 volume % interstitial liquid and resulted in a residual liquid volume from 6.4 – 11% of total saltcake volume after 1000 hours for a single deliquification cycle (Staheli and Peters 1998).

The same initial analysis considered the effect of refilling the pores with a radiologically "clean" liquid and repeating the deliquification cycle. However, refilling the pores by this method would require a substantial addition of clean materials and increase the volume of material to treat for disposal (Staheli and Peters 1998).

In addition, to be successful, this added material would need to be chemically similar to the liquid removed during the first deliquification cycle in order to avoid dissolving saltcake in the process. For example, one million gallons of saltcake would require a refill volume of approximately 250,000 gallons with subsequent storage of the removed liquid. Thus, no advantage is created by any additional deliquification cycles at the cost of the creation of additional waste volume (Staheli and Peters 1998).

The key property to the quality of separation of the liquid phase from the solid saltcake is the amount of residual liquid in the saltcake after deliquification. The residual liquid is an inherent property of the saltcake and varies with the physical structure of the saltcake crystals as well as the chemistry of the liquid and solids. This property is described by hydraulic liquid retention curves because the actual residual content varies with elevation within the saltcake. With empirical data obtained from the first deliquification operation on Tank 41 saltcake in 2002 – 2003, an appropriate range of liquid retention curves was identified (Flach 2003). SRS completed an analysis of deliquification of saltcake with variations in liquid retention curves and initial liquid content (Barnes and Flach 2005, Pike 2005).

In addition to the nominal case of the best-estimated property values, a few select cases were simulated that represent known variability in the properties. These case runs provide an indication of what could reasonably be expected from variability already known to exist. The initial liquid content was nominally determined to be 30 volume % of the saltcake based on data from Tank 41. The analysis included variation of initial liquid content from 25 to 40 volume % of the saltcake. The simulation ran until the removal rate reached 1 gpm average or about 500 to 700 hours of deliquification. The very lowest residual possible for the range of liquid retention curves is 10 to 15% of the saltcake volume (Pike 2005).

Figure 12-1 and Figure 12-2 provide the cases included in the analysis and the relationships between each possible variation. These figures also show the key results of each case. The cases were split into two groups that varied three parameters in order to simplify interpretation. The cube represents the three parameters varied between each set of cases. The axis for each dimension of the cube represents the range of variation expected or known for each parameter. The orientation of the range of values, i.e., high to low, was arranged such that the bottom front left corner represents the least aggressive, least favorable property combination. This combination would be expected to be the least residual liquid, the slowest rate, and, perhaps, the least volume removed. The upper back right corner represents the most aggressive, most favorable property combination.

The results depicted in Figure 12-1 and Figure 12-2 show comparable hydraulically equivalent endpoints, i.e., equivalent hydraulic pressure. The results depicted in the figures were pulled from the case runs when approximately 1 gpm interstitial liquid flow rate is achieved. Continuing to remove liquid in any case will produce a lower residual liquid in the saltcake, but this part of the removal curve also represents the least productive portion of the operation.

Figure 12-3 shows how the continued removal of liquid produces increasingly diminishing progress. Considering that the best process outcome is the lowest amount of residual liquid, not necessarily the most removed liquid, the figures show both values along with estimated time to reach the end state.

Figure 12-1 shows that the time to reach the end state changes relatively little compared to the dramatic variation in removed and residual volumes. Two of the three axis parameters, well height and temperature, can be controlled to some degree by the design of the operation. The variation in intrinsic permeability results in the most variation. Notice that the case with the least residual will take longer and produce more removed liquid volume even though the same stopping point is achieved.

Figure 12-2 shows the variation caused by properties that change the initial liquid volume and volume of retained residual. The cases 1 – 7 were chosen as most physically likely. The analyst considered the combination represented by case 8 and 9 as unlikely combinations that could not readily exist. Cases 8 and 9 were run to make this summary more complete. This figure shows that there is considerably more variability inherent in saltcake physical properties than in controlled properties.

Analysis of the deliquification experience of SRS saltcakes up to now show that approximately 50 percent of the initial volume of liquid can readily be separated from the saltcake. By allowing deliquification to reach infinite duration and allowing for the most favorable variation in physical properties, the most liquid that can be removed is roughly 65% of the original liquid in the saltcake. Deliquification step is considered complete once the average liquid removal rate falls below 1 gpm.

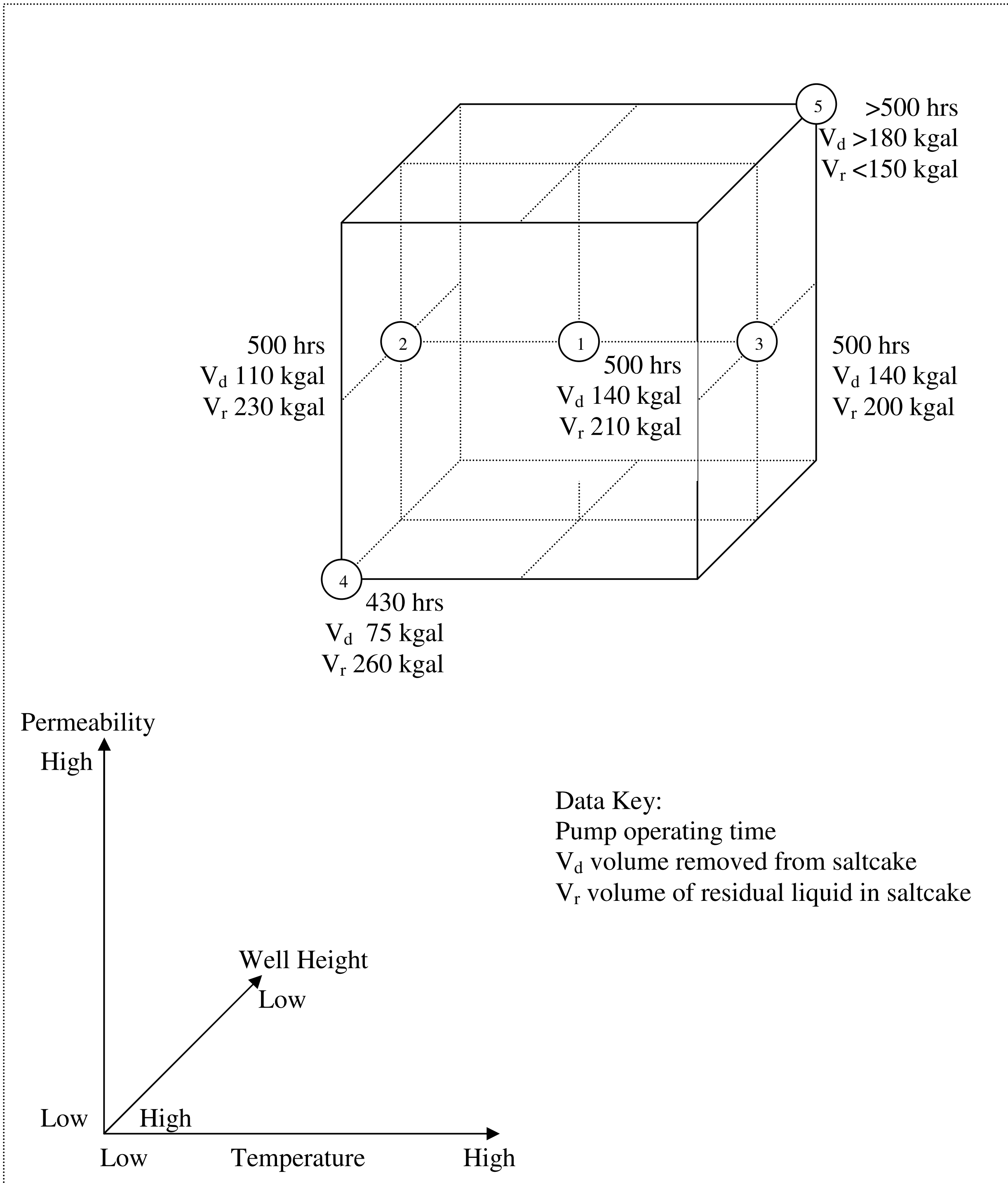



**Figure 12-1: Representation of Cases 1 Through 5**

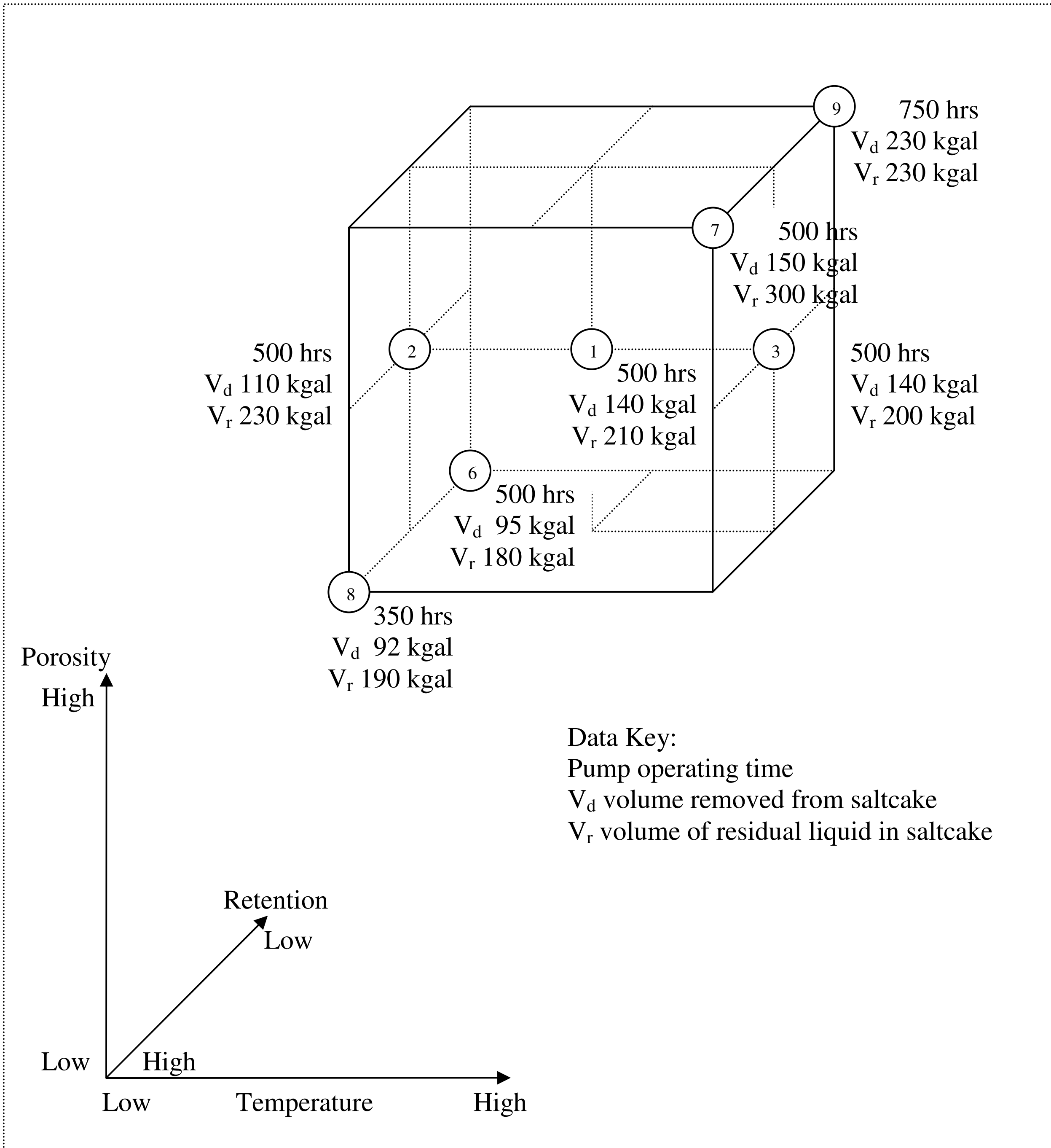



**Figure 12-2: Representation of Cases 6 Through 9 and 1 Through 3**

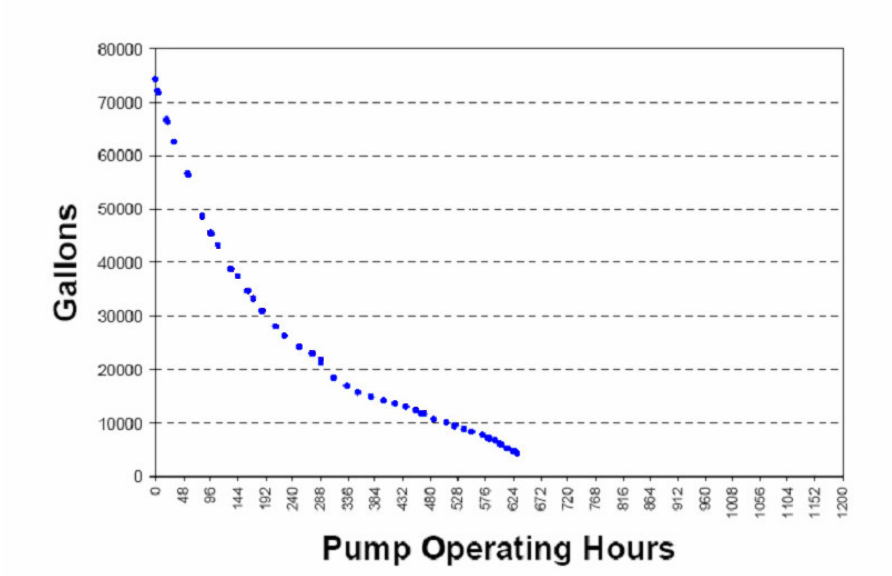



**Figure 12-3: Actual Liquid Removal Progress for Tank 41 from March through June 2003 (Flach 2004)**

## *Parameters Important to Optimizing DDA Treatment of Predominantly Insoluble Radionuclides*

*Insoluble Solids Entrainment During Dissolution*

Sr-90, Pu, Np-237, and Am-241 are predominantly found in insoluble solids (sludge). Minimizing the amount of these radionuclides processed through DDA involves minimizing the amount of entrained sludge in the Saltstone Facility feed. Minimizing the amount of entrained sludge in the Saltstone feed is accomplished by:

1. Selecting tanks with less than 3,000 gallons of low-heat waste (LHW) sludge[6] for DDA processing

2. Allowing sludge entrained in the dissolved salt solution to settle below the elevation of the pump intake following salt dissolution to minimize the amount transferred to Saltstone.

Sludge entrainment during dissolution depends on the particle size of the solids, the extent of particle agglomeration or adhesion between particles, the distribution of particle sizes, the distribution of particles within the waste tank, the location of the pump suction relative to the solid particles, the density and viscosity of the liquid phase, and the velocity pattern of the liquid phase during pumping. Phenomena of entrainment can be described analytically, but values of several parameters are not

[6] High-Heat Waste (HHW) sludges originating from the first canyon cycle have fission product concentrations three orders of magnitude higher than LHW sludges from the second canyon cycle.

known, such as, the distribution of solids within the saltcake or the liquid phase during dissolution. Additionally, the distribution of solids within the tank and in the saltcake changes as dissolution progresses. However, experience with salt dissolution at SRS and recent experience at the Hanford Site provides an indication of how the solids will behave during saltcake dissolution. In addition, analysis performed for entrainment of sludge during liquid waste transfers provides an indication of when solids will be entrained during waste transfer. Sample data from dissolved salt solutions and some solid saltcake samples provide an indication of how much insoluble/low solubility solids can be entrained.

*Insoluble Solids Behavior in Saltcake Tanks*

A saltcake dissolution method similar to DDA was employed to dissolve Tank 20 saltcake. In this case, the saltcake was not deliquified. Dissolution water was added to and removed from the tank in batches as described in the DDA process. Insoluble and low solubility solids remained as the saltcake was dissolved. The solids settled on top of the saltcake. This layer of solids became progressively thicker until successive dissolution water additions became relatively ineffective at dissolving additional saltcake. Approximately two-thirds of the saltcake was dissolved and the remainder was removed several years later after slurry pumps were installed (West 1982). The slurry pumps provided agitation that displaced the solids from the saltcake surface, which resulted in exposing the saltcake to the dissolution water.

Personnel at the Hanford Site recently completed their first saltcake dissolution and removal from Tank S-112 (Barton 2005). This saltcake was deliquified many years before dissolution. In this case, the total liquid inventory in the tank was limited such that the saltcake was not submerged in liquid until most of the saltcake was removed. The water was added in batches and cascaded through the deliquified saltcake. After a short waiting period, the dissolved salt solution was pumped out via saltwell pumping. The wait period progressively increased from 1 to 5 days as dissolution progressed. Photographs/videos from the last 5% or so of the saltcake dissolution show a fine particulate material covering the saltcake. The specific compounds of this apparent low solubility or insoluble material have not yet been identified, but the observations indicate similar behavior of the insoluble solids observed during dissolution of Tank 20.

From these experiences, one can infer that low solubility/insoluble materials, i.e., sludge solids, would tend to settle on top of the saltcake during the DDA process. In addition, the solids layer would become progressively thicker as the saltcake is dissolved, thus, increasing the possibility of entraining more solids during pumping. However, the pump rates remain relatively low which minimizes the liquid phase velocity and, thus, minimizes entrainment. Analysis of the flow pattern around the pump suction for the evaporator systems shows an effective range for entraining sludge solids of about 12 inches from the suction (SRNL 1997).

Based upon these experiences and the plans to dissolve only a portion of the Tank 41, 25 and 28 material during Interim Processing (Mahoney and d'Entremont 2004), it can reasonably be expected that a significant fraction of the low solubility/insoluble materials currently in these tanks will not be removed by the DDA process and will remain in the portion of these tanks that will be processed following Interim Processing. While this solids removal characteristic of the DDA processes is not credited when determining the decontamination achieved by DDA due to uncertainties associated with the insoluble solids content, it does provide further decontamination of the salt waste stored in the tanks. Note as well, that the settling step for dissolved salt solution is included as an integral element of the DDA process to remove the insoluble solids that are not left behind in the tanks associated with Interim Processing.

*Actual Saltcake and Dissolved Salt Solution Sample Data*

Past samples of saltcake and dissolved salt solution show that insoluble solids content can vary widely as shown in Table 12-2. The solid salt samples indicate the total insoluble solids that might transfer with dissolved salt solution without settling or any other solid liquid separation. The dissolved salt samples show that most of the insoluble solids in saltcake are not likely to transfer with dissolved salt solution or will settle out before transferring. Since these results show total solids, sludge solids cannot be separately identified from the available data.

**Table 12-2: Insoluble Solids in Saltcake and Dissolved Salt Solution**

| Tank | Insoluble Solids Concentration in Salt Sample (mg/L) | Approximate insoluble Solids in Equivalent Dissolved Salt Solution (mg/L) |
|---|---|---|
| Tank 38 saltcake (Drumm and Hopkins 2003) | 13,700 | 3,900 |
| Tank 41 saltcake (Drumm and Hopkins 2003) | 13,000 | 4,580 |
| Tank 37 saltcake (Drumm and Hopkins 2003) | 25,800 | 8,720 |
| Tank 24 dissolved salt solution (Fowler 1982) | See Note 1 | 27,300 |
| Tank 24 dissolved salt solution (Walker and Hamm 1983) | See Note 1 | 103 |
| Tank 1 saltcake (Fowler 1981a) | 19,800 | 6,600 |
| Tank 20 dissolved salt solution (Fowler 1981c) | See Note 1 | none detected |
| Tank 19 saltcake (Fowler 1980) | 51,000 | 17,000 |
| Tank 19 dissolved salt solution after Transfer to Tank 18 (Fowler 1981b) | See Note 1 | < 100 |

Note 1: Analysis performed on dissolved salt solution sample, therefore no value for saltcake

From experiences identified and the available sample data for similar conditions, minimal solids are expected to be entrained in the dissolved salt solution. However, the relative amount of insoluble solids in the saltcake show that unexpectedly high entrainment of insoluble solids is possible, thus, requiring a settling step after dissolution until enough dissolution experience shows this step to be unnecessary.

*Insoluble Solids Settling*

Settling rate of the entrained solids is dependent on particle size, particle density, particle density in the liquid phase, liquid density, liquid viscosity, and time. The liquid phase properties are reasonably known or predictable, but the solid phase properties are unknown primarily because measurements of this type have not been made on dissolved salt solution because, historically there has been very limited dissolution of salt. However, solid phase property measurements exist for sludge solids. Since the sludge solids contain the majority of the fission products and actinides (d'Entremont and Drumm 2005), other solids settling are not as important to the radionuclide removal efficiency.

Effectively, settling in a waste tank can be described in terms of the downward movement of an interface with time. The liquid above the interface is clear of any solids larger than a certain minimum size. The minimum size is picked such that more than 99% of the sludge particles are larger than the minimum. The liquid above this interface is effectively decontaminated of sludge particles and only the soluble radionuclides remain. The rate of change in the interface level was estimated for the dissolved salt solution from the first dissolution tank. The rate is expected to be similar for subsequent tanks, but a detailed estimate will be made on a tank-by-tank basis before dissolution occurs. The first tank settling rate is estimated in Table 12-3 (Gillam 2005):

**Table 12-3: Sludge Solids Settling Rates**

| Fraction of Solids Removed | Settling Rate, in./day |
|---|---|
| 0 | 37.00 |
| 0.500 | 16.00 |
| 0.667 | 9.00 |
| 0.750 | 6.84 |
| 0.800 | 5.54 |
| 0.900 | 2.95 |
| 0.935 | 2.03 |
| 0.950 | 1.65 |
| 0.964 | 1.28 |
| 0.975 | 1.00 |
| 1 | 0.35 |

For example, in order to remove 0.667 or 66.7% of the entrained solids from a dissolved salt solution batch 300 inches deep (assuming the settled sludge layer is less than 6 inches deep and approximately 2 feet below pump suction if the pump suction is at 30 inches above the tank bottom), the solids must be allowed to settle 33 days at a settling rate of 9 inches per day. The actual settling time is adjusted to allow adequate time to settle solids to meet SPF process requirements and balance the need to create enough working volume in the tank farm to maintain waste process operations. The current baseline case is a 30-day settling period.

### *Selection of DDA Tanks*

Tanks were selected to undergo the DDA process during Interim Processing using the following criteria:

1. Tanks selected for DDA should be Type III tanks. Type III tanks meet current Environmental Protection Agency (EPA) requirements for full secondary containment and leak detection and are therefore the only tanks deemed suitable for additional waste receipt. Selecting Type III tanks for DDA frees compliant tank space required to receive additional waste streams created during SWPF batch preparation, waste removal and sludge batch preparation, and H-Canyon legacy material stabilization operations.
2. Tanks selected for DDA should not be used for an operational function vital to Tank Farm processes such as evaporator systems or sludge batch preparation. Selecting a tank serving such a function for DDA would incur cost, schedule, and system impacts in order to set up another tank to replace its operational function and, in most cases, would not be physically or chemically possible.
3. Tanks selected for DDA should not be high-heat waste (HHW) tanks. HHW sludges originating from the first-canyon cycle have fission product concentrations three orders of magnitude higher than low heat waste (LHW) sludges from the second-canyon cycle. In order to minimize the amount of these radionuclides carried over through the DDA process, HHW tanks were not selected for DDA.
4. Tanks selected for DDA should contain minimal amounts of insoluble solids. Insoluble Tank Farm solids (sludges) contain larger amounts of strontium and actinides than the supernate phases. In order to minimize the amount of these radionuclides sent to SDF, only tanks estimated to contain minimal amounts of sludge (<3K gal.) were selected for DDA.
5. Tanks selected for DDA should have lower activity supernate waste. In order to identify the tanks with lower activity supernate waste, it is important to identify tanks that are relatively low in Cs-137. Cs-137 is highly soluble and constitutes the bulk of the curies that will be sent to the SDF.

Also, a correlation exists between the Cs-137 concentration and the concentration of other soluble radionuclides important to SDF performance such as I-129, Tc-99, and Sr-90 (Hill 2005, Tran 2005, and Hester 2004).

Using these criteria, seven tanks were identified with Tanks 41, 25, and 28 chosen as the tanks most suitable for DDA processing. The following table lists the Type III tanks in ascending order of their supernate Cs-137 concentration. Table 12-4 designates which tanks contain sludge volumes greater than 3,000 gallons, the type of sludge (HHW or LHW) in each tank, and any current operational function of the tanks in addition to waste storage.

**Table 12-4: Selection of Tanks for DDA Processing**

| Tank | Current Operational Function | Sludge Type | >3k gallons sludge? | Cs-137 Supernate Concentration (Ci/gal) | Suitable for DDA consideration? |
|---|---|---|---|---|---|
| 50 | Saltstone Blending / Feed Tank | n/a | | 4.9E-05 | No |
| 40 | DWPF Sludge Prep / Feed Tank | HHW | Yes | 5.8E-02 | No |
| 48 | Precipitate Storage | n/a | | 6.1E-02 | Yes |
| 51 | DWPF Sludge Prep / Feed Tank | HHW | Yes | 1.8E-01 | No |
| 33 | | HHW | Yes | 3.0E-01 | No |
| 41 | | LHW | | 3.8E-01 | Yes |
| 43 | 2H Evaporator System Feed / Vent Tank | HHW | Yes | 6.7E-01 | No |
| 38 | 2H Evaporator System Drop Tank | n/a | | 7.8E-01 | No |
| 42 | | HHW | Yes | 9.7E-01 | No |
| 47 | 2F Evaporator System Vent Tank | LHW | | 1.6E+00 | No |
| 29 | 3H Evaporator System Vent Tank | n/a | | 3.3E+00 | No |
| 25 | | n/a | | 3.5E+00 | Yes |
| 39 | H-Canyon Receipt Tank | HHW | Yes | 3.6E+00 | No |
| 34 | | HHW | Yes | 4.0E+00 | No |
| 27 | 2F Evaporator System Drop Tank | LHW | | 4.1E+00 | No |
| 28 | | n/a | | 4.5E+00 | Yes |
| 26 | 2F Evaporator System Feed Tank | LHW | Yes | 4.5E+00 | No |
| 45 | | n/a | | 5.0E+00 | Yes |
| 44 | | n/a | | 5.3E+00 | Yes |
| 46 | | n/a | | 7.5E+00 | Yes |
| 35 | | HHW | Yes | 7.7E+00 | No |
| 32 | 3H Evaporator System Feed Tank | HHW | Yes | 9.1E+00 | No |
| 31 | | n/a | | 1.1E+01 | Yes |
| 37 | 3H Evaporator System Drop Tank | n/a | | 1.3E+01 | No |
| 49 | SWPF Feed Tank | n/a | | 1.3E+01 | No |
| 30 | 3H Evaporator Alternate Drop Tank | HHW | | 1.7E+01 | No |
| 36 | | HHW | | 2.1E+01 | No |

Note: Data taken from November 2003 Waste Characterization System (WCS). It was assumed that the Cs-137 concentration is in equilibrium throughout each of the tanks.
Sludge Type "n/a" indicates no appreciable sludge present.

Although Tank 48 will require all the steps associated with DDA processing, disposing of the unique waste in Tank 48 is critical during Interim Processing. As discussed on page 16 of the Salt WD, the Tank 48 waste consists of approximately 0.24 Mgal of a relatively low-activity salt solution containing potassium and cesium tetraphenylborate (TPB) salts generated during an earlier unsuccessful effort to prepare salt waste for disposal, known as the In-Tank Precipitation (ITP) process. The organic nature of TPB salts requires them to be stored separately from other tank waste. This is because TPB can break down into benzene and other organic compounds, and can form a potentially explosive mixture in the vapor space of a waste tank if not carefully managed. Other tanks are not equipped with safety systems required to manage this flammable mixture. Accordingly, all of the space in the 1.3 Mgal Tank 48 is being entirely used to store the 0.24 Mgal of TPB salts.

In addition, this waste cannot be processed through DWPF because the breakdown of TPB in sufficient quantities in the DWPF melter could pose safety concerns. Currently, there is no practically available or contemplated technology that could be used to remove additional radioactivity and dispose of that radioactivity using DWPF. Technologies that were considered for the treatment of the waste in Tank 48 are discussed in the response to NRC Comment 13. Accordingly, the waste in Tank 48 (see pages 40-42 of the Salt WD for more information on the Tank 48 waste) will be processed without further removal of radionuclides by aggregating the Tank 48 stream with another salt waste stream, currently planned to be the low-activity liquid recycle waste stream from DWPF. The two waste streams will be aggregated to ensure the processing limits for allowable organic content at SPF are not exceeded. These limits are contained in the waste acceptance criteria for the Saltstone Processing Facility. This is further discussed in the response to NRC Comment 37. The aggregated low-activity waste stream will then be transferred to the Saltstone Facility feed tank. Dispositioning the waste in Tank 48 during Interim Salt Processing is critical because:

- Dispositioning the waste in Tank 48 allows the use of up to 1.3 Mgal of space in this tank. Without this space, there is not enough space in Type III tanks to stage dissolved salt SWPF feed batches.

- The location of Tank 48 makes it an integral part of staging feed for SWPF.

- Tank 48 is the planned feed tank for the Actinide Removal Process (ARP) and the Modular Caustic Side Solvent Extraction Unit (MCU) process.

As the table demonstrates, Tanks 41, 25, and 28 are the lower activity LHW Type III tanks that have minimal amounts of sludge and no operational function that precludes them from being ideal candidates for DDA. Thus, Tanks 41, 25, and 28 were selected as the tanks containing some of the lowest activity waste most suitable for initial DDA processing. Selecting these lower activity waste tanks for DDA will minimize the amount of radionuclides sent to SDF in the DDA waste.

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**NRC**
**Comment 13:** Detailed technical information on technologies considered for the treatment of Tank 48 waste as well as a cost-benefit analysis that compares alternative treatment methods are needed to provide reasonable assurance that highly radioactive radionuclides will be removed to the maximum extent practical.

**Basis:** The proposed disposal strategy for Tank 48 waste is to dilute the Tank 48 waste with other low-activity waste prior to processing it into grout for disposal at the SDF (pg. 40 of [4]). This strategy will add an estimated 0.8 MCi to the grout, increasing its radioactivity by 30 percent. A detailed cost-benefit analysis describing the various methods of waste removal considered by DOE before selecting this preferred method for treating Tank 48 waste is needed to provide reasonable assurance that the highly radioactive radionuclides will be removed to the maximum extent practical.

**Path Forward:** Provide a description of the various methods of waste removal considered and reasons for selecting the preferred method for disposal of the Tank 48 waste. Include a cost-benefit analysis to show that the technology chosen represents the optimum solution for disposal of the Tank 48 waste.

**SRS Response:** Tank 48 currently contains approximately 0.24 Mgal of a relatively low-activity salt solution containing potassium and cesium tetraphenlyborate (TPB) salts. (See NRC Comment 12 for a discussion on relative curie concentrations of Cs-137.) These salts were generated during an earlier unsuccessful effort to prepare salt waste for disposal, known as the In-Tank Precipitation (ITP) process. Dispositioning the unique waste in Tank 48 allows the use of up to 1.3 million gallons (Mgal) of space in this tank to support sludge removal and treatment in the Defense Waste Processing Facility (DWPF), and earliest possible full Salt Waste Processing Facility (SWPF) operation. As discussed later in this response, any other available new-style tank that could substitute in place of Tank 48 would result in an increase in the number of curies sent to the Saltstone Disposal Facility (SDF).

The organic nature of TPB salts requires them to be stored separately from other tank waste. This is because TPB can break down into benzene and other organic compounds and can form a potentially explosive mixture in the vapor space of a waste tank if not carefully managed. Unlike Tank 48, other tanks are not equipped with safety systems required to manage this flammable mixture.

In addition, this waste cannot be processed through the DWPF because the breakdown of TPB in sufficient quantities in the DWPF melter could pose safety concerns. Currently, there is no practically available or contemplated technology that could be used to remove additional radioactivity and dispose of that radioactivity using DWPF. Accordingly, the waste in Tank 48 will be processed without further removal of radionuclides.

Tank 48 currently contains a relatively small number of curies, approximately 0.8 MCi, when compared to other waste tanks. No other available new-style tank that could substitute in place of Tank 48 contains salt waste that can be disposed of and result in less than 0.8 MCi being sent to SDF. To gain the equivalent tank space that will be provided by processing Tank 48, another waste tank would need to undergo processing during the Interim Salt Processing period. Since the ARP/MCU facilities are already fully utilized once available, the only other treatment option available would be to dispose of the waste from a different tank by the Deliquification, Dissolution and Adjustment (DDA) process. As outlined in Table 12-4 in the response to NRC Comment 12, Tanks 48, 41, 25 and 28 were the tanks selected as most suitable for DDA processing and are already planned to be processed. Tanks 31, 44, 45, and 46 are the remaining tanks suitable for DDA processing. Table 13-1 below compares the curies in these tanks to the 0.8 MCi in Tank 48 (Tran 2005).

Table 13-1. Comparison of Total Curies in Tanks 31, 44, 45, 46 and 48.

| Waste Tank | Total Curies (MCi) |
|---|---|
| 31 | 11.0 |
| 44 | 6.6 |
| 45 | 5.8 |
| 46 | 10.5 |
| 48 | 0.8 |

As indicated by Table 13-1, Tank 48 contains significantly less curies than the other remaining tanks suitable for DDA processing. Therefore, if Tank 48 is not dispositioned and an alternate tank must be processed to support sludge removal and the earliest possible full capacity SWPF operation, there would be a significant increase in the number of curies disposed at SDF.

The Tank 48 disposition strategy was to develop SRS 'in-house' options and, in a parallel effort, to solicit and evaluate vendor bids on the design and installation of a waste treatment unit (WTU) specifically capable of treating the organic component of the Tank 48 waste.

The most recent effort built upon the previous work that was documented in the HLW Tank 48 Disposition Alternatives Identification Phase I and II Summary Report (WSRC 2002), and research data developed by Savannah River National Laboratory (SRNL) (Lambert and Fink 2003, Fowler 2004, Zapp and Mickalonis 2003, Lambert et al. 2003, Peters et al. 2003, Lambert and Stallings 2003). The options were developed to sufficient maturity to allow major risks to be identified, rough order of magnitude (ROM) cost estimates to be developed and preliminary schedule durations to be estimated.

The Department of Energy (DOE) developed weighted evaluation criteria to compare alternatives relating to organic destruction including: cost, schedule, safety basis, research and development, operations, regulatory and downstream process impacts. The options for each of the alternatives were scored to determine a relative listing of viability. A description of the options considered, including the associated ROM cost and expected major risks are provided in Attachment 13-1. The evaluation of alternative methods for disposition of the tetraphenylborate (TPB) in Tank 48 (WSRC 2003a, Dean 2004) resulted in the recommendation of two options:

1) Aggregation of material from Tank 48 with DWPF recycle and subsequent disposal in the Saltstone Disposal Facility (SDF).
2) In-Situ Thermal Decomposition using heat in combination with pH reduction and catalyst addition.

The evaluation further stated that "the selected strategies are not without risk, and will require additional evaluations and testing before a disposition plan can be finalized."

The research and development testing necessary to support development of operating conditions and Safety Basis input parameters was conducted for the In-Situ Thermal Decomposition option (Peters and Lambert et al. 2004). Based on the results of the testing, the use of In-Situ Decomposition was eliminated as a Tank 48 TPB disposition option (Maxwell 2004). The option was eliminated following extensive laboratory testing in which no set of operating parameters could be identified for safe and effective operation that achieved the required end state. Evaluation of similar factors to support the Aggregation approach determined that it was viable as a selected strategy.

Given that the Tank 48 waste disposal is a future activity, the development of the Safety Basis and associated laboratory testing is still ongoing. These activities will be completed according to the project schedule as needed to support processing. However, testing to date on the Aggregation option has been favorable (Cozzi 2004, Peters and Barnes et al. 2004). The management systems in place to assure that safety and environmental requirements are met are described in the responses to NRC Comments 6, 37, and 57.

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## Attachment 13-1 – Tank 48 Alternative Descriptions

A brief discussion of each of the selected Tank 48 treatment alternative processes, from the fundamental chemistry perspective, is provided below. Table 13-2 provides an overview comparison of the treatment options.

### 1. Aggregation

The Aggregation process dispositions the potassium and cesium tetraphenylborate salts (KTPB/CsTPB) in Tank 48 by combining Tank 48 waste with DWPF recycle and other Tank 50 influent waste streams for subsequent disposal in the Saltstone Disposal Facility (SDF). Aggregation is a batch process. A maximum TPB concentration of 3000 mg/L will be sent to Saltstone. In the Aggregation process, DWPF recycle will be transferred from Tank 21, 22, 23 or 24 to Tank 48 and/or Tank 50. The Tank 48 material will be transferred to Tank 50 and processed to the Saltstone Facility for final disposal. Prior to addition of any DWPF recycle material, the free hydroxide concentration will be adjusted by addition of 50 wt% caustic to minimize significant benzene production. During Aggregation, DWPF recycle will also be added to Tank 48, agitated and transferred to Tank 50. It is estimated that approximately 3.4 million gallons of DWPF recycle along with approximately 160,000 gallons of 50 wt% hydroxide are required to meet the objective (Fowler 2005). The cost of this option is estimated at $15 million.

### 2. In-Situ Thermal Decomposition

The In-situ Thermal Decomposition process uses elevated temperature in combination with decreased pH, via nitric acid addition, and catalytic hydrolysis, using palladium, to decompose the TPB in Tank 48. The benzene generated from the decomposition would be controlled so that it would be swept from the tank using the nitrogen purge ventilation system and released through the stack. The salt solution remaining after decomposing the TPB would then be processed through an existing treatment facility. The research and development testing necessary to support operating conditions and Safety Basis input definition was conducted for the In-Situ Thermal Decomposition option (Peters and Lambert et al. 2004). Based on the results of testing, the use of In-Situ Decomposition was eliminated as a Tank 48 TPB disposition option (Maxwell 2004). The cost for the In-Situ Thermal Decomposition option is estimated to be approximately $12 Million.

### 3. Thermal Degradation Using Fluidized Bed Steam Reforming

Superheated steam and redox reactions are used to evaporate liquids, convert organic compounds into carbon dioxide and water, reduce nitrates and nitrites to elemental nitrogen, and convert reactive chemicals to a stable waste product or liquid that incorporates almost all of the radionuclides. Off-gases from the steam reformer vessel are treated to neutralize corrosive acids or bases so that the only emissions released to the atmosphere from the process ideally are carbon dioxide and water vapor.

This alternative utilizes a fluidized bed to maximize the reactive surface area, maximizing the reaction efficiency. The typical reaction temperature ranges from 600 to 800°C. Steam reforming would process the Tank 48 material "as-is" and therefore does not require any pH adjustment. Steam reforming keeps the operating inventory of Tank 48 material small (< 5 wt% of the fluidized bed) which minimizes the material at risk. Steam reforming facilities are currently being successfully used for treating industrial wastes and commercial reactor ion exchange resin (WSRC 2002, WSRC 2003a). The estimated cost of this option is >$40M. This option would require a subcontract and was eliminated due to its funding, schedule and need for additional technical development to address potential downstream impacts.

**4. Catalytic Oxidation Using Fenton's Reagent**

Under moderately acidic conditions (pH 3-5), the combination of hydrogen peroxide and ferrous ion efficiently produce hydroxyl free radicals, which are highly oxidizing. This combination of hydrogen peroxide and iron is known as Fenton's reagent. In the presence of dissolved organic compounds, these free radicals oxidize the organic compounds and convert them into carbon dioxide and water. The TPB salts are sufficiently soluble under these conditions to permit this oxidation reaction to proceed and destroy the organic character of the Tank 48 material. However, at this pH range, the risk of corrosion to the mild carbon of Tank 48 is too great and the process would be limited to an out-of-tank facility. At higher pH conditions, the effectiveness of the reaction is diminished. The advantage of operating a Fenton's reagent process at a higher pH range (mildly alkaline) would be the ability to perform the operation in Tank 48 along with the lower production of benzene during the decomposition process.

The DWPF Salt Cell was also evaluated as a potential location. An advantage to performing the Fenton's reagent option out-of-tank is the processing of small batches which minimizes the material at risk. Cost for the In-Tank Fenton's Reagent is estimated to be approximately $17 Million. Cost for the installation of the Fenton's process in the DWPF Salt Cell is estimated to be approximately $50 Million (WSRC 2003a, Dean 2004).

**5. Catalytic Hydrolysis Using Metals and Decreased pH**

Use of catalytic metals such as copper or palladium can increase the degradation rate of organics in solution, through enhanced hydrolysis. Such reactions were effectively used for increasing the degradation rate of NaTPB in former Tank 49 waste. The resulting benzene was removed through the existing nitrogen purge ventilation system. Tank 48 has a similar nitrogen purge ventilation system. If this process could be performed at mildly alkaline conditions, then the hydrolysis could be done in Tank 48. If the pH range for the hydrolysis must be neutral or acidic, then the process must be done out-of-tank. Cost for the In-Tank Catalytic option is estimated to be approximately $12 Million. The testing completed for In-Situ Thermal eliminated this option as being effective for the KTPB/CsTPB waste in Tank 48 (WSRC 2003a, Dean 2004, Maxwell 2004).

6. **Accelerated Degradation Using Elevated Temperatures and Decreased pH**

   Natural thermal degradation of TPB is a function of temperature and pH. At ambient tank temperatures and high pH conditions, the natural degradation rate is relatively low. At higher temperatures and lower pH conditions, the natural degradation rate is expected to be higher. The cost for the In-Tank Thermal Hydrolysis option is estimated to be approximately $11 Million. This option was eliminated following extensive laboratory testing in which no set of operating parameters could be identified for safe and effective operation that achieved the required end state (WSRC 2002, WSRC 2003a, Dean 2004, Maxwell 2004).

7. **Subcontractor Waste Treatment Unit**

   The use of a waste treatment unit (WTU) constructed by a subcontractor was also evaluated. The subcontractor would provide the materials and services required to design, fabricate, inspect, test, document, and deliver a WTU to the Savannah River Site. The subcontractor would also provide technical support and oversight for WSRC field installation, examination, testing, startup and operation (WSRC 2003b). No further technologies beyond those already discussed were identified for a subcontractor supplied WTU. This option was eliminated due to funding resources.

**Table 13-2 Tank 48 Organics Disposition Options Comparison Chart**. (WSRC 2002, WSRC 2003a, Dean 2004)

| **Option Evaluated** | **Aggregation** | **In-Situ Thermal** | **Steam Reforming (Subcontractor Waste Treatment Unit)** | **In-Tank Fenton's Hydrolysis** | **Salt Cell Fenton's Hydrolysis** | **In-Tank Catalytic Hydrolysis** | **Elevated Temperature & Decreased pH** | **Out of Tank Fenton's (Subcontractor Waste Treatment Unit)** |
|---|---|---|---|---|---|---|---|---|
| **Total Project Cost (ROM)** | ~$15M | ~$12M | >$40M | ~$17M | ~$50M | ~$12M | ~$12M | >$40M |
| **Schedule - Critical Path** | 23 mo | 27 mo | 27 mo | 30 mo | 42 mo | 27 mo | 27 mo | 27 mo |
| **Risk Level** | Moderate / High | Moderate | High | High | High | Moderate | Moderate | High |
| **Significant Risks** | Permit/Regulatory<br><br>Benzene generation requires equipment modifications to Tank 50 and/or SPF | Organic destruction efficiency does not meet end state criteria | Subcontracting a fast track R&D project<br><br>Product compatibility with downstream processes | Organic destruction efficiency does not meet end state criteria<br><br>Reduced Tank service life due to corrosion | DWPF Canister waste loading<br><br>Salt Cell Modification | Organic destruction efficiency does not meet end state criteria | Organic destruction efficiency does not meet end state criteria | Subcontracting a fast track R&D project |

**NRC Comment 14:** Additional information is needed to support the conclusion that treating waste with the ARP only if Sr and actinide removal are needed for the waste to meet Class C limits is consistent with removal of highly radioactive radionuclides to the maximum extent practical and maintains doses ALARA.

**Basis:** The waste determination indicates (pg. 17 of [4]) that after the completion of the ARP, waste will only be sent to the ARP unit if Sr and actinide removal is necessary for the waste to meet Class C limits. However, no basis has been provided to support the conclusion that this approach is consistent with removal of highly radioactive radionuclides to the maximum extent practical or maintains doses ALARA. Evidence is necessary to support the conclusion that it would be impractical to send more of the waste to the ARP once the ARP is built or that the risk reduction that could be achieved by sending more of the waste to the ARP is negligible.

**Path Forward:** Provide the basis, including quantitative and qualitative costs and benefits, to support a decision that individual batches of waste will not need to be processed through the ARP process. Demonstrate that this approach is consistent with removal of highly radioactive radionuclides to the maximum extent practical and maintains doses ALARA. The response should address the risk reduction that would be achieved by treating more of the waste with the ARP as compared to sending only the waste that would not otherwise meet Class C limits. The response also should address the negative impacts of sending more of the waste to the ARP once it is built, such as monetary costs and potential impacts on schedule.

**SRS Response:** Recognizing that the Salt Waste Processing Facility (SWPF) cannot be constructed, permitted, and operated until approximately 2009, the two-part interim processing approach described in the draft Section 3116 Determination [for] Salt Waste Disposal [at the] Savannah River Site (Salt Waste Determination) accelerates risk reduction through processing the minimal amount of some of the lowest activity salt waste (i.e., minimize the curies sent to the Saltstone Disposition Facility (SDF)) to create the necessary tank space for continued sludge removal and treatment in the Defense Waste Processing Facility (DWPF), and the earliest possible full SWPF operation. (See responses to NRC Comments 10, 11, 12 and 13)

One of the input bases to the development of the two-part interim processing strategy, and to any future revisions, is to remove radionuclides to the maximum extent practical while still creating the necessary tank space for continued risk reduction through sludge removal and vitrification to borosilicate glass, and earliest possible full SWPF operation. ARP/MCU are expected to come online in approximately 2007. ARP/MCU will remove approximately 92% (Campbell 2004) of the Cs-137/Ba-137m while also removing insoluble solids which contain the majority of the Sr-90 and actinides. The ARP facilities will also have the capability to remove soluble Sr-90 and actinides through MST strikes.

The two-part interim processing strategy reflected in the Salt Waste Determination was based on preliminary ARP process flowsheet information. A detailed ARP process flowsheet (Subosits 2004) was recently issued which demonstrates the performance of MST strikes is no longer anticipated to be the processing throughput limiting step. Based on this new flowsheet information, it is now planned that MST strikes will be conducted on all salt solution processed through ARP, even if the salt solution already does not exceed Class C concentration limits, as long as throughput can be maintained, with adequate margin, to support necessary tank space needs. An acceptable operational margin can be determined after some operational experience is obtained from operating the ARP/MCU facilities. This is in alignment of the objective to minimize curies to SDF while still meeting tank space objectives.

This emergent information required revisions to applicable sections of the Salt Waste Determination. In particular, the following sections will require revision.

**On page 17 of the Salt Waste Determination, the following paragraph:**

> If sample analyses indicate that salt waste requires removal of soluble Sr-90 and actinides in order to meet Class C concentrations limits in 10 CFR 61.55 in the grouted waste form, the waste will be received into either of the two MST Strike Tanks. Waste received in MST Strike Tank #1 or #2 will be adjusted with water to approximately 5.6 Molar sodium concentration to provide optimum conditions for sorption of Sr-90 and actinides onto MST. Following the addition of MST to either Strike Tank, the contents will be agitated for a reaction period between 4 and 24 hours based on the curie concentration of the soluble actinides to be removed. The resulting slurry will be transferred from either of the strike tanks into the Filter Feed Tank (FFT). If sample analyses demonstrate that decontamination of the salt solution to meet Class C concentration limits in the grouted waste form can be achieved without removal of soluble actinides and Sr-90, then the waste will be transferred without MST treatment from the Tank Farm directly to the FFT for ARP filter-only processing.

should be revised to state the following:

> Based on current process flowsheet information, MST strikes will be conducted on all salt solution processed through ARP, even if the salt solution already does not exceed Class C concentration limits in 10 CFR 61.55 in the grouted waste form, as long as throughput can be maintained, with adequate margin, to support necessary tank space needs. The waste will be received into either of the two MST Strike Tanks. Waste received in MST Strike Tank #1 or #2 will be adjusted with water to approximately 5.6 Molar

sodium concentration to provide optimum conditions for sorption of Sr-90 and actinides onto MST.

> Following the addition of MST to either Strike Tank, the contents will be agitated for a reaction period between 4 and 24 hours based on the curie concentration of the soluble actinides to be removed. The resulting slurry will be transferred from either of the strike tanks into the Filter Feed Tank (FFT). The ARP facilities will be used to remove soluble Sr-90 and actinides through MST strikes, as long as tank space objectives can be met with appropriate operational margin. If emergent technical or processing information becomes known that indicates that tank space objectives cannot be met AND the soluble actinides in the original salt solution are sufficiently low (i.e., below Class C concentration limits) to achieve the necessary tank space recovery prior to SWPF start-up, the stream will only be filtered prior to being sent to MCU.

On pages 38 and 39 of the Salt Waste Determination, the following sentences:

> The ARP facilities will also have the capability to remove soluble Sr-90 and actinides through MST strikes. If the soluble actinides in the original salt solution are sufficiently low (i.e., below Class C concentration limits), to achieve the necessary tank space recovery prior to SWPF start-up, the stream will only be filtered prior to being sent to MCU.

should be revised to state the following:

> The ARP facilities will be used to remove soluble Sr-90 and actinides through MST strikes[25], as long as tank space objectives can be met with appropriate operational margin. If emergent technical or processing information becomes known that indicates that tank space objectives cannot be met AND the soluble actinides in the original salt solution are sufficiently low (i.e., below Class C concentration limits), to achieve the necessary tank space recovery prior to SWPF start-up, the stream will only be filtered prior to being sent to MCU.

Footnote 25 on page 39 of the Salt Waste Determination:

> [25] The current Interim Salt Processing Strategy does not generally contemplate MST strikes of the salt solutions that will be batched through ARP/MCU but an 8-hour MST strike will be performed if necessary to meet Class C limits for disposal of DSS in SDF or if

throughputs can be maintained at 1.5 Mgal per year even if strikes are not necessary to meet Class C concentration limits.

should be revised to state the following:

[25] The duration of the MST strikes of the salt solutions will be dependent on the concentration of the Sr-90 and actinides present, and will range from 4 to 24 hours.

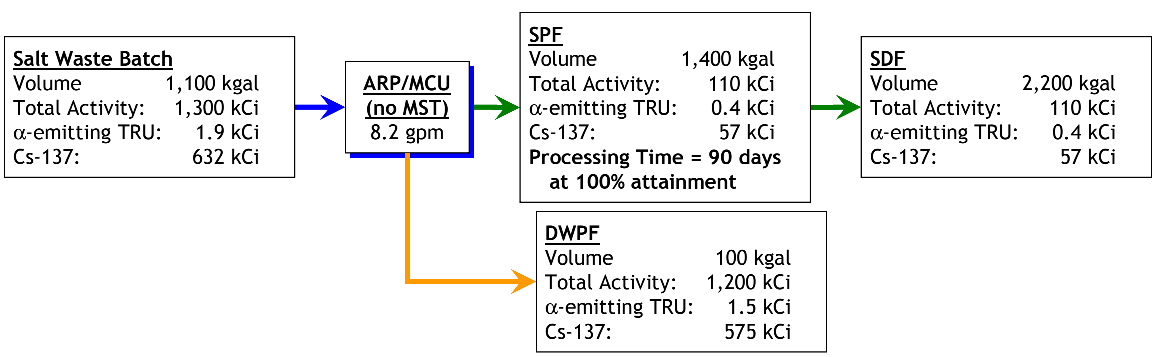
The objective of the Two-part interim processing strategy is to run the interim treatment processes available to minimize curies to SDF while still meeting the tank space objectives. The processing philosophy of minimizing curies to SDF while still meeting tank space objectives can best be illustrated with the following hypothetical example that demonstrates the logic that will be used in making such an evaluation.

A batch of salt solution feed (Batch 1) is prepared and available for processing through to ARP/MCU for treatment before processing at the SPF. Removal of the total volume from the batch is required by a specific time to meet the tank space objectives to support sludge processing and earliest possible full SWPF operation. Processing Plans A and B have Batch 1 being processed through ARP/MCU with no MST strike and with a 24-hour MST strike, respectively. Note that the Total Activity curie numbers shown below include daughter products of Cs-137 and Sr-90.

*Processing Plan A (No MST Strike):*

Assuming:

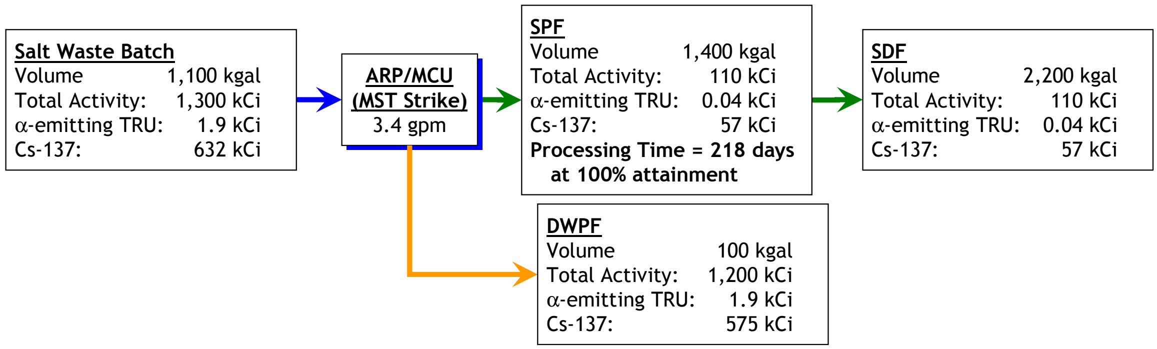
- Processing rate through ARP/MCU is 8.2 gpm




*Processing Plan B (24-Hour MST Strike):*

Assuming:

- Processing rate through ARP/MCU is 3.4 gpm




A comparison of the two cases in the example shown above reveals that even though both processing plans do not exceed Class C concentration limits for disposition to SDF, Processing Plan B results in less alpha emitting transuranic (TRU) curies [40 Ci for Plan B (~98% removal of transuranics) versus 400 Ci (~78% removal of transuranics) for Plan A] being sent to the SDF. However, the total curies, which include the daughter products for Cs-137 and Sr-90, are the same for both cases (~110 kCi – when rounded to the nearest kCi). From a processing duration perspective, it takes ~140% longer (~218 processing days at 100% attainment versus ~90 processing days) to fully disposition the volume in Batch 1. If the processing duration for either case meets tank space objectives, then Processing Plan B would be implemented since it results in fewer curies being sent to SDF. However, if emergent technical or processing information indicates that tank space objectives cannot be met due to the longer processing duration of Processing Plan B, then Processing Plan A would be implemented.

The analyses performed and reported in the Performance Objective Demonstration Document (PODD) to demonstrate compliance with the Performance Objectives in 10 CFR 61 assumed that no MST strikes were performed in the ARP process (i.e., that none of the soluble Sr-90 or the actinides were removed by the ARP process). This same assumption was used in demonstrating compliance with Class C concentration limits. Therefore, if any such evaluation as that described above was performed with a subsequent decision made not to strike, it would not impact the analyses performed to support this waste determination.

In summary, the plan is that MST strikes will be conducted on all salt solution processed through ARP, even if the salt solution already does not exceed Class C concentration limits, as long as throughput can be maintained, with adequate margin, to support necessary tank space needs. An acceptable operational margin can be determined after some operational experience is obtained from operating the ARP/MCU facilities. This is in alignment of the objective to minimize curies to SDF while still meeting tank space objectives.

**References:**

Campbell, S. G., 2004,*"Preliminary Material Balance for the Modular CSSX Unit,"* CBU-SPT-2004-00059, Revision 1, June 22, 2004.

Subosits, S. G., 2004, "Actinide Removal Process Material Balance with Low Curie Salt Feed", X-CLC-S-00113, Rev. 0, September 2004.

**NRC**
**Comment 31:** It is not clear that there is consistency of the simulated fractional release rates with the various leaching, durability, and lysimeter tests described in References 10-13.

**Basis:** Fractional release rates that were independently hand-calculated using the physical dimensions of an intact vault and the effective diffusion coefficients developed in site-specific experiments [10-13] are 2 or more orders of magnitude greater than the reported model-calculated values. It is not clear what processes or parameters in the numerical model are responsible for the differences.

**Path Forward:** Provide a comparison of the model-generated fractional release rates of NO3, Tc-99, I-129, Se-79, Np-237 to those generated based on the results of leaching experiments and lysimeter studies (e.g., those provided on page 2-54 of [1]), applying the appropriate correction and normalization factors.

**SRS Response:** During a meeting between the NRC and DOE on 6/8/05, it was determined that the hand calculations mentioned above did not include the effects of the concrete vault as a diffusion barrier. As described in Section 2.4.1.3 of the 1992 PA (Reference 1 in the NRC RAI), modeling studies showed that disposal in concrete vaults was needed to reduce the release rate of nitrate. Vault 4 was constructed with walls 0.46 m (1.5 ft) thick and a floor 0.76 m (2.5 ft) thick. These thicknesses of concrete serve as diffusion barriers which greatly attenuate the release of mobile constituents.

As a test, the lysimeter experiment whose results are plotted on page 2-54 of the 1992 PA (Reference 1 of the RAI) was set up as a PORFLOW run. Using information from McIntyre and Wilhite 1987 and the intact Saltstone properties used in Cook et al. 2005, a run was made for nitrate ($K_d$ = 0 mL/g), Tc-99 with a $K_d$ of 1000 mL/g (the value used to represent Saltstone with slag), and Tc-99 with a $K_d$ of 1 mL/g (the value for non-slag Saltstone) in order to see if the results compared with the figure on page 2-54 of the 1992 PA. The original figure shown on page 2-54 of the 1992 PA and the results of the PORFLOW run are shown below. The PORFLOW input file for the case of nitrate and Tc with a $K_d$ of 1 mL/g is also shown following the figures.

The range of the nitrate and technetium concentrations, as well as the ratios of Tc to $NO_3$ for Saltstone both with and without slag are quite similar in both sets of runs. Since the $K_d$s of I-129 and Se-79 are similar to the $K_d$s of nitrate ($K_d$ = 0 mL/g) and Tc-99 (oxidizing $K_d$ = 1 mL/g) these radionuclides should behave in a similar manner. These results give assurance that the PORFLOW computer program can provide a good representation of the lysimeter experiment with nitrate and technetium and that the parameters used in the Special Analysis model are reasonable representations of the actual materials in the system.

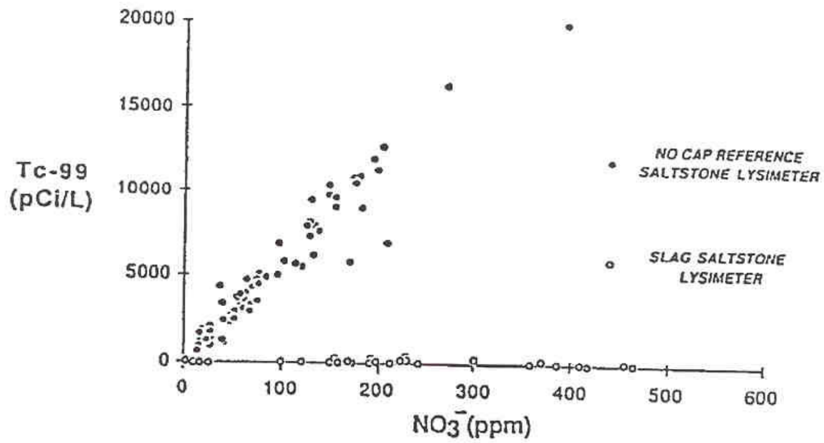
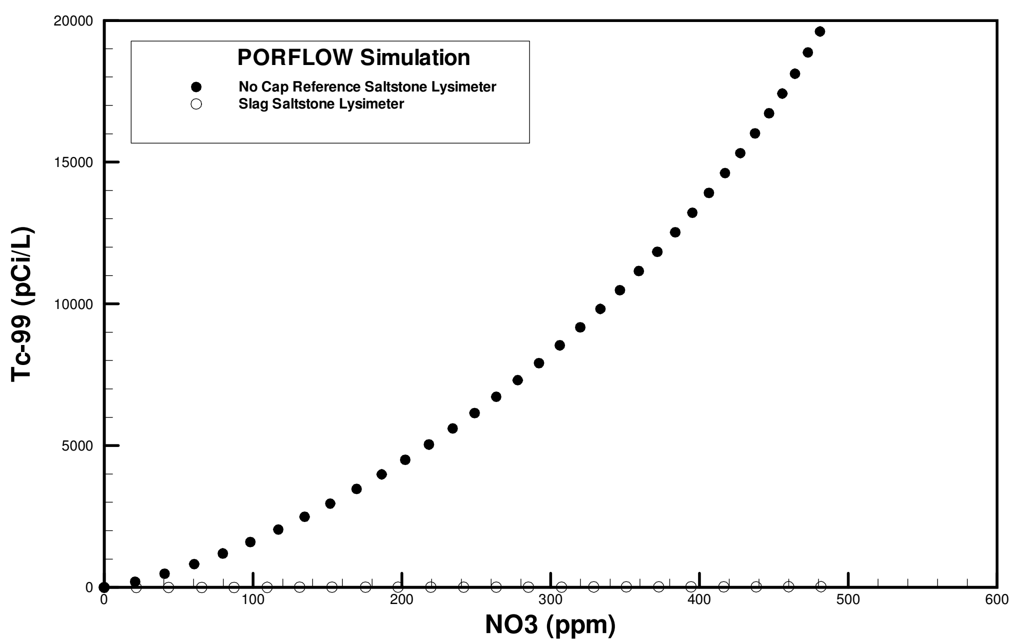



Fig. 2.4-2 Comparison of Technetium vs. Nitrate Leaching for Slag- and Cement-Based Saltstone Lysimeters.



```
! COMPONENTS = NO3 and Tc-99

TITLE Slag Saltstone Lysimeter VADOSE ZONE TRANSPORT RUN 0-730 days (Kd 1)
USER Sebastian Aleman
GRID 62 by 107

!----------------------------------------------------------------------

!Native and Backfill Soil
MATErial type   1  from    1    1  to  62   107

!Drainage Layer
MATErial type   2  from    1    1  to  62   15  !Drain Bottom

!Slag Saltstone
MATErial type   3  from   22   56  to  41   77  !Saltstone

!=======================================================================

!Native Soil
FOR 1
MATErial  DENSity 2.65
MATErial  POROsity = .42  .42  .42
TRAN for C  Kd= 0.00E+00 diff= 4.32E+00 al= 0 at= 0
TRAN for C2 Kd= 1.00E-01 diff= 4.32E+00 al= 0 at= 0

!Drain Bot (Gravel)
FOR 2
MATErial DENSity = 2.65
MATErial POROsity =  0.38  0.38  0.38
TRAN for C  Kd= 0.00E+00 diff= 4.32E+00 al= 0 at= 0
TRAN for C2 Kd= 1.00E-01 diff= 4.32E+00 al= 0 at= 0

!Slag Saltstone
FOR 3
MATErial  DENSity 2.65
MATErial  POROsity = .42  .42  .42
TRAN for C  Kd= 0.00E+00 diff= 4.43E-04 al= 0 at= 0
TRAN for C2 Kd= 1.00E+00 diff= 4.43E-04 al= 0 at= 0

DECAy HALF LIFE for C2 7.7068E+07 day  !! Tc-99  2.1100E+05 year

LOCAte (22,56) to (41,77) ID=WAST

!=======================================================================

BOUN C  X- FLUX= 0.
BOUN C  X+ FLUX= 0.
!BOUN C Y- INTENTIONALLY LEFT OUT
BOUN C  Y+ FLUX= 0.

BOUN C2  X- FLUX= 0.
BOUN C2  X+ FLUX= 0.
!BOUN C2 Y- INTENTIONALLY LEFT OUT
BOUN C2  Y+ FLUX= 0.

!=======================================================================
```

```
SET INVEntory C   3.2181E+08  UNIForm  ID=WAST ! ppm/l
SET INVEntory C2  8.7681E+10  UNIForm  ID=WAST ! pCi/L/l

!======================================================================

PROPerty for C C2 is HARMonic
MATRix C ADI 3
MATRix ITER = 100
LIMIt for C C2 minimum 0.

DIAG TIME C C2 at (31,7) every 100 steps

CONVergence for C C2 REFE LOCAl 1.e-6
OUTPut off

FLUX C   'NO3-Tc-99.FLX'   TIME 1.00E+00 day
FLUX C2  'NO3-Tc-99.FLX'   TIME 1.00E+00 day

! Statistic for C and C2
LOCAte (1,1) to (62,15) ID=MIXC
STATistics C    ID=MIXC   'MIXC-NO3.dat'    TIME 1. day
STATistics C2   ID=MIXC   'MIXC-Tc-99.dat'  TIME 1. day

!======================================================================
! TIME INTERVAL TI01: 0 to 730 days
! READ STEADY-STATE FLOW ARCHIVE
READ 1 '..\..\..\VadoseZoneFlow\Yr-2\Lysimeter-flow.ARC' STARt
TIME = 0. days
SOLV C C2 AUTO 7.3E+02 1.E-04 1.01 0.1 1.E-06 2.0 1.E+6

END
```

**References:**

Cook, J., and J. Fowler. *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, Revision 0. Westinghouse Savannah River Company, Aiken, South Carolina.

Cook, J. R., Wilhite, E. L., Hiergesell, R. A., and Flach, G. P., 2005, *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits*, WSRC-TR-2005-00074, Westinghouse Savannah River Company, Aiken, South Carolina.

McIntryre, P. F., and Wilhite, E. L., 1987, *Slag Saltstone Lysimeter: Monitoring During the First Two Years*, DPST-87-523, Savannah River Laboratory.

**NRC Comment 37** The basis for performance of saltstone containing Tank 48 waste (TPB organics) is not provided. It is not clear what the basis is for the limit on allowable organic content in the Waste Acceptance Criteria (WAC) for the Saltstone Processing Facility (SPF).

**Basis:** Reference 4 (pg. 16) indicates that Tank 48 waste will be sent directly to saltstone without treatment, but that the waste from Tank 48 will be mixed with other streams of low activity waste so that the processing limits for allowable organic content at the SPF are not exceeded. The physical characteristics of saltstone and its durability with respect to the retention of radionuclides may be significantly different when produced with the organic material from Tank 48 waste. For example, biodegradation of an organic-containing wasteform could represent a degradation mechanism
that has not been evaluated in the testing to date.

**Path Forward:** Provide the basis for the performance of the saltstone (including the physical properties) and provide the basis for the limit on allowable organic content in the WAC for SPF.

**SRS Response:** The disposition of Tank 48 salt waste with its associated organic material (mainly potassium and cesium tetraphenylborate) at the Saltstone Disposal Facility (SDF) is a forecasted activity; disposal of similar material has not historically occurred nor been anticipated in the SDF. For this reason, the laboratory studies and associated analyses to support the development of the revised limits associated with the Documented Safety Analysis (DSA) and the Waste Acceptance Criteria (WAC) for both the Saltstone Processing Facility (SPF) and the SDF are not complete. The response to NRC Comment 6 describes this process for establishing DSA limits in more detail. Such changes to both the DSA and WAC limits will not occur without a rigorous, disciplined process to address both the short-term and long-term impacts to the health and safety of occupational workers, the public and the environment.

Changing the WAC for Saltstone to allow it to receive Tank 48 waste follows the thorough process outlined in WSRC Manual S4 Procedure ENG.08 Rev. 2 (WSRC 2005). This manual requires that a proposed change to the WAC to permit acceptance of a new waste stream go through a formal review and approval process. A primary element of that process is a system impact analysis which is performed to characterize the consequences that the proposed change has on the downstream facilities. The system impact analysis is a key component of the WAC and Waste Compliance Plan (WCP) revision process as it identifies the potential for downstream impacts of introducing a new waste stream and initiates the formal engineering review process and the resulting technical evaluation of impacts of the proposed change.

Using the process outlined in ENG.08 to assess the impacts of the forecasted Tank 48 waste stream, there are four primary criteria that form the basis for establishing organic limits in the Saltstone WAC:

1. The salt solution and the resulting grout must be able to be safely processed in the SPF and disposed of in SDF;
2. The final saltstone grout must be characteristically non-hazardous in accordance with RCRA regulations;
3. The respective concentrations of the organic material present (mainly potassium and cesium tetraphenylborate) must not adversely impact the facilities capability to demonstrate compliance with the performance objectives in 10 CFR 61, Subpart C;
4. The organic concentrations must not adversely impact processibility of the salt solution and/or grout.

Safety:

The currently approved WAC for the SPF (Chandler 2004) lists two acceptance limits associated with Tank 48 organics. Both of these limits are provided to protect assumptions made in the Time-to-LFL (Lower Flammability Limit) calculation for the Salt Feed Tank (SFT) used in the SPF Documented Safety Analysis (DSA) (WSRC 2004). The first limit is a maximum concentration limit set on tetraphenylborate (TPB) (both soluble and insoluble) at 30 mg/L. The second is a limit on the maximum allowed benzene generation rate from the decomposition of TPB at 0.092 mg/L/hr. It is anticipated at this time that both of these limits can be increased. The actual limits will be determined following the laboratory testing and analyses.

As is described in Section 7.2.3.14 of the Draft Waste Determination Document (WD) (DOE 2005), before the SPF process is modified including the addition of a new waste stream or modification to the existing salt waste stream, a Consolidated Hazards Analysis (CHA) is performed to identify potential hazards associated with the modification, classify those hazards and evaluate the consequence and frequency of each of the hazards identified. The DSA will document the analysis of hazards identified through the CHA process and will provide the basis for any controls required to achieve safe operations in the SPF. Those controls will be documented in the Technical Safety Requirements (TSR) document for the SPF. If the rigorous analysis process determines that the WAC limits can safely be changed based on the previously described four criteria, then and only then will the WAC limits be revised. The viability of the disposal of Tank 48 salt waste in the SDF will then be dependent on the ability to demonstrate that salt solution from Tank 48 can meet these WAC limits.

Laboratory testing and analyses are on-going to support the evaluation above. Effects of tetraphenylborate decomposition as a function of Saltstone curing temperature and time were investigated using a nonradioactive Tank 48 surrogate composition.

Potassium tetraphenylborate was found to decompose in the Saltstone matrix in samples cured above 75º (Cozzi et al. 2005). Decomposition products include benzene (Cozzi and Zamecnik 2004). An extended testing program of Saltstone made with actual Tank 48 material and simulant is being conducted to evaluate the decomposition of the tetraphenylborate during curing. To date, tetraphenylborate does not appear to affect the durability of Saltstone samples cured below 75ºC. Consequently, one option for operating the facility which is currently being explored is to control the Saltstone curing temperature to a value low enough to prevent decomposition of the potassium tetraphenylborate.

Non-Hazardous Status:

The SDF is permitted as a non-hazardous landfill by the State of South Carolina. Thus, only material deemed non-hazardous in accordance with Resource Conservation and Recovery Act (RCRA) regulations may be placed in the disposal vaults. As described below, testing performed to date indicates that the presence of TPB at concentrations in compliance with the current WAC limits have met the Toxicity Characteristic Leaching Procedure (TCLP) requirements resulting in the saltstone grout being classified as non-hazardous. Any future changes to increase the limits for organics will require verification that the non-hazardous nature of the waste form is not changed by the increase in organic limits.

Testing performed to date includes a preliminary TCLP test. Processing aggregated tank waste containing the actual Tank 48 material was demonstrated and preliminary testing indicated that extraction of mercury in the TCLP leachate is not accelerated by the organics present in the actual waste (Cozzi 2004). (Mercury is the only TCLP metal present in concentrations of concern in the waste.)

Performance Objectives Met:

Literature search to date has not identified any specific studies that have been performed on the long–term effects of organic material on grout performance (i.e., effects of biodegradation). However, the effects of grout degradation over time have been evaluated. In the Special Analysis for Vault 4 (Cook et al. 2005), the long-term effects of grout degradation were evaluated by changing the hydraulic conductivity of the grout as the vaults aged. The sensitivity of grout performance to these changes in hydraulic conductivity is discussed in the response to NRC Comment 19. These sensitivity analyses provided reasonable assurance that the increased hydraulic conductivity associated with hypothetical saltstone grout degradation would not result in exceeding the performance objectives in 10 CFR 61, Subpart C. See the response to NRC Comment 57 for further discussion.

Processibility:

The salt solution has specific physical and chemical properties that must be met in order to process the material through the SPF without causing system upset. These properties are specified in the SPF WAC and include pH of the aqueous solution, the sodium ion concentration, the temperature of the salt solution, and the total mass of insolubles. In addition, the WAC states that aqueous waste sent to the SPF shall not contain or generate volatile organic materials at concentrations that can produce, at equilibrium, vapors in the flammable or explosive range during normal storage, treatment, or disposal operations in the Saltstone Facility. Any future changes to increase the limits for organics will require verification that the processibility of the waste form is not changed by the increase in organic limits.

Conclusion:

The establishment of the limits as described above will be completed prior to the initiation of the processing of the Tank 48 material. The timing for this processing is based on the Interim Salt Processing Strategy Planning Baseline (Mahoney et al. 2004). Upon determination of the most restrictive criteria (safety, non-hazardous, performance and processibility) for TPB/benzene, a WAC limit will be established that is protective of the most restrictive criteria for organics. The WAC undergoes a formal review and approval process by Operations and Engineering Management prior to implementation (WSRC 2005). Likewise, upon revision of the WAC, the WCP for the sending facility will be revised (as required) to document the means that the sending facility will use to demonstrate compliance with the WAC. The revised WCP will go through a formal review and approval process including review by the receiving facility (Saltstone). Upon successful execution of the process described in the WCP to demonstrate compliance with the WAC, the waste stream can be sent from Tank 50 to the Saltstone Facility.

**References:**


Chandler, T.E., 2004, *Waste Acceptance Criteria for Aqueous Waste Sent to the Z-Area Saltstone Production Facility*, X-SD-Z-00001, Rev. 2, December 2004.

Cook, J.R., Wilhite, E.L., Hiergesell, R.A., Flach, G.P., 2005, *Special Analysis: Revision of Vault 4 Disposal Limits*, WSRC-TR-2005-00074, Rev. 0, May 2005.

Cozzi, A.D., 2004, *Formulation Development for Processing Tank 48H in Saltstone*, WSRC-TR-2004-00477, Revision 0, 2004.

Cozzi, A.D. and Zamecnik, J.R., 2004, *Tetraphenylborate Decomposition in Saltstone*, WSRC-RP-2004-00749, Rev. 0, December 16, 2004.

Cozzi, A.D., Cowley, D.A., Duffey, J.M., Eibling, R.E., Jones, T.M., Marinik, A.R., Marra, J.C., and Zamecnik, J.R., 2005, *Measurements of Flammable Gas Generation From Saltstone Containing Simulated Tank 48H Waste (Interim Report)*, WSRC-TR-2005-00180, Rev. 0, April 2005.

Mahoney, M. J. and P. D. d'Entremont, 2004, *Interim Salt Processing Strategy Planning Baseline,* CBU-PED-2004-00027, Revision 0, August 27, 2004.

U.S. DOE, 2005, *Draft Section 3116 Determination Salt Waste Disposal Savannah River Site*, DOE-WD-2005-001, February 2005.

Westinghouse Savannah River Company, 2005, *Waste Acceptance Criteria, Waste Compliance Plan, and Special Waste Compliance Plan*, Manual S4 Procedure ENG.08, Rev. 2, June 2005.

Westinghouse Savannah River Company, 2004, *Saltstone Facility Documented Safety Analysis*, WSRC-SA-2003-00001, Revision 2, November 2004.

**NRC Comment 57:** The potential effects of organic chemicals in the Tank 48 waste and in unintentional contamination from the ARP and CSSX treatments on saltstone durability and radionuclide retention in saltstone should be explained.

**Basis:** Experiments of saltstone durability have been based on samples prepared with simulated saltstone solutions that did not include the organic chemicals present in Tank 48 waste or chemicals that could be unintentionally carried over from ARP or CSSX treatments. Thus the potential effects of these chemicals and their degradation products on saltstone durability should be discussed.

Furthermore, the organic chemicals in Tank 48, as well as the organic chemicals used in the ARP and CSSX process, were designed to react with metals. It is unclear whether tetraphenylborate present in Tank 48 waste, or monosodium titanate and calixarene molecules that could be unintentionally carried over from the ARP and CSSX process could interfere with the precipitation of $Tc_2S_7$ or result in the formation of radionuclide complexes that would have a higher mobility than the uncomplexed radionuclides. Consequently, the effects of chemicals in the Tank 48 waste and any chemicals unintentionally carried over from the ARP and CSSX processes on the retention of radionuclides in saltstone should be addressed.

**Path Forward:** Discuss the expected effects of the organics in Tank 48 waste on saltstone durability and radionuclide retention. Provide an estimate of the types and amounts of organic chemicals that are expected to be carried over from the ARP and CSSX treatments into saltstone. Discuss the potential effects of any solvents and extractants carried over from the ARP and CSSX treatments into saltstone on saltstone durability and radionuclides retention.

**SRS Response:** The disposition of Tank 48 salt waste with its associated organic material (mainly potassium and cesium tetraphenylborate) as well as the disposition of the low-level salt waste streams from Actinide Removal Process (ARP), Modular Caustic Side Solvent Extraction Unit (MCU), and the Salt Waste Processing Facility (SWPF) at the Saltstone Disposal Facility (SDF) are forecasted activities; disposal of similar material with the associated organic contaminants have not historically occurred nor been anticipated in the SDF. To support the technical bases for disposing of these respective salt waste streams, laboratory testing and associated analyses are on-going.

Because the disposing of these waste streams with their associated organic contaminates was not anticipated at the time the current Waste Acceptance Criteria (WAC) for the Saltstone Processing Facility (SPF) and SDF was established, the WAC limits and associated Technical Safety Requirements (TSR) were not developed to support the processing of organic waste streams.

A rigorous process is currently underway to determine the viability of processing these salt waste streams with organic contaminants in SPF and SDF.

The processes described in the responses to NRC Comments 6 and 37 will be followed with respect to the process formality and hierarchy of safety concerns, regulatory compliance, compliance with the performance objectives from 10 CFR 61, Subpart 61, and processibility determination of the WAC for these facilities. These processes will ensure that the appropriate limits are established for organic constituents in the waste streams and that these limits are met by the waste streams prior to authorization for these waste streams to be sent to the SPF.

As part of this extensive evaluation process, determination of the evaluation criteria for these future waste streams with respect to radionuclide leaching and waste form durability is under development. Saltstone testing for leaching and physical property characterization is identified in the Saltstone Performance Assessment (PA) Maintenance Plan. This plan is updated annually and reviewed to prioritize needs.

As an example, elements of the evaluation may include such items as:

- Continued review of available literature on organic impact on grout durability and metals/chemical leaching
- Development of testing with simulants and actual waste forms
- Characterization of the organic bio-degradation including by-products
- Characterization of the interaction between the organics, the degradation products and the grout/waste in the grout
- Understanding of the role that grout durability has on the SDF system performance with respect to radionuclide leaching.

Characteristics of the individual streams are as follows:

Tank 48 Waste

For planning purposes, project documents assume a maximum concentration of 3000 mg tetraphenylborate per liter of salt solution waste entering the SPF (Fowler 2005). This organic is known to decompose through sequential loss of the phenyl groups, eventually producing benzene. The rate of decomposition under Saltstone processing and curing conditions is currently being studied (Cozzi 2004).

To date, feasibility studies related to the disposal of Tank 48 waste Saltstone feasibility studies to date have focused on processing issues and RCRA classification (TCLP testing) of the resulting waste form. The feasibility testing completed to date or underway at the present time is summarized below.

- Processing aggregated tank waste containing the actual Tank 48 material was demonstrated and preliminary testing indicated that extraction of mercury in the TCLP leachate is not accelerated by the organics present in the actual waste (Cozzi 2004). (Mercury is the only TCLP metal present in concentrations of concern in the waste.)

- Effects of tetraphenylborate decomposition as a function of Saltstone curing temperature and time were also investigated using a nonradioactive Tank 48 surrogate composition. Potassium tetraphenylborate was found to decompose in the Saltstone matrix in samples cured above 75 ºC (Cozzi et al. 2005). Decomposition products include benzene (Cozzi and Zamecnik 2004). An extended testing program of Saltstone made with actual Tank 48 material and simulant is being conducted to evaluate the decomposition of the tetraphenylborate during curing. To date, tetraphenylborate does not appear to affect the durability of Saltstone samples cured below 75 ºC. Consequently, an option for operating the facility which is currently being evaluated is to control the saltstone grout curing temperature to a value low enough to prevent decomposition of the potassium tetraphenylborate.

  Feasibility of controlling the pour strategy and monitoring the temperature in the vaults to accomplish this is currently being evaluated. The vaults are instrumented with thermocouples and thermal transient modeling and saltstone grout thermal property data are used to schedule the pour strategy and cell sequencing in the facility.

Actinide Removal Process

The monosodium titanate procurement specification limits the organic content of the manufactured material (<100 ppm total organic carbon; < 500 ppm alcohol -- either isopropyl or methanol) (Shah 2003). Also, most of the trace organics evaporate during storage. Since MST is added at concentrations of 0.4 g/L to the waste and subsequently filtered, the maximum potential organic contribution at SPF and SDF is very low, on the order of 0.04 ppm (Subosits 2003, p. 5). The concentration of organics in this waste stream is insignificant.

Salt Waste Processing Facility (SWPF) or Modular Caustic Side Solvent Extraction Unit (MCU)

The salt solution from the SWPF or MCU will contain entrained solvent, portions of which may transfer to the Saltstone Production Facility. This solvent consists of (0.94 wt %) a calix[4]arene-crown-6 extractant (BOBCalixC6) dissolved in an inert hydrocarbon matrix (at 69.26 wt % Isopar® L). (Delmau et al. 2002) An alkylphenoxy alcohol modifier (at 29.67 wt %) (1-(2,2,3,3-tetrafluoropropoxy)-3-(4-sec-butylphenoxy)-2-propanol, also known as Cs-7SB) added to the solvent enhances the extraction power of the calixarene and prevents the formation of a third phase. An additional additive, trioctylamine (TOA) (at 0.12 wt %), improves stripping performance and mitigates the effects of any surfactants present in the feed stream (Norato et al. 2002, p. 2).

The process designs still for both the SWPF and MCU include operations (i.e., coalescers and decanters) to recover the entrained organic. The current limit for entrained Isopar® L, the most concentrated component in the solvent and the most volatile, is still under development and, once determined, will be controlled through the WAC.

The trioctylamine is volatile and present in low concentrations in the solvent. Process handling and ventilation during the transfers before receipt to the Saltstone facility will largely evaporate this component. The Isopar® L, the major component, is a blend of alkanes similar to the solvent from PUREX processing. Its impact on saltstone properties will likely resemble those of PUREX and, therefore, the impact of the fluorinated modifier is unknown. The modifier is the least resistant of the components to chemical and radiolytic attack. The impact of the extractant is also unknown (Delmau et al. 2002, Peterson 2000).

A test program is currently being developed to perform the first phase of testing to evaluate the release of Isopar® L from Saltstone during curing and the effects of the organics carried over from salt waste decontamination processes on Saltstone leaching (Norato 2005, Cozzi 2005).

**References:**

Cozzi, A. D., 2004, *Formulation Development for Processing Tank 48H in Saltstone*, WSRC-TR-2004-00477, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina, 2004.

Cozzi, A. D., Zamecnik, J. R., 2004, *Tetraphenylborate Decomposition in Saltstone*, WSRC-RP-2004-00749, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina, December 16, 2004.

Cozzi, A. D., Crowley, D. A., Duffey, J. M., Eibling, R., E., Jones, T. M., Marinik, A. R., Marra, J. C., and Zamecnik, J. R., 2005. *Measurements of Flammable Gas Generation from Saltstone Containing Simulated Tank 48H Waste (Interim Report)*, WSRC-TR-2005-00180, Rev. 0, Westinghouse Savannah River Company, Aiken, South Carolina, April, 2005.

Cozzi, A. D., 2005. *Isopar L Release Rates from Saltstone*, WSRC-RP-2005-01581, Rev. 0, Westinghouse Savannah River Company, Aiken, South Carolina, May, 2005

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**NRC**

**Action Item 3 (7/27/05):** ***Support for DOE Definition of Highly Radioactive Radionuclides***

Demonstrate that DOE's definition of highly radioactive radionuclides is based on conservative analysis or provide adequate model support (RAI 11).

**SRS Response:** As a preliminary matter**,** the following response clarifies and summarizes DOE's approach for identifying highly radioactive radionuclides for the purposes of 3116(a)(2) of the Ronald W. Reagan Defense Authorization Act for Fiscal Year 2005 (NDAA), and identifies those radionuclides in the Savannah River Site (SRS) low-activity salt waste that DOE views as being highly radioactive radionuclides. DOE is providing this summary of its approach to clarify any confusion or misinterpretation of DOE's Response to RAI 11, particularly with respect to Se-79, Tc-99 and I-129. As discussed later in this response to Action Item 3, DOE views Se-79, Tc-99 and I-129 in the SRS salt waste to be highly radioactive radionuclides for the purposes of 3116(a) of the NDAA. The response then addresses the specific issue posed by Action Item 3 and addresses other related oral questions asked by the NRC.

<u>Approach and Identification of Highly Radioactive Radionuclides in the SRS Salt Waste for the purposes of 3116(a) (2) of the NDAA</u>

Based on consultation with the NRC, DOE views "highly radioactive radionuclides" to be those radionuclides that, using a risk-informed approach, contribute most significantly to radiological risk to workers, the public, and the environment. Cesium-137 (including its daughter, Ba-137m), Sr-90 (including its daughter Y-90), four alpha-emitting transuranic (TRU) nuclides (Pu-238, Am-241, Cm-244 and Pu-239), Se-79, Tc-99 and I-129 are the highly radioactive radionuclides in the SRS low-activity salt waste for disposal that DOE believes, on the basis of a risk-informed approach, may contribute significantly to radiological risk to workers, the public and the environment, taking into account scientific and health physics principles, knowledge and expertise. Some of the radionuclides listed as highly radioactive radionuclides for the SRS low-activity salt waste may not be listed for other 3116 Determinations if such radionuclides are not present in the waste or do not contribute to dose to the workers, the public, or the intruder. This list of highly radioactive radionuclides was developed beginning with the inventory of radionuclides in the SRS salt waste. As discussed in footnote 10 of DOE's Draft 3116 Determination (DOE 2005), DOE has reviewed the inventory of radionuclides in the salt waste in the SRS waste tanks, as reflected in the current Waste Characterization System database. DOE reviewed this inventory of radionuclides and identified those radionuclides in Tables 1 and 2 of 10 CFR 61.55 Although Tables 1 and 2 in 10 CFR 61.55 specify concentration limits for certain radionuclides in the form of activated metal, DOE includes such radionuclides, if present in the waste, in the list of "highly radioactive radionuclides" as it exists in the waste, without regard to whether such radionuclides are in the form of activated metal. Consistent with Table 1, DOE excludes alpha-emitting transuranic nuclides with half lives of 5 years or less from the list of highly radioactive radionuclides. As discussed in footnote 10 of DOE's Draft 3116 Determination (DOE 2005), all radionuclides in Tables 1 and 2 were considered with respect to section 6 of the draft Determination (concerning 3116(a)(3)(A) of the NDAA) and, where relevant, section 7 of the draft Determination (concerning 3116(a)(3)(A)(i) of the NDAA). However, radionuclides with half lives of 5 years or less, as well as H-3, C-14, Co-60 and Ni-63 (which are present in low concentrations that are well below Class A concentration limits), were not discussed in section 5 of the draft Determination concerning "removal to the extent practical." DOE notes that this approach has not been questioned by the NRC or in public comments, as well as any additional radionuclides that may be important to meeting the performance objectives in 10 CFR 61, Subpart C because they contribute to the dose to workers, the public, and/or the inadvertent intruder (for one or more reasonable intruder scenarios) in the expected and degraded cases. In DOE's view, this approach results in a risk-informed list of highly radioactive radionuclides that includes: those short-lived radionuclides that may present risk because they produce radiation emissions that, without shielding or controls, may harm humans simply by proximity to humans without inhalation or ingestion; and those long-lived radionuclides that persist well into the future, may be mobile in the environment, or may pose a risk to humans if inhaled or ingested.

The above list of highly radioactive radionuclides is the same as the list of radionuclides considered in DOE's Draft 3116 Determination (DOE 2005) with the exception of Sn and U isotopes. Tin and uranium isotopes are excluded from the list of highly radioactive radionuclides based on the results of the 2005 SA (Cook et al. 2005), which used improved analytical models and additional sensitivity analyses that more accurately depicted the potential dose impacts of salt waste disposal. Subsequent to the development of the Draft Section 3116 Determination (DOE 2005), DOE prepared an updated Special Analysis (SA) (Cook et al. 2005) for the Saltstone Facility using improved analytical models and additional sensitivity analyses that more accurately depicted the potential dose impacts of salt waste disposal. Based on the results of this SA and subsequent analysis outlined in the response to NRC RAI Comment 11, Sn-126 and the uranium isotopes were found to be insignificant contributors to the future potential risk to the public, workers, or the environment and, therefore, are no longer being considered for inclusion in the list of highly radioactive radionuclides.

In DOE's response to RAI 11, DOE showed that the concentrations of Se-79, Tc-99 and I-129 in the SRS salt waste are such that they have low associated risks in the expected case based on DOE's analysis premised on the updated SA. DOE also noted that it would not be useful, sensible or reasonable -- that is, it would not be "practical" -- to further remove those radionuclides from the SRS salt waste. DOE also noted that, based on the results of a risk-informed screening approach recommended by the NRC, Se-79, Tc-99 and I-

129 would not necessarily be highly radioactive radionuclides in the expected case. However, DOE continues to include Se-79, Tc-99 and I-129 as "highly radioactive radionuclides" as it did in DOE's Draft 3116 Determination (DOE 2005) based on further NRC consultation.

Action Item 3 Issues

Of the highly radioactive radionuclides listed above, Sr-90, Cs-137 and four alpha-emitting transuranic (TRU) nuclides (Pu-238, Am-241, Cm-244 and Pu-239) are the radionuclides for salt waste disposal at Savannah River Site that contribute most significantly to radiological risk to the workers, the public and the environment, as discussed in the Savannah River Site (SRS) response to the U. S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) Comment 11 (WSRC 2005a). For the reasons discussed below, DOE believes that the analysis outlined in the response to NRC RAI Comment 11, its supporting documentation, and DOE's sensitivity analyses provides a conservative approach which shows that Sr-90, Cs-137, Pu-238, Pu-239, Am-241 and Cm-244 contribute more significantly to radiological risk than the other "highly radioactive radionuclides" in the SRS salt waste.

Approach Includes Conservative Assumptions

The analysis supporting RAI Comment 11 (see response to NRC RAI Comment 11) was based on a series of assumptions/inputs pertaining to waste characterization, disposition, and environmental transport, which were clearly conservative as compared to the anticipated Saltstone Disposal Facility system behavior, and, as explained below, would generate model results which were more pessimistic in several respects than the anticipated Saltstone Disposal Facility system behavior. A summary of the key assumptions/inputs making this analysis conservative is given below:

- Untreated radionuclide inventories represent upper bounding values
  - Characterization approach is conservative for soluble and insoluble phases
  - Characterization assumes all dissolved salt contains 600 mg suspended sludge solids per liter
  - Characterization assumes none of suspended solids are removed via settling
  - Characterization assumes all solids within the saltcake matrix are sent to the SDF

- For the all-pathways scenario, distribution coefficients (Kd) for the baseline case are lower bounding values (where actual Kds were not available) resulting in higher contaminant releases

- Environmental characterization of surrounding soil material indicates that it is predominately sandy loam (Cook et al. 2005)
- The soil Kds are for sand (lower Kd ), rather than sandy loam (higher Kd)

- For the all-pathways scenario, estimated doses are based on "peak" groundwater concentrations for radionuclides whose peak concentrations are not coincident in time -- thus summing the peak doses is conservative.

- For the all-pathways scenario, peak groundwater contribution and peak air contribution are summed, despite differences in times when groundwater and air concentrations are maximum – thus summing these two is conservative.

- For the worker scenario, photon doses are based on liquid waste, not solidified waste. This is conservative because addition of grout reduces radionuclide concentrations and increases photon shielding.

Implications of All-pathways Dose Sensitivity Analysis

As discussed in the response to NRC Action Item 10 (8/17/05), a series of over 30 sensitivity cases was performed with the model used to estimate the all-pathways public dose rates to determine how sensitive the projected doses are to the selection of key input parameters. This model served as the basis for computing the "baseline" Vault 4 inventory limits in the 2005 Vault 4 Special Analysis (Cook et al. 2005). Key input parameters for the model were changed to more pessimistic values, many of which were set to values considered beyond credible. The purpose of this important exercise was to first identify the critical input parameters to the model and then to gain an understanding of how much each parameter can vary before the resulting projected doses will exceed associated performance objectives.

It is important that the models provide a realistic representation of the physical and chemical processes that will occur within the saltstone disposal vaults and surrounding environment for the next 10,000 years. An analysis of the results of the sensitivity cases indicated that the public dose estimates were most sensitive to the two following parameters: 1) amount of precipitation, which affects the infiltration rate of the water reaching the disposal system; and 2) the reduction/oxidization conditions of the saltstone disposal vault and the saltstone grout, which specifically determine the distribution coefficient of technetium (See response to NRC Action Item 10 (8/17/05)). These parameters are ones that DOE has a high degree of confidence will perform as described in the baseline case. This is based on the availability of historic weather data, ability to design and construct a vault cover system that will perform as modeled, and use of the slag as a key construction material in both the vault and saltstone waste form. The unique inclusion of slag in both the vault and the saltstone waste form will maintain a reducing environment as modeled and therefore significantly slow down the release of the technetium to the environment (See response to Action Item 10 (8/17/05)).

With this understanding of the model's sensitivities and the engineering controls that have been included or will be designed (such as inclusion of slag as an inherent construction material in both the vault and the saltstone waste form and the design of the closure cap respectively, see NUREG 1623, "Design of Erosion Protection for Long-Term Stabilization," September 2002) and the associated conservatism in the radionuclide inventory that will be sent to the SDF, DOE believes that the baseline case can be used for the purposes of identifying those radionuclides that, if left untreated and solidified, would contribute most significantly to the radiological risk to the workers, the public and the environment.

Effect of Overlapping Plumes in All-pathways Scenario

The effect of overlapping groundwater plumes resulting from the presence of multiple vaults in the SDF will be a dose increase of ~25% for two adjacent vaults (Cook et al. 2005) and approximately a factor of two for the entire SDF (WSRC 2005c). In this regard, DOE notes that the all-pathways dose rate of the baseline case is extremely low (two orders of magnitude below the limit – see Table 3 of WSRC, 2005b).

Confirmation of Highly Radioactive Radionuclides

Based on consultation with the NRC, DOE views Cs-137 (including its daughter Ba-137m), Sr-90 (including its daughter Y-90), four alpha-emitting transuranic (TRU) nuclides (Pu-238, Am-241, Cm-244 and Pu-239), Se-79, Tc-99 and I-129 to be the highly radioactive radionuclides in the SRS low-activity salt waste that, on the basis of a risk-informed approach, contribute significantly to radiological risk to workers, the public and the environment, taking into account scientific and health physics principles, knowledge and expertise. Of these highly radioactive radionuclides, the response to NRC RAI Comment 11 showed that, in the expected (baseline) case and using a risk-informed analysis recommended by NRC, Sr-90, Cs-137, and four alpha-emitting transuranic (TRU) nuclides (Pu-238, Am-241, Cm-244 and Pu-239) contribute most significantly to radiological risk to the workers, the public and the environment. Subsequent to the issuance of the response to NRC RAI Comment 11 -- and pursuant to consultation with the NRC that reflects a more conservative perspective and for the reasons described in the Draft 3116 Determination -- DOE has retained Se-79, Tc-99 and I-129 on the list of highly radioactive radionuclides for SRS salt waste as in DOE's Draft 3116 Determination (DOE 2005).

Contribution to Radiological Risk Associated with Se-79, Tc-99 and I-129

The anticipated all-pathways dose rate from Se-79 in the 2005 Vault 4 Special Analysis (Cook et al. 2005) is 4.6E-02 mrem/yr. In the sensitivity analysis performed in response to NRC Action Item 10 (8/17/05), the only sensitivity case where the Se-79 dose (61 mrem/yr) exceeded the 25 mrem/yr maximum all-pathways dose rate was in scenario 33, where an infiltration rate of 25 cm/year was assumed through the upper Geosynthetic Clay Liner (GCL) and the drains were assumed to be completely silted up throughout the simulation. This was coupled with a pessimistic value of 5E-7 cm/sec for the hydraulic conductivity of the vault and saltstone grout throughout the simulation and a factor of 10 increase in the effective diffusivity for the vault and saltstone grout. This scenario is not credible in that it represents a disposal system that has no closure cap and no vault and in which the saltstone grout had properties similar to SRS sandy clay soil. See response to NRC Action Item 10 (8/17/05).

The anticipated all-pathways dose rate from Tc-99 in the 2005 Vault 4 Special Analysis (Cook et al. 2005) is extremely small (1.6E-13 mrem/yr). In the sensitivity analysis performed in response to NRC Action Item 10 (8/17/05), the sensitivity cases where the Tc-99 dose ( 90 mrem/yr for scenario 22; 1,200 mrem/yr for scenario 30; 34,000 mrem/yr for scenario 33 oxidizing; and 31 mrem/yr for scenario 33 reducing) exceeded the 25 mrem/yr maximum all-pathways dose rate were those cases in which the saltstone grout and the concrete vaults were both assumed to have a complete loss of reducing capacity at time zero. This assumption is considered unrealistic given that slag is an integral part of the saltstone grout and vault and its demonstrated effectiveness in reducing Tc-99 (see response to NRC Action Item 9 (7/27/05)). In addition, Scenario 33 is not credible because it represents a hypothetical disposal system that has no closure cap and no vault and in which the saltstone grout had properties similar to SRS sandy clay soil. See response to NRC Action Item 10 (8/17/05).

The anticipated all-pathways dose rate from I-129 in the 2005 Vault 4 Special Analysis (Cook et al. 2005) is 2.6E-03 mrem/yr. In the sensitivity analysis performed in response to NRC Action Item 10 (8/17/05), the only sensitivity cases where the I-129 dose (130 mrem/yr) exceeded the 25 mrem/yr maximum all-pathways dose rate was in scenario 33, where an infiltration rate of 25 cm/year was assumed through the upper Geosynthetic Clay Liner (GCL) and the drains were assumed to be completely silted up throughout the simulation. This was coupled with a pessimistic value of 5E-7 cm/sec for the hydraulic conductivity of the vault and saltstone grout throughout the simulation and a factor of 10 increase in the effective diffusivity for the vault and saltstone grout. As discussed above, this scenario is not credible in that it represents a disposal system that has no closure cap and no vault and in which the saltstone grout had properties similar to SRS sandy clay soil.

For perspective, using the analytical process discussed in the response to NRC RAI Comment 11, even when using the radionuclide inventories in the solidified salt waste assuming no radionuclide removal treatment of the waste stream, the resultant dose rates due to Se-79, Tc-99 and I-129 were 3.3E-01 mrem/yr, 4.5E-13 mrem/yr and 6.3E-03 mrem/yr, respectively (WSRC 2005a). All doses, individually and in combination, were well below the 25 mrem/yr performance objective suggesting that these radionuclides pose a low radiological risk to workers, the public and the environment in the expected or baseline case.

Removal to the Maximum Extent Practical

Removal of Sr-90, Cs-137 and the alpha-emitting transuranic nuclides is discussed in the Draft 3116 Determination (DOE 2005) and in the response to NRC RAI Comment 11 (WSRC 2005a).

With respect to Se-79, Tc-99 and I-129, the concentrations of these radionuclides in the salt waste are such that they do not present a significant risk to the workers, the public or the environment in the expected (baseline) case as discussed above. Because of the low associated risk, these radionuclides are not targeted for removal by the processes DOE plans to deploy. In this regard, the "maximum extent practical" removal standard in Section 3116 of the NDAA contemplates, among other things, the exercise of expert judgment and consideration of the sensibleness, reasonableness and usefulness of further removal of radionuclides. For the SRS salt waste streams, the associated risks of Se-79, Tc-99 and I-129 are so low that it would not be sensible or reasonable to target these radionuclides for further removal. Nevertheless, because of the processes utilized at SRS, removal of the insoluble fraction of Se-79, Tc-99 and I-129 will be accomplished through a combination of settling and cross-flow filtration. The insoluble fraction within the salt waste comprises approximately 60%, 6%, and 0.05% respectively of the SRS inventory for each of these radionuclides (WSRC 2005b). However, removal of the soluble-phase of these radionuclides is impractical due to the low maturity of removal technologies (Peterson 1996), particularly in light of the low contribution to risk posed by these radionuclides in the expected (baseline) case. Because of the relative low risk associated with these radionuclides (WSRC 1992, Cook et al. 2005), DOE has not historically contemplated removal of these radionuclides from waste. No significant research and development activities have been conducted on removal of these radionuclides.

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**Department of Energy**
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**JUN 2 8 2005**

Ms. Jean Sulc, Chairperson
Savannah River Site Citizens Advisory Board
24 Harbor River Circle
St. Helena Island, SC 29920

Dear Ms. Sulc:

SUBJECT: Citizens Advisory Board (CAB) Recommendation 211 Draft Salt Waste Determination

Thank you for your May 24, 2005, recommendation regarding the Draft Section 3116 Determination for Salt Waste Disposal at Savannah River Site (SRS). The Department of Energy Savannah River Operations Office (DOE-SR) accepts Recommendation 211 and responds as follows:

**Part 1: DOE-SR proceed with the planned interim technologies to ensure uninterrupted use of the Defense Waste Processing Facility (DWPF) and to enhance risk reduction.**

**Part 3: DOE-SR, working with the South Carolina Department of Health and Environmental Control (SCDHEC), assure flexibility in operating the Saltstone Disposal Facility to accommodate disposal of between three million and five million curies.**

In response to Parts one and three, DOE-SR is currently working with the U.S. Nuclear Regulatory Commission (NRC) to complete consultation on the Draft Salt Waste Determination as required by Section 3116 of the 2005 National Defense Authorization Act. DOE-SR is also working with SCDHEC to develop an acceptable Saltstone Facility operating and disposal permit approach that can be implemented following completion of the NRC consultation process. DOE-SR expects to be able to implement the modified salt processing strategy discussed with the CAB on several occasions and as laid out in the Draft Salt Waste Determination.

**Part 2: DOE-SR provide to the SRS CAB by July 26, 2005, more detailed information on the Tank 48 process strategy, including alternatives, and the potential impacts to DWPF and Saltstone.**

DOE-SR will work with the Waste Management Committee (WMC) to schedule briefings on the Tank 48 recovery strategy, the alternatives that we have considered, and the potential impacts to the downstream facilities at appropriate meetings of the CAB and/or WMC later this year.

**Part 4: DOE-SR provide the results of an independent scientific peer review on both the Vault 4 Saltstone Performance Assessment Special Analysis (SA) and the Performance Assessment (PA) revision.**

The new Saltstone Vault 4 SA is currently awaiting DOE-SR approval. The SA was independently reviewed by a team of technical experts including two members of the Low-Level Waste Disposal Facility Federal Review Group (LFRG). A copy of the evaluation report on the SA is enclosed. The SA will be provided to the NRC as part of their consultation on the Section 3116 Waste Determination for Salt Waste Disposal at SRS. The revised PA, to be completed in 2006, will receive an independent review by the LFRG and will incorporate the analysis from the Vault 4 SA.

**Part 5: Give the CAB the most recent updated tank-leak history and crack history in July 2005, and in April of each year thereafter.**

DOE-SR will work with the WMC to schedule briefings and provide documentation on the tank leakage and crack history at appropriate meetings of the CAB and/or WMC later this year and annually thereafter.

If you have any questions, please contact me or have your staff contact Terrel J. Spears at (803) 208-2845.

Sincerely,

Jeffrey M. Allison

Jeffrey M. Allison
Manager

SPD-05-215

Enclosure:
DOE Saltstone Special
Analysis Evaluation Report

#050689 - Closes