APPENDIX B

ACCIDENT ANALYSIS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

List of Tables

APPENDIX B. ACCIDENT ANALYSIS

This Appendix provides detailed information on potential accident scenarios associated with various alternatives for salt processing at the Department of Energy's (DOE) Savannah River Site (SRS). The Appendix provides estimates of the quantity and composition of hazardous materials that could be released in an accident, as well as the consequences to workers and the public. Estimates are given in terms of dose and latent cancer fatalities for radiological releases and of concentration levels for chemical releases.

The primary source of information for the accident analyses is an engineering calculation prepared specifically to document the accident sequences, frequencies, and source terms for the various alternatives. Unless specifically noted, all references in this Appendix are to Cappucci et al. (2000).

B.1 General Accident Information

An accident, as discussed in this Appendix, is an inadvertent release of radiological or chemical hazardous materials as a result of a sequence of one or more probable events. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events (which could be either dependent on or independent of the initial event), that dictate the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* – normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.

- *External initiators* – independent of facility operations and normally originate outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include helicopter, aircraft, or vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.

- *Natural phenomena initiators* – natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

The likelihood of an accident occurring and its consequences usually depend on the initiator, the sequence of events, and their frequencies or probabilities. Accidents can be grouped into four categories—anticipated, unlikely, extremely unlikely, and beyond extremely unlikely, as listed in Table B-1. DOE based the frequencies of accidents on safety analyses and historical data about event occurrences.

B.2 Accident Analysis Methods

For the salt processing alternatives, potential accident scenarios that could involve release of both radiological and nonradiological hazardous materials were identified. Section B.2.1 provides information about the various alternatives. Sections B.2.2 and B.2.3 provide details about the specific analysis methods used in this Appendix.

The accident sequences analyzed in this SEIS would occur at frequencies generally greater than once in 1,000,000 years. However, the analysis considered accident sequences with smaller frequencies, if their impacts could provide information important to decision making.

Table B-1. Accident frequency categories.

Accident frequency category	Frequency range	Description
Anticipated	Less than once in 10 years but greater than once in 100 years	Accidents that might occur several times during a facility lifetime
Unlikely	Less than once in 100 years but greater than once in 10,000 years	Accidents that are not likely to occur during a facility lifetime; natural phenomena include Uniform Building Code-level earthquake, maximum wind gust, etc.
Extremely unlikely	Less than once in 10,000 years but greater than once in 1,000,000 years	Accidents that probably will not occur during a facility life cycle; this includes the design-basis accidents.
Beyond extremely unlikely	Less than once in 1,000,000 years	All other accidents.

Source: DOE (1994).

The methods of accident analysis are consistent with the guidance provided by DOE's Office of National Environmental Policy Act (NEPA) Policy and Assistance in *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (DOE 1993). In addition to the specific guidance on accident analyses, DOE has applied the recommendation to base analysis on realistic, rather than overly conservative, exposure conditions. DOE has also applied the recommendation to use a *sliding scale* approach, which means to provide a level of detail in the analysis of specific issues and their impacts in proportion to their significance.

Recently the Office of NEPA Policy and Assistance issued draft guidance entitled *Analyzing Accidents Under NEPA* (DOE 2000a). It clarifies and supplements the information in the 1993 guidance. DOE has used the guidance's clarifications on the use of the sliding-scale approach, range of accident scenarios, avoidance of compounding conservatisms, frequency, and risk. However, this Appendix does not include the suggestion in the guidance to present direct and indirect effects of post-accident activities. Such analysis would require the development of methodology to measure these impacts in a consistent basis, followed by the integration of this methodology into the specific salt processing accidents analyzed in this Appendix. In light of these circum-

stances and judicious application of the sliding-scale approach, DOE Savannah River Office (SR) considers the evaluation of post-accident cleanup impacts to be both inefficient and minor in comparison to the customary evaluation of human health impacts of potential accidents.

B.2.1 SALT PROCESSING ALTERNATIVES

The accident data in this Appendix are organized by alternative. The accident impacts in Chapter 4 are also organized by alternative to reflect potential accident occurrences for the associated alternative.

DOE proposes to select a technology and design, construct, and operate the required facilities to replace the In-Tank Precipitation (ITP) process to separate the highly radioactive components of high-level waste (HLW) salt solutions from the low-activity components of the salt solution. The new process would be compatible with existing facilities and processes for HLW storage and vitrification and for disposal of low-level waste at the SRS. The alternatives being considered in this SEIS are:

- No Action

- Small Tank Tetraphenylborate Precipitation

- Crystalline Silicotitanate Ion Exchange

- Caustic Side Solvent Extraction

• Direct Disposal in Grout

Each alternative is discussed in detail in Chapter 2 and Appendix A; however, a brief description of each alternative is included here.

No Action Alternative

Under the No Action alternative, DOE would continue current HLW management activities, including tank space management and tank closure, without a process to separate the high-activity and low-activity salt fractions. The Defense Waste Processing Facility (DWPF) would vitrify only sludge from the HLW tanks. Saltcake and supernatant would remain in the HLW tanks, and monitoring activities would continue. Current tank space management projections indicate that, after 2010, additional tank space would be needed to support continued operations and meet tank closure commitments under the No Action alternative.

As soon as DOE determined that a salt processing facility would not be available by 2010, decisions about additional tank space would have to be made. The course of action that DOE would follow cannot be predicted at this time, but available options may include the following, either individually or in combination.

1. Identify additional ways to optimize tank farm operations

2. Reuse tanks scheduled to be closed by 2019

3. Build tanks permitted under wastewater treatment regulations

4. Build tanks permitted under RCRA regulations

5. Suspend operations at DWPF.

Because the No Action alternative is the basis from which each of the proposed alternatives progresses, the hazards associated with each action alternative are supplemental to those of the No Action alternative. However, through the processing of salt solution, hazards associated with continued storage would decrease over time. Therefore, since the No Action alternative includes only current tank space management operations, which have been evaluated under the NEPA process and in approved safety analysis reports and the activities DOE would pursue during the post tank space management phase have not been determined, this Appendix does not analyze accidents associated with No Action failure of a salt solution hold tank is analyzed in the *High-Level Waste Tank Closure Draft Environmental Impact Statement* (DOE 2000b). The radiological and nonradiological hazards associated with the four action alternatives are evaluated in this Appendix.

Small Tank Precipitation

DOE would construct a new shielded facility to house process equipment to implement this alternative. The Small Tank Precipitation alternative would use the same chemical process as the ITP process to remove high-activity radionuclides from the salt solution. However, radioactive HLW would be processed through the facility in a manner that would control the high benzene generation rates that led DOE to develop an alternative salt processing technology.

Soluble radioactive metal ions (cesium, strontium, uranium, and plutonium) in the salt solution and concentrated supernatant would be precipitated with tetraphenylborate (TPB) or sorbed on monosodium titanate (MST) to form insoluble solids. The resulting solids would be concentrated by filtration and the product slurry treated to yield a non-flammable stream for transfer to DWPF for vitrification. The decontaminated salt solution, containing primarily sodium hydroxide, nitrate, and nitrite would be transferred to the Saltstone Manufacturing and Disposal Facility for disposal as grout.

Ion Exchange

DOE would construct a new shielded facility to house chemical processing equipment (tanks, pumps, filter systems, ion exchange columns) to

implement this alternative. The Ion Exchange process would use crystalline silicotitanate (CST) resin in ion exchange columns to remove cesium from the salt solution. Strontium, plutonium, and uranium would first be removed by adsorption on MST, and the resulting solids would then be transferred to DWPF for vitrification. The cesium-loaded resin would also be transferred to DWPF for vitrification. The low-activity salt solution would be transferred to the Saltstone Manufacturing and Disposal Facility for disposal as grout.

Solvent Extraction

DOE would construct a new shielded facility to house chemical processing equipment (tanks, pumps, filter systems, contactors). The Solvent Extraction process would employ a highly specific organic extractant in a diluent solvent to remove cesium from the caustic salt solution, using centrifugal contactors to provide high surface area interactions between the organic solvent and aqueous solution. The separated cesium would be extracted into an acidic aqueous stream to be transferred as an all-liquid phase to DWPF for vitrification. Prior treatment with MST would remove strontium, uranium, and plutonium from the salt solution for transfer to DWPF. The low-activity salt solution would be transferred to the Saltstone Manufacturing and Disposal Facility for disposal as grout.

Direct Disposal in Grout

DOE would construct a new shielded facility to immobilize the HLW salt solution in grout, without separation of radioactive cesium. Prior treatment with MST would remove strontium, uranium, and plutonium from the salt solution for transfer to DWPF. The cesium-containing solution would be mixed with cement, flyash, and slag for disposal as grout in shielded saltstone vaults in Z Area.

The saltstone waste form generated in this alternative would be required to meet U.S.

Nuclear Regulatory Commission (NRC) Class C low-level waste disposal requirements for near surface disposal.

B.2.2 RADIOLOGICAL HAZARDS

The accidents identified for the salt processing alternatives are described in Section B.3. These descriptions include an approximation of the material at risk (MAR) that would potentially be involved in a given type of accident. Depending on the particular scenario, release fractions have been applied to the MAR to determine the amount of material that could be released to the environment via the air. This amount is referred to as the source term. Source terms are provided as curies of fission products and transuranics. The fission product source term is significantly dominated by radioactive cesium, while plutonium-239 has one of the highest dose factors of the common alpha-emitters found in SRS radiological effluents. Therefore, the analysis used radioactive cesium to represent the fission product source term and plutonium-239 to represent the transuranic source term.

The source terms were calculated by spreadsheet using Microsoft Excel. The Source Term and the Resuspension Source Term were determined using the following formulas.

Source Term: $ST = MAR \times DR \times ARF \times RF \times LPF$, where:

DR = Damage Ratio: fraction of MAR actually impacted by the accident

ARF = Airborne Release Fraction: the coefficient used to estimate the amount of radioactive material suspended in air as an aerosol and thus available for airborne transport due to physical stress from a given accident

LPF = Leak Path Factor: fraction of radionuclides or chemicals in the air transported through some confinement or filtration mechanism.

Resuspension Source Term: $ST_r = MAR \times ARR \times RF$, where:

MAR = Material at Risk: amount of radioactive materials or chemicals available to be acted upon by an event

ARR = Airborne Release Rate: the coefficient used to estimate the amount of material that can be suspended in air and made available for airborne transport under a specific set of induced physical stresses as a function of time.

RF = Respirable Fraction: fraction of airborne radionuclides or chemicals as particles that can be transported through the air and inhaled into the respiratory system

The analysis of airborne releases used the computer code AXAIRQ, which models accidental atmospheric radioactive releases from SRS that are of relatively short duration. AXAIRQ determines the concentration of radiological releases to the atmosphere in every direction around the release location. The code considers the height of the release and wind speed and direction changes in the calculation. AXAIRQ strictly follows the guidance in Regulatory Guide 1.145 (NRC 1982) on accidental releases, and has been verified and validated (Simpkins 1995a and 1995b). Because all considered accidents would occur at either ground level or from a 46-meter stack, the releases for both heights were evaluated using AXAIRQ. In accordance with the regulatory guide, the code considers plume meander and fumigation under certain conditions. Plume rise due to buoyancy or momentum is not available. The program uses a 5-year meteorological database for the SRS, and determines the shortest distance to the Site boundary in each of the 16 compass direction sectors by determining the distance to one of 875 locations along the boundary. The impacts derived from this code used the average, or 50 percent meteorology. The code uses the shortest distance in each sector to calculate the concentration for that sector.

DOE used the computer code PRIMUS, which was developed by the Oak Ridge National Laboratory, to consider decay and daughter in-growth. PRIMUS determines radionculide in-growth matrices from user specified sources. In-growth must be considered for radionculides that are generated from the decay of more than one isotopic chain and their own decay.

Simpkins (1999) provided unit dose conversion factors for the applicable radionuclides for release locations in S and Z Areas. These factors were applied to the airborne source terms from the previously described excel spreadsheet to calculate the doses to various receptors.

For population dose calculations, age-specific breathing rates were applied, but adult dose conversion factors were used. Radiation doses were calculated to the maximally exposed offsite individual (MEI), to the population within 50 miles of the facility, to a noninvolved worker assumed to be 2,100 feet (640 meters) downwind of the facility, to an involved worker assumed to be 328 feet (100 meters) downwind of the facility, and to the onsite population. All doses are committed effective dose equivalents.

After DOE calculated the total radiation dose to the public, it used dose-to-risk conversion factors established by the National Council on Radiation Protection and Measurements (NCRP) to estimate the number of latent cancer fatalities (LCFs) that could result from the calculated exposure. There is inconclusive data that small radiation doses cause cancer; however, to be conservative the NCRP assumes that any amount of radiation has some risk of inducing cancer. DOE has adopted the NCRP factors of 0.0005 LCF for each person-rem of radiation exposure to the general public and 0.0004 LCF for each person-rem of radiation exposure to radiation workers for doses less than 20 rem. For larger doses, when the rate of exposure would be greater than 10 rads per hour, the increased likelihood of LCF is doubled, assuming the body's diminished capability to repair radiation damage (NCRP 1993).

B.2.3 CHEMICAL HAZARDS

For chemically toxic materials, the long-term health consequences of human exposure to haz-

ardous materials are not as well understood as those related to radiation exposure. A determination of potential health effects from exposures to chemically hazardous materials, compared to radiation, is more subjective. Therefore, the consequences from accidents involving hazardous materials are expressed in terms of airborne concentrations at various distances from the accident location, rather than in terms of specific health effects.

To determine potential health effects to workers and the public that could result from accidents involving hazardous materials, the airborne concentrations of such materials released during an accident at varying distances from the point of release were compared to the Emergency Response Planning Guideline (ERPG) values (AIHA 1991). The American Industrial Hygiene Association established these values, which depend on the chemical substance, for the following general severity levels to ensure that necessary emergency actions occur to minimize exposures to humans.

- ERPG-1 Values – Exposure to airborne concentrations greater than ERPG-1 values for a period greater than one hour results in an unacceptable likelihood that a person would experience mild transient adverse health effects (i.e., rash, nausea, headache) or the perception of a clearly defined objectionable odor.

- ERPG-2 Values – Exposure to airborne concentrations greater than ERPG-2 values for a period greater than one hour results in an unacceptable likelihood that a person would experience or develop irreversible or other serious health effects (i.e., organ damage, seizures, pneumonitis) or symptoms that could impair a person's ability to take protective action (i.e., dizziness, confusion, impaired vision).

- ERPG-3 Values – Exposure to airborne concentrations greater than ERPG-3 values for a period greater than one hour

results in an unacceptable likelihood that a person would experience or develop life-threatening health effects (i.e., loss of consciousness, cardiac arrest, respiratory arrest).

B.3 Postulated Accident Scenarios Involving Radioactive Materials

These sections describe the potential accident scenarios associated with each alternative that could involve the release of radioactive materials. The impacts of these scenarios are described in Section B.4.

Several of the accidents identified for a particular alternative are also common to other alternatives. However, they will be discussed individually for each alternative.

B.3.1 SMALL TANK PRECIPITATION

The accidents identified for the Small Tank TPB Precipitation process that result in the release of radiological materials to the environment include:

- Loss of confinement in a process cell

- Beyond design-basis earthquake

- Fire in a process cell

- Benzene explosion in the Precipitate Hydrolysis Cell (PHC)

- Helicopter or aircraft crash

- Benzene explosion in Precipitate Hydrolysis Aqueous (PHA) Surge Tank

B.3.1.1 Loss of Confinement in a Process Cell

Scenario: Mechanical failure or an external event, such as a dropped cell cover or crane mishap, could cause a failure of the primary confinement for a tank or its associated piping. A failure of primary confinement would release material into the process cell. For this event, the entire tank contents at maximum capacity would be released through the rupture. It was assumed

that the release would not be cleaned up for 168 hours (7 days).

The tanks of concern would be the Precipitate Reactor and the PHA Surge Tank. A failure of the Precipitate Reactor or associated piping would release material to the PHC, while a failure of the PHA Surge Tank or associated piping would release material to the PHA Surge Tank process cell. Flammable benzene vapors and hydrogen generated by leaking slurry from the PHA Surge Tank could cause an explosion, if they were allowed to reach flammable concentrations in the presence of an ignition source. A benzene explosion following a PHA Surge Tank loss of confinement event is in the beyond-extremely-unlikely category and is bounded by the benzene explosion in the PHA Surge Tank event discussed in Section B.3.1.6. The precipitate slurry would also be somewhat flammable and, if allowed to reach a combustible state, a large enough ignition source could cause a precipitate fire in the process cell. For this scenario, however, it is assumed that no explosion or fire occurs.

A leak detection system would mitigate the consequences of releases from process tanks and associated piping. This system would be designed to detect the leak and terminate the process, thus minimizing the amount of material that would leak from the system. A shielded secondary confinement system would protect onsite workers from radiological consequences of the leaks.

Probability: The initiating event for the loss of primary confinement of a process tank could be mechanical failure or an external event. External events could cause leaks from tanks or piping. Impacts during cell cover and crane movement are assumed to cause spills from a rupture in the tank or associated piping. It was assumed that there would be 50 feet of piping associated with each tank. The annual frequency of a loss of primary confinement for a process tank was calculated to be 3.4×10^{-2}. Therefore, a loss

of confinement accident would be expected once in 30 years.

Source Term: A dropped cell cover or crane mishap was assumed to damage the affected tank significantly enough to release the entire contents of the tank to the cell. Good engineering practices would be used during design of the process facility to ensure that high-efficiency particulate air (HEPA) filters would be located in a remote part of the facility away from process cells (e.g., event location). DOE would perform regular in-place testing to ensure that installed HEPA filters would have a particle removal efficiency of greater than 99.9 percent. Therefore, the HEPA filters and ventilation system were assumed to be operating due to the physical distance between the filter location and event location, reducing the amount of radioactivity released from the process cell within 99 percent efficiency. The radiological source terms associated with this accident are provided in Table B-2. In addition, a loss of primary confinement for the PHA Surge Tank would release benzene in an uncontrolled manner to the process cell ventilation system. The source terms associated with nonradiological chemical releases are addressed in Section B.5. All releases were postulated to occur from the 46-meter stack.

Table B-2. Source terms for loss of confinement in a process cell of the Small Tank Precipitation facility.

	Source term (Ci)	
	Fission products	Transuranics
Precipitate Reactor	1.1	3.1×10^{-3}
PHA Surge Tank	4.2	0.012

B.3.1.2 Beyond Design-Basis Earthquake

Scenario: The structures for the Small Tank Precipitation process would be designed to withstand Performance Category-3 (PC-3) earthquakes, straight winds, and tornadoes. The PC-3 earthquake is considered to be the bounding Natural Phenomena Hazards (NPH) event. The process vessels, piping, and structures that house the hardware would be designed to withstand

such an earthquake. For the beyond design-basis event, an earthquake slightly stronger than the design-basis earthquake is postulated to occur. This earthquake would cause the primary and secondary confinement to fail, releasing the entire facility inventory into the building. The ventilation system and HEPA filters are also postulated to collapse, resulting in some airborne releases of both transuranic and fission product inventories.

Probability: The structure, primary confinement, and secondary confinement were conservatively assumed to fail due to an earthquake only slightly stronger than the design-basis earthquake of 0.16 g. The annual probability of exceeding a 0.16 g earthquake is 5.0×10^{-4}. Therefore, structural failure of the facility would be expected to occur less than once in 2,000 years.

Source Term: A release of the full inventory from the facility was postulated from collapse of the structure and of the primary and secondary confinement. The airborne source term associated with this accident would consist of 700 curies (Ci) of fission products and 2.0 Ci of transuranics. The release was postulated as a ground-level release.

B.3.1.3 Fire in a Process Cell

Scenario: A fire in any of the process cells could release radiological materials contained in the process vessels. The process would not introduce any combustible materials into the process cells; however, equipment or material that might be left behind during maintenance activities could lead to the initiation of this event. Good engineering practices would be used during design of the processing facility to ensure that HEPA filters would be located in a remote part of the facility away from process cells (e.g., event location). DOE would perform regular in-place testing to ensure that installed HEPA filters would have a particle removal efficiency of greater than 99.9 percent. The fire was assumed to challenge the ventilation

system and process equipment; however, the HEPA filters would be expected to maintain their function due to the physical distance between the filter location and event location and would minimize releases to the environment within 99 percent efficiency. The entire cell inventory was assumed to be at risk. A leak was expected to occur from the fire.

In this scenario, the benzene releases are negligible compared to releases from fires/explosions elsewhere (i.e. Precipitate Hydrolysis Cell) due to the small amount of benzene in the PHA Surge Tank.

Probability: A fire in a process cell was assumed to be limited by the combustible control program, the fire barriers, and the fire department. The annual probability of a fire occurring in a process cell was calculated to be 1.0×10^{-4}. Therefore, a fire in a process cell would be expected to occur once in 10,000 years.

Source Term: The fire was assumed to damage the process vessel enough to cause a leak. The damage was assumed to be equivalent to a 0.5-inch-diameter opening. The leak was assumed to be stopped within 24 hours, allowing the fire department to put out the fire, a response plan to be developed, and implementation of the response plan to control the consequences of the leak. The worst-case scenario would be a fire in the process cell containing the PHA Surge Tank, because this cell has the greatest amount of material. The airborne source term associated with this accident would consist of 37 Ci of fission products and 0.11 Ci of transuranics. Any release was postulated to occur from the 46-meter stack.

B.3.1.4 Benzene Explosion in the PHC

Scenario: Benzene could be introduced into the cell if one of the benzene-containing vessels or piping within the cell developed a leak. An ignition source could then cause a deflagration in the PHC, over-pressurizing the cell and dislodging the cell covers. The cell covers could then fall back into the PHC, striking the Organic Evaporator, Organic Evaporator Condensate Tank, Organic Evaporator Condenser, Organic

Evaporator Decanter, and Salt Cell Vent Condenser and spilling liquid benzene onto the cell floor. Benzene vapors evolving from this spilled inventory could lead to a second PHC deflagration, damaging and releasing the contents of the Precipitate Reactor. This accident assumes that the remaining liquid benzene on the PHC floor would ignite and burn.

The PHC design would incorporate a ventilation system to maintain airflow through the cell and minimize the possibility that benzene could leak into the cell and reach explosive concentrations.

Probability: A benzene explosion in the PHC that damages the cell would have the potential to damage and release the contents of multiple tanks that contain benzene and the Precipitate Reactor. For an explosion to occur, a large explosive benzene vapor cloud must form in the PHC and an ignition source must be present. For an explosive benzene cloud to form, the ventilation system was assumed to fail, eliminating airflow to the PHC, and forcing benzene from the PHC vessels. The annual probability that an explosion would occur in the PHC with damage to the cell was calculated to be 1.01×10^{-5}. Therefore, a benzene explosion would be expected to occur once in 99,000 years.

Source Term: An explosion in the PHC that would damage the cell was assumed to spill the entire contents of multiple tanks that contain benzene, as well as the Precipitate Reactor, which contains radiological material, into the cell. An ensuing fire would consume the benzene, so the accident would only involve radiological releases. HEPA filters are assumed to be damaged, failing to mitigate the release. The airborne source term associated with this accident would consist of 1,800 Ci of fission products and 5.3 Ci of transuranics. The release was postulated to occur from the 46-meter stack.

B.3.1.5 Helicopter or Aircraft Crash

Scenario: External events that could impact the facility include helicopter, aircraft, or vehicle impacts and external fire. According to Cappucci (2000), an unmitigated aircraft impact has the potential to release the entire facility inventory. A vehicle impact would be postulated to only release the contents of the vessel impacted and is therefore no different than the loss of confinement events addressed earlier. The building structure would be a PC-3 structure. Therefore, the building would mitigate the consequences from the postulated vehicle crash by protecting the inventory in primary and secondary confinement within the structure. Additionally, segmentation of the process cells would further mitigate the consequences of this external event. However, the PC-3 structure was assumed to experience local structural failure (collapse) from a helicopter crash and full structural failure (collapse) from an aircraft crash. The helicopter crash was assumed to release the inventory in one cell and the aircraft crash was assumed to release the entire building inventory. Both structural failures were assumed to be coincident with fires from ignition of the helicopter or aircraft fuel. The fires would compound the radiological release inventories.

Probability: The most likely causes of releases from the Small Tank Precipitation facility from external events would be impacts from helicopter or aircraft crashes. The frequency of a helicopter crash onto the Small Tank Precipitation facility was calculated to be 4.8×10^{-7} per year, while the frequency of an aircraft impact was calculated to be 3.7×10^{-7} per year. Therefore, a helicopter crash would be expected once in 2,100,000 years and an aircraft impact would be expected once in 2,700,000 years.

Source Term: The Small Tank Precipitation facility would be a PC-3 structure with primary and secondary confinement. The building structure would be expected to withstand vehicle crashes. Benzene and radiological releases would be expected to occur from helicopter or aircraft crashes. However, benzene would be consumed by the ensuing fire, so airborne releases would only include radiological material.

HEPA filters are assumed to be damaged, failing to mitigate the release. The airborne source terms calculated for the various accident scenarios are shown in Table B-3. These releases were postulated as ground-level releases.

Table B-3. Source terms for helicopter or aircraft crashes into the Small Tank Precipitation facility.

	Source term (Ci)	
	Fission Products	Transuranics
Helicopter Crash[a]		
Fresh Waste Day Tank Cell	160	0.32
Precipitation Tank Cell	190	0.38
Concentrate Tank Cell	760	2.2
Filtrate Hold Tank Cell	8.8	0.025
Wash Tank Cell	940	2.2
PHA Surge Tank	7,400	22
PHC	2,800	8.3
Aircraft Crash	12,000	35

a.   Cappucci 2000.

B.3.1.6   Benzene Explosion in PHA Surge Tank

Scenario: Degradation of TPB produces benzene that would be released to the vapor space of the PHA Surge Tank. Hydrogen and oxygen are produced from the radiolysis (decomposition) of water, forming a flammable mixture. Because the consequences of such an event are unsatisfactory, the PHA Surge Tank would be equipped with a safety-class nitrogen inerting system. In this scenario, both the primary and backup nitrogen systems are assumed to fail and the failure to go undetected. An ignition source could then cause an explosion (detonation or deflagration) in the vapor space and a subsequent fire. (In a deflagration, the shock wave travels at less than the speed of sound; in a detonation, the shock wave travels faster than the speed of sound.) The tanks and piping would maintain their integrity during

a deflagration, but not during a detonation; therefore, the event was conservatively assumed to be a detonation. It was also conservatively assumed that the detonation in the process tanks or piping would release the entire tank contents. The HEPA filters and ventilation were assumed to be damaged and bypassed, failing to mitigate the release. An explosion in the PHA Surge Tank, because of the amount of material at risk, would bound explosions in all other process tanks.

Probability: A benzene explosion in the PHA Surge Tank has the potential to damage the tank and release the entire tank contents. For an explosion to occur, an ignition source and an explosive gas mixture in the tank vapor space must be present. Failure of a safety-class system further increases the probability of occurrence. The annual probability that an explosion would occur in the PHA Surge Tank was calculated to be 1.84×10^{-8}. Therefore, an explosion in the PHA Surge Tank would be expected to occur once in 54,000,000 years and is not a credible event. Since the likelihood of this event is below the credibility threshold of once in 10,000,000 years, it is not evaluated further in this Appendix.

B.3.2   ION EXCHANGE

The accidents identified for the Ion Exchange process that would result in the release of radiological materials to the environment include:

- Loss of confinement in a process cell

- Beyond design-basis earthquake

- Loss of cooling to the Loaded Resin Hold Tanks (LRHTs)

- Fire in a process cell

- Helicopter or aircraft crash

- Hydrogen explosion in a process cell

B.3.2.1   Loss of Confinement in a Process Cell

Scenario: The tanks of concern are the Alpha Sorption Tank (AST), the LRHTs, and tanks in the Alpha Filter Cell (Washwater Hold Tank,

Sludge Solids Receipt Tank, and Cleaning Solution Dump Tank [CSDT]). Because the material inventory in the CSDT would be small compared to the other vessels in the alpha filter cell, a release from the CSDT would be bounded by releases from the other tanks in the cell. See Section B.3.1.1 for a description of the scenario.

Probability: See Section B.3.1.1 for a discussion of the probability of the event occurring.

Source Term: A dropped cell cover or crane mishap was assumed to damage the affected tank significantly enough to release the entire contents of the tank to the cell. Good engineering practices would be used during design of the process facility to ensure that HEPA filters would be located in a remote part of the facility away from process cells (e.g., event location). DOE would perform regular in-place testing to ensure that installed HEPA filters would have a particle removal efficiency of greater than 99.9 percent. The HEPA filters and ventilation system were assumed to be operating due to the physical distance between the filter location and event location, reducing the amount of radioactivity released from the process cell within 99 percent efficiency. The airborne source terms associated with this accident are shown in Table B-4. The release was postulated to occur from the 46-meter stack.

Table B-4. Source terms for loss of confinement in a process cell of the Ion Exchange facility.

	Source term (Ci)	
	Fission products	Transuranics
AST	0.37	7.2×10^{-4}
Washwater Hold Tank	0.023	4.5×10^{-7}
Sludge Solids Receipt Tank	0.041	0.0064
LRHT	2.3	1.1×10^{-6}

B.3.2.2 Beyond Design-Basis Earthquake

Scenario: The structures for the Ion Exchange process would be designed to with-

stand PC-3 earthquakes, straight winds, and tornadoes. See Section B.3.1.2 for a description of the scenario.

Probability: See Section B.3.1.2 for a discussion of the probability of the event occurring.

Source Term: A release of the full inventory from the facility was postulated from collapse of the structure and of the primary and secondary confinement. HEPA filters are assumed to be damaged, failing to mitigate the release. The airborne source term associated with this accident would consist of 1,100 Ci of fission products and 0.72 Ci of transuranics. The release was postulated as a ground-level release.

B.3.2.3 Loss of Cooling to the LRHTs

Scenario: A loss of cooling water to the LRHTs would allow the decay heat of the fission products to raise the temperature of the liquid phase in the involved tanks enough to boil. It was assumed that the liquid would boil for eight hours. Vapors from the boiling liquid would be vented and filtered through HEPA filters operating with an efficiency of 99 percent. It was assumed that the cooling water coils would be designed so that leakage of radionuclides into the cooling water system would not be credible, thereby eliminating direct releases to the aquatic environment.

Probability: The equipment in this scenario was assumed to be similar to vessels in DWPF. Therefore, frequencies and probabilities for DWPF were used as a basis for evaluation. The initiating events that could lead to loss of cooling would be power failure, human error, or equipment failure. In order for a loss of cooling event to result in damage to the vessel, the loss of cooling was coupled with the failure of pressure and temperature indicators. The frequency was estimated to be 1.9×10^{-4} per year. Therefore, a loss of cooling water to the LRHTs would be expected once in 5,300 years.

Source Term: The source term for this scenario was based on the assumption that 65 gallons of the LRHT inventory and 100 gallons of the first CST column (liquid) inventory would be in-

volved. This assumption was based on an estimation of the liquid mass evaporated by the decay heat of the fission products in eight hours. The airborne source terms associated with this accident are shown in Table B-5. The releases were postulated to occur from the 46-meter stack.

Table B-5. Source terms for loss of cooling event in Ion Exchange facility.

	Source term (Ci)	
	Fission products	Transuranics
LRHTs	0.11	5.3×10^{-8}
CST Column	0.0041	8.1×10^{-8}

B.3.2.4 Fire in a Process Cell

Scenario: See Section B.3.1.3 for a description of the scenario.

Probability: See Section B.3.1.3 for a discussion of probability.

Source Term: The fire was assumed to damage the process vessel sufficiently to cause a leak. The damage was assumed to be equivalent to a 0.5-inch-diameter opening. The leak was assumed to be stopped within 24 hours, allowing for the fire department to put out the fire, a response plan to be developed, and implementation of the response plan to control the leak. The process cells that would bound this accident for Ion Exchange would be the AST Cell, the Alpha Filter Cell, and the CST Columns Cell. The airborne source terms associated with a fire in each of these process cells are provided in Table B-6. Any release was postulated to occur from the 46-meter stack.

Table B-6. Source terms for process cell fires in the Ion Exchange facility.

	Source term (Ci)	
	Fission products	Transuranics
AST Cell	1.6	0.0031
Alpha Filter Cell	0.72	0.072
CST Columns Cell	55	3.6×10^{-5}

B.3.2.5 Helicopter or Aircraft Crash

Scenario: See Section B.3.1.5 for a description of the scenario.

Probability: The most likely causes of releases from the Ion Exchange Facility from external events would be impacts from helicopter or aircraft crashes. See Section B.3.1.5 for a discussion of the probability of either event occurring.

Source Term: The Ion Exchange facility would be a PC-3 structure with primary and secondary confinement. The building structure would be expected to withstand vehicle crashes. Releases would be expected to occur from helicopter or aircraft crashes. HEPA filters are assumed to be damaged, failing to mitigate the release. The source terms calculated for the various accident scenarios are shown in Table B-7. These releases were postulated as ground-level releases.

Table B-7. Source terms for helicopter or aircraft crashes into the Ion Exchange facility.

	Source Term (Ci)	
	Fission Products	Transuranics
Helicopter Crash[a]		
AST Cell	5,700	11
Alpha Filter Cell	980	99
CST Columns Cell	75,000	0.050
Aircraft Crash	87,000	110

a.   Cappucci 2000.

B.3.2.6 Hydrogen Explosion in a Process Cell

Scenario: The decomposition of water as a result of radiolysis leads to the production of hydrogen and oxygen. These flammable gases could accumulate in the vapor space of process vessels and, if left unchecked, could eventually reach the lower flammability limit (LFL) required for an explosion. Failure of the purge system to remove flammable gases, coupled with the presence of an ignition source, could initiate a hydrogen explosion (deflagration or detonation). The tanks of concern include the

AST, the tanks in the Alpha Filter Cell (Sludge Solids Receipt Tank, Washwater Hold Tank, and CSDT), and the tanks in the CST columns cell (LRHTs, the CST Columns, and the Product Holdup Tank). The tanks and piping would maintain their integrity during a deflagration, but not during a detonation; therefore, the event was conservatively assumed to be a detonation. An explosion in a process cell was conservatively assumed to release the contents of all vessels within that cell. Significant damage to the HEPA filters and ventilation system was assumed, allowing for an unmitigated radioactive release from the process cell.

Probability: The process equipment was assumed to be similar to process equipment in DWPF. Therefore, frequencies and probabilities for DWPF were used as a basis for this evaluation. The initiating events for a hydrogen explosion in the tank would be the presence of an ignition source and the presence of the explosive gas mixture. The presence of the explosive gas mixture would be due to the loss of purge to the tank that goes undetected and uncorrected. The annual probability that a hydrogen explosion would occur was calculated to be 4.7×10^{-8}. Therefore, a hydrogen explosion in a process cell would be expected to occur once in 21,000,000 years and is not a credible event. Since the likelihood of this event is below the credibility threshold of once in 10,000,000 years, it is not evaluated further in this Appendix.

B.3.3 SOLVENT EXTRACTION

The accidents identified for the Solvent Extraction alternative that would result in the release of radiological materials to the environment include:

- Loss of confinement in a process cell

- Beyond design-basis earthquake

- Fire in a process cell

- Hydrogen explosion in the Extraction Cell

- Helicopter or aircraft crash

- Hydrogen explosion in a process cell

B.3.3.1 Loss of Confinement in a Process Cell

Scenario: Mechanical failure or an external event, such as a dropped cell cover or crane mishap, could cause a loss of the primary confinement for a tank or its associated piping. A loss of primary confinement would release material into the process cell. The tanks of concern are the AST, the tanks in the Alpha Filter Cell (Washwater Hold Tank, Sludge Solids Receipt Tank, CSDT), the Salt Solution Feed Tank, tanks in the Extraction Cell, and the DWPF Salt Feed Tank. Because the material inventory in the CSDT would be small compared to the other vessels in the Alpha Filter Cell, a release from the CSDT would be bounded by releases from the other tanks in the cell. The Strip Effluent Stilling Tank was assumed to contain the bounding inventory in the Extraction Cell. For this event, the entire contents of the bounding tank at maximum capacity would be released through a leak from the tank or associated piping. It was assumed that the release would not be cleaned up for 168 hours (7 days).

A leak detection system would mitigate the consequences of releases from process tanks and associated piping. This system would be designed to detect the leak and terminate the process, thus minimizing the amount of material that would leak from the system. A shielded secondary confinement system would protect onsite workers from radiological consequences of the leaks.

Probability: The initiating event for the loss of primary confinement of a process tank could be mechanical failure or an external event. External events could cause leaks from tanks or from piping. Impacts during cell cover and crane movement are assumed to cause spills from a rupture in the tank or associated piping. It was assumed there would be 50 feet of piping associated with each tank. The annual frequency of a loss of primary confinement for a process tank was calculated to be 3.4×10^{-2}. Therefore, a loss

of confinement accident would be expected once in 30 years.

Source Term: A dropped cell cover or crane mishap was assumed to damage the affected tank significantly enough to release the entire contents of the tank to the cell. Good engineering practices would be used during design of the process facility to ensure that HEPA filters would be located in a remote part of the facility away from process cells (e.g., event location). DOE would perform regular in-place testing to ensure that installed HEPA filters would have a particle removal efficiency of greater than 99.9 percent. The HEPA filters and ventilation system were assumed to be operating due to the physical distance between the filter location and the event location, reducing the amount of radioactivity released from the process cell within 99 percent efficiency. The airborne source terms associated with this accident are shown in Table B-8. The release was postulated to occur from the 46-meter stack.

B.3.3.2 Beyond Design-Basis Earthquake

Scenario: The structures for the Solvent Extraction process would be designed to withstand PC-3 earthquakes, straight winds, and tornadoes. See Section B.3.1.2 for a description of the scenario.

Table B-8. Source terms for loss of confinement in a process cell of the Solvent Extraction facility.

	Source term (Ci)	
	Fission products	Transuranics
AST	0.46	9.1×10^{-4}
Washwater Hold Tank	0.023	4.5×10^{-7}
Sludge Solids Receipt Tank	0.041	0.0064
Salt Solution Feed Tank	0.46	9.0×10^{-6}
Extraction Cell	0.024	1.8×10^{-9}
DWPF Salt Feed Tank	4.8	3.6×10^{-7}

Probability: See Section B.3.1.2 for a discussion of the probability of the event occurring.

Source Term: A release of the full inventory from the facility was postulated from collapse of the structure and of the primary and secondary confinement. The airborne source term associated with this accident would consist of 580 Ci of fission products and 0.74 Ci of transuranics.

The release was postulated as a ground-level release.

B.3.3.3 Fire in a Process Cell

Scenario: See Section B.3.1.3 for a description of the scenario.

Probability: See Section B.3.1.3 for a discussion of the probability.

Source Term: The fire was assumed to damage the process vessel sufficiently to cause a leak. The damage was assumed to be equivalent to a 0.5-inch-diameter opening. The leak was assumed to be stopped within 24 hours, allowing the fire department to put out the fire, a response plan to be developed, and implementation of the response plan to control the leak. The process cells that would bound this accident for the Solvent Extraction process would be the AST Cell, the Alpha Filter Cell, the Extraction Cell, the DWPF Salt Feed Tank Cell, the Salt Solution Feed Tank Cell, and the Decontaminated Salt Solution (DSS) Hold Tank Cell. The airborne source terms associated with a process cell fire in any of these cells are provided in Table B-9. The releases were postulated to occur from the 46-meter stack.

Scenario: The decomposition of water as a result of radiolysis leads to the production of hydrogen and oxygen. These flammable gases could accumulate in the vapor space of process vessels and, if left unchecked, could eventually reach the LFL required for an explosion. Failure of the purge system and the presence of an ignition source could initiate a hydrogen explosion (deflagration or detonation). The vessels of concern would include the Stripping Effluent

Table B-9. Source terms for process cell fires in the Solvent Extraction facility.

	Source term (Ci)	
	Fission products	Transuranics
AST Cell	1.6	0.0031
Alpha Filter Cell	0.46	0.072
Extraction Cell	0.27	2.0×10^{-8}
DWPF Salt Feed Tank Cell	21	1.6×10^{-6}
Salt Solution Feed Tank Cell	1.6	3.1×10^{-5}
DSS Hold Tank Cell	0.011	3.1×10^{-5}

B.3.3.4 Hydrogen Explosion in the Extraction Cell

Stilling Tank, the Aqueous Raffinate Stilling Tank, and six centrifugal contactors. The vessels were assumed to contain a deflagration, but not a detonation. In a deflagration, the process HEPA filters were assumed to be severely damaged, causing a release from the stack. A detonation would be expected to damage the vessel of concern and release its entire inventory. A hydrogen detonation of any of the vessels would be expected to impact other vessels, due to their co-location in the process cell. To prevent this event, a tank purge or inerting system was assumed to be present. The secondary confinement was assumed to mitigate this event.

Probability: A hydrogen explosion in the process vessels would have the potential to damage the vessels and release all the contents. For this explosion to occur, ignition sources and an explosive gas mixture would have to be present. For explosive gases to be present, the nitrogen purge system was assumed to fail and the failure to be undetected. The detonation in this cell was assumed to release the inventories of all 16 vessels containing radionuclides within that process cell. This would result in an overall hydrogen detonation frequency of 7.6×10^{-7} per year. Therefore, a hydrogen explosion

in the Extraction Cell would be expected once in 1,300,000 years.

Source Term: The hydrogen explosion was assumed to release the entire contents of the Stripping Effluent Stilling Tank, the Aqueous Raffinate Stilling Tank, and six centrifugal contactors within the cell. The HEPA filters and the ventilation system were assumed to be damaged and bypassed, failing to mitigate the release from the process cell. The airborne source term associated with this accident would consist of 357 Ci of fission products and 0.00057 Ci of transuranics. The releases were postulated to occur from the 46-meter stack.

B.3.3.5 Helicopter or Aircraft Crash

Scenario: See Section B.3.1.5 for a discussion of the scenario.

Probability: The most likely causes of releases from the Solvent Extraction facility from external events would be impacts from helicopter or aircraft crashes. See Section B.3.1.5 for a discussion of the probability of such events occurring.

Source Term: The Solvent Extraction facility would be a PC-3 structure with primary and secondary confinement. The building structure would be expected to withstand vehicle crashes. Releases would be expected to occur from helicopter or aircraft crashes. HEPA filters are assumed to be damaged, failing to mitigate the release. The source terms calculated for the various accident scenarios are shown in Table B-10. These releases were postulated as ground-level releases.

B.3.3.6 Hydrogen Explosion in a Process Cell

Scenario: The tanks of concern include the AST, the tanks in the Alpha Filter Cell (Sludge Solids Receipt Tank, Washwater Hold Tank, and CSDT), the Salt Solution Feed Tank, and the DWPF Salt Feed Tank. See Section B.3.2.6 for a description of the scenario.

Table B-10. Source Terms for Helicopter or Aircraft Crashes into the Solvent Extraction facility.

	Source term (Ci)	
	Fission products	Transuranics
Helicopter Crash[a]		
AST Cell	810	1.6
Alpha Filter Cell	110	28
Extraction Cell	62	0.00088
Salt Solution Feed Tank Cell	810	0.016
DSS Hold Tank Cell	4.4	0.013
DWPF Salt Feed Tank Cell	8,350	0.00063
Aircraft Crash	10,000	13

a.   Cappucci 2000.

Probability: See Section B.3.2.6 for a discussion of the probability.

B.3.4   DIRECT DISPOSAL IN GROUT

The accidents identified for the Direct Disposal in Grout alternative which could result in the release of radiological materials to the environment include:

• Loss of confinement in a process cell

• Beyond design-basis earthquake

• Fire in a process cell

• Helicopter or aircraft crash

• Hydrogen explosion in a process cell

B.3.4.1   Loss of Confinement in a Process Cell

Scenario: Mechanical failure or an external event, such as a dropped cell cover or crane mishap, could cause a loss of primary confinement for a tank or its associated piping. A loss of primary confinement would release material into the process cell. The tanks of concern are the AST, the Sludge Solids Receipt Tank, the CSDT, the Salt Solution Hold Tank, and the Saltstone Hold Tank. For this event, the entire tank contents at maximum capacity would be released through a leak from the tank or associated piping. It was assumed that the release would not be cleaned up for 168 hours (7 days).

With the exception of the Saltstone Hold Tank, a leak detection system would mitigate the consequences of releases from process tanks and associated piping. This system would be designed to detect the leak and terminate the process, thus minimizing the amount of material that would leak from the system. Because of the viscous nature of the saltstone grout mixture, a leak detection system might not detect a leak from the Saltstone Hold Tank or piping. However, radiation monitors would be available to detect leakage. The monitors were assumed to be properly positioned and calibrated to ensure detection of a grout mixture leak. A shielded secondary confinement system would protect onsite workers from radiological consequences of leaks from tanks and associated piping. No credit was taken for the leak detection system in the analysis of this event.

Probability: See Section B.3.1.1 for a discussion of the probability of the event occurring.

Source Term: A dropped cell cover or crane mishap was assumed to damage the affected tank significantly enough to release entire inventory to the cell. Good engineering practices would be used during design of the process facility to ensure that HEPA filters would be located in a remote part of the facility away from process cells (e.g., event location). DOE would perform regular in-place testing to ensure that installed HEPA filters would have a particle removal efficiency of greater than 99.9 percent. The HEPA filters and ventilation system were assumed to be operating due to the physical distance between the filter location and event location, reducing the amount released from the process cell within 99 percent efficiency. The airborne source terms associated with this accident are shown in Table B-11. The release was postulated to occur from the 46-meter stack.

Table B-11. Source terms for loss of confinement in a process cell of the Direct Disposal in Grout facility.

	Source term (Ci)	
	Fission products	Transuranics
AST	0.37	7.2×10^{-4}
Sludge Solids Receipt Tank	0.038	0.0020
CSDT	3.8×10^{-5}	2.0×10^{-6}
Salt Solution Hold Tank	0.37	7.2
Saltstone Hold Tank	0.0018	3.6×10^{-8}

B.3.4.2 Beyond Design-Basis Earthquake

Scenario: The structures for the Direct Disposal in Grout process would be designed to withstand PC-3 earthquakes, straight winds, and tornadoes. See Section B.3.1.2 for a description of the scenario.

Probability: See Section B.3.1.2 for a discussion of the probability of the event occurring.

Source Term: A release of the full inventory from the facility was postulated from collapse of the structure and of the primary and secondary confinement. The airborne source term associated with this accident would consist of 77 Ci of fission products and 0.28 Ci of transuranics. The release was postulated as a ground-level release.

B.3.4.3 Fire in a Process Cell

Scenario: See Section B.3.1.3 for a description of the scenario.

Probability: See Section B.3.1.3 for a discussion of the probability of the event occurring.

Source Term: The fire was assumed to damage the process vessel sufficiently to cause a leak. The damage was assumed to be equivalent to a 0.5-inch-diameter opening. The leak was assumed to be stopped

within 24 hours, allowing the fire department to put out the fire, a response plan to be developed, and implementation of the response plan to control the leak. The process cells that would bound this accident for the Direct Disposal in Grout process would be the AST Cell, the Sludge Solids Receipt Tank Cell, and the Salt Solution Hold Tank Cell. Good engineering practices would be used during design of the process facility to ensure that HEPA filters would be located in a remote part of the facility away from process cells (e.g., event location). DOE would perform regular in-place testing to ensure that installed HEPA filters would have a particle removal efficiency of greater than 99.9 percent. HEPA filters would be expected to maintain their function due to the physical distance between the filter location the event location, and would minimize releases to the environment 99 percent efficiency. The airborne source terms associated with a process cell fire in any of these cells are provided in Table B-12. The releases were postulated to occur from the 46-meter stack.

Table B-12. Source terms for process cell fires in the Direct Disposal in Grout facility.

	Source term (Ci)	
	Fission products	Transuranics
AST Cell	1.5	0.0029
Sludge Solids Receipt Tank Cell	0.43	0.023
Salt Solution Hold Tank Cell	1.5	2.9×10^{-5}
Saltstone Hold Tank Cell	0.021	4.0×10^{-7}

B.3.4.4 Helicopter or Aircraft Crash

Scenario: See Section B.3.1.5 for a description of the scenario.

Probability: The most likely causes of releases from the Direct Disposal in Grout facility from external events would be impacts from helicopter or aircraft crashes. See Section B.3.1.5 for a discussion of the probability of the event occurring.

Source Term: The Direct Disposal in Grout facility would be a PC-3 structure with primary and secondary confinement. The building structure would be expected to withstand vehicle crashes. Releases would be expected to occur from helicopter or aircraft crashes. HEPA filters are assumed to be damaged, failing to mitigate the release. The source terms calculated for the various accident scenarios are shown in Table B-13. These releases were postulated as ground-level releases.

Table B-13. Source Terms for helicopter or aircraft crashes into the Direct Disposal in Grout facility.

	Source Term (Ci)	
	Fission Products	Transuranics
Helicopter Crash[a]		
AST Cell	5,700	11
Sludge Solids Receipt Tank Cell	590	31
CSDT Cell	0.067	0.0036
Salt Solution Hold Tank Cell	5,700	0.11
Saltstone Hold Tank Cell	3.9	7.6×10^{-5}
Aircraft Crash	1,400	4.8

a.   Cappucci 2000.

B.3.4.5 Hydrogen Explosion in a Process Cell

Scenario: The tanks of concern include the AST, the Sludge Solids Receipt Tank, the CSDT, the Salt Solution Hold Tank, and the Saltstone Hold Tank. See Section B.3.2.6 for a description of the scenario.

Probability: See Section B.3.2.6 for a discussion of the probability of the event occurring.

B.4 Accident Impacts Involving Radioactive Materials

This section presents the potential impacts, including LCFs, expected from offsite impacts associated with accident scenarios in-

volving the release of radioactive materials identified in Section B.3.

B.4.1 SMALL TANK PRECIPITATION

Table B-14 provides the radiological impacts to onsite and offsite receptors from the accidents described in Section B.3.1. The accidents are ordered by decreasing frequency.

B.4.2 ION EXCHANGE

Table B-15 provides radiological impacts to onsite and offsite receptors from the accidents described in Section B.3.2. The accidents are ordered by decreasing frequency.

B.4.3 SOLVENT EXTRACTION

Table B-16 provides radiological impacts to onsite and offsite receptors from the accidents described in Section B.3.3. The accidents are ordered by decreasing frequency.

B.4.4 DIRECT DISPOSAL IN GROUT

Table B-17 provides radiological impacts to onsite and offsite receptors from the accidents described in Section B.3.4. The accidents are ordered by decreasing frequency.

B.5 Postulated Accidents Involving Nonradioactive Hazardous Materials

This section summarizes the potential accident scenarios involving nonradioactive hazardous chemicals for the various processes.

B.5.1 SMALL TANK PRECIPITATION

The accidents identified for the Small Tank Precipitation process that result in the release of non-radioactive hazardous materials to the environment include:

• Caustic Tank loss of confinement

• TPB Storage Tank spill

• Organic Evaporator loss of confinement

• PHA Surge Tank loss of confinement

Table B-14. Accident impacts for the Small Tank Precipitation process.

Accident	Annual frequency (frequency category)	Maximally exposed individual (rem)[a]	Maximally exposed individual LCF	Offsite population (person-rem)[a]	Offsite population LCF	Noninvolved worker (rem)[a]	Noninvolved worker LCF	Involved worker (rem)[a]	Involved worker LCF	Onsite population (person-rem)[a]	Onsite population LCF
Loss of confinement	3.4×10⁻² (Anticipated)										
PHA Surge Tank		0.0016	8.2×10⁻⁷	88	0.044	0.024	9.5×10⁻⁶	3.2×10⁻⁶	1.3×10⁻⁹	39	0.016
Precipitate Reactor		4.1×10⁻⁴	2.0×10⁻⁷	22	0.011	0.0060	2.4×10⁻⁶	8.0×10⁻⁷	3.2×10⁻¹⁰	9.7	0.0039
Beyond design-basis earthquake	<5.0×10⁻⁴ (Unlikely)	0.31	1.5×10⁻⁴	16,000	8.0	9.6	0.0038	310	0.12	9,000	3.6
Fire in a process cell	1.0×10⁻⁴ (Unlikely)	0.014	7.2×10⁻⁶	780	0.39	0.21	8.5×10⁻⁵	2.8×10⁻⁵	1.1×10⁻⁸	340	0.14
Benzene explosion in the PHC	1.0×10⁻⁵ (Extremely Unlikely)	0.70	3.5×10⁻⁴	38,000	19	10	0.0041	0.0014	5.5×10⁻⁷	17,000	6.7
Helicopter Crash	4.8×10⁻⁷ (Beyond Extremely Unlikely)										
Fresh Waste Day Tank Cell		0.049	2.5×10⁻⁵	2,600	1.3	1.5	6.2×10⁻⁴	49	0.020	1,400	0.58
Precipitation Tank Cell		0.059	2.9×10⁻⁵	3,100	1.6	1.8	7.4×10⁻⁴	59	0.024	1,700	0.69
Concentrate Tank Cell		0.34	1.7×10⁻⁴	18,000	9.0	11	0.0043	340	0.14	10,000	4.0
Filtrate Hold Tank Cell		0.0039	1.9×10⁻⁶	200	0.10	0.12	4.9×10⁻⁵	3.9	0.0016	110	0.046
Wash Tank Cell		0.34	1.7×10⁻⁴	18,000	9.1	11	0.0043	350	0.14	10,000	4.0
PHA Surge Tank Cell		3.3	0.0016	170,000	87	100	0.041	3,300	1.3	97,000	39
PHC		1.3	6.3×10⁻⁴	67,000	33	40	0.016	1,300	0.51	37,000	15
Aircraft Crash	3.7×10⁻⁷ (Beyond Extremely Unlikely)	5.4	0.0027	280,000	140	170	0.067	5,400	2.1	160,000	63

a. Refer to the Glossary for the definition of rem and person-rem.
LCF = latent cancer fatality.
PHA = Precipitate Hydrolysis Aqueous.
PHC = Precipitate Hydrolysis Cell.

Table B-15. Accident impacts for the Ion Exchange process.

Accident	Annual frequency (frequency category)	Maximally exposed individual (rem)[a]	Maximally exposed individual LCF	Offsite population (person-rem)[a]	Offsite population LCF	Noninvolved worker (rem)[a]	Noninvolved worker LCF	Involved worker (rem)[a]	Involved worker LCF	Onsite population (person-rem)[a]	Onsite population LCF
Loss of confinement	3.4×10^{-2} (Anticipated)										
AST		9.7×10^{-5}	4.9×10^{-8}	5.2	0.0026	0.0014	5.7×10^{-7}	2.8×10^{-7}	1.1×10^{-10}	2.3	9.3×10^{-4}
Sludge Solids Receipt Tank		8.3×10^{-4}	4.2×10^{-7}	45	0.022	0.012	4.9×10^{-6}	6.4×10^{-8}	2.6×10^{-11}	20	0.0080
Washwater Hold Tank		2.4×10^{-7}	1.2×10^{-10}	0.0013	6.6×10^{-6}	3.6×10^{-6}	1.4×10^{-9}	1.7×10^{-8}	6.9×10^{-12}	0.0057	2.3×10^{-6}
LRHT		1.8×10^{-5}	9.2×10^{-9}	1.0	5.1×10^{-4}	2.8×10^{-4}	1.1×10^{-7}	1.7×10^{-6}	7.0×10^{-10}	0.44	1.8×10^{-4}
Beyond design-basis earthquake	$<5.0 \times 10^{-4}$ (Unlikely)	0.12	5.9×10^{-5}	6,200	3.1	3.7	0.0015	120	0.047	3,500	1.4
Loss of cooling to the LRHTs[b]	1.9×10^{-4} (Unlikely)	9.4×10^{-7}	4.7×10^{-10}	0.052	2.6×10^{-5}	1.4×10^{-5}	5.7×10^{-9}	8.8×10^{-8}	3.5×10^{-11}	0.023	9.0×10^{-6}
Fire in a process cell	1.0×10^{-4} (Unlikely)										
AST cell		4.2×10^{-4}	2.1×10^{-7}	23	0.011	0.0062	2.5×10^{-6}	1.2×10^{-6}	4.8×10^{-10}	10	0.0040
Alpha Filter Cell		0.0094	4.7×10^{-6}	500	0.25	0.14	5.5×10^{-5}	9.1×10^{-7}	3.6×10^{-10}	220	0.089
CST Process Cell		4.4×10^{-4}	2.2×10^{-7}	25	0.012	0.0067	2.7×10^{-6}	4.1×10^{-5}	1.7×10^{-8}	11	0.0043
Helicopter Crash	4.8×10^{-7} (Beyond extremely unlikely)										
AST		0.20	9.8×10^{-5}	10,000	5.2	6.2	0.0025	200	0.079	5,800	2.3
Alpha Filter Cell		1.7	8.5×10^{-4}	89,000	45	53	0.021	1,700	0.68	50,000	20
CST Columns Cell		0.11	5.5×10^{-5}	5,800	2.9	3.5	0.0014	110	0.045	3,300	1.3
Aircraft Crash	3.7×10^{-7} (Beyond extremely unlikely)	2.0	0.0010	110,000	53	63	0.025	2,000	0.81	59,000	24

a. Refer to the Glossary for the definition of rem and person-rem.
b. Combined source terms from the LRHTs and the CST Column were used to determine impacts from the loss of cooling event.
LCF = latent cancer fatality; LRHT = Loaded Resin Hold Tank; AST = Alpha Sorption Tank.

Table B-16. Accident impacts for the Solvent Extraction process.

Accident	Annual frequency (frequency category)	Maximally exposed individual (rem)[a]	Maximally exposed individual LCF	Offsite population (person-rem)[a]	Offsite population LCF	Noninvolved worker (rem)[a]	Noninvolved worker LCF	Involved worker (rem)[a]	Involved worker LCF	Onsite population (person-rem)[a]	Onsite population LCF
Loss of confinement	3.4×10^{-2} (Anticipated)										
AST		1.2×10^{-4}	6.1×10^{-8}	6.5	0.0033	0.0018	7.1×10^{-7}	3.5×10^{-7}	1.4×10^{-10}	2.9	0.0012
Wash Water Hold Tank		2.4×10^{-7}	1.2×10^{-10}	0.013	6.6×10^{-6}	3.6×10^{-6}	1.4×10^{-9}	1.7×10^{-8}	6.9×10^{-12}	0.0057	2.3×10^{-6}
Sludge Solids Receipt Tank		8.3×10^{-4}	4.2×10^{-7}	45	0.22	0.012	4.9×10^{-6}	6.4×10^{-8}	2.6×10^{-11}	20	0.0080
Salt Solution Feed Tank		4.8×10^{-6}	2.4×10^{-9}	0.26	1.3×10^{-4}	7.2×10^{-5}	2.9×10^{-8}	3.4×10^{-7}	1.4×10^{-10}	0.11	4.6×10^{-5}
Extraction Cell		1.9×10^{-7}	9.4×10^{-11}	0.010	5.2×10^{-6}	2.9×10^{-6}	1.1×10^{-9}	1.8×10^{-8}	7.1×10^{-12}	0.0045	1.8×10^{-6}
DWPF Salt Feed Tank		3.8×10^{-5}	1.9×10^{-8}	2.1	0.0010	5.7×10^{-4}	2.3×10^{-7}	3.6×10^{-6}	1.4×10^{-9}	0.91	3.6×10^{-4}
Beyond design-basis earthquake	<5.0×10^{-4} (Unlikely)	0.12	5.8×10^{-5}	6,100	3.0	3.6	0.0015	120	0.046	3,400	1.4
Fire in a process cell	1.0×10^{-4} (Unlikely)										
AST Cell		4.2×10^{-4}	2.1×10^{-7}	23	0.011	0.0062	2.5×10^{-6}	1.2×10^{-6}	4.8×10^{-10}	10	0.0040
Alpha Filter Cell		0.0094	4.7×10^{-6}	500	0.25	0.14	5.5×10^{-5}	7.2×10^{-7}	2.9×10^{-10}	220	0.089
Extraction Cell		2.1×10^{-6}	1.1×10^{-9}	0.012	5.9×10^{-5}	3.2×10^{-5}	1.3×10^{-8}	2.0×10^{-7}	8.0×10^{-11}	0.051	2.0×10^{-5}
Salt Solution Feed Tank Cell		1.7×10^{-5}	8.3×10^{-9}	0.92	4.6×10^{-4}	2.5×10^{-4}	1.0×10^{-7}	1.2×10^{-6}	4.8×10^{-10}	0.40	1.6×10^{-4}
DSS Hold Tank Cell		4.2×10^{-6}	2.1×10^{-9}	0.22	1.1×10^{-4}	6.1×10^{-5}	2.4×10^{-8}	8.3×10^{-9}	3.3×10^{-12}	0.099	4.0×10^{-5}
DWPF Salt Feed Tank Cell		1.6×10^{-4}	8.1×10^{-8}	9.1	0.0045	0.0025	9.9×10^{-7}	1.5×10^{-5}	6.2×10^{-9}	3.9	0.0016
Hydrogen Explosion in the Extraction Cell	7.6×10^{-7} (Beyond extremely unlikely)	0.0029	1.4×10^{-6}	160	0.081	0.044	1.8×10^{-5}	2.7×10^{-4}	1.1×10^{-7}	70	0.028
Helicopter Crash	4.8×10^{-7} (Beyond extremely unlikely)										
AST Cell		0.25	1.2×10^{-4}	13,000	6.5	7.7	0.0031	250	0.099	7,200	2.9
Alpha Filter Cell		1.7	8.5×10^{-4}	89,000	45	53	0.021	1,700	0.68	50,000	20
Extraction Cell		7.2×10^{-4}	3.6×10^{-7}	38	0.019	0.023	9.1×10^{-6}	0.74	2.9×10^{-4}	21	0.0085
Salt Solution Feed Tank Cell		0.0099	5.0×10^{-6}	530	0.26	0.32	1.3×10^{-4}	10	0.0041	290	0.12
DSS Hold Tank Cell		0.0019	9.7×10^{-7}	100	0.051	0.061	2.4×10^{-5}	1.9	7.8×10^{-4}	57	0.023
DWPF Salt Feed Tank Cell		0.079	3.9×10^{-5}	4,200	2.1	2.5	0.0010	81	0.032	2,300	0.94
Aircraft Crash	3.7×10^{-7} (Beyond extremely unlikely)	2.0	0.0010	110,000	54	64	0.026	2,000	0.81	60,000	24

a. Refer to the Glossary for the definition of rem and person-rem.
LCF = latent cancer fatality, AST = Alpha Sorption Tank, DSS = Decontaminated salt solution.

Table B-17. Accident impacts for the Direct Disposal in Grout process.

Accident	Annual frequency (frequency category)	Maximally exposed individual (rem)[a]	Maximally exposed individual LCF	Offsite population (person-rem)[a]	Offsite population LCF	Involved worker (rem)[a]	Involved worker LCF	Noninvolved worker (rem)[a]	Noninvolved worker LCF	Onsite population (person-rem)[a]	Onsite population LCF
Loss of confinement	3.4×10^{-2} (Anticipated)										
AST		9.0×10^{-5}	4.5×10^{-8}	5.3	0.0027	0.0013	5.4×10^{-7}	6.6×10^{-7}	2.6×10^{-10}	1.6	6.3×10^{-4}
Sludge Solids Receipt Tank		2.4×10^{-4}	1.2×10^{-7}	14	0.0072	0.0036	1.5×10^{-6}	7.3×10^{-8}	2.9×10^{-11}	4.2	0.0017
CSDT		2.4×10^{-7}	1.2×10^{-10}	0.014	7.2×10^{-6}	3.6×10^{-6}	1.5×10^{-9}	7.3×10^{-11}	2.9×10^{-14}	0.0042	1.7×10^{-6}
Salt Solution Hold Tank		3.7×10^{-6}	1.9×10^{-9}	0.22	1.1×10^{-4}	5.3×10^{-5}	2.1×10^{-8}	6.6×10^{-7}	2.6×10^{-10}	0.063	2.5×10^{-5}
Saltstone Hold Tank		1.9×10^{-8}	9.3×10^{-12}	0.0011	5.4×10^{-7}	2.7×10^{-7}	1.1×10^{-10}	3.3×10^{-9}	1.3×10^{-12}	3.1×10^{-4}	1.3×10^{-7}
Beyond design-basis earthquake	$<5.0 \times 10^{-4}$ (Unlikely)	0.042	2.1×10^{-5}	2300	1.1	1.3	5.3×10^{-4}	42	0.017	1000	0.41
Fire in a process cell	1.0×10^{-4} (Unlikely)										
AST Cell		3.6×10^{-4}	1.8×10^{-7}	21	0.011	0.0054	2.2×10^{-6}	2.7×10^{-6}	1.1×10^{-9}	6.3	0.0025
Sludge Solids Receipt Tank Cell		0.0027	1.4×10^{-6}	160	0.081	0.041	1.6×10^{-5}	8.2×10^{-7}	3.3×10^{-10}	48	0.019
Salt Solution Hold Tank Cell		1.5×10^{-5}	7.5×10^{-9}	0.87	4.4×10^{-4}	2.2×10^{-4}	8.6×10^{-8}	2.7×10^{-6}	1.1×10^{-9}	0.25	1.0×10^{-4}
Saltstone Hold Tank Cell		2.1×10^{-7}	1.0×10^{-10}	0.012	6.1×10^{-6}	3.0×10^{-6}	1.2×10^{-9}	3.7×10^{-8}	1.5×10^{-11}	0.0035	1.4×10^{-6}
Helicopter Crash	4.8×10^{-7} (Beyond extremely unlikely)										
AST Cell		0.20	9.8×10^{-5}	11,000	5.3	6.2	0.0025	200	0.079	4800	1.9
Sludge Solids Receipt Tank Cell		0.53	2.7×10^{-4}	29,000	14	17	0.0067	530	0.21	13,000	5.3
CSDT Cell		0.0081	4.0×10^{-6}	430	0.22	0.25	1.0×10^{-4}	8.2	0.0033	200	0.078
Salt Solution Hold Tank Cell		4.8×10^{-5}	2.4×10^{-8}	2.6	0.0013	0.0015	6.1×10^{-7}	0.049	2.0×10^{-5}	1.2	4.7×10^{-4}
Saltstone Hold Tank Cell		5.3×10^{-4}	2.7×10^{-7}	29	0.014	0.017	6.7×10^{-6}	0.53	2.1×10^{-4}	13	0.0053
Aircraft Crash	3.7×10^{-7} (Beyond extremely unlikely)	0.74	3.7×10^{-4}	40000	20	23	0.0093	740	0.30	18,000	7.3

a. Refer to the Glossary for the definition of rem and person-rem.
LCF = latent cancer fatality.
AST = Alpha Sorption Tank.
CSDT = Cleaning Solution Dump Tank.

- Beyond design-basis earthquake

- Organic Waste Storage Tank (OWST) loss of confinement

- Loss of cooling

- Benzene explosion in the OWST

B.5.1.1 Caustic Tank Loss of Confinement

Scenario: The Small Tank Precipitation facility would have 5,000 gallons of 50-percent sodium hydroxide in the Caustic Storage Tank and 500 gallons in the Caustic Feed Tank (CFT). The limiting event considered was the spill of the entire inventory of the 5,000-gallon Caustic Storage Tank.

Probability: A leak or rupture of the tank would have the potential to release the tank contents. Spilling of the tank contents could occur from a leak or rupture of the tank or piping. The overall frequency of a spill from a leak or rupture was estimated to be 3.4×10^{-2} per year, or once in 30 years.

Source Term: The source term was estimated by assuming the sodium hydroxide tank would be full and the entire inventory would be released to a diked area outside the facility. The release rate of 1,030 milligrams per second was assumed be at ground level.

B.5.1.2 TPB Storage Tank Spill

Scenario: TPB contains a small amount of benzene (up to 650 parts per million). The TPB Storage Tank would be a 20,000-gallon tank located in the Cold Feeds Area, outside the process areas. A spill from the TPB Storage Tank was assumed to occur, which would cause a benzene release. Some typical causes of accidental spills of chemicals would be overflows, transfer errors, and leaks. The most likely initiator would be a valve or flange leak.

There would be a sump and a dike around the TPB Storage Tank large enough to contain the entire contents of the tank, to prevent it from reaching the environment or process areas in case of a leak.

Probability: The frequency of a spill from the TPB Storage Tank was estimated to be 3.4×10^{-2} per year, or once in 30 years.

Source Term: The following assumptions were made in calculating the benzene source term resulting from a spill from the TPB Storage Tank:

- The concentration of benzene in TPB would be 650 parts per million.

- The spill would result in all of the TPB (20,000 gallons) being released to the Cold Feeds Area dike. At 650 parts per million, the total amount of benzene spilled would be 112 pounds (51.0 kilograms).

The benzene release rate from the spill was calculated to be 110,000 milligrams per second. Release of benzene would occur for 7.5 minutes. The release was assumed to occur at ground level.

B.5.1.3 Organic Evaporator Loss of Confinement

Scenario: A failure of the Organic Evaporator or its associated piping would cause a release of benzene into the PHC. For this event, the entire contents of the evaporator were assumed to be released. A number of initiating events could cause a loss of primary confinement of the evaporator (i.e., leaks, ruptures, crane or cell cover impacts).

Probability: The initiating event frequency is similar to all other loss of confinement events evaluated in this Appendix with a frequency of 3.4×10^{-2} per year, or once in 30 years.

Source Term: The hazardous material source term calculated for this event was a release of 7.8×10^{5} milligrams per second of benzene.

B.5.1.4 PHA Surge Tank Loss of Confinement

Scenario: A failure of the PHA Surge Tank or its associated piping would cause a release of benzene into the PHA Surge Tank process cell. For this event, the entire contents of the tank were assumed to be released. A number of initiating events could cause a loss of primary confinement of the evaporator (i.e., leaks, ruptures, crane or cell cover impacts).

Probability: The initiating event frequency is similar to all other loss of confinement events evaluated in this Appendix with a frequency of 3.4×10^{-2} per year, or once in 30 years.

Source Term: The hazardous material source term calculated for this event was a release of 0.0013 milligrams per second of benzene.

B.5.1.5 Beyond Design-Basis Earthquake

Scenario: The structures for the Small Tank Precipitation process would be designed to withstand PC-3 earthquakes, straight winds, and tornadoes. The PC-3 earthquake is considered to be the bounding NPH event. The process vessels, piping, and structures that house the hardware would be designed to withstand such an earthquake. For the beyond design-basis event, an earthquake slightly stronger than the design-basis earthquake is postulated to occur. This earthquake would cause the primary and secondary confinement to fail, releasing the entire facility inventory into the building. The ventilation system and HEPA filters are also postulated to collapse, resulting in some airborne releases of benzene.

Probability: The initiating event frequency is similar to all beyond design basis earthquake events evaluated in this Appendix with a frequency of 5.0×10^{-4} per year, or once in 2,000 years.

Source Term: The hazardous material source term calculated for this event was a release of 4,600 milligrams per second of benzene.

B.5.1.6 OWST Loss of Confinement

Scenario: The OWST would be a 40,000-gallon tank located outside the process areas. Leak detection would be provided within the secondary tank to alert operators to leakage from the primary tank. The secondary tank would contain any leakage from the primary tank; however, failure of the secondary tank would allow benzene to be released to the ground outside the tank. This scenario would be considered incredible; however, a more likely release scenario would be the failure of the 2-inch process line during benzene transfers from the PHC to the OWST.

Probability: The frequency of concurrent failures of the primary and secondary tanks was calculated to be 7.4×10^{-8}. Failure of the 2-inch process line, however, was deemed to be credible. Assuming that 700 feet of piping would be associated with the tank, and that the transfer operation would be performed 100 hours per year, the frequency of a large spill from the transfer line was calculated to be 7.0×10^{-6} per year, or once in 140,000 years.

Source Term: A rupture of the transfer line from the PHC to the OWST was assumed to release benzene during the transfer operation. The source term calculated for this release of benzene was 5.6×10^{6} milligrams per second.

B.5.1.7 Loss of Cooling

A loss of cooling to the Precipitation, Concentrate, or Wash Tanks would increase the temperature of the liquid phase of the contents of each tank. Benzene generation and releases, due to the radiolytic and catalytic decomposition of TPB, would accelerate. The enhanced benzene evolution would result in a higher benzene concentration in the effluent gas released from these tanks. The effects of a loss of cooling on the Recycle Wash Hold or Filtrate Hold Tanks would be minimal, due to the lack of solids in the liquid phase.

Even with a loss of cooling, the nitrogen flow through the tanks would still maintain the tanks in an inerted condition and would prevent explosions and fires from occurring in the tanks.

The low decay heat rate (approximately 0.005 watts per curie) of the tank contents would mitigate the effects of a loss-of-cooling event. A significant period of time would be required to sufficiently raise the temperature of the tanks to increase benzene generation rates, which would allow operating personnel time to minimize the effects of the accident. In addition, the height of the process stack through which benzene would be released is designed to prevent high concentrations of benzene from reaching onsite workers.

Probability: The frequency of a failure of the cooling water system that would last long enough for process vessels to overheat, resulting in increased benzene emissions, is 6.0×10^{-6} per year, or once in 170,000 years.

Source Term: The following assumptions were made when calculating the benzene source term resulting from a loss of cooling:

- The Small Tank Precipitation facility building stack was assumed to be 46 meters above grade.

- Average exit velocity from the stack would be 10 to 40 meters per second.

- Effluent temperature would be the temperature of the material in the process tanks (45°C).

- The benzene generation per hour would be 50 milligrams per liter of material in the tank.

- Tanks would be at maximum capacity (Precipitation Tanks #1 and #2 – 15,000 gallons each; Concentrate Tank – 10,000 gallons; Wash Tank – 10,000 gallons).

The resulting benzene source term was calculated as 2,600 milligrams per second.

B.5.1.8 Benzene Explosion in OWST

Scenario: Benzene and other organic compounds would normally be present in the OWST. The primary tank would be equipped with a floating roof to restrict organic waste evaporation and to reduce benzene emissions. The primary stainless steel tank would be within a secondary carbon steel tank. To prevent the vapor space from becoming flammable, the OWST would be pressurized with a safety-class nitrogen inerting system. However, the vapor space could become explosive if positive pressure was lost and air leaked into the vessel. With the presence of an ignition source, a deflagration could occur in the tank vapor space and cause the vessel to fail, spilling the liquid benzene inventory into the secondary tank. For this scenario, the secondary tank was also assumed to leak from the force of the explosion.

The OWST would be equipped with a nitrogen purge system and a seismically qualified liquid nitrogen vessel and vaporizer.

Probability: A benzene explosion in the OWST would have the potential to damage and release the entire inventory of benzene. The frequency that an explosion in the tank would occur was calculated to be 1.3×10^{-6} per year, or once in 770,000 years.

Source Term: An explosion of the OWST was assumed to release the entire contents of the primary tank into the secondary tank. The secondary tank was assumed to leak from the force of the primary tank explosion, releasing the entire contents outside the tank. The hazardous material source term was calculated to be 5.2×10^7 milligrams per second of benzene. The release was assumed to occur at ground level.

B.5.2 ION EXCHANGE AND DIRECT DISPOSAL IN GROUT

One bounding chemical accident was evaluated, a CFT loss of confinement that would be com-

mon to both the Ion Exchange and the Direct Disposal in Grout processes.

Scenario: The Ion Exchange facility would have 5,000 gallons of 50-percent sodium hydroxide in the CFT and the Direct Disposal in Grout facility would have 500 gallons of the 50-percent sodium hydroxide solution. Therefore, the limiting event was assumed to be a spill of the entire inventory of the sodium hydroxide tank (5,000 gallons).

Probability: A leak or rupture of the CFT could release the tank contents. The overall frequency of a spill from a leak or rupture was estimated to be 3.4×10^{-2} per year, or once in 30 years.

Source Term: The source term was estimated by conservatively assuming the sodium hydroxide tank would be full and the entire inventory would be released into a diked area outside the building. The release rate of sodium hydroxide was estimated to be 1,030 milligrams per second.

B.5.3 SOLVENT EXTRACTION

The accidents identified for the Solvent Extraction process that result in the release of non-radioactive hazardous materials to the environment include:

- Caustic Tank release
- Caustic Dilution Feed Tank release
- Nitric Acid Feed Tank loss of confinement

B.5.3.1 Caustic Storage Tank Release

Scenario: The Solvent Extraction facility would have sodium hydroxide in the CFT, Filter Cleaning Caustic Tank, Caustic Dilution Feed Tank, Caustic Storage Tank, Caustic Make-up Tank, and Solvent Wash Solution Make-up Tank. The limiting event considered was the spill of the entire inventory of the 5,000-gallon, 50-percent sodium hydroxide Caustic Storage Tank.

Probability: See Section B.5.2 for a discussion of the probability of the event occurring.

Source Term: See Section B.5.2 for a discussion of the source term.

B.5.3.2 Caustic Dilution Feed Tank Loss of Confinement

Scenario: The Solvent Extraction facility would have 15,000 gallons of 2-molar sodium hydroxide in the Caustic Dilution Feed Tank, which would be located in the operating area corridor. For conservatism, the postulated event was assumed to be a spill of the entire inventory, which would be contained in a diked area.

Probability: A leak or rupture of the tank would have the potential for releasing the tank contents. Spilling of the tank contents could occur because of a leak from the tank or piping, or rupture of the tank or piping. The overall frequency of a spill from a leak or rupture was estimated to be 3.4×10^{-2} per year, or once in 30 years.

Source Term: The release of the sodium hydroxide was assumed to be at ground level. The release rate was calculated to be 5,500 milligrams per second.

B.5.3.3 Nitric Acid Feed Tank Loss of Confinement

Scenario: The Solvent Extraction facility would have 1,000 gallons of 50-percent nitric acid in the Nitric Acid Feed Tank located in the Cold Feeds Area outside the main building. For conservatism, the postulated event was assumed to be a spill of the entire inventory, which would be contained in a diked area.

Probability: A leak or rupture of the tank would have the potential for releasing the tank contents. Spilling of the tank contents could occur because of a leak from the tank or piping, or rupture of the tank or piping. The overall frequency of a spill from a leak or rupture was estimated to be 3.4×10^{-2} per year, or once in 30 years.

Source Term: The release of the nitric acid was assumed to be at ground level. The release rate was calculated to be 160 milligrams per second.

B.6 Accident Impacts Involving Nonradioactive Hazardous Materials

As Section B.4 provided for the radiological consequences of identified accidents, this Section provides the potential impacts associated with the release of nonradioactive hazardous materials from the various accident scenarios.

B.6.1 SMALL TANK PRECIPITATION

The accidents described in Section B.5.1 would release hazardous chemicals (sodium hydroxide and benzene). Table B-18 provides atmospheric dispersion factors for two individual receptors: the noninvolved worker and the MEI (Hope 1999). By applying these factors, the maximum concentrations at those receptor locations were calculated. These concentrations are also presented in Table B-18.

The ERPG-1 value (described in Section B.2.3) is 0.5 milligrams per cubic meter (mg/m^3) for sodium hydroxide and 160 mg/m^3 for benzene; therefore, no significant impacts would occur to offsite receptors due to a loss-of-cooling accident or spills from the CFT, the TPB tank, or the Organic Evaporator. By definition, individuals exposed to airborne concentrations below EPRG-1 threshold concentrations would not experience even mild transient adverse health effects or the perception of a clearly defined objectionable odor.

Three of the accidents were shown to exceed the ERPG-2 value of 480 mg/m^3 for benzene concentrations to noninvolved workers. Airborne concentrations from two of these accidents, an explosion in the PHC and OWST loss of confinement, would be below the ERPG-3 value of 3,190 mg/m^3. By defi-

nition, individuals exposed to airborne concentrations above the ERPG-2 threshold could experience or develop irreversible or other serious health effects or symptoms that may impair their ability to take protective action. Airborne concentrations from the third accident, an explosion in the OWST, would exceed the ERPG-3 value. By definition, individuals exposed to airborne concentrations above the ERPG-3 threshold could experience or develop life-threatening health effects. All three of these accidents are in the extremely unlikely category.

B.6.2 ION EXCHANGE AND DIRECT DISPOSAL IN GROUT

The CFT accident described in Section B.5.2 would release sodium hydroxide at a release rate of 1,030 milligrams per second. Table B-19 provides atmospheric dispersion factors for two individual receptors, the noninvolved worker and the MEI (Hope 1999). By applying these factors, the maximum concentrations at those receptor locations were calculated. These concentrations are also presented in Table B-19.

The ERPG-1 value described in Section B.2.3 is 0.5 mg/m^3 for sodium hydroxide; therefore, no significant impacts would occur to onsite or offsite receptors from this accident. Refer to the discussions in Section B.6.1 on the effects of concentrations below EPRG-1 thresholds.

B.6.3 SOLVENT EXTRACTION

The accidents described in Section B.5.3 would release hazardous chemicals (sodium hydroxide and nitric acid). Table B-20 provides atmospheric dispersion factors for two individual receptors, the noninvolved worker and the MEI (Hope 1999). By applying these factors, the maximum concentrations at those receptor locations were calculated. These concentrations are also presented in Table B-20.

The ERPG-1 value (described in Section B.2.3) is 0.5 mg/m^3 for sodium hydroxide and 2.6 mg/m^3 for nitric acid; therefore, no significant impacts would occur to offsite receptors from these accidents. By definition, individuals exposed to airborne concentrations below

Table B-18. Chemical release concentrations from Small Tank Precipitation process.

Scenario	Frequency (frequency category)	Evaporation release rate (mg/s)	Atmospheric dispersion factor (sec/m^3)		Resultant concentration (mg/m^3)[a,b,c,d]		Total atmospheric release (mg)
			Noninvolved worker	MEI	Noninvolved worker	MEI	
Sodium hydroxide							
CFT Loss of Confinement	3.4×10^{-2} (Anticipated)	1,030	1.7×10^{-4}	5.7×10^{-7}	0.18	5.9×10^{-4}	770
Benzene							
TPB tank spill	3.4×10^{-2} (Anticipated)	110,000	1.7×10^{-4}	5.7×10^{-7}	18.7	0.06	5.1×10^{7}
Organic Evaporator Loss of Confinement	3.4×10^{-2} (Anticipated)	780,000	1.7×10^{-4}	5.7×10^{-7}	130	0.45	5.7×10^{9}
PHA Surge Tank Loss of Confinement	3.4×10^{-2} (Anticipated)	0.0013	1.7×10^{-4}	5.7×10^{-7}	2.2×10^{-8}	7.41×10^{-10}	800
Beyond Design-Basis Earthquake	5.0×10^{-4} (Unlikely)	4,600	1.7×10^{-4}	5.7×10^{-7}	0.78	0.0026	1.4×10^{7}
OWST Loss of Confinement	7.0×10^{-6} (Extremely unlikely)	5,600,000	1.7×10^{-4}	5.7×10^{-7}	950	3.2	3.3×10^{9}
Loss of cooling accident	6.0×10^{-6} (Extremely unlikely)	2,600	1.7×10^{-4}	5.7×10^{-7}	0.44	0.0015	7.6×10^{7}
OWST explosion	1.3×10^{-6} (Extremely unlikely)	52,000,000	1.7×10^{-4}	5.7×10^{-7}	8,840	30	9.3×10^{9}

Source: WSMS 2000.
a. ERPG-1 value (sodium hydroxide) = 0.5 mg/m^3.
b. ERPG-1 value (benzene) = 160 mg/m^3.
c. ERPG-2 value (benzene) = 480 mg/m^3.
d. ERPG-3 value (benzene) = 3190 mg/m^3.
mg/s   = milligrams per second.
sec/m^3 = seconds per cubic meter.
mg/m^3 = milligrams per cubic meter.
CFT = Caustic Feed Tank, PHA = Precipitate Hydrolysis Aqueous, OWST = Organic Waste Storage Tank.

EPRG-1 threshold concentrations would not experience even mild transient adverse health effects or the perception of a clearly defined objectionable odor. The Caustic Dilution Feed Tank accident would result in concentrations of sodium hydroxide to the noninvolved worker slightly higher than the ERPG-1 values. By definition, individuals exposed to airborne concentrations above the ERPG-1 threshold may experience mild transient health effects.

B.7 Environmental Justice

In the event of an accidental release of radioactive or hazardous chemical substances, the dispersion of such substances would depend on meteorological conditions, such as wind direc-

tion, at the time. Given the variability of meteorological conditions and the low probability and risk of accidents, an accident would be unlikely to occur that would result in disproportionately high or adverse human health and environmental impacts to minorities or low-income populations.

Table B-19. Sodium hydroxide release concentrations from Ion Exchange and Direct Disposal in Grout processes.

Scenario	(frequency category)	Evaporation release rate (mg/s)	Atmospheric dispersion factor (sec/m^3)		Resultant concentration (mg/m^3)[a]		Total atmospheric release (mg)
			Noninvolved worker	MEI	Noninvolved worker	MEI	
CFT Loss of Confinement	3.4×10^{-2} (Anticipated)	1,030	1.7×10^{-4}	5.7×10^{-7}	0.18	5.9×10^{-4}	770

Source: WSMS 2000.
a.   ERPG-1 value = 0.5 mg/m^3.
mg/s   = milligrams per second.
sec/m^3 = seconds per cubic meter.
mg/m^3 = milligrams per cubic meter.

Table B-20. Chemical release concentrations from Solvent Extraction process.

Scenario	Frequency (frequency category)	Evaporation release rate (mg/s)	Atmospheric dispersion factor (sec/m^3)		Resultant concentration (mg/m^3)[a,b,c]		Total atmospheric release (mg)
			Noninvolved worker	MEI	Noninvolved worker	MEI	
Sodium hydroxide							
CFT Loss of Confinement	3.4×10^{-2} (Anticipated)	1,030	1.7×10^{-4}	5.7×10^{-7}	0.18	5.9×10^{-4}	770
Caustic Dilution Feed Tank Loss of Confinement	3.4×10^{-2} (Anticipated)	5,470	1.7×10^{-4}	5.7×10^{-7}	0.93	0.0031	5.5×10^{3}
Nitric acid							
Nitric Acid Feed Tank Loss of Confinement	3.4×10^{-2} (Anticipated)	155	1.7×10^{-4}	5.7×10^{-7}	0.026	8.8×10^{-5}	95

Source: WSMS 2000.
a.   ERPG-1 value (sodium hydroxide) = 0.5 mg/m^3.
b.   ERPG-2 value (sodium hydroxide) = 5.0 mg/m^3.
c.   ERPG-1 value (nitric acid) = 2.6 mg/m^3.
mg/s   = milligrams per second.
sec/m^3 = seconds per cubic meter.
mg/m^3 = milligrams per cubic meter.

References

AIHA (American Industrial Hygiene Association), 1991, *Emergency Response Planning Guideline*, Emergency Response Planning Guidelines Committee, Akron, Ohio.

Cappucci, A. J., Jr., M. L. Baker, D. E. Welliver, 2000, *Determination of Accident Sequence, Frequency, and Source Term Selection for the Salt Disposition Supplemental Environmental Impact Statement*, S-CLC-G-00187, Rev. 2, Westinghouse Safety Management Solutions, Aiken, South Carolina.

Cappucci, A. J., Jr., (Westinghouse Safety Management Solutions), 2000, "Corrected Table," electronic message to B. Bradford, Tetra Tech NUS, Aiken, South Carolina, September 19.

DOE (U.S. Department of Energy), 1993, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements*, Office of Environment, Safety, and Health (EH-25), Washington, D.C.

DOE (U.S. Department of Energy), 1994, *Preparation Guide for U.S. DOE Non-reactor Nuclear Facility Safety Analysis Reports*, DOE-STD-3009-94, Washington, D.C.

DOE (U.S. Department of Energy), 2000a, *Analyzing Accidents under NEPA – Draft*, Office of NEPA Policy and Assistance, Washington, D.C.

DOE (U.S. Department of Energy), 2000b, *High-Level Waste Tank Closure Draft Environmental Impact Statement*, DOE/EIS-0303D, Savannah River Operations Office, Aiken, South Carolina.

Hope, E. P., 1999, *Parametric Dispersion Calculations for H-Area Releases*, S-CLC-H-00693, Rev. 0, Westinghouse Savannah River Company, Aiken, South Carolina.

NCRP (National Council on Radiation Protection and Measurements), 1993, *Limitation of Exposure to Ionizing Radiation*, Report No. 116, Bethesda, Maryland.

NRC (U.S. Nuclear Regulatory Commission), 1982, *Regulatory Guide 1.145: Atmospheric Dispersion Models for Potential Accidental Consequence Assessments at Nuclear Power Plants*, Rev. 1, Washington, D.C.

Simpkins, A. A., 1995a, *Verification of AXAIRQ*, WSRC-RP-95-708, Savannah River Technology Center, Aiken, South Carolina.

Simpkins, A. A., 1995b, *AXAIRQ User Manual*, WSRC-RP-95-709, Savannah River Technology Center, Aiken, South Carolina.

Simpkins, A. A., (Westinghouse Savannah River Company), 1999, "Salt Disposition Facility EIS Accidental Release Environmental Dosimetry Calculations," SRT-EST-99-316, Interoffice memorandum to C. B. Shedrow, Westinghouse Savannah River Company, Aiken, South Carolina, July 22.

WSMS (Westinghouse Safety Management Solutions), 2000, *ERPGs and TEELs for Chemicals of Concern:* WSMS-SAE-00-0001, Rev. 16, Aiken, South Carolina.

APPENDIX C

PUBLIC COMMENTS AND DOE RESPONSE TO COMMENTS

TABLE OF CONTENTS

APPENDIX C

This appendix provides the comments received during the public comment period and the U. S. Department of Energy's (DOE's) responses to them. Letters received are reproduced here. Comments received at the public meetings in Columbia and North Augusta, South Carolina are summarized. The transcripts from the public meetings can be reviewed at the DOE public reading rooms: DOE Freedom of Information Reading Room, Forrestal Building, Room 1E-190, 1000 Independence Avenue, S.W., Washington, D.C., 20585, phone: 202-586-6020, and DOE Public Document Room, University of South Carolina, Aiken Campus, University Library, 2nd Floor, 171 University Parkway, Aiken, SC 29801, Phone: 803-648-6815.

DOE published the *Savannah River Site Salt Processing Alternatives Draft Supplemental Environmental Impact Statement* (DOE/EIS-0082-S2D) in March 2001. DOE held public meetings on the Draft SEIS in North Augusta, South Carolina on May 1, 2001 and in Columbia, South Carolina on May 3, 2001. The 45-day public comment period ended on May 14, 2001.

Court reporters recorded comments and statements made during the four public meeting sessions. In those sessions, nine individuals provided comments or made statements. DOE also received 12 letters on the Draft SEIS by mail. This Appendix presents the comments received and the DOE responses to those comments. If a comment prompted a modification to the EIS, DOE has noted the change and directed the reader to that change.

Many, but not all, of the comments addressed the four issues described in the following paragraphs. In these paragraphs DOE describes issues that were pointed out by several commenters and provides a general response to the issue.

The National Academy of Sciences – National Research Council Committee on Radionuclide Separation Process for High-Level Waste at the Savannah River Site was given the opportunity to comment on this Final SEIS (FSEIS). The Committee chose not to comment on the FSEIS, but instead to comment on the separation alternatives in its report to DOE, which was submitted on June 4, 2001.

No Action Alternative

Commenters questioned the description of the No Action alternative and its impacts. They generally expressed the opinion that the long-term impacts of No Action would be more severe than DOE portrayed qualitatively in the Draft SEIS and asked that the No Action alternative be modified and the long-term impacts analyzed quantitatively. Several commenters suggested that DOE evaluate a scenario that assumed no salt processing alternative could be developed, and evaluate the impacts of leaving salt waste in HLW tanks until the eventual failure of the tanks.

Response: DOE has revised the analysis of the No Action alternative to provide a more quantitative evaluation of the impacts of the No Action alternative over the long term. DOE has added text to the SEIS, and added data to appropriate tables, that compare the long-term impacts of the No Action alternative to the long-term impacts of the action alternatives. DOE evaluated the impacts of the eventual of tank contents to the environment under a tank overflow scenario, and the consequent health impacts to a person drinking the contaminated water from on-site streams and the Savannah River. DOE also addressed the radiation exposure that could result from external exposure to contaminated soil or by consumption of vegetation or animals fed by contaminated water.

Direct Disposal in Grout Alternative

Several commenters questioned the implementation of the Direct Disposal in Grout alternative because in their view it would result in disposal of HLW at the Savannah River Site (SRS). Other commenters asked about DOE's discussions about the Direct Disposal in Grout alternative with the U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC).

Response: Any of the salt processing alternatives would require a determination that residues to be disposed of as low-level wastes are "waste incidental to reprocessing," not HLW. DOE describes the process for determining whether waste is waste incidental to reprocessing in Section 7.1 of the SEIS. The waste-incidental-to-reprocessing analysis would be applied to any salt processing alternative that DOE selected for implementation. If the waste met the criteria for waste incidental to reprocessing, it could be managed as low-level waste or as TRU waste, depending on the nature of the waste. DOE expects that the waste generated under the direct disposal in Grout alternative would be managed as low-level waste. DOE has had preliminary discussions with SCDHEC at the staff level. SCDHEC conveyed to DOE during those discussions that, as long as DOE followed the waste incidental to reprocessing determination process, SCDHEC found the Direct Disposal in Grout alternative to be acceptable in principle.

Waste Management

Commenters asked how wastes that would be generated by the alternatives, particularly benzene and solvents, would be managed.

Response: Currently, incineration is considered the best available treatment technology for benzene and other organic liquid wastes. DOE expects that these wastes would be disposed of by incineration. DOE has not yet determined whether the Consolidated Incineration Facility, a portable vendor-operated facility, or a suitable offsite facility would be used for incineration of these wastes. DOE previously analyzed the impacts of incineration and various alternatives to incineration in the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE/EIS-0082-S, November 1994). The results of this analysis show that the impacts from the various alternatives to incineration are bounded by the impacts of incineration. The actual treatment facility would be determined during design and construction of the salt processing facility.

Criteria for Selection of the Preferred Alternative

Several commenters asked about the criteria to be used by DOE to select the preferred salt processing technology, and several commenters were especially interested in cost as a criterion.

Response: In addition to reviewing the results of research and development work on the alternative technologies, DOE evaluated each alternative against the following criteria: cost, schedule, technical maturity, technology implementability, environmental impacts, facility interfaces (with existing SRS facilities), process simplicity, process flexibility, and safety. DOE has revised the SEIS (at Section 2.8.3) to incorporate the latest approximate range of costs through construction for each of the alternatives. DOE does not consider the cost estimates available at this time to be reliable enough to be a significant discriminating factor for decision-making. (The National Academy of Sciences final report on SRS salt processing alternatives did not propose criteria for selecting an approach and did not identify a preferred alternative.)

Table C-1. Public Comments on the Draft Salt Processing Alternatives Supplemental EIS

Comment Source Number[a]	Commenter	Page Number
L1	Mr. William Lawless	
L2	South Carolina Budget and Control Board	
L3	Mr. William Lawless	
L4	Mr. William Willoughby	
L5	U. S. Department of the Interior	
L6	Mr. W. Lee Poe, Jr.	
L7	Economic Development Partnership	
L8	Savannah River Site Citizens Advisory Board	
L9	Georgia Department of Natural Resources	
L10	U. S. Environmental Protection Agency	
L11	South Carolina Department of Health and Environmental Control	
L12	Rutgers, The State University of New Jersey	
M1-01, M1-02	Mr. James Hardeman	
M2	No comments were submitted at this meeting session	
M3-01, M3-02	Mr. William Willoughby	
M3-03 through M3-08	Ms. Leslie Minerd	
M3-09 through M3-11	Mr. Ernie Chaput	
M3-12 through M3-14	Ms. Karen Hardison	
M3-15 through M3-17	Dr. Mary Kelly	
M3-18, M3-19	Ms. Leslie Minerd	
M3-20	Ms. Melinda Holland	
M3-21	Ms. Karen Hardison	
M4-01 through M4-03	Ms. Paula Austin	
M4-05 through M4-08	Mr. John Austin	
M4-09 through M4-11	Ms. Paula Austin	

---

[a]   Unique codes were given to each of the letters received and public meeting sessions. L1 is the first letter received and M1 is the afternoon session at North Augusta S.C., M2 is the evening session at North Augusta, S.C., M3 is the afternoon session at Columbia, S.C., and M4 is the evening session at Columbia, S.C. Individual comment are coded L1-01 or M1-01, etc. The 12 letters received are provided in this appendix and complete transcripts of the meetings are available in the DOE Public Document Rooms.

LETTERS

The comment letters DOE received on the Draft Salt Processing Alternatives Supplemental EIS and DOE's responses are provided in the following section. Comments in each letter are identified, and the corresponding responses follow the letter.

----- Forwarded by NEPA/WSRC/Srs on 04/18/01 12:56 PM -----

bill lawless <lawlessw@mail.paine.edu>

04/17/01 06:23 PM
Please respond to lawlessw

To: nepa@mailhub.srs.gov
cc:
Subject: comments on the salt processing alternatives draft seis

andrew grainger, my comments on the subject dseis follow; if you should
have any questions regarding them, please feel free to contact me by
email or at 706-821-8340; thanks, bill lawless

1. the acronyms, abbreviations, scientific notation examples, and metric

conversion tables at the front of the summary are excellent, and should
be duplicated in the full dseis;

2. p. s1, para 6: much greater quantities of benzene were produced than
"anticipated" should be changed to something more explanatory like:
anticipated based on calculations and preliminary small laboratory
experiments;

3. p. s1, para 6, last line: the statement regarding processing of hlw
sludge should be buttressed and clarified for the public; i suggest
something like: sludge processing has worked well and as anticipated and

has led to the production of x number of canisters as of x date (use the

most recent data); also at this point it would help to tell the public
how this compares with other similar facilities such as west valley's
totals and hanford's totals todate (about 300 and 0 respectively);

L1-1

L1-2

L1-3

5/11/2001

Comment L1, Page 1 of 2

4. p. s4 and p. s13: it's confusing to split the columns differently
from the rest of the text as done on these 2 pages; i recommend that
columns be consistent throughout;

L1-4

5. p. s5: in the event that the beginning of salt processing deadline
date of 2010 is not met, it would help the public/decision makers to
have an estimate of the consequences for the range of additional
canisters that may be needed, the additional costs, and the additional
number of years of vitrification that may be required; as is, the public

and decision makers may not have a clear idea of the financial and other

risks to the public for delaying the decision;

L1-5

6. p. s6: if new tanks may be required by 2010, please specifiy the date

for when a decision to construct them must be made, and for at how much
of an estimated cost and for how many new tanks; as in item 5 above, the

seis/summary must be clear about the costs to the public for not making
a timely decision;

L1-6

7. p. 26, the parenthetical date of 2023 is confusing; my suggestion on
how to state it better: i.e., 100 years after 2023;

L1-7

8. p. s5, box, please add: two tanks (tank 20 and tank 17) were formally

closed by srs under a plan approved by dhec on dates x and x,
respectively;

L1-8

9. p. s9, add a section that reviews the status of the evaporator system

at f and h areas and its impact on the tank space and the decision to
initiate salt processing;

L1-9

10. p. s11, last sentence in the "no action" section, i would recommend
that the word "speculative" be changed to "unlikely";

L1-10

11. p. s16, what would happen to the benzene (and other wastes in the
other alternatives) should be stated briefly in this section; i.e., the
bezene would be treated on site, sent to a commercial facillity, or a
decision about treatment would be made by x date; also add how likely
and how easily would treatment be under all alternatives;

L1-11

12. p. s30, the no action alternative should consider the possibility of

an intank explosion from h-gas, and its consequences;

L1-12

13. both the summary and full dseis should collect the estimated costs
for each alternative and locate them in a table early on in the text;

L1-13

14. both the summary and full dseis should include a reveiw of the
maturity of the technologies under consideration (where employed by
other site/industry/country, etc.);

L1-14

15. full dseis, p. 341, graphic for srs = 0.18 mrem is not clear; i
recommend that this be improved by putting the terms "srs 0.18 mrem"
inside of a funnel that opens from a wedge of two lines inside of the
pie so that it not be as confusing as it is;

L1-15

5/11/2001

Comment L1, Page 2 of 2

Response to Comment Letter L1:

L1-1   The acronym, abbreviations, and scientific notation will be included in the final SEIS and the Summary

L1-2   DOE revised the statement as suggested in the comment.

L1-3   Although sludge-only processing is not in the scope of the salt processing alternatives DOE has indicated the number of canisters produced at SRS through May 2001 (about 1,100). However, DOE believes that the topic should be addressed briefly in the background sections of the SEIS. Comparisons with other DOE vitrification operations are not meaningful because of differences among them, for example, in completion of facilities and composition of waste.

L1-4   On both pages S-4 and S-13 of the draft SEIS the text box is the end of a section (e.g., Section S.1 on page S-4). DOE believes that the least confusing page layout is to start the next section (Section S.2) immediately below the text box.

L1-5   The HLW System Plan, Rev 11 (April 2000), indicates that a maximum of 150 fully loaded salt-only canisters can be produced per year. In the event that the salt processing date of 2010 is not met, then the potential exists that up to 150 additional canisters (salt-only) per year would have to be produced for every year lost in the schedule. The cost for additional canister production would be about $300 million per year. In the event that sludge processing were to be completed prior to the initiation of salt processing, it would take 13 years (at 150 canisters per year) to process all of the salt waste at an approximate cost of $4 billion in addition to the cost of construction and operation of the salt processing facility. (Note: These costs do not include Federal Repository costs for transportation and disposal). This discussion has been added to S.3, Section 1.2, and Section 2.7.1.

L1-6   DOE has estimated that a minimum of five years is required to permit and build new HLW storage tanks. Therefore, to meet the 2010 deadline, the permitting process would need to start by 2005. Because of the speculative nature concerning DOE's future course of activities under the No Action alternative, other specifics are unknown.

L1-7   The comment refers to the discussion of scoping comments which has been replaced in the final SEIS with a discussion of comments on the draft SEIS.

L1-8   DOE closed tanks 17 and 20 in 1996 and 1997, respectively. DOE believes this information is peripheral to the SEIS and has not changed the text.

L1-9   The three evaporator systems currently available have sufficient capacity to handle the expected demands of the HLW system once the process and equipment issues associated with the 2H and 3H Evaporator systems are resolved. The three evaporators operating at planned capacity will provide margin to accommodate future system upsets and allow the option to shutdown the 2F Evaporator system at some point in the future.

L1-10   DOE believes that "speculative" is a more accurate modifier for DOE's future course of action.

Response to Comment Letter L1 (continued):

L1-11 Currently, incineration is considered the best available treatment technology for benzene and other organic liquid wastes. DOE expects that these wastes would be disposed of by incineration. However, DOE has not yet determined whether the Consolidated Incineration Facility, a portable vendor-operated facility, or a suitable offsite facility would be used for incineration of these wastes. DOE previously analyzed the impacts of incineration and various alternatives to incineration in the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE/EIS-0082-S, November 1994). The results of this analysis show that the impacts from the various alternatives to incineration are bounded by the impacts of incineration. The actual treatment facility would be determined during design and construction of the salt processing facility.

L1-12 For the short term under all alternatives, the HLW tanks would be subject to the same potential accident risks as exist for current operations. These are evaluated in approved safety documentation and previous EISs as cited in Section 4.1.13. These impacts would persist over a longer period of time under the No Action alternative. Although DOE has not analyzed hydrogen explosion accidents over the long term, the generation of hydrogen decreases with time and accordingly the probability of a hydrogen explosion accident would also decrease over time.

L1-13 The revised Section 2.8.3, Cost, incorporates the latest approximate range of costs through construction for each of the SEIS alternatives. DOE does not consider the cost estimates at this time to be reliable enough to be a significant discriminating factor for decision making.

L1-14 The technical maturity of the salt processing alternatives is among the topics discussed in detail in technical reports cited in Sections 2.6 and 2.8. Because technical maturity is not an important consideration for assessment of environmental impacts, DOE did not repeat this information in the SEIS.

L1-15 The revised Figure 3-13 addresses the comment in a footnote.

STATE OF SOUTH CAROLINA
State Budget and Control Board
OFFICE OF STATE BUDGET

JIM HODGES, CHAIRMAN
GOVERNOR

GRADY L. PATTERSON, JR.
STATE TREASURER

JAMES A. LANDER
COMPTROLLER GENERAL

1122 LADY STREET, 12TH FLOOR
COLUMBIA, SOUTH CAROLINA 29201
(803) 734-2280

LES BOLES
DIRECTOR

HUGH K. LEATHERMAN, SR.
CHAIRMAN, SENATE FINANCE COMMITTEE

ROBERT W. HARRELL, JR.
CHAIRMAN, WAYS AND MEANS COMMITTEE

RICK KELLY
EXECUTIVE DIRECTOR

ACKNOWLEDGEMENT

April 30, 2001

Mr. Andrew R. Grainger
NEPA Compliance Officer
Savannah River Operations Office
Building 742A, Room 183
Aiken, South Carolina 29802
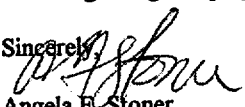
Project Name: Savannah River Site Salt Processing Alternatives Draft Supplemental Environmental Impact Statement March 2001 DOE/EIS-0082-S2D

State Application Identifier:EIS-010402-002
Suspense Date: 6/ 7/2001

Dear Mr. Grainger:

Receipt of the above referenced project is acknowledged. The Grant Services Unit, Office of State Budget, has initiated an intergovernmental review of this project. You will be notified of the results of this review by the suspense date indicated above. South Carolina state agencies are reminded that if additional budget authorization is needed for this project, three copies of the completed GCR-1 form and two copies of the project proposal must be submitted to this office. This action should be initiated immediately, if required. Please include the State Application Identifier in any correspondence with our office regarding this project. If you have any questions please contact me at 734-0485.

Sincerely,

Angela F. Stoner
Fiscal Manager, Grant Services

Fax (803) 734-0645

Comment L2, Page 1 of 1

Response to Comment Letter L2:

No response required.

NEPA

To: Drew Grainger/DOE/Srs@srs, L Ling/DOE/Srs@Srs

cc:

Subject: additional comment for seis

05/07/01 12:34 PM

----- Forwarded by NEPA/WSRC/Srs on 05/07/01 12:38 PM -----

**bill lawless
<lawlessw@mail.pai
ne.edu>**

To: nepa@mailhub.srs.gov

cc:

Subject: additional comment for seis

05/01/01 12:07 PM
Please respond to
lawlessw

Mr. Grainger, please find attached an additional comment for the draft
SEIS, thanks, bill lawless

lawless.new.seis.comment

Comment L3, Page 1 of 3

Andrew R. Grainger, NEPA Compliance Officer
U. S. Department of Energy
Savannah River Operations Office
Building 742A, Room 183
Aiken, South Carolina 29802

Subject: Comments on the March 2001 Savannah River Site Salt Processing
Alternatives Draft Supplemental Environmental Impact Statement
(DOE/EIS-0082-S2D)

Dear Mr. Grainger:

Subject: Additional comment on the draft salt processing SEIS:

After consideration of the no-action alternative which would require SRS
to build new tanks as needed in the event that no decision on the salt
processing alternatives occurs, or in the event that a decision is
rendered but no funding or inadequate funding occurs, in my opinion, the
likely possibility of this set of circumstances renders the no-action
alternative currently in the SEIS unrealistic for the following reasons:

1. DHEC is on record on more than one occasion stipulating that it is
unlikely that new HLW tanks will be permitted to be constructed at SRS.   L3-1

2. If new HLW tanks are precluded, DWPF will have to cease operations,
sometime after 2010.

3. If new HLW tanks are precluded, ending the operations of DWPF earlier
than the time it takes to remove and vitrify all of the sludge at the
bottom of the tanks, where most of the plutonium and actinides are
contained, the residual burden of contamination in the HLW tanks after
the cessation of operations at SRS means that plutonium and other
long-lived actinides will remain in the tanks in addition to the
supernate (e.g., fission products including cesium-137).
                                                                                            L3-2

4. In this more realistic no-action scenario, higher releases of
contamination from the tanks to the environment and the public will
increase significantly over the next few hundred to thousands of years,
compared to the currently presented no-action case.

Therefore, in my opinion, the no-action alternative is unrealistic; a
more realistic no-action alternative should be drafted to help the
public better understand the gravity of not making a timely choice for
one of the salt processing alternatives, or, given that a choice is

Comment L3, Page 2 of 3

made, not having the chosen alternative adequately funded in time, provoking SRS to propose the construction of new HLW tanks, or the shutdown of DWPF.

Thanks,

W.F. Lawless

L3-2

Comment L3, Page 3 of 3

Response to Comment Letter L3:

L3-1   DOE is unaware of official documentation from SCDHEC on the feasibility of permitting new HLW tanks at SRS.

L3-2   DOE has revised the sections on the long-term impacts of the No Action alternative. The Summary, Sections 2.9.2 and 4.2, and Appendix D have been modified to incorporate the results of the analysis of long-term impacts of the No Action alternative. For purposes of analysis, DOE assumes only salt waste remains in the HLW tanks. Section 1.2 includes a discussion of the consequences of a project delay in terms of the cost of producing salt-only canisters.

NEPA

To: Drew Grainger/DOE/Srs@srs, L Ling/DOE/Srs@Srs
cc:
Subject: DOE/EIS-0082-S2D Comments

05/07/01 12:35 PM

----- Forwarded by NEPA/WSRC/Srs on 05/07/01 12:38 PM -----

william willoughby <willow_II@msn.com>

To: nepa@mailhub.srs.gov
cc: Rick McCloud <crescentemc@aol.com>, bill lawless
<lawlessw@mail.paine.edu>, wade waters <wwaters258@aol.com>,
lee poe <leepoe@mindspring.com>, karen patterson
<PattersonK@ttnus.com>, Kelly Dean <kelly.dean@mailhub.srs.gov>
Subject: DOE/EIS-0082-S2D Comments

05/01/01 05:21 PM

Mr. A. Grainger,
    Attached are comments on the Salt Processing SEIS.
William Willoughby II
506 Killington Ct

Columbia, SC 29212 DOE EIS-0082-S2D comments.doc

Comment L4, Page 1 of 2

DOE/EIS-0082-S2D 3/2001 comments William Willoughby II

Comments are made on the base documents and would also apply to the summary document where applicable

p 1-4 insert, 4th line from bottom – the sentence should end with "----managed by compaction.", and the balance of the sentence deleted.

| L4-1

p 2-24, 2nd column, 2nd para; and p 2-25, section 2.8.2, 1st para – do you really mean that **ALL** salt Cs must go into the surplus Pu canisters and there are no low Cs level tanks that after Pu and Sr removal could not go direct to saltstone? How are these paragraphs affected by the reevaluation of surplus scrap Pu disposition?

| L4-2

| L4-3

p 2-35 identify source of dose conversion factors (pCi/vol to mrem)

| L4-4

Table 3-1- does note "d" apply to Cs-137 ?

| L4-5

Tables 3-1,3-3,3-6 uses inconsistent dose conversion factor references and inconsistent dose conversion factors

| L4-6

p 3-45, section 3.9.2, 5th from last line– The sentence should end with "-----than incinerated.", and the balance of the sentence deleted.

| L4-7

p 3-49, section 3.9.6, 2nd line- " atomic weights" should be "atomic numbers"

| L4-8

Table 4-10 do not understand relation between 50-year committed effective dose equivalent and footnote "a."; also how does dose conversion here compare with those for Tables 3-1,3-3,3-6 ?

| L4-9a

| L4-9b

Table 4-30- need an explanation here as why 1000 yr doses are greater than 100 yr doses as well as later in text

| L4-10

Comment L4, Page 2 of 2

Response to Comment Letter L4:

L4-1   The description of CIF suspension has been revised.

L4-2   DOE believes it is more cost effective and environmentally acceptable to operate a single processing facility rather than multiple processing facilities tailored to variable levels of cesium removal. Therefore, DOE has evaluated alternatives that either remove or do not remove cesium from the salt component.

L4-3   DOE has not canceled the Plutonium Immobilization project for disposition of certain quantities of surplus plutonium. Rather, the Secretary of Energy has decided to suspend plutonium immobilization activities because the President's budget for Fiscal Year 2002 and beyond would not simultaneously support the peak construction of the Pit Disassembly and Conversion Facility, the Mixed Oxide Fuel Fabrication Facility, and the Plutonium Immobilization Facility. Delay in implementing the Plutonium Immobilization project would not affect the availability of plutonium for immobilization in DWPF glass, because DOE plans to operate DWPF until all SRS HLW has been vitrified, in about 2023.

L4-4   The sources of the dose conversion factors (picocuries per volume to millirem) are numerous. References are found in Chapter 4 under the environmental dosimetry calculations (e.g., Simpkins, 1999).

L4-5   No. Table 3-1 has been corrected.

L4-6   These tables use different units of measurement and different standards appropriate to the parameter being measured. DOE does not use dose conversion factors in any of these tables.

L4-7   The sentence has been revised.

L4-8   The text has been corrected.

L4-9a   Footnote "a" applies to doses associated with the No Action alternative. The footnote will be relocated in Table 4-10 and associated with the Maximum dose heading.

L4-9b   Refer to response to L4-6.

L4-10   The information in Table 4-30 has been clarified.

United States Department of the Interior

OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL POLICY AND COMPLIANCE
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

May 4, 2001

ER-01/209

Andrew R. Grainger
NEPA Compliance Officer
Savannah River Site
Building 742-A, Room 185
Aiken, SC 29802

RE: Savannah River Site Salt Processing Alternatives Draft Supplemental EIS

Dear Mr. Grainger:

The Department of the Interior has reviewed the referenced document and has no comments to offer at this time. Thank you for the opportunity to review this material.

L5-1

Sincerely,

James H. Lee,
Regional Environmental Officer

CC: FWS-ES, RO, Atlanta
OEPC, WASO

Comment L5, Page 1 of 1

Response to Comment Letter L5:

L5-1   Thank you for your review.

May 7, 2001
807 E. Rollingwood Rd
Aiken, SC   29801

Mr. Andrew R. Grainger
NEPA Compliance Officer
U. S. Department of Energy
Savannah River Operations Office
Building 742-A, Room 183
Aiken, SC   29801

**Comments on Salt Processing Alternatives SEIS
DOE/EIS-0082-S2D, March 2001**

I would like to provide the following comments on DOE/EIS-0082-S2D.

General Comments:

1. After reviewing the SEIS, I conclude that the environmental consequences of the four
    salt processing alternatives are low and there is no significant difference between any
    of the four alternatives. Since there are no significant environmental consequences
    between the technologies, the decision on technology selection should be made on the
    easiest technology to implement at the earliest time with the least cost.   L6-1

2. Of the four salt processing alternatives Direct Disposal in Grout seems to have the
    lowest environmental consequences, cost, and time to get it in operation. The
    technical unknowns in this alternative are least but the political uncertainty, in my
    judgment, is the highest. I could find no mention of this uncertainty in the SEIS.   L6-2
    Please add appropriate text describing the political uncertainty for each alternative.

3. The SEIS seems to try to write-off the Direct Disposal in Grout Alternative by several
    sentences by stating the requirement of DOE Order (or what ever it is – it is called
    different things in different part o the SEIS) 435.1-1 requires further cesium removal
    meet "technically and economically practical" wording. (One such statement is the
    one on page 2-7 at the bottom of Section 2.4.) The discussion on page 7-3 seems to   L6-3
    be more appropriately cover the requirement and does not specify the need for this
    constraint. Delete the bias statements and allow Direct Disposal as Grout to compete
    as an appropriate alternative and be judged with the other alternatives.

4. The analysis of the No Action Alternative is poor and underestimates the
    consequences of that action. The SEIS analysis seems to rely on the analyzed
    consequences from the Tank Closure EIS which is inappropriate since the two No
    Actions Alternatives are totally different. This EIS should contain the consequences   L6-4
    of the alternative described on page 2-4 in Section 2.3 which is to remove all sludge
    and leave existing tanks with salt waste containing 160,000,000 curies of activity,

Page 1

Comment L6, Page 1 of 8

primarily Cs-137. The analogy to the Tank Closure EIS No Action (which contained 200 curies of long lived radionuclides and 9,900 curies of Cs-137 in empty tanks is inappropriate. It is also inappropriate to state "it is clear that the impact to human health resulting from a No Action Alternative would be **catastrophic**" with no calculated impacts to back up the term catastrophic.

The EIS misses the largest long-term contribution to the risk to the public by assuming all radionuclides will reach the public by moving through the ground to the water table then with delay factors built in with the groundwater to the creek. The delay time allows significant radionuclide decay. The analysis should reflect the SRS precipitation filling the tanks, dissolving the salt, and overflowing to the ground surface and flowing to the surface streams after the HLW tank failure (page 2-45) after a few hundred years. (As is known SRS precipitation rate significantly exceeds infiltration rates.)

L6-4

5. The impact of the No Action Alternative should be given on the various tables in the Summary and in Sections 4, and 5. The No Action consequences are the motive force to accept one of the Salt Processing Alternatives. As presented in this EIS the consequences cannot be found except by diligent study and they don't show the need for one of the action alternatives.

L6-5

6. There seems to be some confusion in the EIS on defining this No Action Alternative. Several places the EIS says it may be necessary to "suspend operation of the DWPF" (page 2-4 item 5 in the right hand column). One cannot remove the sludge (as is required by the definition of the No Action Alternative) with the DWPF shutdown. Perhaps "reduce operating rates at the DWPF" is a more appropriate condition.

L6-6

7. The No Action Alternative Sections 2.3.2 – 2.3.4 also seem to be confused.

- Section 2.3.2 continues to use existing HLW Tanks 4 – 8 (which are Type I tanks with a capacity of 750,000 gallons and a fill limit of about 650,000 gallons. If four tanks are used, the maximum that could be stored is about 2.6 not 3.75 million gallons. Also these tanks already contain some waste.
- Section 2.3.3 describes building 6 new Type I (Wastewater Treatment Regulated Tanks). Each Type I tank is designed for a maximum capacity of 750,000 gallons and probably has a fill limit of 650,000 gallons. The section says 800,000 gallons (see page 2-5).
- Section 2.3.4 describes building 18 new Type III tanks. The text gives a storage capacity of each tank to be 800,000 gallons. Type III tanks have a design capacity of 1.3 million gallons and a fill capacity of probably 1.15 million gallons.
- The tank capacity requirements given in these three section are inconsistent. Section 2.3.2 gives 3.75 million gallons, Section 2.3.3 provides 4.8 million gallons, and Section 2.3.4 gives 14.4 million gallons capacity

L6-7

Page 2

Comment L6, Page 2 of 8

These sections should be corrected and expanded to show when this new capacity would be required, when budgeting and licensing would be required and what each would cost.

8. The SEIS should identify the Long-Term Stewardship assumptions made in the analysis. I find no mention of these except to maintain surveillance over the Waste Tanks, and the saltstone vaults for 100 years. EISs should identify whatever controls are considered appropriate and the SEIS should start the process of institutionalization of the needed controls. For example, This EIS describes the consequence to people who live on the waste site and dig into the waste with no controls applied after 100 years. I hope DOE plans controls that prevent/minimize those actions. I think other institutional controls are appropriate for the waste sites and they should be identified in the EIS

9. The Summary and Sections 1 and 2 each have a Table that is a primer. This is a good idea but the primers contains inconsistencies. Make a single primer table and use it for all sections.

Specific Comments:

Number	Page Location	Comment
1	S-1	Add a paragraph following the second paragraph describing how salt cake was formed.
2	S-1	Third full paragraph in right column should mention the 1980's ITP testing and why it was then thought to be viable.
3	S-1	What significance should I place on the bottom paragraph of the right column? ITP had been suspended before the DNFSB determination. Put the paragraph in perspective.
4	S-4	Explain the meaning of "production goals and safety requirements" in the top paragraph.
5	S-4	Need to state why this is a SEIS before the information box.
6	S-5	Include Direct Disposal on Table S-8
7	S-5	Top paragraph in right column says that the number of canisters produced would be "greatly" increased. Quantify the word greatly. From the information I have a several year delay will only marginally increase the number of canisters produced. Even that could be corrected by reducing the canister production rate.
8	S-5	Section S.4 describes a supplement analysis. Provide a reference.
9	S-7	This page couples the Record of Decision to EPA. Is this correct?
10	S-7	In the middle of the right column, DOE established a siting requirement of "within 2,000 feet". Is this siting limit an excludable limit and does it influence site selection? What is the significance/basis of the limit?

L6-7

L6-8

L6-9

L6-10

L6-11

L6-12

L6-13

L6-14

L6-15

L6-16

L6-17

L6-18

L6-19

Comment L6, Page 3 of 8

11	S-7	The bottom full paragraph stated analysis selected four sites. Site A was subsequently excluded. No justification was given. Add it.	L6-20
12	S-13	Precipitate Hydrolysis Aqueous in right column is bolded but not included in Table S-8.	L6-21
13	S-14	The last sentence in Section S.7.4 states SCDHEC is required to be notified if salt stone exceed Class A limits. Where is this requirement and how much waste is involved before this notice must be made?	L6-22
14	S-15 Table S-2	The capacity given in the first two lines for Direct Disposal show the capacity the same. I also understand that all of these throughput rates are based upon 75% availability. Please fix this table so the reader will not think that Direct Disposal is shown operating at 100% attainment.	L6-23
15	S-15 Table S-2	Planned canister production row assumes that adequate funding is made available. I think that qualification should be added to this section. (It seems to be an item discussed each year.)	L6-24
16	S-16	Section S.7.7 needs to state why a new Direct Disposal Building is required.	L6-25
17	S-16	Section S.7.7 should discuss timing and how funding will be justified for each of these new facilities.	L6-26
18	S-18	Fix figure to be more reader friendly. Are the sections marked infiltration a drain or do they cause infiltration? Define the three sump appearing devices (left, center, and right on the drawing) on the figure and where do they drain? Add the word Normal to the bottom Water Table line.	L6-27
19	S-21 thru S-24	Simplify the Table (perhaps break it into several tables) to make it more reader friendly and to show major differences between alternatives. Most of the information presented is not significant.	L6-28
20	S-25	I find the second paragraph under accidents, states No Action is safer than the other alternatives. This doesn't seem correct. Expand paragraph to more properly state why this is true, if it is.	L6-29
21	S-26 thru S-29 & S-30	Same comment apply to Tables S-6 and S-7 as made for Table S-5 in comment 19. Select major parameters and give them and tell readers all of the calculated information is presented in Section 4.	L6-30
22	S-30	Logic described for No Action under General Comment 4 applies here.	L6-31
23	S-31	Table S-7 provides a range of information for each entry with no rationale as to why a range is given.	L6-32
24	S-31	Table S-7 shows the results of Agricultural scenario and Residential scenarios for 100 and 1,000 years. (I expect there is a typo error in the last line – should be 1,000 years not 100 years.) The associated text does not describe what is contained and the intended significance of it.	L6-33

Page 4

Comment L6, Page 4 of 8

25	1-3	Since this section is the same as in the summary, I offer the same comments as I offered on the Summary (Numbers 1 – 4).	L6-34
26	Sect 2 General	Remove the calculated consequences from section 2. They have been summarized in the Summary and are given in Section 4. (Delete Tables 2-6, 2-7, & 2-8.)	L6-35
27	Sect 2 General	If calculated results are not removed from Section 2 as requested in comment number 26, simplify the tables as requested in comments 19 –21.	L6-36
28	2-1	Add a table with the radioactive nuclides and the chemicals that are in the waste tanks. Might be good to show the variation in the HLW at the same time. I would expect to see the 160 million curies of Cs-137 in such a table (see p4-49).	L6-37
29	2-3	Are Pu judgments based on mass or activity? I would expect Pu-238 to be the largest Pu by activity.	L6-38
30	2-6	First full paragraph on page gives a 5-year schedule for design, permit and construct of four tanks. It is unclear what this refers to. John Renolds told the FG in July that it would require 4 years to do the same thing for wastewater treatment permitted tanks (like the Type I tanks or 5 years for RCRA permitted tanks. Correct this statement to show the estimate for both type tanks.	L6-39
31	2-6	The second paragraph says new tanks would be extremely costly to build. Do not use unsupported terms like "extremely costly". Provide an estimate for the tanks so the reader will be able to make his/her own judgment.	L6-40
32	2-7	Reference site selection in the bottom paragraph of left column.	L6-41
33	2-11 Table 2-2	The definition of centrifugal contactor should be made more generic. As written it describes the extraction stages but not the strip stages. Centrifugal contactors perform both functions.	L6-42
34	2-15	Include Direct Disposal in Table 2-2.	L6-43
35	2-15	Same comment as #7.	L6-44
36	2-19	Include a sentence or two in the bottom full paragraph telling the reader how the MST precipitate would be handled in Z-Area.	L6-45
37	2-25	Section 2.8.2 should be expanded or omitted because of the budget causing significant delay or canceling the Pu vitrification facility. If that facility is canceled this section has no value, if delayed, will the Pu be available in time to be incorporated into the borosilicate glass from the DWPF.	L6-46
38	2-26	Update the costs described in Section 2.8.3. The costs described are 1998 costs and badly out of date. The FG was told new costs would be available by now but they have not been shared with us.	L6-47
39	Table 2-6	Treatment of No Action is inadequate in Table 2-6. Air pollutants for continued management of No Action are for the entire site not the tank farm. This and other SRS reference footnotes should be reconsidered. Alternative-specific values should be given.	L6-48

Page 5

Comment L6, Page 5 of 8

40	2-36	Source of the 12 additional LCF couldn't be found. What does the "additional" mean? List total LCF for the Alternative.	L6-49
42	2-39	Table 2-7 is very difficult to get a comparison of alternatives out of. Suggest listing the risk of each accident to Onsite population and totaling the risk. Do the same for off-site population. The sum of the risks for accidents is an appropriate comparator. I have attached an example that shows the risk of accidents to onsite population is greatest for Small Tank and least to Direct Disposal. Ion Exchange and Solvent Extraction are essentially equal and in-between the two extremes.	L6-50
43	2-45	The conclusion of Geologic Resources section seems to be in error. It seems to me that when the No Action tanks fail by collapse and the waste contaminates the soils, that condition would be an impact to geologic resources.	L6-51
44	4-3	It is unclear why tank space optimization for the No Action Alternative stops in 2010. All of the sludge would not have been removed by that time.	L6-52
45	4-4	The call out reference in the last paragraph seems to be in error. Section 4.1.1 does not discuss the 18 tanks. It is discussed in Section 2.3.4.	L6-53
46	4-7	What does the stipulation "previously disturbed area" mean as it is used in the second full paragraph? Please clarify so all of us will understand it.	L6-54
47	4-13	Why is the siting statement in Section 4.1.3.2 significant? Why not locate waste tanks in previously contaminated areas rather than continue to contaminant new land?	L6-55
48	4-15	The air emission statement in the second paragraph for the No Action Alternative does not seem to be correct. As tank space management continues to get tighter and tighter, HLW transfers will increase in frequency and emissions should increase. Long term emissions will also be significantly.	L6-56
49	4-15	The term "slight increases above baseline" for the No Action Alternative should be quantified. Statement seems to be unsubstantiated.	L6-57
50	Pages 4-41-45	Compare the total exposure risk from these accidental releases so the various alternatives can be compared. Similar to comment 42.	L6-58
51	Section 4.2 General	No Action consequences should show up in all of Section 4.2. See General Comment 5.	L6-59
52	Section 4.2 General	Detailed comments on No Action are not provided. Analysis approach seems to be faulted. See General Comments # 4 through 7.	L6-60
53	Chapter 5 General	Add No Action consequence to this section. See General Comment #5.	L6-61

Page 6

Comment L6, Page 6 of 8

54	5-11	In Table 5-3, quantify salt processing liquid releases. What is "reportable" – footnote d?	L6-62
55	5-11	Cumulative effect given in this table shows that the four alternatives all will triple the consequence of airborne releases of the remainder of SRS, (both present and projected) combined with Plant Vogtle releases. My judgment tells me there is no way this could be true. I think the values used in this table contain some problem.	L6-63
56	5-11	Quantify the consequence of liquid releases from salt processing and include in this table.	L6-64
57	7-3	Discussion in Chapter 7 and in particular on this page does not seem to preclude Direct Disposal in Grout as has been done in other parts of the SEIS.	L6-65
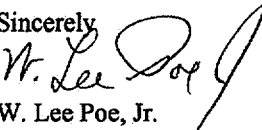
I did not review the Appendices in this SEIS. Where they are the source of the information on which I commented, they should be revised as needed.

I hope these comments are useful in reaching a decision that allows salt processing to start as soon as possible. The process should recognize the potential that salt processing will be more difficult and perhaps more expensive than planned and include a pre-planned process to accepts the uncertainty and get on with the job. This includes emptying and closing waste tanks, and managing the risks from the salt so it will not significantly impacting safety of future generations downstream from SRS. I consider it imperative to get on with the salt processing. Leaving the salt in the waste tanks longer than necessary would increase the risk to the public and should be minimized.

If I can answer questions or shed additional light on these issues, please call me.

Sincerely

W. Lee Poe, Jr.

Attached is an example table for Accidental Risk four salt processing alternatives to On Site Population

Page 7

Comment L6, Page 7 of 8

Attachment to Poe's Comments on Salt Processing SEIS

**Risk of Latent Cancer per Year
To On Site Population
During Operational Phase**

Accident	Small Tank	Ion Exchange	Solvent Extraction	Direct Disposal
Loss of Confinement	5.30E-04	2.70E-04	2.70E-04	5.70E-05
Beyond DBE	1.80E-03	6.90E-04	6.80E-04	2.10E-04
Loss of Cooling to Loaded Resin Hold Tank		1.70E-09		
Fire in Process Cell	1.50E-05	8.90E-06	8.90E-06	1.90E-06
Benzene Explosion	6.80E-05			
H_2 Explosion in Ext. Cell			2.10E-08	
Helicopter Impact	1.90E-05	9.50E-06	9.60E-06	2.50E-06
Aircraft Impact	2.30E-05	8.80E-06	8.90E-06	2.70E-06
Sodium Hydroxide Release				
Nitric Acid Release				
Benzene Release				
Total Risk	**2.46E-03**	**9.87E-04**	**9.77E-04**	**2.74E-04**

Comment L6, Page 8 of 8

Response to Comment Letter L6:

L6-1   DOE agrees with the commenter's conclusion. DOE has established a number of criteria on which a technology selection would be made. The criteria include those requested by the commenter (but in different words): "easiest technology to implement" (technology implementability); "at the earliest time" (schedule); "with the least cost" (cost). However, DOE does not consider the cost estimates at this time to be reliable enough to be a significant discriminating factor for decision making.

L6-2   The purpose of the SEIS is to describe the environmental impacts of the alternatives for salt processing. Political considerations are beyond the scope of the SEIS.

L6-3   Section 2.4 has been modified to address this concern. The discussion in Section 7.1 describes DOE's process for making waste incidental to reprocessing determinations. One criterion is that wastes must have been or will be processed to remove key radionuclides to the maximum extent that is technically and economically practical. This criterion must be applied to any technology that would result in management of waste as low-level waste. DOE believes it objectively analyzed all alternatives.

L6-4   The Summary, Sections 2.9.2 and 4.2, and Appendix D have been modified to incorporate the results of the analysis of long-term impacts of the No Action alternative. For purposes of analysis, DOE assumes only salt waste remains in the HLW tanks and that it reaches onsite streams via surface flow rather than through the groundwater.

L6-5   The Summary, Sections 2.9.2 and 4.2, and Appendix D have been modified to incorporate the results of an analysis of the long-term impacts of the No Action alternative.

L6-6   It is DOE's intent to continue operations of DWPF under the No Action alternative until HLW tank space management restrictions dictate otherwise. Section 2.3.1 identifies reduced DWPF production as one method for optimizing tank farm operations. DOE considers suspension of DWPF operations to be an option of last resort.

L6-7   DOE's attempts at quantification of potential scenarios under the No Action alternative are rough approximations of events that could occur. Section 2.3.2 dealt with five tanks (Tanks 4 through 8) with a gross total capacity of 3.75 million gallons (5 tanks x 750,000 gallons). Nevertheless, DOE adjusted Section 2.3.4 on RCRA - compliant tanks in response to this comment.

L6-8   For purposes of analysis, DOE conservatively estimates institutional control for no more than 100 years for projection of environmental impacts to persons exposed to radiological release from the salt processing facilities and waste disposal sites.

L6-9   DOE has corrected the inconsistencies in the primer tables.

L6-10   DOE has incorporated an explanation of the formation of saltcake.

L6-11   The SEIS discussed ITP for the purpose of introducing the need for an alternative technology. Therefore, further discussion of the development of the ITP process provides no additional value to this section of the SEIS.

L6-12   DOE has revised the text to put the paragraph in perspective.

Response to Comment Letter L6 (continued):

L6-13   These are production goals and safety requirements realized by satisfactory separation of highly radioactive constituents (cesium, strontium, and actinides) from HLW salt solution without excessive tetraphenylborate decomposition (benzene generation).

L6-14   Refer to the Cover Sheet, S.4 of the Summary or Section 1.3 of the main document for an explanation of the rationale for the Supplemental EIS.

L6-15   DOE included the Direct Disposal in Grout alternative in Table S-8.

L6-16   See response to comment L1-5.

L6-17   References are not provided in the Summary. Refer to Section 1.3 for the reference to the Supplement Analysis.

L6-18   The Notice of Availability is published by EPA. The Record of Decision is issued by DOE no sooner than 30 days after the Notice of Availability appears.

L6-19   Site Selection for the Salt Disposition Facility at Savannah River Site (WSRC-RP-99-00517 Rev. A, pg. 4) cites site specific technical requirements as locations within 2000 ft radius of the low point pump pit, the Late Wash facility, or the south end of 221-S (DWPF). Transfer of product slurries at proper solids concentration farther than 2000 ft is impractical because either dilution, which reduces salt processing rate, or an additional costly pump pit would be required.

L6-20   An explanation for the exclusion of Site A has been included in S.6 and Section 2.5.

L6-21   The term "precipitate hydrolysis aqueous" has been removed from Summary.

L6-22   The requirement is found in Industrial Wastewater Permit IWP-217, Z-Area Saltstone Disposal Facility. Section 7.2 provides more detail of the saltstone permit requirements.

L6-23   Tables S-2, 2-3, and A-3 have been amended to indicate facility throughput for each technology specified at 75% attainment. The throughput of all action alternatives is limited to 6 million gallons per year due to physical constraints on removing waste from the waste tanks. Required capacity throughput for Direct Disposal in Grout facility (6.0 million gallons/year) is less than for the other technologies because the Direct Disposal in Grout facility can operate even if DWPF is in an outage for melter replacement. The other technologies cannot operate if DWPF is in an outage; therefore, they would have to operate at a higher production rate so that the salt processing schedule could be maintained even in the event of DWPF down-time.

L6-24   The reference is based on the High-Level Waste System Plan (HLW-2000-00019, Rev. 11, pg. 2-50) target case that assumes adequate funding is available. This is noted in Table 2-3.

L6-25   A new Direct Disposal process building is needed to provide capability for MST treatment to remove Sr and actinides from salt solution before immobilization in grout and to provide enhanced shielding and remote handling for grout processing operations. This has been inserted in Sections S.7.5 and Section 2.7.3.

Response to Comment Letter L6 (continued):

L6-26   DOE plans to have a salt facility on line by 2010. Projects would be funded through the federal budget process.

L6-27   The figure has been modified.

L6-28   The largest impacts for select parameters have been bolded so it is easier for the reader to identify the alternative with the highest impacts.

L6-29   DOE has clarified that this paragraph refers to the short term No Action alternative. The reader is referred to the long-term No Action alternative in Section S.9.2.

L6-30   See response to comment L6-28. Accident impacts in Table S-6 are accident consequences, not risks. It is not appropriate to tally consequences to determine a cumulative effect because the accidents would not occur simultaneously.

L6-31   See response to L6-4.

L6-32   DOE has eliminated the range of values from Table S-7 and from the EIS. Although the doses listed are quite conservative, the higher doses were retained.

L6-33   The typographical error has been corrected in Table S-7. A more detailed explanation is found in Chapter 4 and Appendix D of the EIS.

L6-34   DOE has made changes to Chapter 1 as described in the responses to comments L6-10, -12, and –13. No change was made in response to comment L6-11.

L6-35   DOE has chosen to leave the tables in Chapter 2. They have been modified as discussed in the response to comment L6-30.

L6-36   See response to comment L6-35.

L6-37   DOE has revised the text to indicate that 158 million of 160 million curies is Cs-137. DOE does not believe the additional information requested by the commenter would assist the reader in describing the HLW inventory or differentiating between alternatives.

L6-38   Pu-238 is greatest by radioactivity, Pu-239 by mass. The commenter's judgement is correct. Both are included in radioactivity tables in the Summary and Chapter 1.

L6-39   The commenter is correct and the text has been modified in Section 2.3.3.

        DOE has estimated that about 4 years would be required to design, permit under wastewater treatment regulations, and construct 6 waste water storage tanks. This activity would be initiated about 2006.

L6-40   Cost estimates are not provided because constructing new tanks would not meet purpose and need.

L6-41   The appropriate reference is given in paragraph 1 of Section 2.5.

Response to Comment Letter L6 (continued):

L6-42   DOE has revised the definition.

L6-43   DOE has included Direct Disposal in Table 2-2.

L6-44   Refer to the response to comment L1-5.

L6-45   DOE has included the following description: MST processing [to remove strontium and actinides from salt solution prior to Direct Disposal] would be the same as far as the CST Ion Exchange and Solvent Extraction technologies. Equipment required as shown in Figure 2-7 and A-16 would include an alpha soprtion tank and filter unit to separate the MST sorbed constituents prior to grouting the cesium-containing salt solution for disposal in saltstone.

L6-46   See response to comment L4-3.

L6-47   Refer to response to comment L1-13.

L6-48   Table 2-6 represents short-term impacts for each of the salt processing alternatives. The short term impacts of the No Action alternative are described in Section 2.9.1. In response to comments L6-4, -5, and -6, DOE has revised the analysis of the long-term impacts of the No Action alternative.

L6-49   The source of the 0.12 LCF is found in Table 2-6. Additional LCF means the incremental cancers attributable to the operation of the salt processing alternative.

L6-50   Accident impacts calculated in Table 2-7 are accident consequences, not risk. It is not appropriate to tally consequences to determine a cumulative effect because the accidents would not occur simultaneously. Chapter 4 analyses the impacts of these accident scenarios. Section 2.9.1, Accidents Summary, indicates the highest accident impact to the receptors.

L6-51   The commenter is correct. DOE has revised Sections 4.2 and 2.9.2 accordingly.

L6-52   Tank space optimization would continue as long as such activities facilitated the continued operation of DWPF.

L6-53   The section reference has been corrected.

L6-54   "Previously disturbed area" means an area used in the past for industrial activities.

L6-55   The statement in Section 4.1.3.2 refers to DOE's intent to avoid construction in contaminated areas because of the potential radiological exposures to construction and operation workers. Radiological exposure to workers could occur if tanks were to be constructed in radiologically contaminated areas.

L6-56   Radioactive liquid waste would be returned to the HLW tank farms and treated in waste evaporators. No radioactive liquids would be released to the environment.

L6-57   Due to the hypothetical nature of the No Action alternative, DOE is unable to quantify the increases above baseline.

Response to Comment Letter L6 (continued):

L6-58   Refer to comment response to L6-50.

L6-59   Refer to comment response to L6-5.

L6-60   Refer to responses to comments L6-4 through L6-7.

L6-61   Refer to response to comment L6-5.

L6-62   Footnote (d) in Table 5-3 has been revised to explain that no radioactive liquids would be released to the environment because they would be returned to the tank farms and treated in the HLW evaporators.

L6-63   Table 5-3 accurately portrays the available data.

L6-64   Refer to response to comment L6-62.

L6-65   Other portions of the SEIS have been revised to be consistent with the discussion in Chapter 7.

ECONOMIC DEVELOPMENT PARTNERSHIP
Serving Aiken & Edgefield Counties

Fred E. Humes
  Director

May 7, 2001

Andrew Grainger
NEPA Compliance Officer
Savannah River Operations Office
U. S. Department of Energy
Building 730B, Room 2418
Aiken, SC 29802

Attn: Salt Processing Alternatives SEIS

Dear Mr. Grainger:

We are pleased to provide comments on the *Savannah River Site Salt Processing Alternatives Draft Supplemental Environmental Impact Statement (EIS) (DOE/EIS-0082-S2D)* as provided by your letter of March 23, 2001. We have one general comment and four specific comments on this document and SRS high level waste activities.

General Comment: We believe that the approximately 34 million gallons of high level liquid wastes, containing approximately 480 million curies of activity, represent the greatest potential SRS hazard to the offsite public and the environment. As such we have continually supported the removal of these wastes from the aging underground tanks and its placement into the significantly more stable vitrified form. We continue to encourage DOE to accelerate all aspects of the high level waste program to vitrify these wastes at the earliest possible time.

L7-1

Specific Comments:

1. The impacts of the "no action" alternative are significantly understated in the SEIS document. The document narrative states that the no action alternative would lead to eventual failure of the HLW tanks and release of approximately 450 million curies of activity to groundwater and eventually surface water (pages S-29 and 30). On page S-30 the impacts of such a release are described as "catastrophic." This level of concern is not conveyed in Table S-5 (Summary comparison of short-term impacts) or Table S-7 (Summary comparison of long-term impacts). In Table S-5 the comments under the "no action" alternative are "No change" or "minimal." In Table S-7 the "no action" alternative is not included. We recommend that the no action alternative be included in these tables on a basis comparable to the other alternatives, and that the no action alternative be based on the failure of the underground tanks and

L7-2

L7-3

Post Office Box 1708 ▪ Aiken, SC 29802 ▪ 171 University Parkway ▪ USCA
(803) 648-3362 ▪ FAX (803) 641-3369 ▪ edpsc@aol.com ▪ http://www.edpsc.org

Comment L7, Page 1 of 2

release of 450 million curies of radioactive waste into the environment. Other tables in the document need to be modified in a similar manner.

| L7-3

2. We note that there are no significant differences in the safety and environmental consequences between the four action alternatives. Accordingly, we recommend that DOE select its salt processing alternative on the basis of the following criteria in priority order: (1) earliest schedule for emptying all HLW tanks, (2) highest level of technical surety and (3) cost. As noted in our general comment above, we believe that waste should be removed from the underground tanks at the earliest possible time.

| L7-4

3. It is not clear how DOE will evaluate the "Direct Grout" alternative vis-à-vis the other three action alternatives. There has been much discussion of direct grout as "an alternative of last resort" or "the regulatory approval and public acceptance processes may be too difficult." There should be no undue bias against direct grout in the alternative selection process. Selection of the preferred alternative should be on the basis of schedule, technical and cost merit. If there is concern about regulatory approval, we recommend that the regulatory agencies be approached now with a specific proposal so they can provide a definitive response. If public reaction is a concern, consider public input on this SEIS or specifically solicit public input. Without hard data, DOE should not presuppose regulatory or public acceptance of the direct grout option.
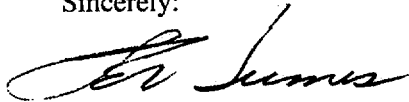
| L7-5

4. We recommend that the final SEIS include a discussion of the basis for selecting the alternative(s) included in the preferred alternative.

| L7-6

Thank you for the opportunity to comment on this very important document.

Sincerely:

Fred E. Humes

Comment L7, Page 2 of 2

Response to Comment Letter L7:

L7-1   DOE's goal, and DOE's commitment under the Federal Facility Agreement, is to remove waste from the HLW tanks and place it in a form suitable for safe disposal.

L7-2   Refer to comment response L3-1. Under the No Action alternative, DOE would process sludge to the extent practicable. For purposes of analysis, DOE assumes only salt waste remains in the HLW tanks. (See response to comment L6-4.)

L7-3   DOE has added the impacts of the No Action alternative in Tables S-7 and 4-30.

L7-4   See response to comment L6-1. DOE evaluated each alternative on the following criteria in the process of selecting a preferred alternative: cost, schedule, technical maturity, technology implementability, environmental impacts, facility interfaces, process simplicity, process flexibility, and safety.

L7-5   See response to comment L6-3.

L7-6   DOE has discussed the basis for selecting the preferred alternative in Section 2.6.

Savannah River Site
CITIZENS ADVISORY BOARD
A U.S. Department of Energy Site-Specific Advisory Board

May 9, 2001

Mr. Andrew Grainger, NEPA Compliance Officer
U.S. Department of Energy
Savannah River Operations Office
Building 742-A, Room 183
Aiken, S.C. 29802

Subject: Comments on the March 2001 Savannah River Site Salt Processing Alternatives
        Draft Supplemental Environmental Impact Statement (DOE/EIS-0082-S2D)

Dear Mr. Grainger:

At the request of the Savannah River Site (SRS) Citizens Advisory Board (CAB) Waste
Management Committee, the Salt Team Focus Group (FG) has been asked to review and comment
on the March 2001 Salt Processing Alternatives Draft Supplemental Environmental Impact
Statement (SEIS). The FG was formed three years ago to evaluate the process used by SRS to select
salt processing alternatives and to examine in detail the four alternatives.

During this three-year period, DOE has set numerous milestones associated with salt processing
activities and many times, these dates have not been met. Furthermore, DOE's past performance on
similar projects is not encouraging.

As DOE states in the SEIS, current operational constraints are already required to enhance storage
capacity in the HLW tanks to maintain tank space until 2010. If a salt processing facility is not
operational by 2010, then more drastic measures must be implemented, such as the closure of DWPF
or the controversial position of building new HLW tanks. The ability of DOE to meet the current
schedule to have a salt processing facility operational by 2010, still remains the primary concern of
the FG.

In reference to the SEIS, we offer the following comments for your review and consideration:

1. Based upon a review of the data in Table 2-8, the long-term impacts associated with the four
action alternatives are very similar. There is no significant difference between any process
alternative being considered. Therefore, the Salt Team FG believes DOE should move forward with
a decision on a preferred alternative and base the decision on the following criteria (listed in order of
preference): (1) most expeditious implementation schedule, (2) technological merit, (3) operational
surety, and (4) cost.

L8-1

2. It is clear to the Salt Team FG that the environmental and safety impacts associated with the No
Action alternative is greater than any action alternative. However, the general public may not be
able to discern this from reading the SEIS because in many tables an equal comparison of the No
Action alternative against the four action alternatives is not made. The No Action alternative should
be listed in all comparison tables and a discussion included in the text.

L8-2

Comment L8, Page 1 of 2

Page 2, Letter to Mr. Andrew Grainger

3. The SEIS underestimates the consequences of the No Action alternative. In Section 2.3 (page 2-4), the No Action alternative is stated to include the storage of the salt component in the HLW tanks with DWPF vitrifying the sludge. Based upon this description, the HLW tanks will contain approximately 160 million curies. This is the activity level that should be modeled for long-term impacts when the tanks fail. The SEIS incorrectly assumes the removal of most of the waste and inappropriately relies on the consequences described in the tank closure scenario (Tank Closure Draft EIS).

L8-3

4. Calculated impacts are required for the No Action alternative to fully demonstrate to the public the need to select, fully fund, and make operational one of the salt processing alternatives before 2010. The modeling estimates should show the "catastrophic" results as predicted by DOE, but not supported by any calculations. In addition, one aspect not discussed nor explored is the potential for the No Action alternative to release contamination by the filling and overflowing of the failed tanks from rainfall events. The SEIS only assumes that rainfall will fill the tanks and infiltrate to the groundwater, which significantly understates the potential health and environmental impacts. The Salt Team FG recommends that the very likely potential for the failed tanks to release contaminated media to surface run-off be addressed.

L8-4

L8-5

5. The SEIS provides contradictory descriptions of the No Action alternative. DOE can not suspend operation of DWPF, as stated in several places of the SEIS, and still remove sludge from the HLW tanks. However, as described in the EIS, the No Action alternative requires the removal of the sludge component (see page 2-4). Furthermore, the FG believes the "intruder analysis" needs further explanation and specially needs to address the No Action alternative as discussed above (see item #4).

L8-6

L8-7

6. The SEIS needs to provide primary references for all regulatory standards and dose conversions as denoted in data tables. Also, consistency is needed. In some tables, the regulatory limit for the same parameter is referenced to be from DOE Derived Concentration Guides and other times as an EPA proposed primary drinking water standard (for example Uranium-238 in Table 3-1 and Table 3-6).
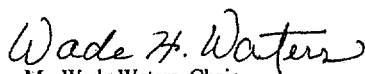
L8-8

L8-9

7. It appears to the FG that there may be a bias against Direct Disposal in Grout alternative in the SEIS. The SEIS has several statements that allude to the issue of cesium removal not being technically and economically practical (per DOE Guidance 435.1). The FG believes these statements should be removed from the SEIS and the Direct Disposal in Grout alternative evaluated on its own merits without bias on an equal basis with the other alternatives.

L8-10

As discussed above, the salt processing activity schedule is very important to the Salt Team FG. One way to gain valuable time is for DOE to provide a response to our comments in 30 or 45 days, instead of waiting to include a response in the final SEIS. This expeditious response schedule will provide the FG a head start on understanding the DOE approach to salt processing and circumvent timely dialogue if we wait until the final SEIS is published. Therefore, we request a response to our comments in 45 days or less.

Thank you for the opportunity to offer our comments.

Sincerely,

Mr. Wade Waters, Chair
Waste Management Committee
308 Pinewood Drive
Pooler, GA 31322

Comment L8, Page 2 of 2

Response to Comment Letter L8:

L8-1   Refer to response to comment L6-1.

L8-2   DOE has added the impacts of the No Action alternative in Tables S-7 and 4-30.

L8-3   Refer to responses to comment L3-1 and L7-2

L8-4   Refer to responses to comment L6-4.

L8-5   Refer to responses to comment L6-4.

L8-6   Refer to response to comment L6-6.

L8-7   Impacts to trespassers were not considered for the action alternatives because the impacts on
        a trespasser would be small relative to the impacts for the agricultural scenario which was
        analyzed for the action alternatives.

        For the No Action alternative, which assumes that the tank tops collapse, DOE did not model
        the potential exposures to potential future residents in a house built over the HLW tanks.
        DOE assumed that the collapsed tank tops would preclude building a residence over a tank.

L8-8   DOE believes that Section 4.1.3.2 describes the primary references requested by the
        commentor (i.e., Hamby 1992 and NRC 1977).

L8-9   DOE has applied the appropriate standards for the media discussed in the tables cited by the
        commenter.

L8-10   See response to comment L6-3. Section 2.4 has been modified to address this concern. DOE
        believes it objectively analyzed the impacts of all the alternatives.

---- Forwarded by Drew Grainger/DOE/Srs on 05/16/01 07:27 AM ----

Jim Hardeman <Jim_Hardeman@mail.dnr.state.ga.us>

05/14/01 05:45 PM

To: drew.grainger@mailhub.srs.gov
cc: Jim Setser <Jim_Setser@mail.dnr.state.ga.us>
Subject: Comments re: DOE/EIS-0082-S2D

Drew -

Attached please find comments related to DOE/EIS-0082-S2D, the Savannah River Site Salt Processing Alternatives Draft Supplemental Environmental Impact Statement. I also ask that this e-mail be considered a formal comment on the EIS.

As I indicated in my earlier e-mail, I am disturbed news that we just heard today that DOE has decided not to immobilize plutonium using the Defense Waste Processing Facility (DWPF). If this news is indeed true, the timing of this decision, while the Salt Processing Alternatives SEIS is still out for comment, appears to be suspect, even in the best possible light. The decision not to immobilize (and thus, to no longer require that cesium be separated from salt), coupled with the aggressive schedule for publication of a final EIS (a draft final EIS is scheduled to be transmitted to DOE headquarters less than three (3) weeks after closure of the comment period on the draft EIS) makes it appear that DOE has, in fact, already made a decision regarding the technology to be used for salt processing, and that the NEPA process is mere window dressing.

Thanks again for the opportunity to comment on this document. We trust that DOE will seriously consider our views in this matter.

Jim Hardeman, Manager
Environmental Radiation Program
Georgia Environmental Protection Division
4244 International Parkway, Suite 114
Atlanta, GA 30354
(404) 362-2675
Fax: (404) 362-2653
E-mail: Jim_Hardeman@mail.dnr.state.ga.us

Attachment: MS Word document "Comments on Salt Treatment Alternatives EIS.doc"

5/16/2001

L9-1

Comment L9, Page 1 of 3

Georgia Department of Natural Resources

4244 International Parkway, Suite 114, Atlanta, Georgia 30354

Lonice C. Barrett, Commissioner
Environmental Protection Division
Harold F. Reheis, Director

May 14, 2001

Mr. Andrew Grainger, NEPA Compliance Officer
Savannah River Operations Office
U.S. Department of Energy
Building 730B, Room 2418
Aiken, SC 29802

Re: Salt Processing Alternatives SEIS (DOE/EIS-0082-S2D)

Dear Mr. Grainger:

The Georgia Environmental Protection Division (EPD) appreciates the opportunity to comment on the Savannah River Site (SRS) Salt Processing Alternatives Draft Supplemental Environmental Impact Statement (SEIS).

As you know, the State of Georgia is opposed to the disposal of high-level radioactive waste onsite at SRS, and has expressed this opposition to the Department of Energy (DOE) and its predecessor agencies many times over the years, dating as far back as the administration of Governor Jimmy Carter. We consider "Direct Disposal in Grout" to be nothing more than onsite disposal of high-level waste, and for this reason, we are strongly opposed to the "Direct Disposal in Grout" option as presented in the SEIS. We also note that both the "No Action" and "Direct Disposal in Grout" alternatives are inconsistent with the "Record of Decision for the Surplus Plutonium Disposition Final Environmental Impact Statement", published in the Federal Register on January 11, 2000 (65 FR 1608). We therefore view both the "No Action" and "Direct Disposal in Grout" alternatives as "Unacceptable", and strongly urge the Department of Energy not to consider either of these alternatives in its technology selection process.

L9-2

L9-3

Of the remaining three (3) alternatives, "Small Tank Tetraphenylborate Precipitation" ("Small Tank Precipitation"), "Crystalline Silicotitanate Ion Exchange" ("Ion Exchange"), and "Caustic Side Solvent Extraction" ("Solvent Extraction"), we urge the DOE to select Ion Exchange as the technology of choice for removal of cesium from high-level waste salt at SRS. Ion Exchange appears to have several technical and operational advantages over the other two technologies, including operational simplicity and reduced worker and public radiation doses. In addition, both the Small Tank Precipitation and Solvent Extraction processes generate secondary wastes for which there is currently no identified disposal path.
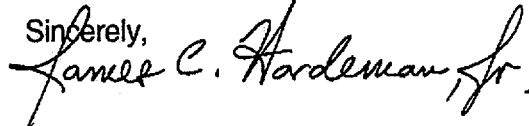
L9-4

Comment L9, Page 2 of 3

Comments on Salt Processing Alternatives SEIS
May 14, 2001
Page 2 of 2

Thank you again for the opportunity to comment on this document. If you have any questions regarding these comments, please contact me by letter, by telephone at (404) 362-2675, or by electronic mail at Jim_Hardeman@mail.dnr.state.ga.us

Sincerely,

James C. Hardeman, Jr., Manager
Environmental Radiation Program

Comment L9, Page 3 of 3

Response to Comment Letter L9:

L9-1   DOE has not canceled the Plutonium Immobilization project for disposition of certain quantities of surplus plutonium, nor has DOE selected a technology for HLW salt processing (although this Final SEIS states DOE's preferred alternative). Rather, the Secretary of Energy has decided to suspend plutonium immobilization activities because the President's budget for Fiscal Year 2002 and beyond would not simultaneously support the peak construction of the Pit Disassembly and Conversion Facility, the Mixed Oxide Fuel Fabrication Facility, and the Plutonium Immobilization Facility. In addition, because DOE now anticipates that a salt processing alternative would not be operational until about Fiscal Year 2010, cesium-bearing HLW would not be available to support the immobilization project until that time, if DOE selects a salt processing alternative that would produce cesium-bearing HLW for vitrification. The environmental evaluation in this EIS is an important factor in DOE's selection of a salt processing alternative.

L9-2   DOE acknowledges the State of Georgia's opinion regarding the Direct Disposal in Grout alternative. Section 7.1 of the EIS describes DOE's process for making waste incidental to reprocessing determinations. Any salt processing alternative that DOE selected for implementation would be subjected to this process which, as described in Section 7.1, would include consultation with the Nuclear Regulatory Commission.

L9-3   DOE recognizes that the Direct Disposal in Grout alternative would not allow the production of vitrified HLW that would support the plutonium immobilization described in DOE/EIS-0283, Surplus Plutonium Disposition (November 1999), and selected for disposition of certain quantities of plutonium in the Record of Decision (65 FR 1608, January 11, 2000). DOE describes this situation in Section 2.8.3 of the SEIS. Nonetheless, DOE has considered the Direct Disposal in Grout alternative throughout the technology review and evaluation process, as described in the SEIS.

L9-4   DOE acknowledges the State of Georgia's preference for the Ion Exchange alternative.

EPA R4 ORC   ID:404-562-9598   MAY 15'01   14:03 No.001 P.01

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

May 15, 2001

4EAD

Mr. Andrew R. Grainger
NEPA Compliance Officer
Savannah River Site
Building 742-A, Room 185
Aiken, SC 29802

RE: EPA Review and Comments on
       Savannah River Site Salt (SRS) Processing Alternatives
       Draft Supplemental Environmental Impact Statement (DSEIS)
       CEQ No. 010097

Dear Mr. Grainger:

        Pursuant to Section 102(2)(C) of the National Environmental Policy Act (NEPA) and
Section 309 of the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has reviewed
the subject Draft Supplemental Environmental Impact Statement (DSEIS). The document
provides information to educate the public regarding general and project-specific environmental
impacts and analysis procedures, and follows the public review and disclosure aspects of the
NEPA process. The purpose of this letter is to give you the results of our review of the DSEIS.

        The DOE proposes to select a salt processing technology to design, construct, and operate
the facilities required to process high-level waste (HLW) salt.   The document evaluates
alternatives for separating the high-activity and low-activity salt waste from the liquid high-level
radioactive waste now stored in underground tanks at SRS. The DSEIS evaluates alternatives for
separating high-activity and low-activity fractions of the liquid high-level radioactive waste, which
is now stored in underground tanks at SRS.   The document evaluates potential environmental
impacts of alternatives to the In-Tank Precipitation Process (ITP).

        Thank you for the opportunity to comment on this DSEIS. Based on the information
provided in the DSEIS, the rating for this document is "EC-2," that is, we have environmental
concerns about impacts of the project, and more information is needed. Our concerns are
detailed in the attached comments, and primarily pertain to details of potential alternatives.

L10-1

Internet Address (URL) • http://www.epa.gov
Recycled/Recyclable • Printed with Vegetable Oil Based Inks on Recycled Paper (Minimum 30% Postconsumer)

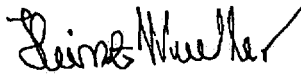**Comment L10**, Page 1 of 4

EPA R4 ORC   ID:404-562-9598   MAY 15'01   14:04 No.001 P.02

    Please keep us informed of any technical and/or policy meetings related to this project.   If
you have any questions or require technical assistance, you may contact Ramona McConney of
my staff at (404) 562-9615.

                                Sincerely,

                                Heinz J. Mueller, Chief
                                Office of Environmental Assessment

Enclosure

Comment L10, Page 1 of 2

EPA Comments on
Savannah River Site Salt (SRS) Processing Alternatives
Draft Supplemental Environmental Impact Statement (DSEIS)

NEPA Process - Distribution of the DSEIS to the public was thorough; it appears that all appropriate federal and state agencies, libraries, citizens groups, and individuals received copies of the document and had the opportunity to comment.

Cumulative Impacts - We note that any new facility would be sited on previously disturbed and developed land, and we appreciate this effort to avoid further impacts to the environment. Section 6.2 lists several environmental media which would be affected by potential emissions from implementation of the alternatives.

     While it is noted on page 6-6 that air emissions from the new facility would be below applicable limits, it is unclear what the total effects and cumulative impacts of the combined air, groundwater, and waste emissions would be, in conjunction with the other operations already existing at SRS.

L10-2

L10-3

Alternatives - Four proposed alternatives were developed for the processing of High Level Waste (HLW) remaining from the production of tritium for the U.S. nuclear weapons program. The waste is in alkaline form, and consists of a salt solution and insoluble sludge. Both components contain highly radioactive residues.

     For Direct Disposal in Grout (DDG), prior to solidifying the salt solution as grout, monosodium titanate would be used to remove the strontium and actinide to meet saltstone waste acceptance criteria as Low Level Waste. All processes will yield final waste forms to be incorporated in a vitrified glass and saltstone, which is a cement-like mixture. The first process proposed is Small Tank Precipitation. Sorption and precipitation processes would be used to remove the radioactive components, which consists of strontium, plutonium, and cesium. The second process is Ion Exchange. This is a sorption and ion exchange process. The third process is solvent extraction, which consists of sorption and organic extraction. The fourth and last process is Direct Disposal in Grout and consists of sorption.

     Sec.2.8.1, page 2-24, states that if the preferred three treatments are deemed not feasible, Direct Disposal in Grout (DDG) would be the next alternative. DOE states on page 2-24 that SCDHEC "...and EPA indicate general acceptance of the Direct Disposal in Grout concept,..." If the DDG Alternative were selected, EPA would need further details. This issue is related to the whole matter of when is waste deemed no longer High-Level, which has yet to be demonstrated by DOE.

L10-4

     The amount of curies of Cs-137 of concern [for disposal] for the Ion Exchange Alternative does not appear to be clarified in the tables associated with the discussion [e.g., Table 2-3, 2-4, etc.]. This does not necessarily imply that this should be considered a less preferred alternative. In addition, the amount of waste generated per alternative is not apparent from the information in Table 4-19.

L10-5

L10-6

Comment L10, Page 3 of 4

EPA R4 ORC   ID:404-562-9598   MAY 15'01   14:05 No.001 P.04

Table 3-1, P.3-12, contains incorrect MCLs for some radionuclides. The MCL for uranium was finalized in 10/00 at 30 ug/L. The other radionuclides, beta/photon, remain the same as the original 1976 levels, as calculated 4mrem/yr per ICRP2 or NBS69. Likewise, Table 3-6, P.3-22 has incorrect MCLs for some radionuclides. As well the units should be in pCi/L. Please correct all tables to these units [another e.g. Table 3-8].

The main differences between the alternatives are the amounts of technology that must be developed to construct and operate each facility. Pilot plants will be required for all alternatives except for the DDG option. It must be established that the final waste form resulting from DDG is not High Level Waste and complies with 65 FR 1608, which addresses surplus weapons-grade plutonium. Building specs would be similar for all alternatives, but DDG facility would be somewhat smaller, less costly, less water and electricity usage. Severe accident potential is also less for DDG, and DDG would contribute the smallest amount of liquid high-level waste.

L10-7

L10-8

L10-9

Comment L10, Page 4 of 4

Response to Comment Letter L10:

L10-1   DOE has added additional information.

L10-2   No response required.

L10-3   Chapter 6 deals with the impacts associated with the construction and operation of salt processing facilities. Cumulative impacts are presented in Chapter 5. See Tables 5-1 and 5-3 for the cumulative emissions to air and water. Table 5-4 presents cumulative waste generation.

L10-4   Section 2.4 and 2.8 have been modified to address this concern. DOE has identified caustic side solvent extraction as the preferred alternative.

L10-5   Tables 2-3 and 2-4 account for product inputs and outputs. The curie content of the process streams is taken into account in the Chapter 4 analysis of impacts.

L10-6   DOE has revised Table 4-19 in an attempt to clarify waste generation quantities. Each waste type has been reported and compared in its conventional units.

L10-7   Table 3-1 has been revised.

L10-8   Table 3-6 has been updated. The source document reports the values as μci/ml (microcuries per milliliter), therefore DOE chose to retain the units for ease of comparison.

L10-9   Section 7.1 discusses the process of determining waste incidental to reprocessing.

D H E C

PROMOTE PROTECT PROSPER

2600 Bull Street
Columbia, SC 29201-1708

COMMISSIONER:
Douglas E. Bryant

BOARD:
Bradford W. Wyche
Chairman

William M. Hull, Jr., MD
Vice Chairman

Mark B. Kent
Secretary

Howard L. Brilliant, MD

Brian K. Smith

Louisiana W. Wright

Larry R. Chewning, Jr., DMD

May 16, 2001

Andrew R. Grainger
NEPA Compliance Officer
Savannah River Site
Building 742-A, Room 185
Aiken, SC 29802

RE: Savannah River Site Salt Processing Alternatives Draft Supplemental Environmental
Impact Statement; March 2001;(SEIS)(SOE/EIS-0082-S2)

Dear Mr. Grainger:
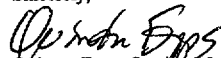
We have reviewed the above referenced draft EIS submitted on March 23, 2001. The
South Carolina Department of Health and Environmental Control Bureau of Water
administers applicable regulations pertaining to water quality standards and classifications,
including 401 Water Quality Certifications. A 401 Water Quality Certification will be
required for any part of the proposed work that impacts jurisdictional wetlands or waters of
the U.S.

This document describes the stream and wetland resources that will potentially be
impacted by the proposed project. In consideration of the site selection, the draft EIS
provides an extensive alternatives analysis, which addresses factors such as
socioeconomics, traffic volume/service, project costs, cultural resources, waste generation,
worker and public health, various environmental resource impacts, and land use in addition
to stream and wetlands impacts.

If it is determined that an Army Corps of Engineers 404 permit is required for the
proposed project, a South Carolina 401 Water Quality Certification will also be required.
The Water Quality Certification may be conditioned to address specific modifications and
measures that may be required to further reduce impacts to water resources after a detailed
review of project drawings. If required, a final mitigation plan must be reviewed and
approved by the Department during the certification process.

Thank you for the opportunity to comment on this project. If you have any questions,
please feel free to call John Collum at (803) 898-4179.

Sincerely,

Quinton Epps, Section Manager
Water Quality Certification and
Wetlands Programs Section

L11-1

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Comment L11, Page 1 of 1

Response to Comment Letter L11:

L11-1   There will be no discharges to surface waters and no wetlands will be disturbed, therefore, a 401 Certification will not be required.

THE STATE UNIVERSITY OF NEW JERSEY

RUTGERS

Professor Michael Greenberg, Associate Dean of the Faculty &
Director, National Center for Neighborhood and Brownfields Redevelopment
Bloustein School of Planning and Public Policy - Rutgers, The State University
33 Livingston Avenue, Suite 100, New Brunswick, New Jersey 08901-1958
Phone: 732/932-4101 ext 673   Fax: 732/932-0934   e-mail mrg@rci.rutgers.edu

May 20, 2001

Andrew R. Grainger
NEPA Compliance Officer
U.S. Department of Energy
Savannah River Operations Office
Building 742A, Room 183
Aiken, South Carolina
Attention: Salt processing EIS
(DOE/EIS-0082-S20)
Subject: Economic Impacts of Salt Processing Facility

Dear Mr. Grainger:

On behalf of the Consortium for Risk Evaluation with Stakeholder Participation (CRESP), I am
writing this letter to address the social and economic impacts discussed in this EIS report on
pages 4-28 and 4-29.

Enclosed you will find the galley pages of a paper that will shortly be published by the Journal of
Environmental Management and Planning. The subject of the paper is the interregional economic
impacts of the four alternatives being considered for salt processing at the Savannah River site.
This is not the final version of the paper, but the only changes would be final editing for spacing.
For the record, the results of the full study from which this paper was drawn were submitted to
the DOE Savannah River site. So DOE staff, notably John Reynolds, Thomas Heenan, and
Howard Gnann, have seen this work. In fact, without their help, the work would not have been
possible.

Briefly, CRESP has a grant from DOE to assist stakeholders by evaluating important issues. This
salt processing project was identified by Greg Rudy as an important project and the citizen's
advisory group has been receiving briefings and reviewing the options. Two of my doctoral
students and I reviewed the engineering documents prepared for the DOE and met with the
above-mentioned DOE staff to develop cost estimates. These estimates were then converted and
inserted into our regional economic simulation model to produce the results summarized in the
paper. These estimates are clearly different from those in the EIS because we spent a lot of time
reviewing the plans for the projects, and our model is among the most sophisticated in existence

1

Comment L12, Page 1 of 17

for converting large-scaled engineering projects into estimates of regional jobs, income and other economic measures. Notwithstanding what I have just said, I must refer you to the statement on page 382 (second full paragraph), in which we note that our estimates are based on initial designs, which I am sure you realize could change dramatically as the technologies are refined and tested. Nevertheless, the method used in the EIS to make the estimates is less than desirable.

With this caveat in mind, I'm going to briefly summarize the key findings of the research in bulleted form:

1. Assuming that the funds for these projects came from new funds added to the DOE budget rather than from any other existing DOE budget item, then job impacts in the region surrounding the Savannah River site during design range from a high of about 2,900 for ion exchange to a low of 1,400 for grout. During construction, the high is 3,750 for caustic to a low of about 2,600 for grout. And during start-up the range is from 2,300 for caustic to 1,200 for grout. | L12-1

2. These variations are explained by a number of factors, most notably the different costs of the four technologies; the number of workers and their salary levels; the amount and timing of purchases for building the facilities; and the location of design and testing. All of these are important; however, the last is critical and is the major reason why the caustic and ion exchange technologies do not produce even more local jobs and gross regional product in the host region. In fact, regarding caustic and ion exchange, for the first few years a good deal of the beneficial impact occurs in other regions. | L12-2

3. The assumption that the funds for this project will be a net addition to the DOE budget is probably overly optimistic. We provide other options, such as DOE cuts all other budgets (environment, defense, energy research) at all of its sites to pay for this project, DOE cuts only environmental budgets at all of its sites to pay for this project, and DOE takes the money for this project from the Savannah River site budget. The results of those payment options are striking. Table 3 from our paper illustrates them with the small tank option. Without doubt, the most distinctive option economically is the one in which the costs for this project are subtracted from other Savannah River site projects. In some years, the host region would suffer a net loss of jobs, because the project is buying equipment, nearly all of which is produced outside the host region. During those years, other regions realize the benefits. Figures 1 and 2 and table 3 illustrate the critically important issue of who pays for the project. | L12-3

Overall, our study provides more specific estimates than the current EIS, although we reiterate that these numbers will likely change as the technologies are refined. The important points from regional economic theory that apply to the policy decision are that the cost of the project is not the only thing that matters. Where the technology is designed and tested is critical, and the type (added, substituted) of funding is likely more important than cost in assessing the socioeconomic impacts. | L12-4

Comment L12, Page 2 of 17

Methodologically, this study demonstrates that we have the ability to estimate the economic impacts on the host and other regions that include DOE sites. So, for example, Table 4 estimates job impacts in other regions as a result of this project.
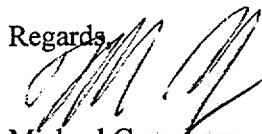
L12-4

We conclude by recognizing that health and safety are the most important drivers of this choice. However, if economic impact is important then the estimates provided in the attached paper should provide a more informative set of results and explanation for the results than those in the current EIS.

L12-5

CRESP researchers are extremely interested in the tank wastes and their disposition, and we hope to provide further comments on this important subject in the future.

Regards,

Michael Greenberg
Director, Social and Economic Center, CRESP

cc: Charles Powers

Enclosure: "Regional economic impacts of environmental management of radiological hazards: an initial analysis of a complex problem"

Comment L12, Page 3 of 17

Regional Economic Impacts of Environmental Management of Radiological Hazards: An Initial Analysis of a Complex Problem

MICHAEL GREENBERG, DAVID LEWIS & MICHAEL FRISCH

E.J. Bloustein School of Planning and Policy, Rutgers University, 33 Livingston Avenue, Suite 100, New Brunswick, NJ 08901–1958, USA. E-mail: mrg@rci.rutgers.edu

(Received September 2000; revised December 2000)

ABSTRACT *We conducted an economic analysis of four different billion-plus dollar technological options for managing the salt wastes in the high-level waste tanks at the Savannah River nuclear weapons site (SRS) in South Carolina, USA. While US Department of Energy leadership is appropriately most concerned with health, safety and the environment, the economic implications of the choice cannot be dismissed. Combinations of technologies, where the technology is to be designed and tested, and who pays for it, were considered. With the caveat that the engineering designs are not the final versions and are therefore subject to change, we found that the most expensive technologies to design and build may not produce the most jobs or the greatest gross regional product in the SRS region because a great deal of the design and engineering from prototype to testing will not be done in the host region. Furthermore, in terms of the local economic impacts in the SRS region, this analysis shows that the policy choice regarding the method of funding the project (which budget the money comes from) matters as much as the selection of the remediation technology.*

Introduction

High-level waste (HLW) is the by-product of nuclear fuel reprocessing, in which irradiated fuel and target elements from production reactors are dissolved in acids and chemically processed in order to separate the plutonium and uranium from less toxic materials. The management of this waste is daunting because of the toxicity of the materials, the indefinite period of time some of it will need to be managed and the enormous cost of managing it. While health, safety and cost are obviously the primary considerations for the US Department of Energy (DOE), the regional economic impact of environmental management (EM) choices is important to the surrounding regions, which have a half-century-long history of dependence on the DOE.

There is nothing new about economic impact research: when federal government projects are proposed, the agency is required to estimate the number of jobs and dollars added to the regional economy, and these estimates are included as part of an environmental impact and/or socio-economic impact statement. What is new here is that we did not assume that the surrounding

Comment L12, Page 4 of 17

378   *M. Greenberg, D. Lewis & M. Frisch*

region would necessarily benefit economically from the EM project. Using the region surrounding the Savannah River site (SRS) as the focal point, the purpose of this project was to determine: combinations of technologies; the places where the technologies would be designed, tested, constructed and operated; and sources of funding that would lead to increases in jobs and gross regional product (GRP) and combinations that would not.

EM and Regional Economic Contexts

The management of HLW is arguably the most technologically daunting EM problem facing the USA. The public must not be allowed to come into contact with HLW because a great deal of HLW is extremely toxic, containing radio-nuclides and hazardous chemical agents. Indeed, the Nuclear Waste Policy Act 1982 (42 USCA) requires permanent isolation of these wastes. Much of the waste has a half-life of 50 years, so it needs to be isolated for 100–400 years. Some of the material, such as plutonium, has a half-life of tens of thousands of years, and we do not know how to prevent exposure to it for many centuries.

Ninety-five per cent of the HLW is stored at over 200 tanks at the Hanford (Washington), and Savannah River (South Carolina) weapons sites (Office of Environmental Management, 1995a). The materials in the tanks are a combination of liquids, sludges and solids. The DOE's radioactive waste management strategy has been to stop building more underground storage tanks and instead to transform the highly radioactive elements of the waste into stable and insoluble solids. Some of the DOE's EM plan has been implemented. For example, the DOE built and has been using a vitrification plant (the Defense Waste Processing Facility) at SRS, which blends the solids and sludges with borosilicate glass at 2100° F into a glass matrix and then places it in stainless-steel canisters (US General Accounting Office (US GAO), 1999; Reynolds, J.M., personal communication). However, the DOE has been unable to successfully demonstrate a technology that will separate the high-level and low-level wastes in the tanks without producing other potentially dangerous conditions that cannot be addressed in an economically efficient way (Stakeholder Focus Group of Citizens Advisory Board, 1998; US GAO, 1999).

After exploring 140 technologies, the DOE is focusing on four options, which are described elsewhere in detail (US Environmental Protection Agency, 1985; Stakeholder Focus Group of Citizens Advisory Board, 1998; Reynolds, 1999; US GAO, 1999; Citizens Advisory Board, 2000): (1) small tank precipitation; (2) grout and caesium encapsulation; (3) crystalline silicotitanate ion exchange and vitrification; and (4) caustic side solvent extraction and vitrification.

DOE policy makers cannot ignore the cost and economic benefits of their EM decisions about HLW, for two reasons. First, the costs of HLW management are enormous by any standard. The DOE estimated the costs of clean-up as part of a two-stage process in which more would be spent during the period 1997–2006 to reduce the overall cost during subsequent years. The post-2006 costs range from $53 billion to $88 billion over 63 years (2007–2070). The HLW portion is $33 billion and $49 billion, i.e. 62% and 56%, respectively (Office of Environmental Management, 1997a, b; Greenberg *et al.*, 1999a). In other words, dealing with HLW will represent the bulk of the so-called 'Cold War mortgage' by the end of environmental risk, the high cost to US taxpayers is one reason for Americans to be concerned about HLW.

Comment L12, Page 5 of 17

Environmental Management of Radiological Hazards   379

The second reason why the DOE cannot ignore the economics of the issue is that EM investments provide a substantial economic benefit to a few regions in the USA. More specifically, the DOE's EM budget has averaged around $6 billion during the 1990s (Frisch & Lewis, 2000). About 70% of the DOE's EM budget is spent at the sites in South Carolina, Washington, Colorado, Idaho and Tennessee (Office of Environmental Management, 1995a, b, c). The EM budgets of the Savannah River and Hanford sites each exceed $1 billion a year. We cannot find any comparable EM investment anywhere in the world. For example, elsewhere we have calculated that the EM budget accounts for 14%, 8% and 17% of the GRP of the regions surrounding the Hanford, Savannah River and Idaho National Engineering and Environmental Laboratory (INEEL) sites (Frisch et al., 1998). Even a modest economic multiplier implies that 15–35% of the economies of these regions is directly and indirectly attributable to the DOE's EM programme. These remarkable proportions are even more salient economic drivers when we consider that defence spending at these sites has plummeted since the end of the Cold War. EM spending has helped compensate for the loss of millions of dollars and jobs that formerly were devoted to developing, building and testing bombs (Greenberg et al., 1999a, b). Studies of news media coverage, interviews with local government officials, including city planners, and a survey of residents of the SRS region all underscore the high priority the local stakeholders attach to the economic impact of the DOE site. In many ways, they consider it as important as EM of the site, and it influences the DOE's credibility (Lowrie et al., 1999, 2000; Williams et al., 1999; Lowrie, 2000).

There are good reasons to be cautious about assuming that any other major on-site project represents a free lunch for the surrounding region that really wants help. One is that these heavily dependent regions have been swinging on an economic pendulum during the last 50 years (Lancaster, 1984; Schill, 1996). Brauer (1995, 1997) argues that the DOE has created a bifurcated labour market in the SRS region, which deters private employers from locating there. Lowrie et al. (1999) interviewed 26 local treasurers, comptrollers and chief financial officers in towns and counties near seven major facilities (Oak Ridge, SRS, Hanford, Sandia, Los Alamos, INEEL and Rocky Flats). These sites lost tens of thousands of jobs during the period 1994–99 (Office of Worker and Community Transition, 1999). The picture that emerged was that fluctuating site budgets have caused serious fiscal strains on local governments. Many have sunk money into water and sewer lines, schools and other infrastructure during the period of growth only to find that they are struggling to pay them off as the DOE sites downsize. Many noted that they were not sure that they had sufficient resources to deal with their capital investments, with declining property values and unsold properties, and they questioned their attractiveness to new businesses that would help them diversify their economies (Lowrie et al., 1999).

The 'nuclear mushroom cloud' issue, the most feared toxic symbol, decreases the potential for regional economic development in these regions (Mitchell et al., 1989; Slovic et al., 1991). Regions where bombs were developed, tested and detonated, and where nuclear waste is located, should be expected to suffer from an environmental stigma that would discourage investment and relocation. There is no way of determining how long a stigma effect lingers. There certainly are instances, for example Pittsburgh, Pennsylvania, where the clean-up and redevelopment of an area have led to marked economic growth and the positive

Comment L12, Page 6 of 17

380   *M. Greenberg, D. Lewis & M. Frisch*

perception of a community. Yet there is no evidence to suggest what are the long-term implications of being a place where nuclear bombs have been detonated and built, and where nuclear waste is stored. In this regard, we can only hypothesize that the more dependent rural sites where bombs have been developed, built and tested (SRS, Hanford and Nevada Test Site) are clearly at a disadvantage with regard to nuclear-related stigma compared with sites where the effort has been largely focused on science and research (Los Alamos and Sandia).

A third reason to be concerned about the regional economic benefits is that the two regions where nearly all the HLW is located have had a rocky economic road in the recent past, and that road is not expected to improve much in the near future. For example, Table 1 shows that the SRS region has the third lowest per capita income of those we studied, and that its regional population and employment increases are estimated to be relatively smaller than those of any of the others. In essence, the SRS region contains rural counties that never recovered from the decline of cotton and the great migration of African Americans to urban centres. In short, the economic implications of the tank waste investment are more important for the SRS region than the same investment would be in other, more populous, growing and affluent regions.

Furthermore, the more DOE-dependent rural sites, such as SRS, are also at a disadvantage with regard to creating local multiplier effects, compared with less dependent and larger, more urbanized ones. For example, the region centred on the Oak Ridge site is much more populated and urbanized than the one surrounding INEEL (Frisch *et al.*, 1998; Greenberg *et al.*, 1999a). An investment in EM at the Oak Ridge site produces more than 50% more jobs than the same investment in more rural Idaho. This result is due to the lack of forward and backward industrial linkages at the more rural locations (Frisch *et al.*, 1998). That is, the DOE allocates funds to site missions, but many purchases take place outside the region, a good deal of the skilled labour has to be brought into the region, and a lot of the research and development and pilot testing does not take place in these rural regions.

Given this context, we focused on circumstances that would notably impact on regional jobs, GRP and income. If research and development, pilot construction and testing occur in the region, if local construction workers are hired and if products (cement and metal bars, etc.) are purchased in the region, then the region will benefit economically. However, if the technology is developed and pilot-tested outside the region, and if workers and products are mostly brought in from outside the region, then the region will benefit relatively little.

In addition to technology choice, the region will benefit maximally if project costs are paid by funds in addition to the site's budget for other intended activities. This scenario would mean that the US public pays through additional taxes, or another government agency pays by having a smaller budget. If the DOE takes money from its budget, then the other DOE site regions will lose jobs and GRP. So this form of payment for the project, in essence, becomes a tax on the other DOE sites and programmes.

To help unravel which regions gain jobs and GRP from EM of the salt wastes in the HLW tanks at SRS, we selected illustrative combinations of technologies, locations for design and testing and methods of funding. These options are described in the five following questions.

Comment L12, Page 7 of 17

Table 1. Study regions

Name of region	States (number of counties)	Metropolitan statistical area	Population (×1000), 2000	Per capita income ($, ×1000)	Percentage change in employment and population, 2000–15
SRS	Georgia, South Carolina (11)	Augusta–Aiken	647	17.8	Emp. = 11, pop. = 9
Hanford	Washington (7)	Richland–Yakima–Kennewick–Pasco	599	17.7	Emp. = 15, pop. = 13
Oak Ridge	Tennessee (10)	Knoxville	787	20.0	Emp. = 13, pop. = 12
Rocky Flats	Colorado (9)	Denver	2 477	22.9	Emp. = 21, pop. = 24
INEEL	Idaho (7)	Pocatello	248	17.0	Emp. = 22, pop. = 13
Los Alamos/ Sandia	New Mexico (7)	Santa Fe Albuquerque	932	20.4	Emp. = 23, pop. = 27
Pantex	Texas (5)	Amarillo	251	20.4	Emp. = 13, pop. = 13
Nevada Test Site	Nevada, Arizona (4)	Las Vegas	1 447	19.0	Emp. = 30, pop. = 46
Fernald/ Mound	Kentucky, Indiana, Ohio (19)	Cincinnati–Hamilton Dayton	3 057	21.4	Emp. = 17, pop. = 13
Headquarters	DC, Maryland, Virginia, West Virginia (26, including cities)	Washington, DC	4 861	24.4	Emp. = 20, pop. = 17
Rest of USA	—	—	256 988	20.6	Emp. = 16, pop. = 14

382   *M. Greenberg, D. Lewis & M. Frisch*

(1) What are the likely economic impacts of the four technologies on the SRS region and the other regions if US taxpayers pay the full cost of the project though a tax increase, raising the overall DOE budget? (We call this the 'new money' option.)

(2) What are the likely economic impacts if the DOE decides to pay for this project by reducing its defence, science and energy and other budgets across all of its sites? In other words, SRS gains more funding for salt waste management, but other programmes, including some at SRS, lose funding. (We label this the 'DOE zero-sum' question.)

(3) What are the likely economic impacts if the DOE decides to pay for this project by reducing environmental projects across all of its sites? In other words, SRS gains more funding, but Hanford, Oak Ridge and others lose funding. (We label this the 'DOE EM zero-sum' question.)

(4) What are the likely economic impacts if no new environmental funding is provided to SRS for this project? In other words, this is a zero-sum game for the SRS region. (We call this the 'SRS zero-sum' question.)

(5) What are the likely differences in the economic impacts between the four alternative tank waste technologies using the 'all new money' scenario? This question examines the differences between the technologies, independent of the funding issues.

Other options were also plausible, such as zero-sum major EM sites (SRS, Hanford, INEEL and Rocky Flats). The chosen scenarios are representative of what could happen, and are not meant to be definitive. The DOE might choose to implement a hybrid of these alternatives.

In undertaking this analysis, we were aware of two limitations that needed to be noted. We recognized that the engineering cost estimates for the four technologies were the initial set and that these would change as each technology was tested. It is quite possible that the technology that has the best regional economic impact credentials could be eliminated for health, safety, engineering and various other reasons. Secondly, although DOE engineers indicated where the design and testing of each technology were likely to occur, in fact their suggestions might not materialize. Overall, it is important that the reader recognizes that the results are not to be interpreted as final estimates but, rather, are initial estimates that we hope will provoke discussion about the choice of technology, where the project is designed and who pays for it.

Data, Methods and Preliminary Computations

An economic simulation model built by Regional Economic Modeling Inc. (REMI) (1997) was used to determine the implications of the technological alternatives. The simulation model uses a modified national forecast based on estimates developed by the US Bureau of Labor Statistics. It incorporates econometric estimates of the relationships between factors such as population, employment, income, wages, prices, trade and migration by industry and by region in order to produce regional forecasts (Treyz, 1993). In essence, the model allows the user to understand how the forecast would change in response to changes that occur within a region, for example changes in final demand for regional products. In order to measure the regional impacts, the national forecasts are adjusted according to the historical performance of the region from

Comment L12, Page 9 of 17

1969 to 1996 to generate regional multipliers, regional purchase coefficients, regional trade coefficients and other important characteristics, such as migration and population growth. Because the model is multi-regional, we are able to determine how a change in one region impacts on other regions, which provides a national perspective on the project.

Five key decisions were made about the methods. Briefly, all counties in the primary metropolitan statistical areas of nine regions with major DOE facilities were selected. In addition, headquarters (Washington, DC), and the rest of the USA as an aggregate, were considered as regions. The forecasting period was a second design issue. REMI provides a baseline forecast from 1997 to 2035 based on historical data from 1969 to 1996. However, studies show that estimates that go much beyond a decade deviate substantially from reality because assumptions built into models are no longer valid (Treyz, 1993). Legally, the HLW tanks are to be emptied by 2022. Our analysis begins with the first investments in 2000, but we were reluctant to use the model beyond 15 years, so we chose 2015 as the end of our forecasting period, which provides results for the design, construction, start-up and operating periods. The extent of inter-industry detail was a third design decision. The model has 53 economic sectors, which means that we get considerable detail on purchases from manufacturing sectors of the economy. The development of a baseline to compare with the salt waste-influenced results was the fourth decision. Description of the steps is beyond the scope of this paper (Frisch & Lewis, 2000). The end result was a DOE budget with explicit EM, defence, science and energy, and administrative and other elements that could be altered. In the analyses that follow, the changes are made relative to this derived DOE baseline. That is, the DOE baseline produces employment, GRP, personal income and other output estimates for every year. When we make an explicit change in the DOE budget, the regional economic differences are attributable to the change in the DOE budget because everything else has been held constant within the model. For example, if the DOE baseline forecasts 5000 jobs in a region and a policy modification produces an estimate of 4000 jobs, then the 1000 fewer jobs are attributable to that policy change. The fifth and most difficult set of decisions involved converting the technology plans of the DOE and its contractors into investments in the economy. This required studying the engineering plans and meeting with DOE engineers. We were able to categorize the DOE's investments into 26 labour and 19 capital cost sectors (which themselves are an aggregation of roughly 150 different four-digit standard industrial codes). Another important decision was how to regionalize the design and engineering portion of the budget. Our proportioning of this expenditure by region was based on discussions with SRS engineers. The proportioning of the design and engineering expenditures is a potential source of error. The regionalization of other purchases is based on historical data of the percentage of national production of a particular product or service in a region. These data by region are contained in the regional purchase coefficients that are embedded in the REMI model (Treyz, 1993). This fifth set of decisions was critical to the results of this study.

Results

Before describing the regional economic impacts, a lot can be learned by examining the investments themselves. The aggregate cost (in 1999 dollars) is

Comment L12, Page 10 of 17

384 *M. Greenberg, D. Lewis & M. Frisch*

estimated to be $1.36 billion for the caustic technology, $1.19 billion for the ion exchange, $1.08 billion for the small tank system and $0.91 billion for grout. These differences of up to $450 million between the technologies were not expected to be proportional in their regional economic impacts because much of the development of the grout and small tank technologies has been at SRS, whereas caustic and particularly the ion technologies have been heavily developed outside the region. The amount of economic leakage out of the region by technology is a critical factor that determines the economic impacts on the SRS region. The percentage of expenditure made in the SRS region, the retention rate, is quite different between the four technologies. Grout, which mostly relies on local products and labour, has a retention rate of 84%, and the small tank technology has a retention rate of 82%, primarily because much of the design and early development has occurred in the SRS region. In contrast, more of the design and construction work for caustic side extraction and ion exchange has taken place outside the SRS region, and so their retention rates are 78% and 65%, respectively. In other words, even though the caustic and ion exchange technologies cost more to design, build and operate, the fact that a lot of the money is spent outside the SRS region means that the economic impact on the SRS region is less than what is implied by looking at the total cost of the project.

Technology Options

Presenting all of the results from the simulations is beyond the scope of this paper. Here we focus on changes in total employment and changes in GRP as measures of economic impacts. Table 2 provides summary results of the new money scenarios, which assume that the US population pays for the technology fully through a tax increase. The tax increase that proportionately distributes the total by region is based on the historical proportion of the taxes paid by each of

Table 2. Economic impacts of four technology options and new money option on SRS region (values are differences from DOE baseline, 1992 constant dollars)

Technology	Average design, 2001–03	Average construction, 2004–07	Average start-up, 2008–09	Percentage difference from small tank, all phases, 2001–09
Small tank				
Employment	2650	3085	1242	—
GRP[a]	90	145	85	—
Grout				
Employment	1417	2606	1167	−25
GRP[a]	43	112	91	−26
Ion exchange				
Employment	2927	2863	1539	2
GRP[a]	100	133	119	5
Caustic				
Employment	2157	3749	2287	14
GRP[a]	76	171	161	21

[a] In millions of chained 1992 dollars.

Comment L12, Page 11 of 17

Environmental Management of Radiological Hazards 385

the 12 regions. Over the course of the 9 years, on average there is not much difference between the small tank, ion exchange and caustic technologies in their ability to create jobs and add to GRP. Each creates an average of more than 600 jobs and $25 million more GRP than grout.

Looking back at the differences in total cost shows that the small tank technology produces more local jobs and greater GRP in the SRS region per unit of cost than do the other three technologies. Small tank costs 16% more than grout, but produces about 25% more jobs. Small tank costs 9% less than ion exchange, but we estimate it to produce almost as many jobs for the region. Similarly, small tank costs 26% less than caustic, but we estimate that the investment in the caustic technology will add only 14% more jobs in the SRS region.

Results averaged over the life of a facility can obscure important variations in the economic impacts. Therefore, we examine differences between the technologies in four phases of the project. The last phase, operations and maintenance, is the most similar across the technologies. There are three reasons for this last outcome: there are significantly fewer leakages out of the regions across technologies for this phase; the amount of additional investment is approximately the same for each technology at this phase; and the model assumptions of national growth and our assumptions regarding the DOE baseline dominate the results. The 1–2% differences between the four technologies in operation and maintenance will not be noticeable in the SRS region.

In essence, the economic differences occur during the design, construction and start-up phases. Table 2 presents the results for each technology and the new money payment option. There is a jump in employment through the design and construction phases, with an equally rapid and steady decline as construction winds down and the start-up phase ensues. The caustic extraction technology is a good one to illustrate the complexity of regional economic impacts. It has the highest overall cost. Yet a lot of up-front design and engineering work is done off-site, notably at Oak Ridge, INEEL and Los Alamos/Sandia, which are estimated to add 480, 710 and 230 jobs, and $14 million, $16 million and $6 million in GRP, respectively, during 2002–04. However, the bulk of the work is done on-site, including the construction of large tanks and engineered systems to support the technology. So, in terms of creating jobs, if the DOE does not need to reallocate money from other projects to pay for this one, i.e. there is new money, then multiple regions will gain jobs and GRP.

Payment Options

The results presented in Table 2 assume that new money is added to the DOE SRS budget, which is likely to be a much better payment arrangement than the SRS region will get. The DOE's overall budget has been under a great deal of pressure since the end of the Cold War, and within that budget the EM budget has been declining relative to the DOE's defence, energy and science budgets (Frisch & Lewis, 2000). Hence, our zero-sum options are probably closer to reality than is the new money one. Using the small tank and ion exchange options as illustrations, Table 3 and Figures 1 and 2 illustrate the impact of the three zero-sum payment scenarios. We can see a scaling down of benefits to the SRS region, depending on the payment option. When we examine the SRS zero-sum funding option, we see a bottoming out, which clearly demonstrates

Comment L12, Page 12 of 17

386   *M. Greenberg, D. Lewis & M. Frisch*

Table 3. Payment options, small tank option (values are differences from DOE baseline, 1992 constant dollars)

Payment option	Average design, 2001–03	Average construction, 2004–07	Average start-up, 2008–09	Percentage difference from new money, all 2001–09
New money				
Employment	2650	3085	1242	—
GRP[a]	90	145	85	—
DOE zero-sum				
Employment	2512	2877	1195	−6
GRP[a]	85	137	93	−3
EM zero-sum				
Employment	2310	2573	1127	−14
GRP[a]	77	125	91	−10
SRS zero-sum				
Employment	879	424	638	−77
GRP[a]	21	40	76	−63

[a] In millions of chained 1992 dollars.
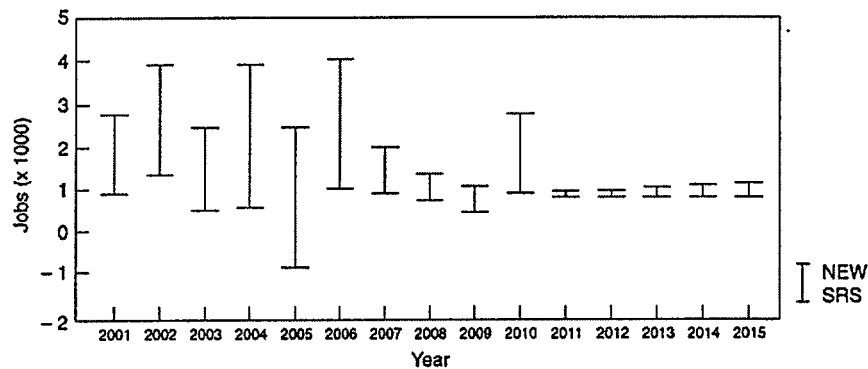
Figure 1. Small tank: new money vs. SRS pays.
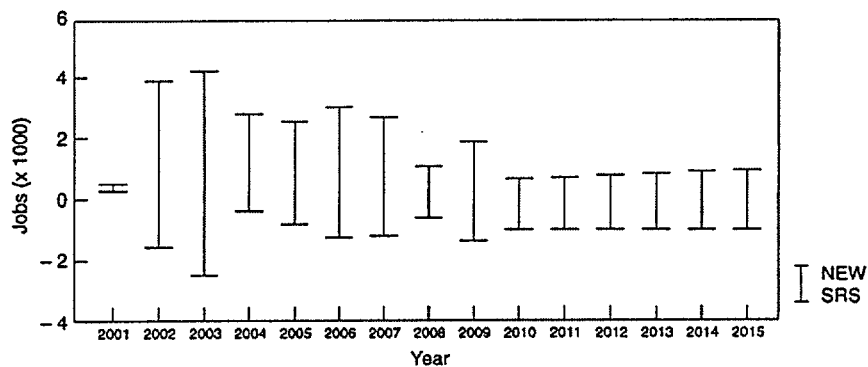
Figure 2. Ion exchange: new money vs. SRS pays.

Comment L12, Page 13 of 17

Environmental Management of Radiological Hazards 387

the negative economic effects of investment leakage on the SRS regional economy.

The average annual difference in the SRS region of paying for the salt tank clean-up out of the full $16 billion DOE budget is estimated to be about 100 fewer jobs and $4 million in GRP, or about 5% of the potential economic impact. The impact of the DOE EM zero-sum option is slightly more serious for the SRS region, estimated annually at 300 jobs and $9 million less in GRP, or 12% of the total. The larger impact occurs because the SRS region has received about 20% of the EM budget for more than a decade. So, in fact, the SRS site would pay about 20% of the salt waste tank costs out of its existing funding under the EM zero-sum payment option.

The most severe economic impact for the SRS region clearly is the SRS zero-sum option, where the net SRS budget for all purposes is reduced by the amount of the cost of the tank waste project. Table 3 offers two noteworthy insights into this option. One is that the SRS region has an overall annual average job benefit of about 600 jobs, rather than no net job change. This finding is explained by the fact that much of the small tank technological development is on-site, whereas other SRS activities, by comparison, make more purchases of products and labour off-site (Greenberg *et al.*, 1999a; Frisch & Lewis, 2000). In addition, the hiring of many more engineers (many of whom will migrate into the region), paid at a higher rate than the average engineer in the region, will increase demand for upmarket housing, and their substantial disposal income will increase demand for many other services and recreations. However, even this SRS-friendly technology suggests some cause for concern. The simulation suggests that 805 jobs and $34 million in GRP are estimated to be lost in 2005. According to site plans for the small tank technology, a considerable amount of the budget for that year is for buying steel pipe and other products outside the region, so the retention rate drops and hence the region loses jobs and GRP. In addition, many of the engineers may leave the region as regional demand for their services declines.

Figure 1 illustrates graphically the combination of new money and SRS zero-sum payment options for the small tank option. Before describing the sequence, we should say that we expect the DOE and its contractors to attempt to smooth this forecasted roller-coaster for the period 2001–07. The first 2 years involve building the pilot facility on-site, and so many jobs are created. In 2003, the start of construction of the permanent facility is signalled by off-site purchases, hence local jobs drop. Employment jumps again in 2004 as the products are used to build the facility. However, in 2005 a great deal of money is used to purchase engineered systems, pipe and other products from outside the region, and hence the region loses jobs. A year later, the employment impact peaks to almost 4100 jobs as the construction phase peaks. On-site activities change dramatically after 2006. In 2007, pilot testing and personnel training become the major activities. Training becomes the major activity in 2009. The facility begins operation in 2010. The graph also clearly shows that the real difference to regional economic impact is during design and construction. After 2009, there is little difference in the operational costs by technology, and total operational costs are relatively low compared with construction costs. Hence, the difference in funding mechanism (who pays) does not lead to large differences in impact after 2010.

Figure 2 shows the new money vs. SRS pays options for ion exchange. The

Comment L12, Page 14 of 17

388   *M. Greenberg, D. Lewis & M. Frisch*

difference between the best-case scenario (new money funding for the ion exchange technology) and the worst-case scenario (SRS zero-sum funding option for the ion exchange technology) illustrates graphically the dramatic negative effects of economic leakage on the SRS region. The ion exchange technology has the lowest investment retention rate of all four technologies, punctuated by a loss of over 40% of investment during the construction phase. Looking at the salt waste EM problem as an economic issue, Figure 2 is a provocative demonstration of the need to think hard about who pays for this technology, because the SRS region loses employment every year from 2000 to 2015 as a result of the expected site budget absorbing the full costs of this project.

Peak Impacts and Inter-regional Effects: 2006

Clearly, most of the economic impacts of managing salt waste fall within the SRS region. However, there are inter-regional impacts of this SRS-centred EM programme that must be reported in more detail. Table 4 shows these for the small tank option and the four payment options for the peak construction year, 2006, when the site is gaining the most investment. The new money option has almost no impact on the other DOE sites. The job gains in the SRS region are matched by losses in the rest of the USA. The DOE zero-sum option shows losses in the rest of the USA. However, Los Alamos/Sandia, Oak Ridge and the headquarters regions, which have major budget commitments from the DOE defence, energy and science programmes, also lose about 1300 jobs.

   The DOE EM zero-sum scenario has more concentrated impacts, falling on Hanford and INEEL; the two relatively poor regions with major EM programmes lose 950 jobs. Oak Ridge, Los Alamos/Sandia, the Nevada Test Site region and Fernald/Mound also each lose over 100 jobs in this peak year. The SRS zero-sum option shows a gain of only 1000 jobs in the region during the peak year. Nearly all the losses are in the rest of the nation.

Table 4. Employment impact by site region, 2006, small tank option (numbers in table are rounded to nearest 10)

Site region	New money	DOE zero-Sum	EM zero-Sum	SRS zero-Sum
SRS	4100	3850	3500	1000
Hanford	—	−250	−550	—
Oak Ridge	—	−300	−210	−30
Rocky Flats	40	−110	−40	40
INEEL	—	−200	−400	—
Los Alamos Sandia	—	−650	−220	10
Pantex	—	−40	—	—
Nevada	10	−70	−140	20
Fernald Mound	30	−60	−170	10
Headquarters	—	−330	−260	50
Rest of U.S.	−4600	−2600	−1800	−1400
Total U.S.	−400	−750	−610	−200

Note:—, Impact is fewer than ± 10 jobs.

Comment L12, Page 15 of 17

Environmental Management of Radiological Hazards 389

Discussion

The authors of this paper do not have the ability to assess the public health and environmental implications of each of the technologies proposed for the salt wastes in the HLW tanks. Assuming that the DOE's engineering cost estimates are currently reasonable and will become more accurate as design and testing continue, that our sectorizing of them into the economy is accurate, that the regional cost allocations (particularly for engineering services) are realistic and that the historical patterns of trade in the USA captured in the model are appropriate for the near future, then, from an economic perspective, we are able to estimate the impact of each technology on the SRS-centred region and other regions of the USA.

The policy message is not subtle. The assumption that new projects lead to host-region economic benefits is not necessarily true. In an era when budgeting seems to have become a zero-sum game or is close to that reality, a new project is going to be paid for by postponing or eliminating another project. Regional planners need to probe beyond the technological choices because the decisions about where the design and engineering are done and how the project is funded are critical. If the host region pays the full cost of the project by postponing or cancelling other tasks, then the overall net benefit will be reduced, including job and GRP losses in some years. Smoothing out the building process can help flatten the roller-coaster, but it is unrealistic to assume that any of these new technologies can be optimized in the way an off-the-shelf technology could be. Lastly, as practitioners of environmental risk management, it would be remiss of us if we did not conclude by noting that the regional economic benefits are only an important consideration if all four technologies protect public health, safety and the environment.

Acknowledgements

The authors would like to thank Charles Powers, Bernard Goldstein, Elaine Faustman, Arthur Upton and other colleagues for encouraging this work. The project was begun under a co-operative grant to the Consortium for Risk Evaluation with Stakeholder Participation from the US DOE, Instrument DE-FC01–95EW 55084, and it was completed under a second co-operative grant, DE-FG26–00NT40938. The authors would like to thank DOE scientists and engineers, notably John Reynolds, Thomas Heenan and Howard Gnann, for spending a lot of time with us explaining the details of the project estimates and reviewing an initial version of the larger economic study of the salt waste management issue. Finally, they would like to thank their colleagues Henry Mayer and Karen Lowrie for participating in conversations about this study for many months. The observations, conclusions and interpretations drawn from the data are solely the responsibility of the authors and should not be interpreted as representing the views of any of the people acknowledged, nor should it be inferred that they agree with the conclusions drawn from the analysis.

References

Brauer, J. (1995) US Military nuclear production sites: do they attract or reject jobs? *Medicine and Global Survival*, 2, pp. 35–44.

Brauer, J. (1997) Do military expenditures create net employment? The case of US military–nuclear

Comment L12, Page 16 of 17

390   *M. Greenberg, D. Lewis & M. Frisch*

production sites, in: J. Brauer & W. Gissy (Eds) *Economics of Conflict and Peace* (Brookfield, VT, Ashgate).

Citizens Advisory Board (2000) Selection of HLW salt processing alternative, *Recommendation 112*, 25 January (Aiken, SC).

Frisch, M. & Lewis, D. (2000) What happened to conversion in the nuclear weapons complex? An analysis of regional spending on environmental management and defense programs in the Department of Energy, *Report 34 to CRESP-EOHSI* (New Brunswick, NJ).

Frisch, M., Solitare, L., Greenberg, M. & Lowrie, K. (1998) Regional economic benefits of environmental management at the US Department of Energy's major nuclear weapons sites, *Journal of Environmental Management*, 54, pp. 23–37.

Greenberg, M., Solitare, L., Frisch, M. & Lowrie, K. (1999a) Economic impact of accelerated cleanup on regions surrounding the US DOE's major nuclear weapons sites, *Risk Analysis*, 19, pp. 629–641.

Greenberg, M., Isserman, A., Frisch, M., Krueckeberg, D., Lowrie, K., Mayer, H., Simon, D. & Sorenson, D. (1999b) Questioning conventional wisdom; the regional economic impacts of major US nuclear weapons sites: 1970–1994, *Socio-economic Planning Sciences*, 33, pp. 183–204.

Lancaster, J. (1984) Aiken, SC—town that lives by the bomb, *Atlanta Constitution*, 6 December, p. A–1.

Lowrie, K. (2000) Land use planning at energy sites involves communication, coordination, and commitment, *Public Management*, 82, pp. 18–23.

Lowrie, K., Greenberg, M. & Frisch, M. (1999) Economic fallout, *Forum for Applied Research and Public Policy*, 14(2), pp. 119–125.

Lowrie, K., Greenberg, M. & Waishwell, L. (2000) Hazards, risk, and the press: a comparative analysis of newspaper coverage of nuclear and chemical weapons sites, *Risk: Health, Safety, & Environment*, 49, pp. 49–67.

Mitchell, R., Payne, B. & Dunlap, R. (1989) Stigma and radioactive waste: theory, assessment, and some empirical findings from Hanford, Washington, *CENTED Report No. 78* (Worcester, MA).

Office of Environmental Management (1995a) *Estimating the Cold War Mortgage*, 2 vols (Springfield, VA, US DOE).

Office of Environmental Management (1995b) *Closing the Circle on Splitting the Atom* (Washington, DC, US DOE).

Office of Environmental Management (1995c) *Baseline Environmental Management Report* (Washington, DC, US Government Printing Office).

Office of Environmental Management (1997a) Accelerated cleanup: focus on 2006, *Discussion Draft* (Washington, DC, US DOE).

Office of Environmental Management (1997b) *Linking Legacies* (Washington, DC, US Government Printing Office).

Office of Worker and Community Transition (1999) *Annual Report of Contractor Work Force Restructuring* (Washington, DC, US DOE).

Regional Economic Modeling Inc. (REMI) (1997) *The REMI EDFS-53 Forecasting & Simulation Model, Volume 1, Model Documentation* (Amherst, MA, REMI).

Reynolds, J.M. (1999) High level waste salt disposition alternatives, historical overview, *Briefing to Citizens Advisory Board*, Aiken, SC, 27, July.

Schill, K. (1996) SRS losses mount, *Augusta Chronicle*, 20 March, p. 1.

Slovic, P., Layman, M. & Flynn, J. (1991) Risk perception, trust and nuclear waste: lessons from Yucca Mountain, *Environment*, 33, pp. 6–11.

Stakeholder Focus Group of Citizens Advisory Board (1998) *Independent Review of WSRC Process for Selection of HLW Salt Disposition Alternatives, Aiken, SC* (Aiken, SC, Citizens Advisory Board).

Treyz, G. (1993) *Regional Economic Modeling: A Systematic Approach to Economic Forecasting and Policy Analysis* (Boston, MA, Kluwer).

US Environmental Protection Agency (1985) High level and transuranic wastes, *Background Information Document [for final rules*, see EPA 520/1–85–023].

US General Accounting Office (US GAO) (1999) Nuclear waste: process to remove radioactive waste from Savannah River tanks fails to work, *GAO/RCED-99–69* (Washington, DC, US GAO).

Williams, B., Brown, S., Greenberg, M. & Kahn, M. (1999) Risk perception in context: the Savannah River Site Stakeholder Study, *Risk Analysis*, 19, pp. 1019–1035.

Comment L12, Page 17 of 17

Response to Comment Letter L12:

L12-1 DOE did not attempt to estimate the total number of jobs generated in the region by implementation of the salt processing alternatives, but estimated the number of direct construction and operations jobs that might be created. DOE believes the differences in numbers of construction and operations jobs estimated by CRESP and DOE are attributable to different assumptions used in the analyses. Further, DOE does not believe that the project cost estimates, an important basis for the CRESP analysis, are refined enough to distinguish between the alternatives, with the exception that Direct Disposal appears to be less costly than the other alternatives.

L12-2 DOE agrees that the results are explained by a number of factors, and that cost of the technologies is an important factor. DOE also agrees that the location of the design and testing functions will affect the local economic impact of the salt processing technology implementation.

L12-3 DOE agrees that the funding mechanism would be important in determining the local economic impacts. DOE does not assume that funds for any specific project would be in addition to a baseline of SRS funding. Funds for SRS operations are appropriated annually by the Congress, on the basis of the President's budget request and the Congress' own analysis of priorities.

L12-4 DOE agrees that the CRESP analysis provides more specific evaluations of the economic impacts, and that the data are based on very preliminary design and cost estimates. The CRESP analysis tends to support DOE's evaluation that economic impacts are not a discriminating factor among the alternatives, especially when the preliminary nature of the design and cost estimates is recognized. The scope of this study exceeded what DOE considered to be necessary to understand the potential impacts of the salt processing alternatives.

L12-5 DOE used several factors to evaluate the alternatives, including cost, schedule, technical maturity, technical implementability, environmental impacts, facility interfaces, process simplicity, process flexibility, and safety.

PUBLIC MEETINGS

The public meetings consisted of brief presentations by DOE on the Draft Supplemental EIS, followed by a question and answer and comment period. In this section, each public meeting speaker's statement is placed in context and paraphrased because some statements are dependent on previous statements and interspersed with other discussion. The transcripts from the meetings can be reviewed at the DOE Public Reading Rooms: DOE Freedom of Information Reading Room, Forrestal Building, Room 1E-190, 1000 Independence Avenue, S.W., Washington, D.C., 20585, phone: 202-586-6020 and DOE Public Document Room, University of South Carolina, Aiken Campus, University Library, 2nd Floor, 171 University Parkway, Aiken, SC 29801, Phone: 803-648-6815.

Paraphrased comments from the meetings and DOE's responses are as follows:

M1-01: One commenter asked that DOE explain the differences in waste generation between the various alternatives, and how waste solvents used in the Solvent Extraction Alternative would be managed.

Response: Waste generation that DOE expects to result from operation of each of the alternatives is shown in Tables 4-18 and 4-19 of the Supplemental EIS. DOE would clean and reuse solvent that would be used in the solvent extraction alternative. Evaluations to date indicate solvent would function as intended for at least one year and perhaps as long as three years. Currently, incineration is considered the best available treatment technology for benzene and other organic liquid wastes. DOE expects that these wastes would be disposed of by incineration. DOE has not yet determined whether the Consolidated Incineration Facility, a portable vendor-operated facility, or a suitable offsite facility would be used for incineration of these wastes. DOE analyzed the impacts of incineration and various alternatives to incineration in the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE/EIS-0082-S, November 1994). The results of this analysis show that the impacts from the various alternatives to incineration are bounded by the impacts of incineration. The actual treatment facility would be determined during design and construction of the salt processing facility.

M1-02: The commenter asked if there were waste management issues with alternatives other than Solvent Extraction.

Response: Management of benzene that would be generated from operation of the Small Tank Precipitation alternative is also an issue. See also response to M1-01.

M2-01: No public comments were made at meeting M2.

M3-01: A commenter asked how the benzene generated from the Small Tank Precipitation alternative would be managed.

Response: See response to comment M1-02.

M3-02: The commenter asked if selection of the Small Tank Precipitation alternative for implementation would affect DOE's decision on the future of the Consolidated Incineration Facility.

Response: Currently, incineration is considered the best available treatment technology for benzene and other organic liquid wastes. DOE expects that these wastes would be disposed of by incineration. DOE has not yet determined whether the Consolidated Incineration Facility, a portable vendor-operated facility, or a suitable offsite facility would be used for incineration of these wastes. DOE

analyzed the impacts of incineration and various alternatives to incineration in the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE/EIS-0082-S, November 1994). The results of this analysis show that the impacts from the various alternatives to incineration are bounded by the impacts of incineration. The actual treatment facility would be determined during design and construction of the salt processing facility.

M3-03 and M3-04: One commenter asked if the salt processing alternative selected would account for the possibility of a liquid waste stream from the Mixed Oxide Fuel Fabrication Facility, currently planned for the Savannah River Site. The commenter also asked if the waste stream from the Mixed Oxide Fuel Fabrication Facility would be similar in composition to the HLW to be processed in the proposed salt processing facility.

Response to comments M3-03 and M3-04: The salt processing alternative would be designed to separate the high-activity and low-activity fractions of any waste stream that has been or would be sent to the Savannah River Site HLW tanks for storage. DOE believes a liquid waste stream from the Mixed Oxide Fuel Facility would be similar enough to existing SRS HLW that it could be safely stored in the SRS HLW tanks and managed through the SRS HLW system, including the salt processing alternative. The annual volume of liquid waste from the Mixed Oxide Fuel Facility is expected to be small relative to the annual volumes of waste generated by DWPF and other Site activities. The impact of that waste stream will be considered in more detail in the U.S. Nuclear Regulatory Commission's EIS on the Mixed Oxide Fuel Facility (See Notice of Intent; 66 FR 1394; March 7, 2001).

M3-05 and M3-06: One commenter asked which of the salt processing alternatives would be the most cost effective, and also asked how much had been spent on the In-Tank Precipitation process.

Response to comments M3-05 and M3-06: Based on very preliminary estimates the Direct Disposal in Grout alternative would be the least expensive to construct and operate. DOE spent approximately $500 million on the In-Tank Precipitation program.

M3-07: One commenter observed that DOE expected that the Direct Disposal in Grout would be the least costly alternative to implement, but that its implementation would necessitate reclassification of the Saltstone Disposal Facility.

Response: The saltstone vaults are designed to the requirements for disposal of Class C low-level waste. The commenter is correct in that DOE would be required to notify the South Carolina Department of Health and Environmental Control if DOE proposed to dispose of waste that exceeded the Class A standards.

M3-08: One commenter wanted to know the half-life of cesium.

Response: The half-life of cesium-137, the dominant radionuclide in SRS salt waste, is 30 years.

M3-09: One commenter asked what discussions had been held with the Environmental Protection Agency and the South Carolina Department of Health and Environmental Control regarding the acceptability of the Direct Disposal in Grout alternative.

Response: Preliminary discussions with regulators (Nuclear Regulatory Commission, SCDHEC, and EPA-Region IV) indicate general acceptance of the Direct Disposal in Grout concept, provided DOE could establish that the final waste form does not require management as HLW. However, if Direct

Disposal in Grout were selected as the preferred alternative, additional discussion with the regulating agencies would be necessary to address regulatory issues.

M3-10 and M3-11: One commenter asked if in the No Action alternative DOE assumed periodic replacement of high-level waste tanks and transfer of waste to new tanks. The commenter also asked if DOE had evaluated in the No Action alternative the failure of HLW tanks and release of HLW to the environment.

Response to comments M3-10 and M3-11: The No Action alternative does not assume that DOE would continue to replace HLW tanks indefinitely if no effective salt processing alternative is found. DOE did not quantitatively evaluate the impacts of the failure of HLW tanks and the release of the contents to the environment in the Draft Supplemental EIS. However, in response to this and other comments, DOE has evaluated the impacts of such a scenario in this Final Supplemental EIS.

M3-12, M3-13, and M3-14: One commenter asked about leaking HLW tanks: how many are leaking now, how many have leaked in the past, what is done with a leaking tank, and in what year did a HLW tank leak to the environment.

Response to Comments M3-12, M3-13, and M3-14: Fifty-one HLW tanks have been constructed at the Savannah River Site, the first in the early 1960s and the last about 1980. Ten of these tanks have had identified leak sites, and only one tank has leaked to the environment (Tank 8, in 1961) and the waste has been removed from that tank. In general, if a leak is identified DOE would lower the waste level in the tank so it was below the leak site. SCDHEC would be notified, as required by the Federal Facility Agreement, and DOE would formulate and implement a plan to stop the leak and clean up any environmental contamination. Because of the radiation environment in tanks, the technology does not exist to repair leak sites. Most of the leaks identified in Savannah River Site have been into the annulus between the primary tank and the secondary containment structure. Collection systems are in place for those tanks that do not have secondary containment.

M3-15: One commenter observed that there were public meetings on the In-Tank Precipitation Process in 1995, and asked what had been done in the interval about precipitation in the HLW tanks.

Response: DOE believes the commenter is referring to public meetings on DOE/EIS-0082-SD, Draft Supplemental Environmental Impact Statement, Defense Waste Processing Facility, which were held in Columbia, South Carolina on September 20, 1994. That Supplemental EIS addressed the proposed operation of the Defense Waste Processing Facility, including the In-Tank Precipitation process. Since that time, DOE has determined that the In-Tank precipitation process cannot meet production goals and safety requirements and is pursuing a technology to replace the In-Tank Precipitation process. Alternative technologies for replacement of the In-Tank Precipitation process are the subject of this Final Supplemental EIS.

M3-16 and M3-17: One commenter expressed the opinion that someone had a lot to answer for, because cleanup is seemingly stopping yet DOE is proceeding with the Mixed Oxide Fuel Fabrication Facility and bringing plutonium from many locations to the Savannah River Site. The commenter asked if DOE had ever planned to remove HLW waste from the HLW tanks.

Response to comments M3-16 and M3-17: The HLW tanks at the Savannah River Site were designed as temporary storage facilities and were never intended for permanent disposal of HLW. DOE and its predecessors began planning for disposal of this HLW more than two decades ago. Cleanup, including nuclear material stabilization and HLW vitrification, is a continuing SRS mission and is not stopping.

M3-18, M3-19, and M3-21: Two commenters expressed opposition to the Mixed Oxide Fuel Fabrication Facility and support for the No Action Alternative in the Salt Processing Alternatives Supplemental EIS. The commenters support the No Action Alternative while the impacts of the potential liquid waste stream from the Mixed Oxide Fuel Fabrication Facility on the Savannah River Site HLW management system is determined.

Response to comments M3-18, M3-19, and M3-21: The purpose and need for DOE action in this SEIS is to achieve the ability to safely process 31.2 million gallons of salt component containing approximately 160 million curies. This need is urgent and predates the proposal for a mixed oxide (MOX) fuel fabrication facility. The notice of intent by the U.S. Nuclear Regulatory Commission to prepare an EIS for a MOX facility was published recently (66 FR 1394; March 7, 2001). At this stage of early planning, DOE does not know if the SRS Tank Farms could or would receive MOX waste. Therefore, DOE must proceed with the salt processing action based on its primary and urgent mission to vitrify the existing waste in the SRS Tank Farms.

M3-20: One commenter asked if there would be a public comment period after the preferred alternative is identified in the Final Salt Disposition Alternatives Supplemental EIS.

Response: Neither the Council on Environmental Quality Regulations implementing the National Environmental Policy Act, nor DOE's regulations implementing NEPA, require a public comment period after a Final EIS (or Final Supplemental EIS) is issued, and DOE does not plan to have such a comment period. DOE may not, however, issue its Record of Decision until 30 days after the Notice of Availability for the Final Supplemental EIS is published in the Federal Register, and members of the public are free to comment during the 30-day period. Generally, DOE addresses any comments received on a Final EIS in its Record of Decision for the EIS.

M4-1 and M4-2: One commenter observed that risk was not a clear discriminator among alternatives and asked what would be the determining factor in the selection process and if DOE was leaning toward one of the alternatives.

Response: DOE has established nine criteria for use in evaluating the salt processing alternatives. These are identified in Section 2.6. There are technical risks associated with each of the alternatives. The research and development process has focused on reducing those risks. There is no one factor that would be the determining factor. At the time of this public meeting, DOE did not have a preferred alternative, but identifies its preferred alternative in this final SEIS.

M4-3, M4-10 and M4-11: One commenter asked if DOE was going to do a pilot demonstration of one or more than one salt processing technology. The commenter also asked about the anticipated operating time of the pilot facility and if a new contractor would be responsible for the pilot facility or only for the construction and operation of the full scale salt processing facility.

Response to comments M4-3, M4-10, and M4-11: As described in Section 4.1.14, DOE has not decided if one or more than one technology would be tested at the pilot scale. DOE plans to operate the pilot plant for a period of 6 to 18 months. DOE has not determined if a new contractor would operate the pilot plant and construct and operate the full-scale facility.

M4-4: One commenter observed that comparing 10 CFR 61.55 Class C waste disposal regulations to the Direct Disposal in Grout alternative may not be appropriate.

Response: DOE has investigated this issue and can find no limit on the quantity of Class C waste that could be placed in a disposal unit (e.g., a disposal cell). The Direct Disposal in Grout alternative

would comply with the waste classification and stability requirements in 10 CFR 61.55 and 10 CFR 61.56. DOE Manual 435.1-1 establishes a process for making waste incidental to reprocessing determinations. This process evaluates candidate waste streams to determine if they can be managed as low-level waste or transuranic waste. Wastes can be managed as low-level waste if they meet specific criteria including being managed pursuant to DOE's authority under the Atomic Energy Act of 1954 and, provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the concentration limits for Class C low-level waste in 10 CFR 61.55. The performance assessment would consider the facility design and location and waste characteristics.

M4-5: One commenter observed that the Ion Exchange alternative seemed to be the simplest and most straightforward alternative and asked if simplicity or relative simplicity was a consideration in the process for selecting a salt processing alternative.

Response: The relative simplicity of the technology is a factor in the technology selection process.

M4-6 and M4-7: One commenter asked where all of the uncertainties with the alternatives were discussed and if bidders on the salt processing facility contract would have access to those uncertainties.

Response to comments M4-6 and M4-7: Uncertainty regarding implementation of the alternatives is a factor in the technology selection process. DOE's evaluations leading to the selection of the preferred alternative will be made available to the public.

M4-8: One commenter observed that the Solvent Extraction alternative was once considered too technically immature to be pursued, and asked what was the maturing process that had made it a reasonable alternative.

Response: The principal developers of the solvent extraction technology had received other funding for their research and development efforts and made considerable progress in developing a stable solvent that performs its functions efficiently for use in the process. Therefore, because other aspects of the technology appear to be mature enough for implementation, DOE has evaluated solvent extraction as a reasonable salt processing alternative.

M4-9: One commenter asked if there were contingencies to free up HLW tank space if the salt processing technology was not operational by 2010.

Response: DOE continues to evaluate contingencies for gaining tank space. These include actions to increase the operational availability of the HLW evaporators, alternatives for management of DWPF recycle waste, and other management efficiencies. Some of the potential actions are described in more detail in Section 2.3 of this Final Supplemental EIS.

M4-10: One commenter asked if DOE intended to try to use existing facilities within SRS for salt processing activities.

Response: DOE does intend to use existing facilities to the extent possible, but each of the action alternatives would require a new facility, which DOE would build on a previously disturbed site in the DWPF area.

M4-11: One commenter asked if the pilot plant would be built and operated by DOE's current contractor or if it would be part of the new salt processing contract.

Response: Contracting questions are outside the scope of the NEPA process.

APPENDIX D

LONG-TERM PERFORMANCE EVALUATION
FOR THE ACTION ALTERNATIVES

TABLE OF CONTENTS

List of Tables

APPENDIX D. LONG-TERM PERFORMANCE EVALUATION FOR THE ACTION ALTERNATIVES

This Appendix describes the methodology used by the U.S. Department of Energy (DOE) in determining long-term impacts that could occur from implementation of the action alternatives described in Chapter 2 of this Supplemental Environmental Impact Statement (SEIS). Long-term impacts of the No Action alternative are described in Chapter 4.

The long-term analysis covers that period of time following 100 years of institutional control as specified in DOE Order 435.1 for determining impacts of low-level waste disposal facilities. DOE expects the primary source of long-term impacts to be saltstone disposal in Z Area. In accordance with the requirements of DOE Order 5480.2A, the *Radiological Performance Assessment for the Z-Area Saltstone Facility* (WSRC 1992), referred to as the RPA, was prepared based on the expected chemical composition of the salt solution that would be transferred from the In-Tank Precipitation (ITP) Facility and the Effluent Treatment Facility. As part of this SEIS process, DOE reviewed the RPA to determine how its conclusions could change if the chemical composition of the salt solution changed as a result of the alternatives analyzed in this SEIS, and how information from the RPA could be used to estimate impacts of the alternative salt solutions.

Although new groundwater models for the Savannah River Site (SRS) are currently under development, DOE believes that the methodology used in the RPA provides a reasonable basis for estimating impacts in this SEIS. Therefore, DOE has chosen to use the general methodology of the RPA to the maximum extent practical, making changes only for those parameters that are unique to the proposed new processes and those that were not analyzed in the RPA, such as differing concentrations of salt in the feed solution among alternatives.

D.1 Description of RPA Approach

This section provides a brief overview of the general methodology used to determine impacts in the RPA. The reader is referred to the RPA (WSRC 1992) for additional details.

As stated, the RPA based its analysis on the source term in the salt solution that was expected to be transferred to the Saltstone Manufacturing and Disposal Facility from the ITP and the Effluent Treatment Facilities, with the bulk of the material coming from ITP.

Because the high-level waste (HLW) tanks contain a myriad of fission products, activation products, actinides, and chemicals, the RPA performed a sensitivity analysis to identify those contaminants that would be most likely to present long-term impacts. This was based on a variety of factors, such as the quantity of the material projected to be present in the saltstone, the half-lives of the radiological constituents, and the ability of the saltstone to chemically bind the contaminants to minimize leaching.

The RPA also considered the pathways by which individuals could be exposed in the future to determine which pathways warranted detailed analysis. Based on early estimates, the primary pathways to which a person could be exposed were the following:

- A drinking water scenario where the individual consumes water from a well drilled into the aquifer that contains contaminants from the saltstone. This scenario is not assumed to be possible until at least 100 years post-closure.

- An agricultural scenario, in which an individual unknowingly farms on the soil above the saltstone vaults and constructs a home on the vaults. In this scenario, the individual is assumed to derive half of his vegetable consumption from a garden planted in contaminated soil located over the vaults. The

time spent gardening is assumed to be short (100 hr/yr), compared to the amount of time spent indoors (4000 hr/yr) or farming. Doses from external radiation, inhalation, incidental soil ingestion, and vegetable ingestion are calculated only for indoor residence and outdoor gardening activities. Since the farming activities are assumed to occur over a widespread area that would include uncontaminated and undisturbed soil not subject to irrigation with contaminated water, the meat and milk pathways would not contribute significantly to the individual's dose. DOE expects that the saltstone would remain relatively intact for an extended period of time; therefore, DOE does not believe this scenario would be reasonable until approximately 10,000 years post-closure because, at least until that time, an individual could identify that he was digging into a cementitious material. However, for conservatism, DOE calculated the impacts of the agricultural scenario at 1,000 years post-closure.

- A residential scenario, in which an individual constructs and lives in a permanent residence on the vaults. This scenario has two options: construction at 100 years post-closure and construction at 1,000 years post-closure (evaluated as part of the agricultural scenario). Under the first option, a sufficient layer of soil would be present over the still-intact vaults so that the resident would be unaware that the residence was constructed on the vaults. Under the second option, the saltstone is assumed to have weathered sufficiently so that the resident could construct a residence without being aware of the presence of the saltstone.

The RPA assumed that institutional control would be maintained for 100 years after closure, during which time the land encompassing the saltstone vaults would be managed to prevent erosion or other conditions that would lead to early degradation of the vaults. The public is also assumed to have no access to Z Area during this time.

The analysis of groundwater impacts is based on PORFLOW-3D, a 3-dimensional finite difference model of flow and transport for both the near field and the far field. The near-field analysis considers flow and transport from the ground surface, through the saltstone, vault, and unsaturated zone, to the water table. The far-field analysis considers flow and transport through the water table and underlying aquifers. The ultimate results of the modeling effort are the maximum concentrations of the contaminants of interest at a point 100 meters downgradient from the downgradient edge of the disposal facility. It is at this "compliance" point that the groundwater quality is compared to water quality standards.

The analysis of doses from other pathways in the agricultural and residential scenarios begins with the calculated concentrations in the saltstone and surrounding soil, to which the appropriate pathway transfer coefficients and dose conversion factors are applied.

The RPA examined the potential impacts of saltstone disposal for the cases in which the saltstone remained intact and in which the saltstone failed structurally. For groundwater modeling, the greater impacts presented in the RPA are associated with failed saltstone. Therefore, this SEIS presents the results associated with failed saltstone.

D.2 Modifications to the RPA Approach for the SEIS Analysis

Because of the extensive nature of the RPA, DOE chose to rely on many of the technical bases presented in it. However, DOE did modify the calculations in the RPA to account for the following:

- the differences in salt solution concentrations for the Ion Exchange alternative, the Solvent Exchange alternative, and the Direct Disposal in Grout alternative from those for

the ITP case (equivalent to the Small Tank Precipitation alternative)

- the difference in number and design of vaults for the current suite of alternatives, compared to the vaults analyzed in the RPA

- the need to calculate groundwater concentrations 1 meter downgradient from the downgradient edge of the disposal facility to be consistent with the SRS Tank Closure EIS. Because Z Area is a low-level waste disposal facility, it is exempt from the Resource Conservation and Recovery Act (RCRA) regulations pertinent to the high-level waste tanks that require an assessment of impacts 1 meter downgradient. The analysis is included to better compare the impacts of the two actions.

- the need to calculate groundwater concentration at the seeplines of nearby streams to determine impacts on ecological resources

- the difference in measured properties of the current formulation of saltstone, compared to those analyzed previously in the RPA.

The saltstone concentrations for analysis in this SEIS were based on the concentrations in the original RPA, adjusted to account for the increase in sodium molarity as projected in the engineering flow sheets (WSRC 1998) for the alternatives. Increased sodium molarity is indicative of increased overall concentrations; the alternatives with higher sodium molarities were assumed to also have higher overall concentrations of other constituents in proportion to the increase in sodium molarity. The concentration of cesium isotopes for the Direct Disposal in Grout alternative was calculated, based on the estimated cesium-137 inventory in the HLW tanks and the volume of saltstone produced. The concentrations of other cesium isotopes were calculated, based on isotopic ratios derived from the RPA. For this SEIS, the

source information from Tables A-1 and A-2 in Appendix A was used.

The methodology used in the RPA for the agricultural and residential scenarios was unchanged and is not repeated in this Appendix. Most of the other changes to calculations in the RPA pertained to groundwater modeling, as discussed in the following section.

D.3 Groundwater Modeling Modifications

The present analysis is based on the results of the detailed peer-reviewed model in the RPA. The results presented there are used here, for conditions at which the RPA calculations and the SEIS are equivalent. For non-equivalent conditions, the RPA results are scaled by use of an analytical model which includes all of the important transport mechanisms. Modifications to the previous study were included to account for changes in the release rate to the water table (Table D-1). These changes would occur because of changes in radionuclide content of the saltstone among the alternatives, because of modifications to saltstone transport parameters established in Langton 1999, and because of a change in the total number of vault cells from the earlier study. Extensions to the previous modeling study were also included to allow for calculation of concentrations at locations other than the compliance point. Specifically, concentrations were calculated for a well 1-meter downgradient of Z Area and for the seeplines of the water table (to McQueen Branch) and Gordon (to Upper Three Runs) aquifers. The seepline aquifer discharge points were taken to be 450 and 1,500 meters, respectively, from the downgradient edge of the facility.

The extension of the previous modeling study was based on the assumption that an analytical model of aquifer transport, which includes the important mechanisms included in the original study, would simulate the relative downgradient concentrations in the aquifer. The model chosen (Pigford et al. 1980) considers three-dimensional dispersion, advection, adsorption, and decay

Table D-1. Modifications to the RPA's parameters for this SEIS.

Parameter	Previous study (RPA)	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Number of cells	174	109	90	101	82
Waste solution sodium molarity	4.6	4.6	5.3	4.3	5.6
Nitrate diffusivity through saltstone, (square centimeters per second)	5.07×10^{-9}	6.00×10^{-8}	6.00×10^{-8}	6.00×10^{-8}	6.00×10^{-8}
Cesium adsorption co-efficient in saltstone (milliliters per gram)	2	200	200	200	200

from a continuous release. Continuous re-lease is necessary because of the long-term releases from the facility. This model in-cludes daughter ingrowth and independent transport (i.e., with the daughter's transport parameters), although the contaminants of concern for the present study are not daughter products. The model, as originally presented, calculates concentration as a function of release rate, aquifer velocity, dispersivity (in three dimensions), decay rate, adsorption coefficient, and time. The concentrations are given in terms of distance (longitudinal, lateral, and vertical to aquifer flow) from a point source release. Because of the size of the facility (on the order of a few hundred meters on a side), relative to the downgradient distances of interest (i.e., 1 and 100 meters), it was necessary to modify the point source solution to account for an area source. The point source solution of the original source was generalized to a horizontal area source solution (consistent with the saltstone footprint) by integrating the point source solution over the facility area and dividing by this area. If the area source solution described above is denoted $C_a(x,y,z,t)$ and the solution of the previous detailed model is $C_{rpa}(100,0,0,t_{max})$ (i.e., the maximum concentration at the compliance point), then the concentration as presented here is estimated as:

$$Cs = \frac{C_{rpa}(100,0,0,t_{max}) \times C_a(x,y,z,t)}{C_a(100,0,0,t_{max})}$$

where C = concentration, x = distance along aq-uifer flow path, y = distance horizontally trans-verse to aquifer flow, z = vertical distance (all directions measured from the projection of the middle of the downgradient edge of the facility on the water table), and t = time from initial re-lease to water table.

For the conditions analyzed in the RPA (x = 100m, y = z = 0, t = t_{max}), Cs = C_{rpa}), com-paring Table D-2 with the results of the RPA illustrates some of the changes from the RPA analysis to this SEIS. The Small Tank Precipi-tation alternative is most similar to the process analyzed in the RPA; the Direct Disposal in Grout alternative is the least similar. Therefore, the Small Tank Precipitation alternative results would be expected to be most similar to the RPA results, based on the number of vault cells (see Table D-1); with fewer vault cells, the other ce-sium removal alternatives should result in smaller concentrations at 100 meters. This is the case (Table D-2). Using this reasoning, the Di-rect Disposal in Grout alternative would also be expected to result in smaller concentrations than the Small Tank Precipitation alternative because it has fewer vault cells. However, in this case, a reduction in the number of vault cells is offset by an increase in solution sodium molarity of Direct Disposal in Grout saltstone (Table D-2). Both alternatives result in slightly lower con-centrations than that of the RPA analysis. Note that the RPA did not analyze the concentration of Cs-135; it is a relatively important contributor only to the Direct Disposal in Grout alternative.

Table D-2. Maximum Groundwater concentrations at 1 meter downgradient, 100 meters downgradient, and at the seepline.[a]

		Carbon-14 (picocuries per liter)[b]	Selenium-79 (picocuries per liter)[b]	Technetium-99 (picocuries per liter)[b]	Tin-126 (picocuries per liter)[b]	Iodine-129 (picocuries per liter)[b]	Cesium-135 (picocuries per liter)[b]	Nitrate (milligrams per liter)[c]
1-meter concentrations								
Upper Three Runs Aquifer	Small Tank Precipitation	1.0×10^{-4}	7.0	17	0.0039	0.11	4.0×10^{-5}	56
	Ion Exchange	1.1×10^{-4}	8.2	20	0.0047	0.13	4.5×10^{-5}	66
	Solvent Extraction	9.4×10^{-5}	6.4	15	0.0036	0.10	3.7×10^{-5}	51
	Direct Disposal in Grout	1.2×10^{-4}	8.2	20	0.0046	0.13	0.50	66
Gordon Aquifer	Small Tank Precipitation	6.7×10^{-4}	42	104	0.024	0.68	2.5×10^{-4}	338
	Ion Exchange	6.7×10^{-4}	49	121	0.029	0.82	2.7×10^{-4}	395
	Solvent Extraction	5.6×10^{-4}	38	94	0.022	0.63	2.3×10^{-4}	307
	Direct Disposal in Grout	7.2×10^{-4}	49	120	0.029	0.81	3.1	394
100-meter concentrations								
Upper Three Runs Aquifer	Small Tank Precipitation	8.2×10^{-6}	0.59	1.4	3.0×10^{-4}	0.0096	3.5×10^{-6}	4.8
	Ion Exchange	8.9×10^{-6}	0.63	1.5	3.2×10^{-4}	0.01	3.7×10^{-6}	5.1
	Solvent Extraction	7.5×10^{-6}	0.54	1.3	2.7×10^{-4}	0.0088	3.2×10^{-6}	4.4
	Direct Disposal in Grout	9.6×10^{-6}	0.68	1.7	3.5×10^{-4}	0.011	4.2×10^{-2}	5.6
Gordon Aquifer	Small Tank Precipitation	5.0×10^{-5}	3.5	8.8	0.0019	0.059	2.2×10^{-5}	29
	Ion Exchange	5.3×10^{-5}	3.8	9.4	0.002	0.063	2.3×10^{-5}	31
	Solvent Extraction	4.5×10^{-5}	3.2	8.0	0.0017	0.054	2.0×10^{-5}	26
	Direct Disposal in Grout	5.8×10^{-5}	4.1	10	0.0022	0.069	0.26	33
	RPA[c]	6.0×10^{-6}	4.4	11	0.0022	0.075	Not calculated	36
Seepline concentrations								
McQueen Branch	Small Tank Precipitation	1.9×10^{-6}	0.16	0.42	5.7×10^{-5}	0.0028	9.8×10^{-7}	1.4
	Ion Exchange	2.1×10^{-6}	0.17	0.44	6.1×10^{-5}	0.0029	1.0×10^{-6}	1.5
	Solvent Extraction	1.8×10^{-6}	0.15	0.38	5.2×10^{-5}	0.0029	8.9×10^{-7}	1.3
	Direct Disposal in Grout	2.2×10^{-6}	0.19	0.48	6.6×10^{-5}	0.0032	0.012	1.6
Upper Three Runs	Small Tank Precipitation	2.0×10^{-6}	0.23	0.66	3.9×10^{-5}	0.0045	1.5×10^{-6}	2.2
	Ion Exchange	1.9×10^{-6}	0.23	0.64	3.9×10^{-5}	0.0044	1.5×10^{-6}	2.1
	Solvent Extraction	1.7×10^{-6}	0.20	0.58	3.5×10^{-5}	0.0039	1.3×10^{-6}	1.9
	Direct Disposal in Grout	2.1×10^{-6}	0.25	0.72	4.3×10^{-5}	0.0049	0.017	2.4

Source: WSRC (1992) Table 4.1-6.

a. The concentrations reported are the maximum for each nuclide and alternative that would occur in the 1,000-year period of analysis. The maximum occurrences are not simultaneous; they would occur at different times during the 1,000-year time period.

b. Concentrations of radiological constituents are presented in units of picocuries per liter.

c. Concentrations of nonradiological constituents are presented in units of milligrams per liter.

The number of saltstone vaults is presented in Chapter 2 and Appendix A of this document. The effect of reducing the number of saltstone vaults on the modeling is to decrease the surface area through which precipitation will infiltrate and leach the constituents; the previous study's release rates were therefore multiplied by the ratio of facility surface areas. The saltstone concentration increases with increasing sodium molarity; the previous study's release rates were multiplied by the ratio of molarities. The exception to the latter was for the cesium isotopes in the Direct Disposal in Grout alternative, as described in Chapter 2 and Appendix A of this SEIS.

A recent laboratory study (Langton 1999) indicates that the diffusivity of nitrate through saltstone is greater than that assumed in the previous RPA. This has the potential to increase the nitrate release rate from the saltstone after failure. The RPA showed that the nitrate release has two components: an advective "fracture" release (decreasing over time) from the cracks formed in the grout; and a later "intact" diffusive release from the internal pores of the grout to the fracture planes. Changes in the "intact" diffusive release have been shown to be proportional to the square root of the ratio of diffusivities (Wallace 1986). The time-dependent nitrate release rate indicated in the previous RPA was re-examined in light of the revision in diffusivity indicated in Table D-1. It was found that the initial "fracture" release was larger than the sum of the later "fracture" releases plus the "intact" release. The initial "fracture" release rate, which is independent of diffusivity, was conservatively assumed for this analysis.

The Langton study also indicated an increase in cesium adsorption coefficient in saltstone from that used in the RPA. This increase in saltstone constituent adsorption coefficient results in an approximately linear decrease in cesium concentration in pore water and, therefore, an approximately linear decrease in the cesium release rate.

The values from the Langton study are expected to better represent the conditions for salt processing than the values chosen for the RPA. The former were laboratory measurements of adsorption between the constituents studies (nitrate and cesium) and the saltstone formulae that would be used for this project; the latter were conservatively low choices from a range of literature values describing adsorption of the constituents with concrete not specific to salt processing. Use of the cesium adsorption coefficient suggested by the Langton study, in place of the literature value used in the RPA, will significantly decrease the predicted cesium transport.

All other parameters used in the previous study were used in the present study. Because the previous study only considered a single point (compliance point), a single value of dispersivity for each direction was used. The values used at that location (3 meters for longitudinal, 0.3 meters for transverse) were generalized to other distances by assuming that the ratio of distance to dispersivity is constant. The vertical dispersivity was taken as 2.5×10^{-3} times the longitudinal dispersivity (Buck et al. 1995).

D.4 Results

Table D-2 presents the maximum groundwater concentrations calculated by using the methodology described above. For comparison purposes, the results from the RPA are presented at the 100m compliance point. Table D-3 presents the radiological doses resulting from concentrations of radiological constituents in the groundwater. The source information in these tables was used for the SEIS.

- Table D-4 presents the calculated doses for the agricultural and residential scenarios. For all the scenarios, most of the dose is due to external exposure. External radiation exposures were calculated, based on the same assumptions regarding post-closure conditioning in the vaults used in the RPA. Dose correction factors were derived using an approach that considered a finite size of the excavation, which would not uncover the

TC

Table D-3. Radiological doses due to consumption of groundwater 1 meter downgradient, 100 meters downgradient, and at the seepline.

Downgradient		Total (millirem per year)	Carbon-14 (millirem per year)	Selenium-79 (millirem per year)	Technetium-99 (millirem per year)	Tin-126 (millirem per year)	Iodine-129 (millirem per year)	Cesium-135 (millirem per year)
1-meter doses								
Upper Three Runs Aquifer	Small Tank Precipitation	0.080	1.5×10^{-7}	4.3×10^{-2}	1.6×10^{-2}	5.0×10^{-5}	2.2×10^{-2}	2.1×10^{-7}
	Ion Exchange	0.095	1.7×10^{-7}	5.0×10^{-2}	1.9×10^{-2}	6.1×10^{-5}	2.6×10^{-2}	2.3×10^{-7}
	Solvent Extraction	0.074	1.4×10^{-7}	3.9×10^{-2}	1.5×10^{-2}	4.7×10^{-5}	2.0×10^{-2}	1.9×10^{-7}
	Direct Disposal in Grout	0.096	1.8×10^{-7}	5.0×10^{-2}	1.9×10^{-2}	6.0×10^{-5}	2.6×10^{-2}	2.6×10^{-3}
Gordon Aquifer	Small Tank Precipitation	0.49	9.1×10^{-7}	2.6×10^{-1}	9.8×10^{-2}	3.1×10^{-4}	1.4×10^{-1}	1.3×10^{-6}
	Ion Exchange	0.58	1.0×10^{-6}	3.0×10^{-1}	1.2×10^{-1}	3.8×10^{-4}	1.6×10^{-1}	1.4×10^{-6}
	Solvent Extraction	0.45	8.4×10^{-7}	2.3×10^{-1}	8.9×10^{-2}	2.9×10^{-4}	1.3×10^{-1}	1.2×10^{-6}
	Direct Disposal in Grout	0.57	1.1×10^{-6}	3.0×10^{-1}	1.1×10^{-1}	3.8×10^{-4}	1.6×10^{-1}	1.6×10^{-2}
100-meter doses								
Upper Three Runs Aquifer	Small Tank Precipitation	6.8×10^{-3}	1.2×10^{-8}	3.6×10^{-3}	1.4×10^{-3}	3.8×10^{-6}	1.9×10^{-3}	1.8×10^{-8}
	Ion Exchange	7.3×10^{-3}	1.3×10^{-8}	3.8×10^{-3}	1.5×10^{-3}	4.2×10^{-6}	2.1×10^{-3}	2.0×10^{-8}
	Solvent Extraction	6.2×10^{-3}	1.1×10^{-8}	3.3×10^{-3}	1.2×10^{-3}	3.5×10^{-6}	1.8×10^{-3}	1.7×10^{-8}
	Direct Disposal in Grout	7.9×10^{-3}	1.4×10^{-8}	4.2×10^{-3}	1.6×10^{-3}	4.5×10^{-6}	2.2×10^{-3}	2.2×10^{-4}
Gordon Aquifer	Small Tank Precipitation	4.2×10^{-2}	7.4×10^{-8}	2.2×10^{-2}	8.4×10^{-3}	2.5×10^{-5}	1.2×10^{-2}	1.1×10^{-7}
	Ion Exchange	4.4×10^{-2}	8.0×10^{-9}	2.3×10^{-2}	8.9×10^{-3}	2.7×10^{-5}	1.3×10^{-2}	1.2×10^{-7}
	Solvent Extraction	3.8×10^{-2}	6.8×10^{-8}	2.0×10^{-2}	7.6×10^{-3}	2.2×10^{-5}	1.1×10^{-2}	1.1×10^{-7}
	Direct Disposal in Grout	4.8×10^{-2}	8.7×10^{-8}	2.5×10^{-2}	9.7×10^{-3}	2.9×10^{-5}	1.4×10^{-2}	1.3×10^{-3}
Seepline doses								
McQueen Branch	Small Tank Precipitation	1.9×10^{-3}	2.9×10^{-9}	1.0×10^{-3}	4.0×10^{-4}	7.4×10^{-7}	5.6×10^{-4}	5.1×10^{-9}
	Ion Exchange	2.0×10^{-3}	3.1×10^{-9}	1.0×10^{-3}	4.2×10^{-4}	7.9×10^{-7}	5.9×10^{-4}	5.4×10^{-9}
	Solvent Extraction	1.7×10^{-3}	2.7×10^{-9}	9.0×10^{-4}	3.6×10^{-4}	6.7×10^{-7}	5.0×10^{-4}	4.8×10^{-9}
	Direct Disposal in Grout	2.2×10^{-3}	3.4×10^{-9}	1.1×10^{-3}	4.5×10^{-4}	8.5×10^{-7}	6.4×10^{-4}	6.0×10^{-5}
Upper Three Runs	Small Tank Precipitation	2.9×10^{-3}	2.9×10^{-9}	1.4×10^{-3}	6.3×10^{-4}	5.1×10^{-7}	8.9×10^{-4}	7.8×10^{-9}
	Ion Exchange	1.8×10^{-3}	2.9×10^{-9}	1.4×10^{-3}	6.1×10^{-4}	5.0×10^{-7}	8.7×10^{-4}	7.7×10^{-9}
	Solvent Extraction	2.5×10^{-3}	2.6×10^{-9}	1.2×10^{-3}	5.5×10^{-4}	4.5×10^{-7}	7.8×10^{-4}	7.3×10^{-9}
	Direct Disposal in Grout	3.2×10^{-3}	3.2×10^{-9}	1.5×10^{-3}	6.8×10^{-4}	5.6×10^{-7}	9.7×10^{-4}	8.5×10^{-5}

Table D-4. Radiological doses from the agricultural and residential scenarios.

	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Agricultural scenario at 1,000 years post-closure[a]				
Inhalation while outdoors (millirem per year)	0.010	0.012	0.0096	0.013
Ingestion of vegetables (millirem per year)	42	49	39	52
Incidental ingestion of soil (millirem per year)	0.7	0.81	0.66	0.88
Inhalation while indoors (millirem per year)	0.26	0.3	0.24	0.32
External radiation while outdoors (millirem per year)	0.33	0.39	0.31	0.41
External radiation while indoors (millirem per year)	69	80	65	85
Total (millirem per year)	110	130	110	140
Residential scenario at 100 years post-closure[b] (millirem per year)	0.11	0.13	0.10	1200[c]
Residential scenario at 1,000 years post-closure[a,b] (millirem per year)	69	80	65	85

a. Residential scenario at 1,000 years post-closure is also included in the agricultural scenario.
b. The external radiation dose and latent cancer fatalities 1,000 years post-closure are higher than that 100 years post-closure because soil cover that would provide adequate shielding would be present 100 years post-closure, but is assumed to have eroded away by 1,000 years post-closure.
c. The external dose for the Direct Disposal in Grout alternative in the 100-year scenario is due primarily to cesium-137 (30 year half-life). For all other alternatives and scenarios, the external dose is due primarily to isotopes with long half-lives.

area of an entire vault and would result in a four-fold reduction in external dose relative to the dose from a fully uncovered vault. The differences in the ranges of external doses among alternatives are due to the different concentrations of radionuclides. For the Direct Disposal in Grout alternative's 100-year residential exposure scenario, the external dose is due primarily to cesium-137; for all other alternatives and scenarios, the external dose is due primarily to tin-126 and its decay products.

D.5 Discussion of Uncertainty

In this SEIS, DOE has made assumptions regarding the numerical parameters that affect the calculated impacts. Some uncertainty is associated with the values of these parameters, due to unavailable data and cur-

rent knowledge concerning closure processes and long-term behaviors of materials. The principal parameters that affect modeling results are the following:

- **Saltstone characteristics:** The volume of saltstone and constituent chemical and radionuclide concentrations determine the concentrations of release constituents at any given location. As discussed earlier, the concentrations of the saltstone constituents inventory are based primarily on data previously presented in the RPA and updated with information from more recent engineering flow sheets.

- **Hydraulic conductivity:** The rate of water movement through material is ultimately affected by the hydraulic conductivity of the geologic strata underneath the source. Gen-

L6-32

L4-10

TC

TC

erally, the grout or concrete basemat is the limiting layer with regard to water infiltration. Over time, cracks developing in the saltstone increase the hydraulic conductivity dramatically, making more water available to carry contaminants to the aquifer. This increase results in greater doses/concentra-tions, due to the increased transport of the contaminants.

- **Distribution coefficient:** The distribution coefficient (K_d) affects the rate at which contaminants move through the geologic strata. Large K_d values provide holdup time for short-lived radionuclides.

  Vadose zone thickness: The thickness of the geologic strata between the contaminated region and the aquifer does not necessarily reduce the concentration as much as it slows movement of contaminants toward the aquifer. For shorter-lived radionuclides, extra time provided by thicker strata decreases the

activity of the contaminants reaching the aquifer.

- **Distance downgradient to receptor location:** The distance to a given receptor location affects (a) the time at which contaminants will arrive at the receptor location, and (b) the extent of dispersion that occurs. For greater distances, longer travel times will occur, resulting in lower activity values for short-lived radioactive constituents and greater dispersion for all constituents.

DOE recognizes that, over the period of analysis in this SEIS, there is also uncertainty in the structural behaviors of materials and the geologic and hydrogeologic setting of the SRS. DOE realizes that overly conservative assumptions can be used to bound the estimates of impacts; however, this approach could result in masking differences of impacts among alternatives. Therefore, DOE has used assumptions in its modeling analysis that are reasonable, based on current knowledge, to develop meaningful comparisons among alternatives considered.

References

Buck, J. W., G. Whelan, J. G. Droppo, Jr., D. L. Strenge, K. J. Castleton, J. P. McDonald, C. Sato, and G. P. Striele, 1995, *Multimedia Environmental Pollutant Assessment System (MEPAS) Application Guidance*, PNL-10395/UC-630, Pacific Northwest Laboratory, Richland, Washington.

Langton, C. A., 1999, *Direct Grout Stabilization of High Cesium Salt Waste: Cesium Leaching Studies*, WSRC-TR-99-00227, Rev. 0, Savannah River Technology Center, Aiken, South Carolina.

Pigford, T. H., P. L. Chambré, M. Albert, M. Foglia, M. Harada, F. Iwamoto, T. Kanki, D. Lenng, S. Masnada, S. Muraoka, and D. Ting, 1980, *Migration of Radionuclides through Sorbing Media Analytical Solutions – II*, LBL-11616, Lawrence Berkeley Laboratory Earth Sciences Division, Berkeley, California.

Wallace, R. M., (Savannah River Laboratory), 1986, "Simple Model of Nitrate Release from a Saltstone Vault Containing Concrete Barriers," memorandum to E. L. Wilhite, Savannah River Laboratory, DPST-86-487, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1992, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, WSRC-RP-92-1360, Prepared by Martin Marietta Energy Systems, Inc.

WSRC (Westinghouse Savannah River Company), 1998, *Bases, Assumptions, and Results of the Flowsheet Calculations for the Short List Salt Disposition Alternatives*, WSRC-RP-98-00168, Rev. 1, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 2000, *Savannah River Site High Level Waste System Plan*, HLW-2000-00019, Rev. 11, Aiken, South Carolina.

LIST OF PREPARERS

This section lists the individuals who contributed to the technical content of this supplemental environmental impact statement (SEIS). The preparation of the SEIS was directed by A. R. Grainger and L. T. Ling of the U. S. Department of Energy (DOE) and B. H. Bradford of Tetra Tech NUS, Inc.

Some of the individuals listed below prepared specific sections in accordance with their technical qualifications. Other technical experts provided input to those sections through in-depth review and data verification. Still others provided overall technical or management reviews for their respective organizations.

NAME:	**BRUCE H. BRADFORD, P.E.**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	Ph.D., Civil Engineering, 1974 M.S., Civil Engineering, 1966 B.S., Civil Engineering, 1965
TECHNICAL EXPERIENCE:	Fifteen years of preparing NEPA documents; 31 years of experience in civil engineering, specializing in hydrology, hydraulics, and water resources.
SEIS RESPONSIBILITY:	Project Manager; prepared Comparison of Impacts Among Alternatives in Chapter 2.
NAME:	**STEVE CONNOR**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.S., Physics, 1974 B.S., Physics, 1973
TECHNICAL EXPERIENCE:	Twenty-three years of experience in environmental management systems, radiological effluent monitoring, analytical laboratory quality assurance, gamma spectrometry, radiological transportation risk assessments, environmental transport, dose assessments, human health risk assessments, and NEPA document preparation.
SEIS RESPONSIBILITY:	Line Manager.

NAME:	**WILLIAM J. CRAIG**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.S., Planning, 1977 B.S., Forestry, 1972
TECHNICAL EXPERIENCE:	Twenty years of experience in utility fuel planning and nuclear power plant siting.
SEIS RESPONSIBILITY:	Prepared Socioeconomics and Land Use sections of Chapters 3 and 4.
NAME:	**KENT T. CUBBAGE**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.S., Ecotoxicology, 1993 B.S., Biology, 1991
TECHNICAL EXPERIENCE:	Five years of experience as an ecotoxicologist.
SEIS RESPONSIBILITY:	Prepared Long-Term Ecological Resources sections of Chapter 4 and Appendix D.
NAME:	**ERNESTO R. FAILLACE, CHP**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	EngD., Nuclear Engineering, 1988 M.S./B.S., Nuclear Engineering, 1984
TECHNICAL EXPERIENCE:	Two years of experience performing analyses for NEPA documents; 13 years of experience in nuclear engineering and health physics performing nuclear safety analysis, radiological dose assessments, human health risk assessments, and environmental transport and training.
SEIS RESPONSIBILITY:	Contributed to chapters 1, 2 and 4, Appendix D, and Glossary.
NAME:	**D. SCOTT FLICKINGER**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.E.M., Natural Resource Economics and Policy, 1988 B.A., Biology and Political Science, 1985
TECHNICAL EXPERIENCE:	Three years of preparing NEPA documents; 13 years of experience in hazardous waste management and remediation, specializing in natural attenuation, permitting, and closure documentation.
SEIS RESPONSIBILITY:	Reviewer for Chapters 3 and 4 Waste Management elements and Chapter 7. Coordinator of Comment Resolution on Preliminary SEIS.

NAME:	**PHILIP C. FULMER, CHP**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	Ph.D., Nuclear Engineering, 1993 M.S., Health Physics, 1990 B.S., Health Physics, 1989
TECHNICAL EXPERIENCE:	Ten years of experience in radiation protection, internal radiation dosimetry, and external radiation dosimetry.
SEIS RESPONSIBILITY:	Lead analyst for Long-Term Performance Evaluation sections of Chapter 4 and Appendix D.
NAME:	**NEIL J. GILBERT, P.E., P.G.**
AFFILIATION:	Zapata Engineering, P.A.
EDUCATION:	M.S., Geotechnical Engineering, 1972 M.A., Geology, 1969 A.B., Geology, 1967
TECHNICAL EXPERIENCE:	Twenty-seven years of experience in geologic mapping and development of tectonic histories for permitting of nuclear facilities, geotechnical engineering for structures and dams, and hydrogeology for evaluation, permitting, and design of waste facilities.
SEIS RESPONSIBILITY:	Prepared Geology and Groundwater sections of Chapters 3 and 4.
NAME:	**ANDREW R. GRAINGER**
AFFILIATION:	U. S. Department of Energy
EDUCATION:	M.S., Wildlife Ecology, 1978 B.S., Natural Resources, 1975
TECHNICAL EXPERIENCE:	Twelve years of preparing NEPA documents; 18 years of experience in terrestrial ecology, facility siting, wetlands ecology, and endangered species management.
SEIS RESPONSIBILITY:	NEPA Compliance Officer; NEPA Specialist for the SEIS; DOE-SR reviewer for Draft SEIS; prepared Summary, Chapters 1 and 2, and Appendix C.

NAME:	**GARY L. GUNTER**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	B.S., Geology, 1984
TECHNICAL EXPERIENCE:	Ten years of experience in geology and hydrogeology projects, specializing in groundwater assessment and remediation.
SEIS RESPONSIBILITY:	Reviewed Geologic Resources and Groundwater sections of Chapters 3 and Short-Term Geologic and Groundwater Resources sections of Chapter 4; prepared Long-Term Geologic Resources sections of Chapter 4 and Appendix D.

NAME:	**KATHRYN B. HAUER**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.A., English, 1985 B.A., English, 1983
TECHNICAL EXPERIENCE:	Eleven years of experience in technical writing, editing, and teaching in both government and business disciplines.
SEIS RESPONSIBILITY:	Technical Editor.

NAME:	**BRIAN A. HILL**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	B.S., Health Physics/Industrial Hygiene, 1988
TECHNICAL EXPERIENCE:	Three years of preparing NEPA documents; 12 years of experience in the areas of health physics, industrial hygiene, occupational safety, emergency preparedness, and waste management.
SEIS RESPONSIBILITY:	Prepared Environmental Justice sections of Chapters 3 and 4.

NAME:	**ALLAN JENKINS**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	B.S., Geology, 1975 A.S., General Studies, 1972
TECHNICAL EXPERIENCE:	Seventeen years of experience in engineering geology, hydrogeology, environmental investigations, and remediation of petroleum-contaminated soil and groundwater.
SEIS RESPONSIBILITY:	Prepared Long-Term Groundwater Resources section of Chapter 4; contributed to Appendix D.

NAME:	**LARRY T. LING**
AFFILIATION:	U. S. Department of Energy
EDUCATION:	B.S., Chemical Engineering, 1982
TECHNICAL EXPERIENCE:	Three years of preparing or reviewing NEPA documents; over 17 years of experience in nuclear facilities and systems.
SEIS RESPONSIBILITY:	Document Manager; DOE reviewer of Draft SEIS.
NAME:	**ANNE C. LOVELL, P.E., CHMM**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	B.S., Chemical Engineering, 1985
TECHNICAL EXPERIENCE:	Seventeen years of experience in chemical/environmental engineering in DOE and commercial nuclear projects, systems engineering, risk assessment, waste management, and regulatory compliance. Three years of experience in preparing NEPA documents.
SEIS RESPONSIBILITY:	Primary author of Chapter 4 and Appendix B; contributor to Chapters 1, 2, 3, 5, and 6.
NAME:	**LISA A. MATIS**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.S., Mechanical Engineering, 1989 B.S., Chemical Engineering, 1984
TECHNICAL EXPERIENCE:	Fourteen years of experience in chemical-environmental engineering.
SEIS RESPONSIBILITY:	Prepared Waste and Materials sections of Chapters 3 and 4; prepared Chapter 7.
NAME:	**JAMES W. MCCULLOUGH, JR., P.E.**
AFFILIATION:	U. S. Department of Energy
EDUCATION:	B.S., Civil Engineering, 1975
TECHNICAL EXPERIENCE:	Twenty-six years of experience in engineering design and program management for nuclear systems and facilities.
SEIS RESPONSIBILITY:	DOE reviewer of Draft SEIS; contributed to Chapter 2.

NAME:	**WILLIAM R. McDONELL**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	Ph.D., Nuclear Chemistry, University of California (Berkeley), 1951 M.S., Chemistry, University of Michigan, 1948 B.S., Chemistry, University of Michigan, 1947
TECHNICAL EXPERIENCE:	Forty-nine years of experience in nuclear and radiation technologies, including development of strategies for disposal of nuclear wastes.
SEIS RESPONSIBILITY:	Data Manager; prepared Appendix A.
NAME:	**PHILIP R. MOORE**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.S., Wildlife and Fisheries Biology, 1983 B.A., English, 1975
TECHNICAL EXPERIENCE:	Seventeen years of experience as fishery biologist and aquatic ecologist.
SEIS RESPONSIBILITY:	Prepared Surface Water and Ecological sections of Chapters 3 and 4.
NAME:	**APARAJITA S. MORRISON**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	B.S., Health Physics, 1985
TECHNICAL EXPERIENCE:	Eleven years of experience in environmental and occupational radiological programs, including management of an environmental monitoring laboratory, startup testing of nuclear instrumentation, training, and technical assessments of environmental and radiation protection programs.
SEIS RESPONSIBILITY:	Prepared Human Health and Safety sections of Chapters 3 and 4; prepared Chapter 5.
NAME:	**JAMES L. OLIVER**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	B.S., Biology (Fisheries), Murray State University, 1971
TECHNICAL EXPERIENCE:	Twenty-three years of experience in research and impact assessment projects for the U.S. Department of Interior and DOE, review of environmental and natural resource management issues, and strategic planning for NEPA documentation for DOE.
SEIS RESPONSIBILITY:	Management Reviewer. Prepared Chapter 6.

NAME:	**RICHARD F. ORTHEN, CHMM**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	B.S., Chemistry, 1979
TECHNICAL EXPERIENCE:	Six years of preparing NEPA documents; 20 years of experience in occupational and environmental protection management, specializing in health physics, hazardous materials, and worker/public health and safety.
SEIS RESPONSIBILITY:	Prepared Chapters 3 and 4 sections on Energy and Utilities and Traffic and Transportation; reviewed Cumulative Impacts section of Chapter 5.

NAME:	**KAREN K. PATTERSON**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.A., Biology, 1977 B.A., Biology, 1973
TECHNICAL EXPERIENCE:	Twenty years of technical and environmental science experience; 10 years of technical editing; 5 years of preparing NEPA documents.
SEIS RESPONSIBILITY:	Document Manager; technically edited the SEIS as Lead Editor.

NAME:	**JOHN M. REYNOLDS**
AFFILIATION:	U. S. Department of Energy
EDUCATION:	B.S., Chemical Engineering, 1973
TECHNICAL EXPERIENCE:	Nine years of preparing or reviewing NEPA documents; over 25 years of experience in nuclear facilities and systems.
SEIS RESPONSIBILITY:	DOE reviewer of Draft SEIS.

NAME:	**JOSEPH W. RIVERS**
AFFILIATION:	Jason Associates Corporation
EDUCATION:	B.S., Mechanical Engineering, 1982
TECHNICAL EXPERIENCE:	Three years of experience in preparing NEPA documents; 16 years in commercial and DOE nuclear projects; design, systems engineering, safety and accident analysis, and regulatory compliance.
SEIS RESPONSIBILITY:	Lead author of Accident Analysis section of Chapter 4; co-author of Appendix B.

NAME:	**DIANE S. SINKOWSKI**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.E., Nuclear Engineering, 1994 B.S., Nuclear Engineering Sciences, 1990
TECHNICAL EXPERIENCE:	Six years of experience in air permitting, fate and transport modeling, human health impacts, environmental compliance, and health physics.
SEIS RESPONSIBILITY:	Prepared Air Resources sections of Chapters 3 and 4; contributed to Appendix D.

NAME:	**JAMES A. STAPEL**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.S., Geography, 1999 (proposed) B.S., Geography, 1995
TECHNICAL EXPERIENCE:	Two years of experience in management and applications of geographic information systems (GIS).
SEIS RESPONSIBILITY:	Co-author of Land Use and Socioeconomics sections in Chapters 3 and 4; graphics/cartographic support.

NAME:	**ALAN L. TOBLIN**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.S., Chemical Engineering, University of Maryland, 1970 B.E., Chemical Engineering, The Cooper Union, 1968
TECHNICAL EXPERIENCE:	Twenty-three years of experience in analyzing radiological and chemical contaminant transport in water resources.
SEIS RESPONSIBILITY:	Lead modeler for Appendix D.

NAME:	**JAMES S. WILLISON, P.E., CHP**
AFFILIATION:	Tetra Tech NUS, Inc.
EDUCATION:	M.S., Nuclear Engineering, 1982 B.S., Nuclear Engineering, 1980
TECHNICAL EXPERIENCE:	Three years of preparing NEPA documents; 14 years of accident analyses at nuclear facilities; health physics and radiological engineering.
SEIS RESPONSIBILITY:	Reviewed Accident Analyses, Transportation, Air Resources, and Human Health Effects Sections of Chapter 4 and Appendix B.

NAME:	**PHILIP L. YOUNG, CHP**

AFFILIATION: Tetra Tech NUS, Inc.

EDUCATION: M.S., Health Physics, 1989
B.S., Radiation Health (Health Physics), 1988

TECHNICAL EXPERIENCE: Ten years of experience in environmental health physics and environmental impact assessment, with emphasis on radiological effluent monitoring, environmental surveillance, environmental dosimetry, radiological risk assessment, and radioactive waste management.

SEIS RESPONSIBILITY: Technical reviewer; contributed to Chapters 1 and 5 and Appendix D.

NAME: **JEFFREY L. ZIMMERLY**

AFFILIATION: Tetra Tech NUS, Inc.

EDUCATION: M.S., Environmental Engineering, anticipated 2001
B.S., Health Physics, 1996

TECHNICAL EXPERIENCE: One year of experience in environmental health physics. One year of experience preparing NEPA documents, ecological and human health risk assessments, and accident analysis.
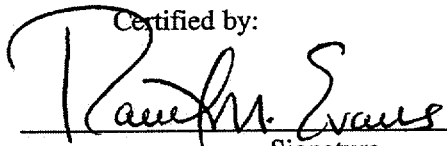
SEIS RESPONSIBILITY: Contributing author to Appendix B.

<u>**NEPA DISCLOSURE STATEMENT**</u>
<u>**FOR**</u>
<u>**PREPARATION OF THE SAVANNAH RIVER SITE HIGH LEVEL WASTE SALT**</u>
<u>**PROCESSING ALTERNATIVES SUPPLEMENTAL ENVIRONMENTAL IMPACT**</u>
<u>**STATEMENT**</u>

CEQ Regulations at 40 CFR 1506.5c, which have been adopted by the U. S. Department of Energy (DOE) (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure statement specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17(a) and (b).

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)." See 46 FR 18026-18031.

In accordance with these requirements, I hereby certify (or as a representative of my organization, I hereby certify) that, to the best of my knowledge and belief, no facts exist relevant to any past, present or currently planned interests or activities (financial, contractual, organizational or otherwise) which relate to the proposed work and bear on whether I have (or the organization has) a possible conflict of interest with respect to (1) being able to render impartial, technically sound, and objective assistance or advise, or (2) being given an unfair or competitive advantage.

Certified by:

_____
Signature

Daniel M. Evans
Name (Printed)

General Manager
Title

Tetra Tech NUS, Inc.
Company

March 26, 1999
Date
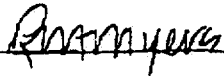
ORGANIZATIONAL CONFLICT OF INTEREST DISCLOSURE STATEMENT
FOR
PREPARATION OF THE SAVANNAH RIVER SITE HIGH LEVEL WASTE SALT PROCESSING ALTERNATIVES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

No actual or potential conflict of interest or unfair competitive advantage exists with respect to other advisory and assistance services being provided by Zapata Engineering relative to the Salt Disposition Alternatives Supplemental Environmental Impact Project under Subcontract No. GCRB-99-77613-034 between Tetra Tech NUS, Inc. and Zapata Engineering.

Company Name: _Zapata Engineering_

Signature:

Printed Name: _Mary F. Richards_

Title: _Sr. Vice President_

Date: _March 12, 2001_

<u>**ORGANIZATIONAL CONFLICT OF INTEREST DISCLOSURE STATEMENT**</u>
<u>**FOR**</u>
<u>**PREPARATION OF THE SAVANNAH RIVER SITE HIGH LEVEL WASTE SALT**
PROCESSING ALTERNATIVES SUPPLEMENTAL ENVIRONMENTAL IMPACT
STATEMENT</u>

No actual or potential conflict of interest or unfair competitive advantage exists with respect to the advisory and assistance services provided by Jason Associates Corporation relative to the Salt Disposition Alternatives Supplemental Environmental Impact Project under Master Agreement No. GCMF-97-77613-002/Task Order Nos. DE-AT09-99SR22042, DE-AT09-99SR22043, and DE-AT09-99SR22043-02 between Tetra Tech NUS, Inc. and Jason Associates Corporation.

Company Name: <u>Jason Associates Corporation</u>

Signature: <u>*R Mark Myers*</u>

Printed Name: <u>R. MARK MYERS</u>

Title: <u>CONTRACTS OFFICER</u>

Date: <u>March 12, 2001</u>

DISTRIBUTION LIST

DOE provided copies of the *Savannah River Site Salt Processing Alternatives Supplemental Environmental Impact Statement* (SEIS) to Federal, state, and local elected and appointed officials and agencies of government; Native American groups; Federal, state, and local environmental and public interest groups; and other organizations and individuals listed below. Copies will be provided to other interested parties upon request as identified in the cover sheet of this SEIS.

CONTENT

A. UNITED STATES CONGRESS

A.1 SENATORS FROM AFFECTED AND ADJOINING STATES

The Honorable Max Cleland
United States Senate

The Honorable Ernest F. Hollings
United States Senate

The Honorable Zell Miller
United States Senate

The Honorable Strom Thurmond
United States Senate

A.2 UNITED STATES SENATE COMMITTEES

The Honorable Jack Reed
Ranking Minority Member
Subcommittee on Strategic Forces
Committee on Armed Services

The Honorable Robert C. Byrd
Ranking Minority Member
Committee on Appropriations

The Honorable Pete V. Domenici
Chairman
Subcommittee on Energy and Water
  Development
Committee on Appropriations

The Honorable Carl Levin
Ranking Minority Member
Committee on Armed Services

The Honorable Harry Reid
Ranking Minority Member
Subcommittee on Energy and Water
Development
Committee on Appropriations

The Honorable Wayne Allard
Chairman
Subcommittee on Strategic Forces
Committee on Armed Services

The Honorable Ted Stevens
Chairman
Committee on Appropriations

The Honorable John Warner
Chairman
Committee on Armed Services

A.3 UNITED STATES HOUSE OF REPRESENTATIVES FROM AFFECTED AND ADJOINING STATES

The Honorable James E. Clyburn
U.S. House of Representatives

The Honorable Charlie Norwood
U.S. House of Representatives

The Honorable Nathan Deal
U.S. House of Representatives

The Honorable Henry E. Brown
U.S. House of Representatives

The Honorable Lindsey Graham
U.S. House of Representatives

The Honorable Floyd Spence
U.S. House of Representatives

The Honorable Jack Kingston
U.S. House of Representatives

The Honorable John M. Spratt, Jr.
U.S. House of Representatives

The Honorable Cynthia McKinney
U.S. House of Representatives

The Honorable Jim DeMint
U.S. House of Representatives

A.4 UNITED STATES HOUSE OF REPRESENTATIVES COMMITTEES

The Honorable Peter Visclosky
Ranking Minority Member
Subcommittee on Energy and Water
    Development
Committee on Appropriations

The Honorable Floyd Spence
Chairman
Subcommittee on Military Procurement
Committee on Armed Services

The Honorable C. W. Bill Young
Chairman
Committee on Appropriations

The Honorable Sonny Callahan
Chairman
Subcommittee on Energy and Water
    Development
Committee on Appropriations

The Honorable David Obey
Ranking Minority Member
Committee on Appropriations

Ranking Minority Member
Subcommittee on Military Procurement
Committee on Armed Services

The Honorable Ike Skelton
Ranking Minority Member
Committee on Armed Services

The Honorable Bob Stump
Chairman
Committee on Armed Services

B. FEDERAL AGENCIES

Mr. A. Forester Einarsen
NEPA Coordinator
Office of Environmental Policy
U.S. Army Corps of Engineers

Mr. Bill Champion
West Valley Nuclear Services
U.S. Department of Energy

Mr. Douglas H. Chapin
Richland Operations Office
U.S. Department of Energy

Commander, Savannah District
Attn: Planning Division
U.S. Army Corps of Engineers

Ms. Marjorie S. Davenport
District Chief
Water Resources Division
U.S. Geological Survey
U.S. Department of Interior

Mr. Paul F. X. Dunigan, Jr.
Richland Operations Office
U.S. Department of Energy

Mr. Robert Fairweather
Chief, Environment Branch
Office of Management and Budget

Mr. Joseph R. Franzmathes
Assistant Regional Administrator, Office of
    Policy and Management
U.S. Environmental Protection Agency,
Region IV

Mr. Dan Fontozzi
U.S. Department of State

Mr. Mark Frei (EM-40)
Office of the Deputy Assistant Secretary for
    Project Completion

Mr. Daniel Funk
U.S. DOE, NE-40

Mr. Kenneth W. Holt
Centers for Disease Control and Prevention
National Center for Environmental Health
U.S. Department of Health and Human Services

Mr. Dave Huizenga (EM-20)
Office of Deputy Assistant Secretary for
    Integration and Disposition
U.S. Department of Energy

Mr. Michael Jansky
WM Hanford
U.S. Department of Energy

Mr. Don L. Klima
Director, Office of Planning & Review
Advisory Council on Historic Prevention

Mr. Keith Klein
Director, U. S. DOE, Richland Operations
Office

Mr. Ron Koll
FDH-USDOE Hanford

Mr. Andreas Mager, Jr.
Habitat Conservation Division
National Marine Fisheries Service
National Oceanic and Atmospheric
    Administration
U.S. Department of Commerce

Mr. James Melillo
Executive Director
Environmental Management Advisory
    Board
U.S. Department of Energy

Mr. Heinz Mueller
Office of Environmental Assessment
U.S. Environmental Protection Agency

Mr. Finn Neilsen
Acting Director, SO-22

Mr. Charles Oravetz
Chief
Protected Species Management Branch
Southeast Regional Office
National Marine Fisheries Service
National Oceanic and Atmospheric
    Administration
U.S. Department of Commerce

Ms. Cynthia Carpenter
Branch Chief, Generic Issues, Environmental
Financial Rulemaking Branch
U.S. Nuclear Regulatory Commission

Mr. Bob Peralta
Chief Council
Argonne National Laboratory
U.S. Department of Energy Laboratory

Mr. Jon Richards
Region IV
U.S. Environmental Protection Agency

Dr. Libby Stull
Argonne National Laboratory
U.S. Department of Energy Laboratory

Mr. Tom Taggart
461 Dirksen Senate Office Building
Washington DC 20510

Mr. Willie R. Taylor
Director
Office of Environmental Policy & Compliance
U.S. Department of Interior

Mr. Andrew Thibadeau
Director, Division of Information Technology
    and Security
Defense Nuclear Facility Safety Board

Mr. Barry Zalcman
Section Chief of Environment and Finance
U.S. Nuclear Regulatory Commission

C. STATE OF SOUTH CAROLINA

C.1 STATEWIDE OFFICES AND LEGISLATURE

The Honorable Jim M. Hodges
Governor of South Carolina

The Honorable Bob Peeler
Lieutenant Governor of South Carolina

The Honorable Charles Condon
Attorney General

The Honorable James E. Smith, Jr.
South Carolina House of Representatives

Ms. Omeagia Burgess
Grant Coordinator
Office of the State Budget

C.2 STATE AND LOCAL AGENCIES AND OFFICIALS

The Honorable Jackie Holman
Mayor of Blackville

Coordinator
Aiken County Civil Defense
Aiken County Emergency Services
Attn: Freddie M. Bell

Mr. Russell Berry
South Carolina Department of Health and
Environmental Control

Mr. Frank Brafman
Hilton Head Town Council

Keith Collinsworth
Federal Facility Liaison
South Carolina Department of Health and
Environmental Control

Mr. Donnie Cason
South Carolina Department of Highways and
Public Transportation

Mr. G. Kendall Taylor
Division of Hydrogeology
Bureau of Land and Hazardous Waste
Management
South Carolina Department of Health and
Environmental Control

Mr. David Wilson
Division of Hydrogeology
Bureau of Land and Hazardous Waste
Management
South Carolina Department of Health and
Environmental Control

D. STATE OF GEORGIA

D.1 STATEWIDE OFFICES AND LEGISLATURE

The Honorable Roy Barnes
Governor of Georgia

The Honorable Mark Taylor
Lieutenant Governor of Georgia

The Honorable Charles W. Walker
Georgia Senate

The Honorable Thurbert Baker
Attorney General

The Honorable Ben L. Harbin
Georgia House of Representatives

E.   NATURAL RESOURCE TRUSTEES, SAVANNAH RIVER SITE

Mr. Douglas E. Bryant
Commissioner, SCDHEC
Natural Resource Trustee

Mr. A. B. Gould
Director
DOE-SR Environmental Quality
Management
Natural Resource Trustee

Mr. Robert Riggs
SRS Natural Resource Trustee
US Army Corps of Engineers
Charleston District
Department of the Army

Mr. David Holroyd
SRS Natural Resource Trustee
US Environmental Protection Agency
Region IV

Mr. Ronald W. Kinney
SRS Natural Resource Trustee
SCDHEC Waste Assessment and
    Emergency Response

Dr. Thomas Dillion
SRS Natural Resource Trustee
National Oceanic and Atmospheric
    Administration
US EPA Waste Division

Mr. James H. Lee
Regional Environmental Officer
SRS Natural Resource Trustee
US Department of the Interior

Mr. Jim O. Stuckey, II
SRS Natural Resource Trustee
South Carolina Office of the Governor

Mr. James Setser
Chief, Program Coordinator Branch
SRS Natural Resource Trustee
Department of Natural Resources

Dr. Paul A. Sandifer
Director
SC Department of Natural Resources
SRS Natural Resource Trustee

F.   NATIVE AMERICAN GROUPS

The Honorable Gilbert Blue
Chairman
Catawba Indian Nation

The Honorable Bill S. Fife
Principal Chief
Muscogee (Creek) Nation

G.   ENVIRONMENTAL AND PUBLIC INTEREST GROUPS

Mr. David Becker
The Sierra Club

Ms. Beatrice Brailsford
Program Director
Snake River Alliance

Mr. Tom Clements
Executive Director
Nuclear Control Institute

Dr. Thomas B. Cochran
Director, Nuclear Programs
Natural Resources Defense Council

Mr. Steve Dolley
Research Director
Nuclear Control Institute

Mr. David Becker
The Sierra Club

Ms. Maureen Eldredge
Program Director
Alliance for Nuclear Accountability

Ms. Susan Gordon
Program Director
Alliance for Nuclear Accountability

Mr. Robert Holden
Director, Nuclear Waste Programs
National Congress of American Indians

Mr. Richard Sawicki
Administrative Assistant
Ecology and Economics Research
Department
The Wilderness Society

Mr. Gawain Kripke
Director, Economics Program
Friends of the Earth

Dr. Daniel Lashof
Research Analyst
Natural Resources Defense Council

Dr. Ed Lyman
Research Director
Nuclear Control Institute

Dr. Mildred McClain
Executive Director
Harambee House, Inc.
Project: Citizens for Environmental Justice,
Inc.

Mr. Alden Meyer
Director, Government Relations
Union of Concerned Scientists

Mr. Joel Yudken
Economist
Department of Public Policy
AFL-CIO

Mr. Damon Moglen
Greenpeace
Washington, D.C.

Ms. Betsy Merritt
Associate General Counsel
Department of Law & Public Policy
National Trust for Historic Preservation

Mr. Kevin O'Neill
Deputy Director
Institute for Science and
International Security

Mr. Donald Moniak
SRS Project Coordinator
Blue Ridge Environmental
Defense League

Mr. Robert Musil, Ph.D.
Executive Director
Physicians for Social Responsibility

Ms. Karen Patterson
SRS Citizens Advisory Board

Ms. Meg Power
National Community Action Foundation

Mr. Paul Schwartz
National Campaign Director
Clean Water Action

Mr. Steven Shimberg
Vice-President
National Wildlife Foundation

Mr. Paul Schwartz
National Campaign Director
Clean Water Action

Ms. Beatrice Brailsford
Program Director
Snake River Alliance

H.   OTHER GROUPS AND INDIVIDUALS

Mr. Peter Allan

Dr. Dave Amick
SAIC

Mr. Tom Anderson
Battelle-Evergreen

Ms. Margaret Aoki
NINNHO IWAI American Corporation

Ms. Jila Banaee
Lockheed-Martin Idaho Technologies
Company

Mr. Cy Banick

Mr. Sy Baron
MUSC

Ms. Sonya Barnette

Mr. James R. Barrett
B&W Services, Inc.

Ms. Lisa Baxter
Georgia Technical College

Mr. Edward P. Blanton, Jr.

Mr. Colin Boardman
Business Development Manager
BNFL, Inc.

Mr. Edmund D. Boothe
Aiken Technical College

Mr. R. P. Borsody
S.P.A.C.E.-PSI

Mr. Carlos W. Bowen

Ms. Sara Jo Braid

Mr. Dannion Brinkley

Mr. Bill Brizes

Ms. Elizabeth R. Brown
Oak Haven of Charleston

Mr. James L. Buelt
Battelle, Pacific Northwest Division

Mr. Ken Bulmahn

Mr. Earl Cagle, Jr.

Ms. Donna Campbell
Foster Wheeler Environmental Corporation

Mr. Rich Campbell
Chem-Nuclear Systems

Mr. Ron Campbell

Mr. George R. Caskey

Mr. Donnie Cason
South Carolina Department of Highways and
Public Transportation

Dr. Kailash Chandra
Savannah State University

Mr. Doughlas Chapin
U.S. DOE-Richland

Mr. Ernie Chaput

Mr. Vladimir Y. Chechik
Shaw, Pitman, Potts, & Trowbridge

Mr. Carl E. Cliche

Ms. Marilena Conde
Edlow International Company

Mr. Steve Connor

Mr. John Contardi
Defense Nuclear Facilities Safety Board

Mr. S. W. Corbett

Mr. Todd Crawford

Dr. Tim Devol
Clemson University
Environmental Systems Engineering
Department

Mr. Sal Dimaria
Battelle Memorial Institute

Mr. John Dimarzio

Mr. Ross Dimmick

Mr. John F. Doherty, J.D.

Mr. George Dudich
Washington Group International, Inc.

Mr. David C. Durham
Fluor Corporation

Mr. Eugene Easterling, Jr.

Dr. Linda B. Eldridge

Mr. Dave Ecklund

Ms. Lynne Fairobent

Ms. Rita Fellers
Department of Geography
University of North Carolina at Chapel Hill

Mr. Leverne P. Fernandez

Mr. Ken Fitch

Ms. Bonnie Fogdall
SAIC

Dr. Charles Forsberg
Oak Ridge National Laboratory

Mr. Mike French

Professor H. Paul Friesema
Institute for Policy and Research
Northwestern University

Mrs. Nadia Friloux
COGEMA Inc.

Mr. Melvyn P. Galin

Mr. Ben Gannon

Mr. John Geddie

Mr. Stanley G. Genega
Stone & Webster, Inc.

Ms. Stacy Gent-Howard
Federal Facility Coordinator
U. S. EPA Region IV

Colonel George A. Gibson

Mr. Anthony P. Gouge

Ms. Kathleen Gore
Exploration Resources

Dr. Randall Guensler
School of Civil & Environmental Engineering
Georgia Institute of Technology

Mr. Robert Guild

Mr. Brandon Haddock
Augusta Chronicle

Mr. Jan Hagers

Mr. David Haines

Mr. C. Hardigree
Plumbers & Steamfitters Local Union #150

Mr. Larry Harrelson
District Chief, Water Resources Division, U. S,
Geological Survey

Mr. Thomas F. Hash
Bechtel National, Inc.

Ms. Kathryn Hauer

Mr. Dusty Hauser
Office of Senator Max Cleland

Ms. Shelley Hawkins
Jacobs Engineering Group, Inc.

Mr. Warren Hills
Laborers Local 1137
AFL-CIO

Mr. C. C. Holcomb

Ms. Melinda Holland
CRESP

Mr. Robert A. Hollingsworth

Mr. Leonard Huesties

Mr. Charles E. Irvin

Mr. Cliff Jarman

Ms. Gail Jernigan

Mr. Keith Johnson

Mr. Norman Kaish

Mr. Roy Karimi

Mr. Richard Kimmel

Mr. Ronald Knotts

Mr. Larry Kripps

Mr. Joseph Krupa

Mr. Paul Krzych
Dynamic Corporation

Ms. Cynthia E. Lake

Mr. Jim Laplander
City of Savannah

Mr. Bill Lawless

Mr. David Lechel

Dr. William A. Lochstet
University of Pittsburgh at Johnstown
Physics

Mr. Robert Maher

Mr. Steve Maheras

Ms. Karen Malone
West Valley Nuclear Services

Mr. Stephen Marchetti
Parsons Infrastructure & Technology
    Group, Inc.

Dr. Gary Marshall
ES&H Program Control Manager
Argonne Medical Laboratory-West

Mr. Joseph A. Martillotti
Texas Department of Health
Bureau of Radiation Control

Mr. Bob Matthews

Mr. Carl Mazzola
Stone and Webster Engineering Corporation

Ms. Elizabeth McBride

Ms. Trish McCracken

Dr. William R. McDonell

Mr. Henry E. McGuire
Foster Wheeler Environmental Corporation

Ms. Dana McIntyre
WJBF-TV
Channel 6

Mr. Frank Metz

Ms. Louise M. Montgomery

Ms. Linda Nass

Ms. Kim Newell
Public Information Director
SCDHEC

Mr. R. I. Newman

Mr. Ralph Norman
Burns and Roe Enterprises

Mr. James L. Oliver

Mr. J. F. Ortaldo

Mr. Robert F. Overman

Mr. Bruce Palmer

Mr. Aris Papadopoulous

Mr. Robert Peralta

Ms. Jean Pasquale

Dr. Ruth Patrick
Division of Limnology and Ecology
Academy of Natural Sciences of
Philadelphia

Mr. Mark A. Petermann
Hydrogeologist
RMT, Inc.

Mr. Jeff Petraglia

Mr. W. Lee Poe

Mr. Richard H. Powell

Ms. Essie M. Richards
Carver Heights Community Org.

Mr. F. A. Riemann

Mr. Jacob Charles Robertson

Mr. Paul Robinson
Southwest Research & Information Center

Ms. Linda Rogers

Mr. Gene Rollins
Dade Moeller and Associates

Dr. May Samuel

Mr. Edward Scalsky

Mr. Guy R. Selph

Mr. John O. Shipman

Mr. Charles Simpson

Ms. Kimberly Sizemore

Mr. Arthur H. Smith, Jr.

Mr. Don Solki
Carpenter's Local 283

Mr. Paul Stansbury
PNL

Ms. Josephine Stegall

Mr. Jim Steinke
Newport News Shipbuilding Co.

Mr. Bill Stokes

The Reverend Thomas A. Summers

Mr. Arthur Sutherland
Rogers & Associates Engineering Corporation

Mr. Edward S. Syrjala

Dr. D. William Tedder
Associate Professor
School of Chemical Engineering
Georgia Institute of Technology

Mr. James W. Terry
Oak Ridge National Laboratory

Ms. Ruth Thomas
Environmentalists, Inc.

Dr. Vincent Van Brunt
University of South Carolina
Chemical Engineering Department

Mr. Alan Vaughan
Nuclear Fuel Services

Mr. Martin Vorum
Commodore Advanced Sciences, Inc.

Mr. Jim Wanzeck

Mr. Payton H. Ward, Jr.
Ironworkers Local Union #709

Mr. Frank S. Watters

Dr. Gary Wein
Savannah River Ecology Laboratory

Robert Weiler
Duke Engineering and Services

Mr. Kim Welsch

Mr. Edgar West
Ironworkers Local Union #709

Dr. F. Ward Whicker
Radiological Health Services
Colorado State University

Ms. Reba White
Teledyne Brown Engineering, Inc.

Ms. Pam Whitson
Oak Ridge Associated Universities

Mr. Patrick L. Whitworth

Mr. Don J. Wilkes
Jacob Engineering Group

Mr. Jermetia L. Williams

Mr. Michael Witunski

Mr. Mel Woods

Dr. Abe Zeitoun
ATL

Mr. Francis P. Zera
The Georgia Guardian

I.   READING ROOMS AND LIBRARIES

Freedom of Information Public Document
Room
University of South Carolina at Aiken SC
Gregg-Graniteville Library
Aiken, SC

Freedom of Information Reading Room
U.S. Department of Energy
Washington, D.C.

Battelle-Pacific Northwest Laboratories
Attn: Technical Library
Richland, WA

Librarian
Chatham-Effingham-Liberty Regional
Library
Savannah, GA

Librarian
Los Alamos Technical Association
Los Alamos, NM

Head, Document Department
The Libraries
Colorado State University
Fort Collins, CO

Librarian
Erskine College
McCain Library
Due West, SC

Parsons Brinckerhoff Library
Denver, CO

Public Reading Room
Chicago Operations Office
Argonne, IL

Mr. Michael Simpson
Library of Congress
Washington, D.C.

Ms. Judy Smith
Monographs Acquisition Services
Colorado State Universities Libraries
Fort Collins, CO

Ms. Felicia Yeh
Technical Services Librarian
South Carolina State Library
Columbia, SC

Librarian
Westinghouse Savannah River Company
    Library
776-H
Aiken, SC

Librarian
South Carolina State Library
Columbia, SC

Librarian
Technical Library
Argonne National Laboratory
Idaho Falls, ID

Librarian
Georgia Institute of Technology Library
Atlanta, GA

Librarian
Pullen Public Library
Atlanta, GA

Librarian
Freedom of Information Act (FOIA) Reading
    Room
DOE-Albuquerque Operations Office
Albuquerque, NM

Librarian
Public Reading Room
DOE Oak Ridge Operations Office
Oak Ridge, TN

Librarian
Reese Library
Augusta State University
Augusta, GA

Librarian
County Library
Charleston, SC

Librarian
Government Information Dept.
Zimmerman Library
University of New Mexico
Albuquerque, NM

Public Reading Room
Richland, WA

Librarian
Information Resource Center
Oak Ridge, TN

Public Reading Room
Idaho Falls, ID

GLOSSARY

Terms in this glossary are defined in accord with customary usage, as presented in the Glossary of Terms used in DOE NEPA Documents, followed as needed by specific usage in the context of this SEIS.

accident
>   An unplanned sequence of events that results in undesirable consequences.

acid solution
>   A liquid in which an acid compound is mixed with water. As used in this SEIS, it is an aqueous solution containing a low concentration of nitric acid, used to remove or recover salt constituents from organic phase in the solvent extraction process.

actinide
>   Any member of the group of elements with atomic numbers from 89 (actinium) to 103 (lawrencium), including uranium and plutonium. All members of this group are radioactive.

adsorption
>   The adhesion of a substance to the surface of a solid or solid particle.

alternative
>   A major choice or strategy to address the SEIS "Purpose and Need" statement, as opposed to the engineering options available to achieve the goal of an alternative.

antimony
>   Metallic element belonging to the nitrogen family (Group Va of the periodic table). The symbol for antimony is Sb; Sb-125 is the principal radioactive isotope of this element present in the HLW tanks at SRS.

applicable or relevant and appropriate requirements (ARARs)
>   Requirements, including cleanup standards, standards of control, and other substantive environmental protection requirements and criteria for hazardous substances, as specified under Federal and state law and regulations, that must be met when complying with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

aqueous phase
>   Water-based solution of soluble chemical species, generally inorganic salts.

aquifer
>   A body of rock or sediment that is capable of transmitting groundwater and yielding usable quantities of water to wells or springs.

as low as reasonably achievable (ALARA)
>   A process by which a graded approach is applied to maintaining dose levels to workers and the public, and releases of radioactive materials to the environment at a rate that is as far below applicable limits as is reasonably achievable.

atomic number
>The number of positively charged protons in the nucleus of an atom and the number of electrons on an electrically neutral atom.

average throughput
>Volume of salt solution processed per year as restricted by limitations external to a given facility.

back extraction
>Transfer of extracted constituent in organic phase to secondary aqueous phase in solvent extraction process. As used in this SEIS, this process serves to recover separated radioactive cesium for delivery to DWPF.

backfill
>Material, such as soil or sand, used in refilling an excavation.

background radiation
>Radiation from cosmic sources, naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material), and global fallout as it exists in the environment from the testing of nuclear explosive devices.

batch process
>Process with operations performed on fixed volumes of material requiring specific time period(s) for completion.

benzene
>Toxic, flammable organic liquid containing six carbon and six hydrogen atoms (C_6H_6); major decomposition product of tetraphenylborate.

beyond design basis accident (BDBA)
>An accident with an annual frequency of occurrence between 1 in 1,000,000 and 1 in 10,000,000 (1.0×10^{-6} and 1.0×10^{-7}).

biodiversity
>Pertains to the variety of life (e.g., plants, animals, and other organisms) that inhabits a particular area or region.

biphenyl
>Organic solid consisting of two phenyl groups ($C_{12}H_{10}$); minor decomposition product of tetraphenylborate.

blackwater stream
>Water in coastal plains, creeks, swamps, and/or rivers that has been imparted a dark or black coloration due to dissolution of naturally occurring organic matter from soils and decaying vegetation.

borosilicate
>A form of glass containing silica sand, boric oxide, and soda ash.

borosilicate glass

Refractory glass waste form with high capacity for immobilization of HLW components; representative composition 10 weight percent B_2O_3, 45 weight percent SiO_2, 10 weight percent Na_2O, 35 weight percent waste oxides.

borrow material

Material, such as soil or sand, that is removed from one location and used as fill material in another location.

bounding accident

A hypothetical accident, the calculated consequences of which equal or exceed the consequences of all other potential accidents for a particular activity or facility.

cancer

The name given to a group of diseases characterized by uncontrolled cellular growth.

canister

A container (generally stainless steel) into which immobilized radioactive waste is placed and sealed.

capable fault

In part, a capable fault is one that may have had movement at or near the ground surface at least once within the past 35,000 years, or has had recurring movement within the past 500,000 years. Further definition can be found in 10 CFR 100, Appendix A.

capacity throughput

Maximum volume of salt solution that a facility is designed to process per year.

carbon

Nonmetallic chemical element in Group IVa of the periodic table. The symbol for carbon is C; C-14 is the principal radioactive isotope of this element present in the HLW tanks at SRS.

carcinogen

A radionuclide or nonradiological chemical that has been proven or is suspected to be either a promoter or initiator of cancer in humans or animals.

catalyst

A substance, usually used in small amounts relative to the reactants, that modifies and increases the rate of a chemical reaction without being consumed or produced by the reaction.

catalytic decomposition

A chemical reaction in which a compound is broken down into simpler compounds or elements in the presence of a catalyst.

caustic solution

Alkaline solution containing sodium hydroxide or other light metal hydroxides. SRS HLW solutions are caustic solutions. As used in this SEIS, an aqueous solution containing 3-5 molar concentrations of sodium hydroxide used to convert insoluble aluminum hydroxide in HLW sludge to soluble aluminate form.

cement
> A building material made by grinding calcined limestone and clay (silica, lime, and other mineral oxides) to a fine powder, which can be mixed with water and poured to set as a solid mass or used as an ingredient in making mortar or concrete. As used in this SEIS, an ingredient of saltstone.

centrifugal contactor
> A device used in the Solvent Extraction salt processing alternative to separate cesium from HLW salt solution. Aqueous waste enters the contactor and is mixed with an organic solvent, which extracts the cesium. The two liquids are then separated by centrifugal force in a rapidly rotating inner chamber of the device.

cesium
> Chemical element of Group Ia of the periodic table, the alkali metal group, of which sodium and potassium are also members. The symbol for cesium is Cs; Cs-137, Cs-135, and Cs-134 are the principal radioactive isotopes of this element present in the HLW tanks at SRS.

characterization
> The determination of waste composition and properties (by review of process knowledge, nondestructive examination or assay, or sampling and analysis), generally done for the purpose of determining appropriate storage, treatment, handling, transport, and disposal requirements.

chronic exposure
> A continuous or intermittent exposure of an organism to a stressor (e.g., a toxic substance or ionizing radiation) over an extended period of time or significant fraction (often 10 percent or more) of the life span of the organism. Generally, chronic exposure is considered to produce only effects that can be observed some time following initial exposure. These may include impaired reproduction or growth, genetic effects, and other effects such as cancer, precancerous lesions, benign tumors, cataracts, skin changes, and congenital defects.

clarification
> As used in this SEIS, a process in which small residual volumes of insoluble solids (sludge) are removed from soluble salt solution.

Class A, B, & C low-level waste limits
> Waste classification system in 10 CFR 61.55 that prescribes requirements for disposal of low-level radioactive wastes in accordance with the concentrations of radioactive constituents in the wastes.

Code of Federal Regulations (CFR)
> A document containing the regulations of Federal executive departments and agencies.

collective effective dose equivalent
> The sum of the individual effective dose equivalents received in a given period of time by a specified population from exposure to a specified source of radiation. The units for this are person-rem or person-sievert.

committed dose equivalent
> The committed dose in a particular organ or tissue accumulated in a specified period (e.g., 50 years) after intake of a radionuclide.

committed effective dose equivalent

> The dose value obtained by (1) multiplying the committed dose equivalents for the organs or tissues that are irradiated and the weighting factors applicable to those organs or tissues, and (2) summing all the resulting products. Committed effective dose equivalent is expressed in units of rem.

conceptual design

> The conceptual design phase includes the fundamental decisions that are made regarding the desired chemistry or processing operations to be used, the sequencing of unit operations, the relationship of the process with other operations, and whether batch or continuous processing will be employed. Often, these decisions must be made preliminary to the collection of any engineering data regarding actual process yields, generation of reaction by-products, or the efficacy of any needed separation steps. The conceptual design phase is also used to determine the economic feasibility of a process.

condensate

> Liquid that results from condensing a gas by cooling below its saturation temperature.

condenser-decanter

> As used in this SEIS, a process vessel used to separate benzene distilled from a mixture produced by decomposition of tetraphenylborate precipitate. Benzene and water vapors are cooled to immiscible liquids in the condenser and separated by withdrawal of lighter benzene from the top of the decanter.

confining (unit)

> A rock layer (or stratum) having very low hydraulic conductivity (or permeability) that restricts the movement of groundwater either into or out of adjacent aquifers.

contaminant

> Any gaseous, chemical, or organic material that contaminates (pollutes) air, soil, or water. This term also refers to any hazardous substance that does not occur naturally or that occurs at levels greater than those naturally occurring in the surrounding environment (background).

contamination

> As used in this SEIS, the deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel.

continuous process

> As used in this SEIS, process conducted in a flowing system to promote mixing, rapid reaction, and separation of radioactive constituents within limited times needed to minimize competitive side reactions (decomposition).

countercurrent extraction

> A liquid-liquid extraction process in which the organic and the aqueous process streams in contact flow in opposite directions, progressively concentrating the extracted constituent in one phase while depleting the constituent in the other phase.

crane maintenance area

> Shielded space in a process facility that is provided for inspection and repair of overhead crane mechanisms.

criticality
>   The condition in which a system (including materials such as plutonium) is capable of sustaining a nuclear chain reaction.

crossflow filtration
>   As used in this SEIS, a process for concentrating precipitate slurry by passing it through a porous metal pipe under pressure to force solution into surrounding pipe.

crystalline
>   Being, relating to, or composed of crystals.

crystalline silicotitanate
>   Insoluble granular inorganic solid ($Na_4SiO_4 \cdot TiO_2$) ion exchange material. As used in this SEIS, a specially developed material to provide capability for removal of cesium from acid or alkaline solutions containing high sodium and potassium concentrations.

curie (Ci)
>   The basic unit used to describe the intensity of radioactivity in a sample of material. A curie is equal to 37 billion disintegrations per second, which is approximately the rate of decay of 1 gram of radium. A curie is also a quantity of any radionuclide that decays at a rate of 37 billion disintegrations per second. A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

decommissioning
>   The process of removing a facility from operation, followed by decontamination, entombment, dismantlement, or conversion to another use.

decomposition
>   The process by which a compound is broken down into simpler compounds or elements by chemical or physical reactions.

decontamination
>   The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive contamination on or in facilities, soil, or equipment. Decontamination processes include washing, chemical action, mechanical cleaning, or other techniques.

decontamination factor
>   Ratio of initial specific radioactivity to final specific radioactivity resulting from a separations process.

dedicated area
>   Space in a facility set aside and equipped for a specific function, such as tool and equipment decontamination.

Defense Waste Processing Facility (DWPF) melter
>   Large ceramic vessel used to incorporate HLW components into molten glass; internally (Joule) heated by electric current flow within the glass melt.

design basis accident (DBA)
   An accident postulated for the purpose of establishing functional and performance requirements for safety structures, systems, and components.

design-basis earthquake
   The maximum-intensity earthquake that might occur along the fault nearest to a structure. Structures are built to withstand a design-basis earthquake.

diluent
   A substance used to dilute. As used in this SEIS, the principal component of organic phase employed to separate constituents from aqueous phase in a solvent extraction process.

diversion boxes
   Specialized containment spaces using removable pipe segments (jumpers) to direct the transfer of process streams; usually underground, constructed of reinforced concrete, and sealed with waterproofing compounds or lined with stainless steel.

DOE Orders
   Requirements internal to the U.S. Department of Energy (DOE) that establish DOE policy and procedures, including those for compliance with applicable laws.

dosage
   The concentration-time profile for exposure to toxicological hazards.

dose (or radiation dose)
   A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined elsewhere in this glossary.

dose equivalent
   A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. Defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. The unit of dose equivalent is the rem.

drinking water standards
   Prescribed limits on chemical, biological, and radionuclide concentrations in groundwater sources of drinking water, expressed as maximum contaminant levels (MCLs).

effective dose equivalent (EDE)
   The dose value obtained by multiplying the dose equivalents received by specified tissues or organs by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all of the resulting products. It includes the dose from radiation sources internal and external to the body. The effective dose equivalent is expressed in units of rem.

effluent
   A waste stream flowing into the atmosphere, surface water, groundwater, or soil. Most frequently, the term applies to wastes discharged to surface waters.

effluent monitoring
   Sampling or measuring specific liquid or gaseous effluent streams for the presence of pollutants.

elevation
>   Vertical cross-section of a facility, showing height requirements for operating areas and process facilities.

elutable ion exchange
>   Process in which a chemical species is separated from solution by replacement of a constituent of a solid (resin), then removed from the resin by replacement (elution) with another chemical species in solution.

endemic
>   Native to a particular area or region.

environmental restoration
>   Cleanup and restoration of sites and decontamination and decommissioning of facilities contaminated with radioactive and/or hazardous substances during past production, accidental releases, or disposal activities.

environmental restoration program
>   A DOE subprogram concerned with all aspects of assessment and cleanup of both contaminated facilities in use and of sites that are no longer a part of active operations. Remedial actions, most often concerned with contaminated soil and groundwater, and decontamination and decommissioning are responsibilities of this program.

evaporator
>   A facility that mechanically reduces the water contents in tank waste to concentrate the waste and reduce storage space needs.

exposure pathways
>   The course a chemical or physical agent takes from the source to the exposed organism. An exposure pathway describes a mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a release site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium, such as air or water, is also included.

external accident (or initiator)
>   An accident that is initiated by manmade energy sources not associated with operation of a given facility. Examples include airplane crashes, induced fires, transportation accidents adjacent to a facility, and so forth.

extractant
>   As used in this SEIS, a component of the solvent used in the solvent extraction process to facilitate the removal of radioactive cesium from HLW salt solution.

facility flowrate
>   Volume of salt solution processed per unit time under normal operating conditions, as required to meet design performance objectives.

final design

  In the final design phase, the emphasis shifts almost completely from the qualitative aspects of the process to the quantitative. Major process vessels are sized, and initial valve counts are often completed. By the end of this phase, a preliminary piping and instrumentation diagram (P&ID) will typically be complete, and broad considerations of facility site design will have been concluded. Opportunities for major process changes are few at this stage, but preliminary cost estimates (on the order of +/- 30%) and economic analyses can be produced.

fission

  A nuclear transformation that is typically characterized by the splitting of a heavy nucleus into at least two other nuclei, the emission of one or more neutrons, and the release of a relatively large amount of energy. Fission of heavy nuclei can occur spontaneously or be induced by neutron bombardment.

fission products

  Nuclides (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by radioactive decay of the fission fragments.

floodplain

  The level area adjoining a river or stream that is sometimes covered by flood water.

flyash

  Fine particulate material produced by the combustion of a solid fuel, such as coal, and discharged as an airborne emission or recovered as a byproduct for various commercial uses. As used in this SEIS, an ingredient in saltstone to limit water infiltration by decreasing porosity.

frames

  Structural components holding assemblies of centrifugal contactors for installation into a remotely operated shielded process cell.

fresh resin

  Condition of an ion exchange solid (resin) before loading with chemical species to be separated from solution.

geologic repository

  A deep (on the order of 600 meters [1,928 feet] or more) underground mined array of tunnels used for permanent disposal of radioactive waste.

groundwater

  Water occurring beneath the earth's surface in the interstices between soil grains, in fractures, and in porous formations.

grout

  A fluid mixture of cement, flyash, slag, and salt solution that hardens into solid form (saltstone).

grout curing

  Process for bringing freshly placed grout to required strength and quality by maintaining humidity and temperature at specified levels for a given period of time.

habitat
    The sum of environmental conditions in a specific place occupied by animals, plants, and other organisms.

half-life
    The time in which half the atoms of a particular radioactive substance disintegrate to another nuclear form. Measured half-lives vary from millionths of a second to billions of years. Also called physical half-life.

hazard index
    The sum of several hazard quotients for multiple chemicals and/or multiple exposure pathways. A hazard index of greater than 1.0 is indicative of potential adverse health effects. Health effects could be minor temporary effects or fatal, depending on the chemical and amount of exposure.

hazard quotient
    The ratio of an exposure level to a substance to a toxicity reference value selected for risk assessment purposes.

hazardous chemical
    A term defined under the Occupational Safety and Health Act and the Emergency Planning and Community Right-to-Know Act as any chemical that is a physical hazard or a health hazard.

hazardous material
    A substance or material, including a hazardous substance, which has been determined by the U.S. Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce.

hazardous substance
    Any substance that, when released to the environment in an uncontrolled or unpermitted fashion, becomes subject to the reporting and possible response provisions of the Clean Water Act and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

hazardous waste
    A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 40 CFR 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the Environmental Protection Agency in 40 CFR 261.31 through 40 CFR 261.33. Source, special nuclear material, and by-product material, as defined by the Atomic Energy Act, are specifically excluded from the definition of solid waste.

heavy metals
    Metallic elements with high atomic weights (for example, mercury, chromium, cadmium, arsenic, and lead) that can damage living things at low concentrations and tend to accumulate in the food chain.

HEPA filter (High Efficiency Particulate Air filter)
    Gas filter with fibrous medium that produces a particle removal efficiency greater than 99.97 percent.

high-level waste or high-level radioactive waste (HLW)

> Defined by statute (the Nuclear Waste Policy Act) to mean the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products nuclides in sufficient concentrations; and other highly radioactive material that the U.S. Nuclear Regulatory Commission (NRC), consistent with existing law, determines by rule requires permanent isolation. The NRC has not defined "sufficient concentrations" of fission products or identified "other highly radioactive material that requires permanent isolation." The NRC defines HLW to mean irradiated (spent) reactor fuel, as well as liquid waste resulting from the operation of the first cycle solvent extraction system, the concentrated wastes from subsequent extraction cycles in a facility for reprocessing irradiated reactor fuel, and solids into which such liquid wastes have been converted. In this SEIS, "high-level waste" is stored in the F- and H-Area Tank Farms.

HLW components

> The HLW from the SRS chemical separations process consists of water soluble salts and insoluble sludges. The sludges settle to the bottom of the HLW tanks. The salt solutions are concentrated by evaporation to reduce their volume, forming a solid saltcake and a concentrated supernatant salt solution in the tanks.

hydrology

> The study of water, including groundwater, surface water, and rainfall.

hydrolysis

> Decomposition of chemical substance by water. As used in this SEIS, the process by which tetraphenylborate precipitate is catalytically decomposed to benzene and a soluble salt solution of waste constituents that is fed to the DWPF melter.

immobilization

> A process (e.g., grouting or vitrification) used to stabilize waste. Stabilizing the waste inhibits the release of waste to the environment.

in situ

> A Latin term meaning "in place".

inadvertent intrusion

> The inadvertent disturbance of a disposal facility or its immediate environment by a potential future occupant that could result in loss of containment of the waste or exposure of personnel. Inadvertent intrusion is a significant consideration that shall be included either in the design requirements or waste acceptance criteria of a waste disposal facility.

incineration

> Controlled burning of solid or liquid wastes to oxidize the combustible constituents and, especially for liquid wastes, to vaporize water so as to reduce waste volume; in this SEIS, the process used to destroy benzene generated from decomposition of tetraphenylborate precipitate in DWPF.

inhibited water

> Water to which sodium hydroxide has been added to inhibit corrosion.

institutional control

> The control of waste disposal sites or other contaminated sites by human institutions in order to prevent or limit exposures to hazardous materials. Institutional control may be accomplished by (1) active control measures, such as employing security guards and maintaining security fences to restrict site access, and (2) passive control measures, such as using physical markers, deed restrictions, government regulations, and public records and archives to preserve knowledge of the site and prevent inappropriate uses.

In-Tank Precipitation (ITP)

> Previously selected process for separation of radioactive cesium and other radioactive constituents from HLW salt solutions by tetraphenylborate precipitation and associated sorption processes, to be replaced by another salt processing alternative that avoids excessive benzene generation.

internal accidents

> Accidents that are initiated by man-made energy sources associated with the operation of a given facility. Examples include process explosions, fires, spills, and criticalities.

involved workers

> Workers who would be involved in a proposed action (as opposed to workers who would be on the site of a proposed action, but not involved in the action).

iodine

> Chemical element of Group VIIa of the periodic table, the halogen group, of which chlorine is a member. The symbol for iodine is I; I-129 is the principal radioactive isotope of this element present in the HLW tanks at SRS.

ion exchange, ion exchange medium (resin)

> The process by which salts present as charged ions in water are attached to active groups on and in an ion exchange resin and other ions are discharged into water allowing separation of the two types of ions. Ion exchange resins can be formulated to remove specific chemicals and radionuclides from the salt solutions in the HLW tanks.

isotope

> One of two or more atoms with the same number of protons, but different numbers of neutrons, in their nuclei. Thus, carbon-12, carbon-13, and carbon-14 are isotopes of the element carbon; the numbers denote the approximate atomic weights. Isotopes have very nearly the same chemical properties, but often have different physical properties (for example, carbon-12 and -13 are stable, while carbon-14 is radioactive).

jumpers

> As used in this SEIS, removable pipe segments used to direct the flow of process streams in transfer operations.

Late Wash Facility

> Assemblage of currently inoperative tanks originally intended for washing soluble corrosion inhibitors from tetraphenylborate precipitate stream from ITP to DWPF. Proposed location of Pilot Plant for selected salt processing alternative.

latent cancer fatality
>   Death from cancer resulting from, and occurring some time after, exposure to ionizing radiation or other carcinogens.

layout plan
>   Floor plan of facility showing operating areas and typical process equipment.

lifting lug
>   Projection on a metal part that serves as handle, support, or fitting connection for attachment of a lifting device.

low-level mixed waste (LLMW)
>   Waste that contains both hazardous waste under RCRA and source, special nuclear, or by-product material subject to the Atomic Energy Act of 1954 (42 USC 2011, et seq.).

low-level waste (LLW)
>   Radioactive waste that contains typically small amounts of radioactivity and is not classified as, HLW transuranic waste, spent nuclear fuel or by-product tailings from processing uranium or thorium ore.

low point drain tank
>   Intermediate transfer facility for delivery of high-activity salt solution from a tank farm to the Grout Facility in the Direct Disposal in Grout alternative, and transfer of washed MST and sludge solids from the Grout Facility to DWPF.

macroinvertebrate
>   Small animal, such as a larval aquatic insect, that is visible to the naked eye and has no vertebral column.

manipulator
>   Mechanical device for handling operations inside a radiation-shielded area, controlled manually by hand operations outside the shielded area.

maximally exposed individual (MEI)
>   A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (e.g., inhalation, ingestion, direct exposure).

millirad
>   One thousandth of a rad (see rad).

millirem
>   One thousandth of a rem (see rem).

mixed waste
>   Waste that contains both hazardous material wastes under RCRA and radioactive source, special nuclear, or by-product material subject to the Atomic Energy Act of 1954.

modifier
>   Component of organic phase added to solvent to enhance separation of a specified constituent in the solvent extraction process.

modular confinement
Containment system consisting of movable, replaceable structural units.

modular shielding
Shielding components assembled from movable, replaceable units.

modular structure
Building constructed of pre-assembled or pre-sized units of a standard design.

module
Self-contained unit that serves as a building block for a structure.

monosodium titanate (MST)
Water-insoluble inorganic substance ($NaTiO_5H$) used to remove residual actinides (uranium, plutonium) and fission product strontium by sorption from waste salt solutions.

nanocurie
One billionth of a curie (see curie).

natural grade
Elevation of a finished surface for an engineering project; ground level.

natural phenomena accidents
Accidents that are initiated by phenomena such as earthquakes, tornadoes, floods, and so forth.

nitrate
Any member of a class of compounds derived from nitric acid. The nitrates are ionic compounds containing the negative nitrate ion, NO_3, and a positive ion, such as sodium (Na) in sodium nitrate ($NaNO_3$). Sodium nitrate is a major constituent of the salt component in the HLW tanks.

nitrite
Any member of a class of compounds derived from nitrous acid. Salts of nitrous acid are ionic compounds containing the negative nitrite ion, NO_2, and a positive ion such as sodium (Na) in sodium nitrite ($NaNO_2$).

nonelutable ion exchange
Process in which a chemical species is separated from solution by replacement of a constituent of a solid (resin), but is not removed (eluted) from the solid before final disposition.

noninvolved workers
Workers in a fixed population outside the day-to-day process safety management controls of a given facility area. In practice, this fixed population is normally the workers at an independent facility area located a specific distance (often 100 meters) from the reference facility area.

nuclear criticality
A self-sustaining nuclear chain reaction.

nuclide
A general term referring to any one of all known isotopes, both stable (279) and unstable (about 5,000), of the chemical elements.

offsite
> Away from the SRS site.

offsite population
> For facility accident analyses, the collective sum of individuals located within a 50-mile (80-kilometer) radius of a facility and within the path of the plume with the wind blowing in the most populous direction.

onsite
> On the SRS property.

Organic Evaporator
> As used in this SEIS, a process vessel provided to decontaminate benzene recovered from the decomposition of tetraphenylborate precipitate. Benzene is washed with water and separated by distillation.

oxalic acid
> A water-soluble organic acid, $H_2C_2O_4$, being considered as a cleaning agent to use in spray washing of tanks, because it dissolves sludge and is only moderately aggressive against carbon steel, the material used in construction of the waste tanks.

particulate
> Pertains to minute, separate particles. An example of dry particulate is dust.

performance modeling
> A systematic mathematical analysis to estimate potential human exposures to hazardous and radioactive substances. It may include specification of potential releases, exposure pathways, effects of facility degradation, transport in the environment, uptake by the affected recipient, and comparison of estimated exposures to regulatory limits or other established performance.

performance objectives
> Parameters within which a facility must perform to be considered acceptable.

permanent disposal
> For HLW, the term means emplacement in a repository for HLW, spent nuclear fuel, or other highly radioactive material with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste.

permeability
> The degree of ease with which water can pass through rock or soil.

person-rem
> A unit of collective radiation dose applied to populations or groups of individuals; that is, a unit for expressing the dose when summed across all persons in a specified population or group.

pH
> A measure of the relative acidity or alkalinity of a solution. A neutral solution has a pH of 7, acids have a pH of less than 7, and bases have a pH of greater than 7.

picocurie
> One trillionth of a curie (see curie).

plutonium
> Chemical element of the actinide series in Group IIIb of the periodic table. All isotopes of plutonium are radioactive. The symbol for plutonium is Pu.

population
> For risk assessment purposes, population consists of the total potential members of the public or workforce who could be exposed to a possible radiation or chemical dose from an exposure to radionuclides or carcinogenic chemicals.

population dose
> The overall dose to population, consisting of the sum of the doses received by individuals in the population.

Precipitate Hydrolysis
> As used in this SEIS, a chemical process in which tetraphenylborate precipitate is catalytically decomposed to benzene and a soluble salt solution of waste constituents to be fed to the DWPF water.

Precipitate Hydrolysis Aqueous
> As used in this SEIS, the soluble salt solution generated by the precipitate hydrolysis process to be fed to the DWPF melter.

Precipitate Hydrolysis Cell
> As used in this SEIS, a shielded enclosure in the Small Tank Precipitation facility that is equipped for tetraphenylborate precipitate decomposition operations.

Precipitate Reactor
> As used in this SEIS, a process vessel provided for decomposition of tetraphenylborate precipitate by the precipitate hydrolysis process to eliminate benzene.

precipitate washing
> Process in which precipitate solids are washed to remove water-soluble salts and excess sodium tetraphenylborate.

precipitation (chemical)
> The formation of an insoluble solid by chemical or physical reaction of constituent in solution.

preconceptual design
> The preconceptual design phase includes the early articulation of process objectives, selection of process steps, and determination of constraints.

pump pits
> As used in this SEIS, intermediate stations in the waste transfer system equipped with tanks and pumps to maintain the flow of process streams, constructed of reinforced concrete with stainless steel liners for containment of radioactive solutions.

purge system
> A method for replacing atmosphere in a containment vessel by an inert gas to prevent the formation of a flammable or explosive mixture.

rad

>   The special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram.

radiation (ionizing radiation)

>   Alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as it is used here, does not include nonionizing radiation such as radio- or microwaves or visible, infrared, or ultraviolet light.

radiation worker

>   A worker who is occupationally exposed to ionizing radiation and receives specialized training and radiation monitoring devices to work in such circumstances.

radioactive

>   Describing a property of some elements having isotopes that spontaneously transform into one or more different nuclides, giving off energy in the process.

radioactive waste

>   Waste that is managed for its radioactive content.

radioactivity

>   The property of unstable nuclei in certain atoms of spontaneously emitting ionizing radiation in the form of subatomic particles or electromagnetic energy during nuclear transformations.. The unit of radioactivity is the curie (or becquerel).

radionuclide/isotope

>   A radionuclide is an unstable isotope that undergoes spontaneous transformation, emitting radiation. An isotope is any of two or more variations of an element in which the nuclei have the same number of protons (i.e., the same atomic number), but different numbers of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties, but often different physical properties.

radiolytic decomposition

>   A physical process in which a compound is broken down into simpler compounds or elements from the absorption of sufficient radiation energy to break the molecular bonds.

raffinate

>   Decontaminated salt solution produced by removal of radionuclides from HLW solution, using the solvent extraction process.

reagent

>   A substance used in a chemical reaction to detect, measure, examine, or produce other substances.

Record of Decision (ROD)

>   A concise public document that records a Federal agency's decision(s) concerning a proposed action.

reconstituted salt solution

>   Waste salt solution obtained by dissolving saltcake in water and combining with supernatant salt solution in HLW tanks.

reducing grout

A grout formulated to behave as a chemical reducing agent. A chemical reducing agent is a substance that reduces other substances (i.e., decreases their positive charge or valence) by supplying electrons. The purpose of a reducing grout is to provide long-term chemical durability against leaching of the residual waste by water. Reducing grout could be composed primarily of cement, blast furnace slag, masonry sand, and silica fume.

reinforced concrete

Concrete containing steel bars to increase structural integrity.

rem

A unit of radiation dose that reflects the ability of different types of radiation to damage human tissues and the susceptibility of different tissues to the damage. Rems are a measure of effective dose equivalent. The dose equivalent in rems equals the absorbed dose in rads multiplied by factors that express the biological effectiveness of the radiation producing it.

remote equipment laydown area

Shielded space provided in processing facility for temporary placement and storage of equipment used in facility operation.

risk

Quantitative expression of possible loss that considers both the probability that a hazard causes harm and the consequences of that event.

ruthenium

Chemical element, one of the platinum metals of Group VIII of the periodic table. The symbol for ruthenium is Ru; Ru-106 is the principal radioactive isotope of this element present in the HLW tanks at SRS.

Safety Analysis Report (SAR)

A report, prepared in accordance with DOE Orders 5481.1B and 5480.23, that summarizes the hazards associated with the operation of a particular facility and defines minimum safety requirements.

salt

As used in this SEIS, salt is the soluble component of the radioactive wastes in the HLW tanks. The salt component consists of saltcake and salt supernate containing principally sodium nitrate with radionuclides mainly isotopes of cesium and technetium.

saltcake

Solid crystalline phase of salt component in HLW tanks remaining after the dewatering of salt solution by evaporation.

salt supernatant

Concentrated solution of salt components in HLW tanks after dewatering of primary salt solution by evaporation.

saltstone

Cementitious solid waste form employing blend of cement, flyash, and slag to immobilize low-radioactivity salt solutions for onsite disposal.

saltstone vaults
> Near-surface concrete containment structures that are used for disposal of low-level radioactive waste in the form of saltstone. The vaults serve as forms for poured saltstone.

saturated resin
> Condition of an ion exchange solid (resin) used to separate a chemical species from solution when no additional quantity of the chemical species can be loaded onto the solid.

scrub
> Process stage in a solvent extraction procedure for removing secondary salt constituents from organic phase before recovery of principal constituent.

secondary containment system
> Supplementary means for containment of gases or liquids that leak or escape from primary waste process or storage vessels.

seepline
> An area where subsurface water or groundwater emerges from the earth and slowly flows over land.

segregation
> The process of separating (or keeping separate) individual waste types and/or forms in order to facilitate their cost-effective treatment, storage, and disposal.

seismicity
> The phenomena of earth movements; seismic activity. Seismicity is related to the location, size, and rate of occurrence of earthquakes.

selenium
> Chemical element in the oxygen family (Group VIa) of the periodic table, closely allied in chemical and physical properties with the elements sulfur and tellurium. The symbol for selenium is Se; Se-79 is the principal radioactive isotope of this element present in the HLW tanks at SRS.

slag
> The vitreous material left as a residue by the smelting of metallic ore. As used in this SEIS, a component of saltstone added to reduce release of certain waste constituents (technetium, chromium).

sludge
> Component of HLW consisting of the insoluble solids that have settled at the bottom of the HLW storage tanks. Radionculides present in the sludge include fission products and long-lived actinides.

sodium
> Chemical element of Group Ia of the periodic table, the alkali metal group. The symbol for sodium is Na. Sodium salts are a major constituent of the salt component in the HLW tanks.

sodium tetraphenylborate
> Organic reagent used in tetraphenylborate precipitation process for removal of radioactive cesium from HLW salt solution. Chemical formula for sodium tetraphenylborate is $Na(C_6H_5)_4B$.

solids slurry washing

As used in this SEIS, dilution of salt solution in contact with solids, followed by filtration to reduce concentration of soluble salts in slurried solids.

solvent

Substance (usually liquid) capable of dissolving one or more other substances.

solvent extraction

Process for separation of a constituent from an aqueous solution by transfer to an immiscible organic phase. As used in this SEIS, employed to separate radioactive cesium from HLW salt solution.

sorbent

A material that sorbs another substance; i.e. that has the capacity or tendency to assimilate the substance by either absorption or adsorption.

sorption

Assimilation of molecules of one substance by a material in a different phase. Adsorption (sorption on a surface) and absorption (sorption into bulk material) are two types of sorption phenomena.

source material

(a) Uranium, thorium, or any other material that is determined by the U.S. Nuclear Regulatory Commission pursuant to the provisions of the Atomic Energy Act of 1954, Section 61, to be source material; or (b) ores containing one or more of the foregoing materials, in such concentration as the U.S. Nuclear Regulatory Commission may by regulation determine from time-to-time [Atomic Energy Act 11(z)]. Source material is exempt from regulation under the RCRA.

source term

The amount of a specific pollutant (e.g., chemical, radionuclide) emitted or discharged to a particular environmental medium (e.g., air, water) from a source or group of sources. It is usually expressed as a rate (e.g., amount per unit time).

spent nuclear fuel

Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated.

stabilization

Treatment of waste to protect the environment from contamination. This includes rendering a waste immobile or safe for handling and disposal.

stilling tanks

Process vessels for holdup of decontaminated salt raffinate and concentrated strip effluent from solvent extraction operations to allow floating and removal of entrained organic phase.

strip effluent

As used in this SEIS, the aqueous cesium solution resulting from the back extraction of cesium from the organic phase in the Solvent Extraction salt processing alternative.

stripping

Process operation for recovery of constituents extracted into the organic phase in the solvent extraction operation by contacting the organic phase with a dilute acid stream.

strontium
    Chemical element of Group IIa of the periodic table, the alkaline-earth metal group, of which
    calcium is a member. The symbol for strontium is Sr; Sr-90 is the principal radioactive isotope of
    this element present in the HLW tanks at SRS.

subsurface
    The area below the land surface (including the vadose zone and aquifers).

supernatant salt solution
    Saturated solution of salt wastes remaining in waste tanks after dewatering of salt wastes by
    evaporation.

suppressor
    Component of organic phase added to diluent to promote recovery of constituent extracted into
    organic phase in solvent extraction operations.

tank farm
    An installation of multiple adjacent tanks, usually interconnected, for storage of liquid radioactive
    waste.

technetium
    Chemical element, a metal of Group VIIb of the periodic table. All isotopes of technetium are
    radioactive. The symbol for technetium is Tc; Tc-99 is the principal radioactive isotope of this
    element present in the HLW tanks at SRS.

tetraphenylborate
    Chemical consisting of four phenyl groups attached to boron atom $(C_6H_5)_4$ B.   Sodium
    tetraphenylborate used to separate radioactive cesium from HLW salt solution by precipitation,
    forming insoluble cesium tetraphenylborate.

Tetraphenylborate Precipitation
    Process used to separate cesium, potassium, and ammonium constituents from HLW salt solution
    by formation of insoluble solids. The process is projected for use in the Small Tank Precipitation
    salt processing alternative.

tin
    Chemical element belonging to the carbon family, Group IVa of the periodic table. The symbol for
    tin is Sn; Sn-126 is the principal radioactive isotope of this element present in the HLW tanks at
    SRS.

total effective dose equivalent
    The sum of the external dose equivalent (for external exposures) and the committed effective dose
    equivalent (for internal exposures).

transuranic waste
> Waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes, with half-lives greater than 20 years, per gram of waste, except for (a) HLW; (b) waste that the U.S. Department of Energy has determined, with the concurrence of the Administrator of the U.S. Environmental Protection Agency, does not need the degree of isolation required by 40 CFR 191; or (c) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.

treatment
> Any activity that alters the chemical or physical nature of a hazardous waste to reduce its toxicity, volume, or mobility or to render it amenable for transport, storage, or disposal.

tritium
> A radioactive isotope of hydrogen whose nucleus contains one proton and two neutrons. The symbol for tritium is H-3. In the HLW tanks at SRS, tritium is usually bound in water molecules, where it replaces one of the ordinary hydrogen atoms.

uranium
> Chemical element of the actinide series in Group IIIb of the periodic table. All isotopes of uranium are radioactive. The symbol for uranium is U.

vadose zone
> The zone between the land surface and the water table. Saturated bodies, such as perched groundwater, may exist in the vadose zone. Also called the zone of aeration and the unsaturated zone.

valve box
> Transfer system component regulating the flow of process streams in a piping system by manual or remote valve adjustment.

vitrification
> As used in this SEIS, a method of immobilizing waste (e.g., radioactive, hazardous, and mixed), by melting glass frit and waste into a solid waste form suitable for long-term storage and disposal.

volatile organic compounds (VOCs)
> Compounds that readily evaporate and vaporize at normal temperatures and pressures.

waste minimization
> An action that economically avoids or reduces the generation of waste by source reduction, reducing the toxicity of hazardous waste, improving energy usage, or recycling.

waste stream
> A waste or group of wastes with similar physical form, radiological properties, U. S. Environmental Protection Agency waste codes, or associated land disposal restriction treatment standards. May result from one or more processes or operations.

wetlands
> Areas that are inundated or saturated by surface water or groundwater and that typically support vegetation adapted for life in saturated soils. Wetlands generally include swamps, marshes, bogs, and similar areas.

wind rose
> A circular diagram showing, for a specific location, the percentage of the time the wind is from each compass direction. A wind rose for use in assessing consequences of airborne releases also shows the frequency of different wind speeds for each compass direction.

INDEX

flyash, 2-15, A-7, A-22, A-23, B-4

formic acid, 4-13

G

geologic repository, 1-1, 1-7, 1-14, 2-1, 2-6, 4-33, 4-34, A-1, A-4, A-6

glass waste form, 1-11, 2-1, 2-10, 2-18, A-1, A-6, A-13, A-16, A-20

groundwater, 1-7, 2-29, 2-37, 2-49, 2-50, 2-53, 3-1, 3-4, 3-9, 3-15, 3-17, 3-18, 3-19, 3-20, 3-22, 3-23, 3-24, 3-25, 3-34, 3-42, 3-51, 4-4, 4-6, 4-25, 4-28, 4-47, 4-52, 4-53, 4-54, 4-55, 4-56, 4-57, 4-58, 4-59, 4-60, 4-62, 5-4, 5-10, 5-14, 6-1, 6-4, 6-5, 6-6, 6-7, 7-7, A-7, C-27, D-1, D-2, D-3, D-6, D-7

grout, 1-3, 1-8, 1-11, 1-13, 2-7, 2-11, 2-14, 2-18, 2-20, 2-21, 2-26, 2-34, 2-46, 2-53, 3-1, 4-15, 4-33, 4-34, 4-37, 4-62. 4-63, 5-7, 6-4, 6-5, A-7, A-20, A-22, A-26, A-36, A-38, A-41, A-43, A-47, B-3, B-4, B-16, B-18, B-25, B-27, C-28, D-6, D-9

H

hazardous waste, 1-7, 3-45, 3-46, 3-47, 3-50, 4-35, 5-12, 6-9, 7-7, 7-13, A-1

hydrolysis, 2-11, 2-12, 2-19, 2-46, 4-33, 4-37, 4-42, 4-43, A-6, C-28

I

incidental waste, 7-3, 7-4, 7-12, C-46

industrial waste, 4-37, 5-4, 5-12, 7-8

injuries, 2-34, 2-39, 3-43, 3-52, 4-22, 4-31, 4-49, 6-3, 6-4, 7-14

institutional control, 2-47, 3-35, 4-1, 4-28, 4-50, 4-61, 4-62, 6-1, 6-4, C-27, D-1, D-2

In-Tank Precipitation (ITP), 1-3, 2-4, 5-7, 7-8, A-1, B-2, D-1

involved worker, 2-32, 2-36, 2-37, 2-38, 2-40, 4-17, 4-19, 4-20, 4-21, 4-22, 4-41, 5-2, 5-12, B-5

isotope, 1-1, 1-13, 2-3, 4-57, 4-64

L

land use, 2-5, 2-34, 2-39, 2-49, 2-53, 4-25, 4-28, 4-29, 4-49, 4-52, 4-61, 6-4, 6-6

latent cancer fatalities, 2-38, 2-40, 2-53, 4-17, 5-2, 5-4, 5-11, 5-12, B-1, B-5

lead (Pb), 3-24

loss of confinement, 2-40, 2-46, 4-41, B-iv, B-7, B-9, B-11, B-14, B-17, B-18, B-23, B-24, B-25, B-26, B-27

loss of cooling, 2-40, A-27, B-iv, B-11, B-12, B-20, B-24, B-25

low activity salt solution, 2-14, A-1, A-6, A-7, A-11, A-16

low-level radioactive waste (LLW), 1-3

M

monosodium titanate (MST), 2-10, 4-33, 6-7, B-3

N

nitrogen dioxide, 3-24, 4-9, 4-10, 4-14, 6-6

noninvolved worker, 2-32, 2-37, 2-39, 4-13, 4-15, 4-17, 4-18, 4-19, 4-20, 4-21, 4-25, 4-41, 4-43, 4-44, 4-45, 4-46, 4-48, 6-3, B-5, B-27, B-28

nonradioactive liquid waste, 2-35, 4-50

Nuclear Regulatory Commission (NRC), 4-15, 7-4, B-4

O

offsite population, 2-37, 2-38, 2-40, 4-15, 4-16, 4-20, 4-41, 5-2, 5-10, 5-11, 5-12