S.1 Introduction

The U.S. Atomic Energy Commission, a U.S. Department of Energy (DOE) predecessor agency, established the Savannah River Site (SRS) near Aiken, South Carolina, in the early 1950s. The primary mission of SRS was to produce nuclear materials for national defense. With the end of the Cold War and the reduction in the size of the United States' stockpile of nuclear weapons, the SRS mission has changed. While national defense is still an important facet of the mission, SRS no longer produces nuclear materials and the mission is focused on material stabilization, environmental restoration, waste management, and decontamination and decommissioning of facilities that are no longer needed.

As a result of its nuclear materials production mission, SRS generated large quantities of highly corrosive and radioactive waste known as high-level waste (HLW). The HLW resulted from dissolving spent reactor fuel and nuclear targets to recover the valuable radioactive isotopes. DOE had stored the HLW in 51 large underground storage tanks located in the F- and H-Area Tank Farms at SRS. DOE has emptied and closed two of those tanks. DOE is treating the HLW using a process called vitrification. The highly radioactive portion of the waste is mixed with a glass-like material and stored in stainless steel canisters at SRS, pending shipment to a geologic repository for disposal. This process is currently underway at SRS, in the Defense Waste Processing Facility (DWPF).

The HLW tanks at SRS are of four different types, which provide varying degrees of protection to the environment due to different degrees of containment. The tanks are operated under the authority of the Atomic Energy Act of 1954 (AEA) and DOE Orders issued under the AEA. The tanks are permitted by the South Carolina Department of Environmental Control (SCDHEC) under the South Carolina wastewater regulations, which require permitted facilities to be closed after they are removed from service. DOE has entered into an agreement with the U.S. Environmental Protection Agency (EPA) and SCDHEC to close the HLW tanks after they have been removed from service. Closure of the HLW tanks will comply with DOE's responsibilities under the AEA and the South Carolina closure requirements, and be carried out under a schedule agreed to by DOE, EPA, and SCDHEC.

There are several ways to close the HLW tanks. DOE has prepared this Environmental Impact Statement to ensure that the public and DOE's decisionmakers have a thorough understanding of the potential environmental impacts of alternative means of closing the tanks before one method is chosen. This Summary provides a brief description of the HLW tanks and the closure process, describes the National Environmental Policy Act (NEPA) process that DOE is using to aid in decisionmaking, summarizes the alternatives for closing the HLW tanks and identifies DOE's preferred alternative, and outlines the major conclusions, areas of controversy, and issues that remain to be resolved as DOE proceeds with the HLW tank closure process.

S.2 High-Level Waste Storage and Tank Closure

S.2.1 HIGH-LEVEL WASTE

DOE Manual 435.1-1, which provides direction for implementing DOE Order 435.1, Radioactive Waste Management, defines HLW as "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 in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation."

S.2.2 HIGH-LEVEL WASTE MANAGEMENT AT THE SAVANNAH RIVER SITE

Currently, about 34 million gallons of HLW are stored in 49 underground tanks in two tank farms, the F-Area Tank Farm and the H-Area Tank Farm. Two additional tanks have been closed. The tank farms are in the central part of the SRS, about 5.5 miles from the SRS boundaries. Figure S-1 shows the locations of F- and H-Areas and the tank farms.

The HLW in the tanks is in three forms: sludge, salt, and liquid. The sludge is solid material that has precipitated and settled to the bottom of the tank. The salt is comprised of salt compounds[1] that have crystallized as a result of concentrating the liquid by evaporation. The liquid is a highly concentrated solution of salt compounds in water. Although some tanks contain all three forms, many tanks are considered primarily sludge tanks, while others are considered salt tanks, containing both salt and liquid.

HLW management systems at SRS are designed to place the high-radioactivity fraction of the HLW in a form (borosilicate glass) that can be disposed of in a geologic repository, and to dispose of the low-radioactivity fraction in vaults at the SRS. The sludge portion of the HLW is being transferred to the DWPF for vitrification in borosilicate glass. The glass is poured into stainless steel canisters at the DWPF and the filled and sealed canisters are stored nearby, pending shipment to a geologic repository. Almost 1,000 canisters have been filled and stored.

The salt and liquid portions of the HLW must be separated into high-radioactivity and low-radioactivity fractions before treatment. As described in the *Defense Waste Processing Facility Supplemental Environmental Impact Statement* (DOE/EIS-0082S*)*, any In-Tank Precipitation Process would separate the salt and liquid portions of the HLW into high- and low-radioactivity fractions. The high-radioactivity fraction would be transferred to the DWPF for vitrification along with the sludge portion. The low-radioactivity fraction would be transferred to the Saltstone Manufacturing and Disposal Facility in Z-Area and mixed with grout to make a concrete-like material to be disposed of in vaults at SRS. Since issuance of that EIS, DOE has concluded that the In-Tank Precipitation Process, as currently configured, cannot achieve production goals and meet safety requirements for processing the salt portion of HLW (64 FR 8559, February 22, 1999). DOE is conducting research and development for a new technology for separating the salt and liquid portions of the HLW and is preparing an EIS, *High-Level Waste Salt Disposition Alternatives at the Savannah River Site*, to evaluate the impacts of alternative technologies. Figure S-2 shows the current configuration of the SRS HLW management system.

[1] A salt is a chemical compound formed when one or more hydrogen ions of an acid are replaced by metallic ions. Common salt, sodium chloride, is a well-known salt.

S.2.3 HIGH-LEVEL WASTE TANKS AND TANK FARMS

The F-Area Tank Farm is a 22-acre site that contains 20 active waste tanks, 2 closed waste tanks (Tanks 17 and 20), 2 evaporator systems, transfer pipelines, 6 diversion boxes, and 3 pump pits. Figure S-3 shows the general layout of the F-Area Tank Farm. The H-Area Tank Farm is a 45-acre site with 29 waste tanks, 3 evaporator systems (including the new Replacement High-Level Waste Evaporator), the In-Tank Precipitation Process, the Extended Sludge Processing Facility, transfer pipelines, 8 diversion boxes, and 10 pump pits. Figure S-4 shows the general layout of the H-Area Tank Farm.

The HLW tanks are of four different designs, all constructed of carbon-steel inside reinforced concrete containment vaults. The major design features and dimensions of each tank design are shown in Figure S-5.

There are 12 Type I tanks (4 in H-Area and 8 in F-Area) that were built in 1952 and 1953. These tanks have partial height secondary containment and active cooling. The tank tops are 9.5 feet below grade, and the bottoms of Tanks 1 through 8 in F-Area are above the seasonal high water table. The bottoms of Tanks 9 through 12 in H-Area are in the water table. Tanks 1 and 9 through 12 are known to have leak sites where waste has leaked from the primary to the secondary containment. There is no evidence that the waste has leaked from the secondary containment.

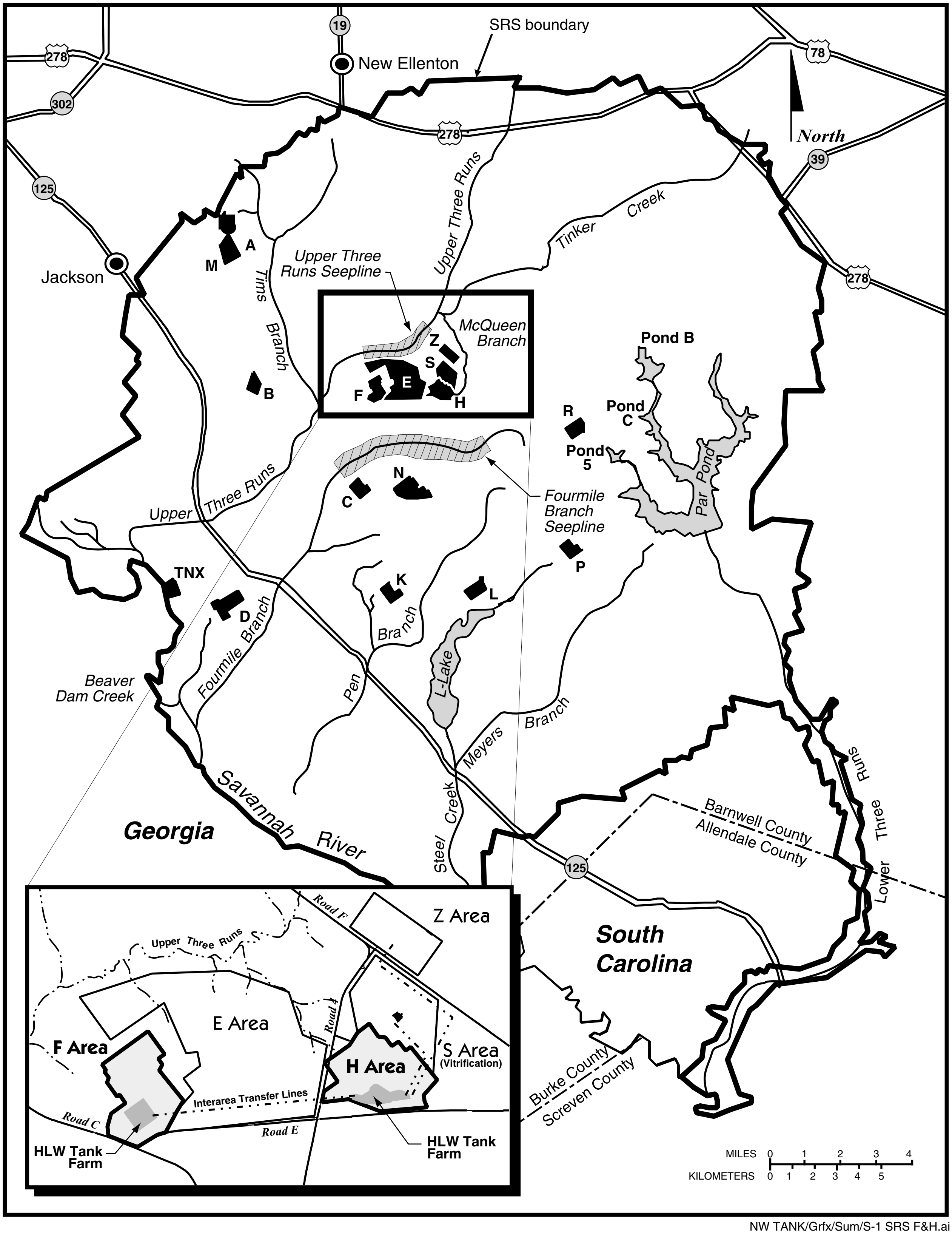
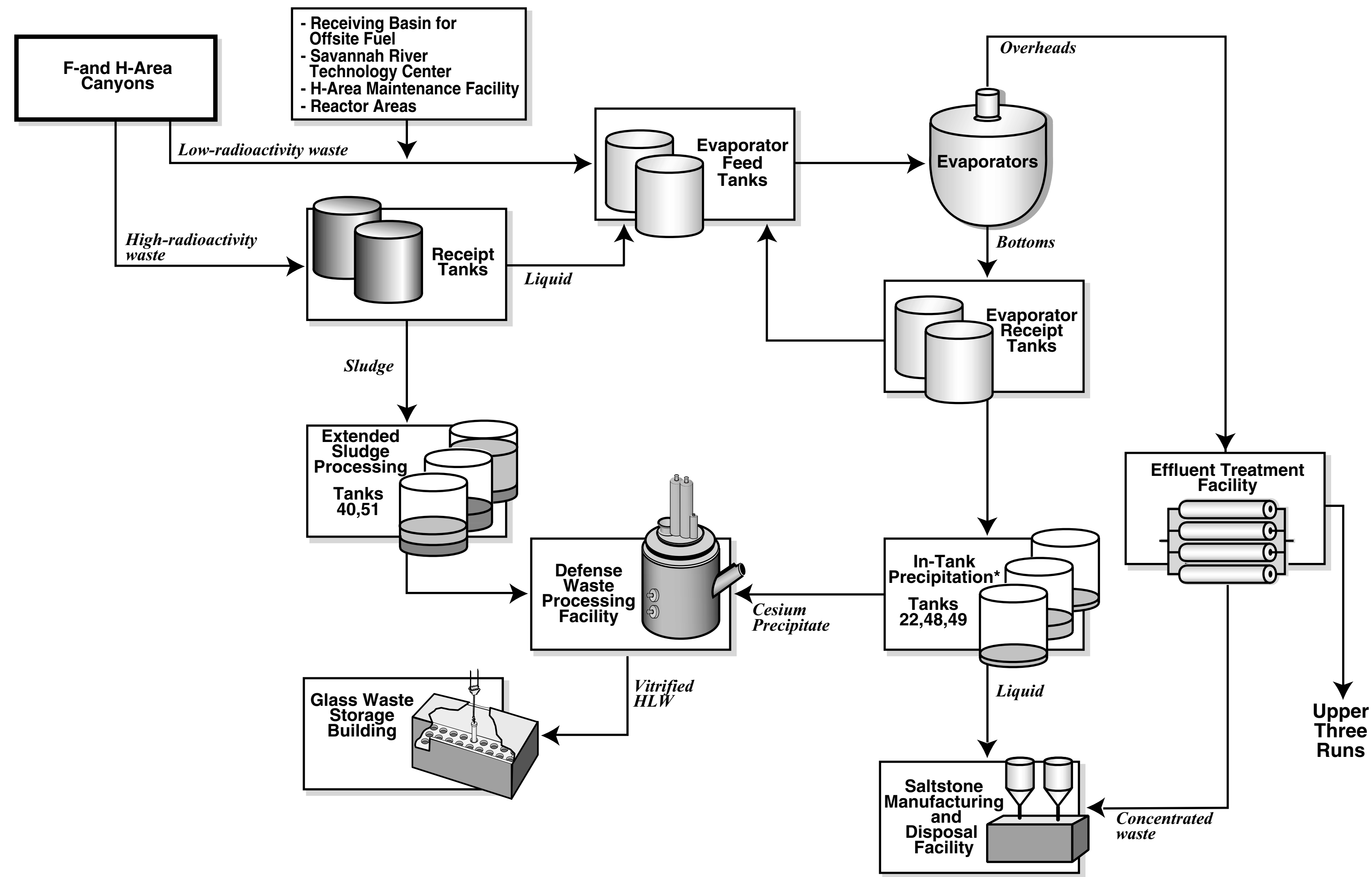


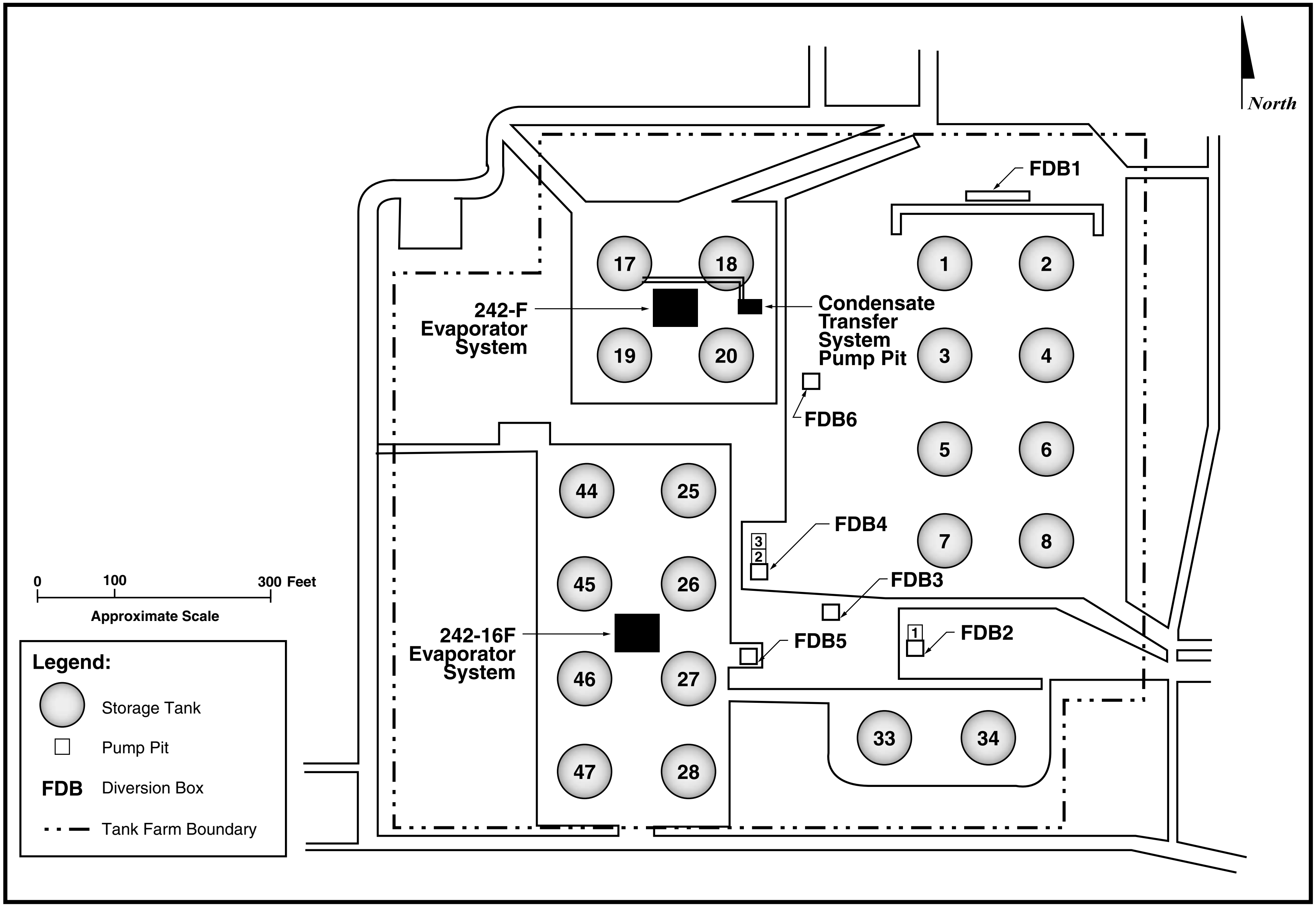
Figure S-1. Savannah River Site map with F- and H-Areas highlighted.



*This process will be replaced. DOE is evaluating alternatives to this process in a separate EIS (see 64 FR 8559).

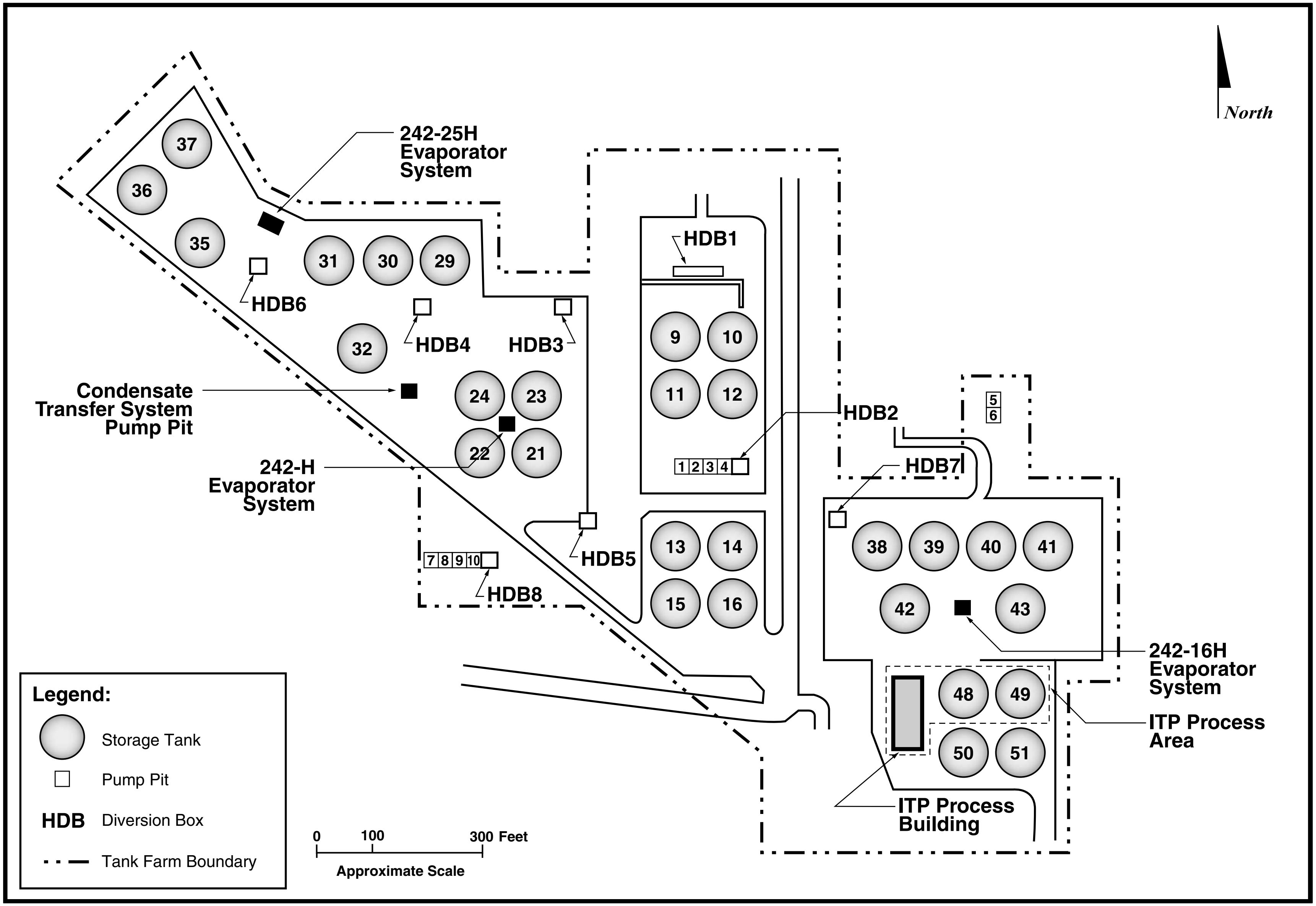
NW TANK/Grfx/Sum/S-2 HLW mgt syst.ai

Figure S-2. Process flows for Savannah River Site High-Level Waste Management System.



NW TANK/Grfx/Sum/S-3 F_Tank.ai

Figure S-3. General layout of F-Area Tank Farm.



NW TANK/Grfx/Sum/S-4 H_Tank.ai

Figure S-4. General layout of H-Area Tank Farm.

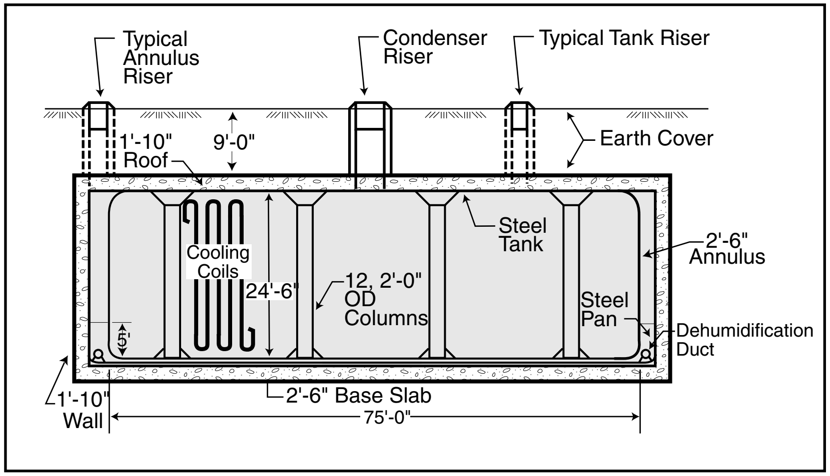


Figure A-4.A. Cooled Waste Storage Tank, Type I (Original 750,000 gallons)

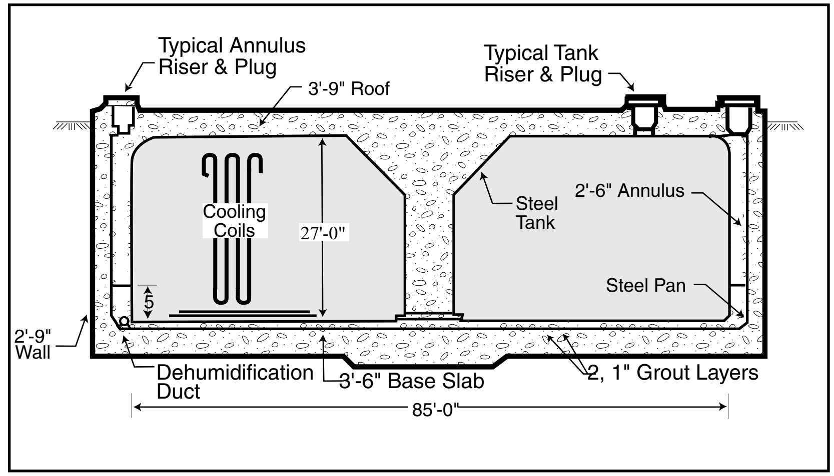


Figure A-4.B. Cooled Waste Storage Tank, Type II (1,030,000 gallons)

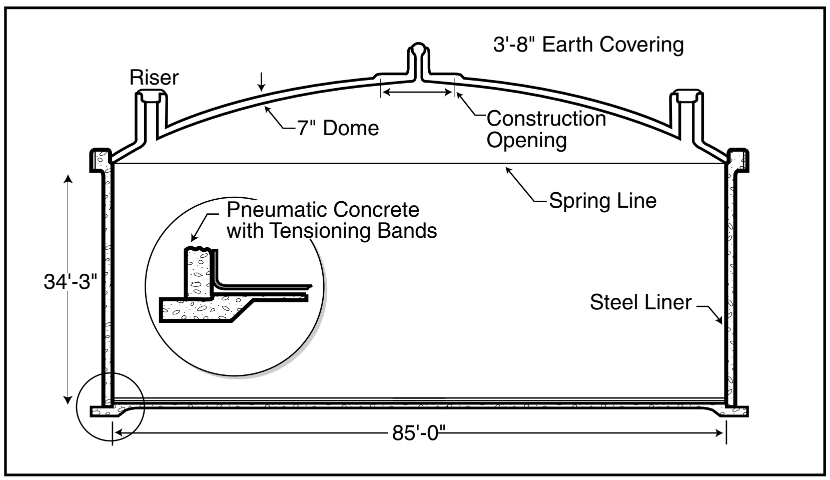


Figure A-4.C. Uncooled Waste Storage Tank, Type IV (Prestressed concrete walls, 1,300,000 gallons)

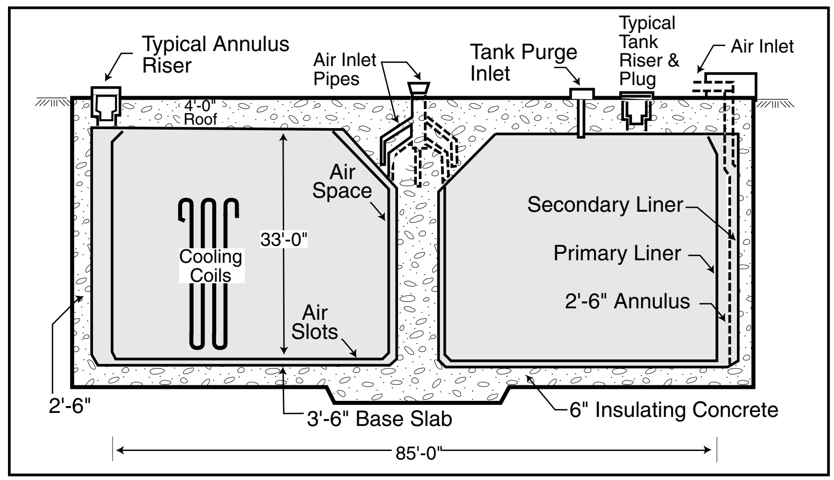


Figure A-4.D. Cooled Waste Storage Tank, Type III (Stress Relieved Primary Liner, 1,300,000 gallons)

NW TANK/Grfx/Sum/S-5 Tank config.ai

Figure S-5. Tank configuration.

Four Type II tanks, Tanks 13 through 16, were built in 1956 in H-Area. These tanks have partial-height secondary containment and active cooling. These tanks are above the seasonal water table. All four tanks have known leak sites where waste has leaked from the primary to the secondary containment. In Tank 16, waste overflowed the annulus pan (secondary containment) and migrated into the surrounding soil. Waste removal from the Tank 16 primary vessel was completed in 1980, but waste that leaked into the annulus has not been removed.

Eight Type IV tanks, Tanks 17 through 24, were built between 1958 and 1962. These tanks have single steel walls and do not have active cooling. Tanks 17 through 20 in the F-Area Tank Farm are slightly above the water table. Tanks 19 and 20 have known cracks that are believed to have been caused by groundwater corrosion of the tank walls in the past. Small amounts of groundwater have leaked into these tanks, but there is no evidence that waste ever leaked out. Tanks 17 and 20 have been closed in the manner described in the Clean and Fill with Grout Option of the Clean and Stabilize Tanks Alternative evaluated in this EIS. Tanks 21 through 24 in the H-Area Tank Farm are above the groundwater table, but are in a perched water table, caused by the original construction of the tank area.

The newest design, Type III tanks, have a full-height secondary tank and active cooling. These 27 tanks were placed in service between 1969 and 1986, with 10 in the F-Area and 17 in the H-Area Tank Farms. All Type III tanks are above the water table.

S.2.4 HIGH-LEVEL WASTE TANK CLOSURE

Tank closure would begin when bulk waste has been removed from an HLW tank system (a tank and its associated piping and equipment) for treatment and disposal.

DOE has reviewed bulk waste removal of waste from the HLW tanks in the Waste Management Operations, Savannah River Plant EIS (ERDA-1537) and the Long-term Management for Defense High-Level Radioactive Wastes (Research and Development Program for Immobilization) Savannah River Plant EIS (DOE/EIS-0023). In addition, the SRS Waste Management EIS discusses high-level waste management activities as part of the No Action Alternative (continuing the present course of action), and the Defense Waste Processing Facility Savannah River Plant EIS (DOE/EIS-0082) and the Final Supplemental Environmental Impact Statement Defense Waste Processing Facility (DOE/EIS-0082S) discuss management of high-level waste after it is removed from the tanks.

In accordance with the SRS Federal Facility Agreement between DOE, EPA, and SCDHEC, DOE intends to remove the tanks from service as their storage missions are completed. DOE is obligated to close 24 tanks that do not meet the EPA's secondary containment standards under the Resource Conservation and Recovery Act (RCRA) by 2022. The 24 Type I, II, and IV tanks have been or will be removed from service before the 27 Type III tanks. Type III tanks will remain in service until there is no further need for them, which DOE currently anticipates would occur before the year 2030.

The HLW tank systems at SRS are operated in accordance with a permit issued by SCDHEC under the authority of the South Carolina Pollution Control Act as industrial wastewater treatment facilities. DOE is required to close the tank systems in accordance with AEA requirements (i.e., DOE Orders) and South Carolina Regulation R.61-82, "Proper Closeout of Wastewater Treatment Facilities." This regulation requires that closures be carried out according to site-specific guidelines established by SCDHEC to prevent health hazards and to promote safety in and around the tank systems. DOE has adopted a general strategy for HLW tank system closure, set forth in the *Industrial Wastewater Closure Plan for the F- and H-Area High-Level Waste Tank Systems* (DOE 1996), known as the General Closure Plan. The General Closure Plan has been approved by SCDHEC.

The General Closure Plan identifies the resources (e.g., groundwater, air) potentially affected by contaminants remaining in the tanks after waste removal and closure, describes how the tanks would be cleaned and how the tank systems and residual wastes would be stabilized, and identifies Federal and state regulations and guidance that apply to the closures. It describes the use of fate and transport models to calculate potential environmental exposure concentrations or radiological dose rates from the residual waste left in the tank systems. The General Closure Plan describes the method DOE will use to make sure the impacts of closure of individual tank systems do not exceed the environmental standards that apply to the entire F - and H-Area Tank Farms. Chapter 7 of this EIS gives more detail on the development of the General Closure Plan and the environmental standards that apply to closure of the HLW tanks.

Performance Objective

Under the action alternatives, DOE will establish performance objectives for closure of each HLW tank. Each performance objective will correspond to an overall performance standard in the General Closure Plan and will ensure that the overall performance standard can be met. For example, if the performance standard for drinking water in the receiving stream is 4 millirem per year, the contribution from contaminants from all tanks will not exceed the 4-millirem-per-year-limit. DOE will evaluate closure options for specific tanks to determine if use of a specific closure option will allow DOE to meet the performance objectives. Based on this analysis, DOE will develop a Closure Module (a tank-specific closure plan) for each HLW tank such that the performance objectives for the tank can be met. The Closure Module must be approved by SCDHEC before tank closure can begin.

Waste Incidental to Reprocessing

An important issue associated with tank closure, and a subject of controversy, is the determination of the regulatory classification of residual waste in the tanks. Before bulk waste removal, the content of the tanks is HLW. The goal of the bulk waste removal and subsequent cleaning of the tanks is to remove as much waste as can reasonably be removed.

In July 1999, DOE issued Order 435.1, Radioactive Waste Management, and the associated Manual and Implementation Guide. DOE Manual 435.1-1 prescribes two processes, by citation or by evaluation (see text box), for determining that waste resulting from reprocessing spent nuclear fuel can be considered "waste incidental to reprocessing."

Waste Incidental to Reprocessing Determination

The two processes for determining that waste can be considered incidental to reprocessing are "citation" and "evaluation." Waste incidental to reprocessing by "citation" includes spent nuclear fuel processing plant wastes that meet the description included in the Nuclear Regulatory Commission's Notice of Proposed Rulemaking (34 FR 8712; June 3, 1969) for promulgation of proposed Appendix D, 10 CFR Part 50, Paragraphs 6 and 7 that later came to be referred to as "waste incidental to reprocessing." These radioactive wastes are the result of processing plant operations, such as, but not limited to contaminated job wastes, such as laboratory items (clothing, tools, and equipment).

Waste incidental to reprocessing by "evaluation" includes spent nuclear fuel processing plant wastes that meet the following three criteria: (1) have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical, (2) will be managed to meet safety requirements comparable to the performance standards set forth in Subpart C of 10 CFR 61 (if low-level waste) or will be incorporated in a solid physical form and meet alternative requirements for waste classification and characteristics authorized by DOE (if transuranic waste), and (3) managed as low-level or transuranic waste pursuant to DOE's authority under the Atomic Energy Act in accordance with the applicable provisions of DOE M 435.1-1.

According to Order 435.1, waste resulting from reprocessing spent nuclear fuel that is determined to be incidental to reprocessing is not HLW, and shall be managed under DOE's regulatory authority in accordance with requirements for transuranic waste or low-level waste, as appropriate.[2] Section 7.1.3 of this EIS discusses the waste incidental to reprocessing process in more detail.

HLW Tank Cleaning

Tank cleaning by spray water washing involves washing each tank using hot water in rotary spray jets. The spray nozzles can remove waste near the edges of the tank that is not readily removed by slurry pumps. After spraying, the contents of the tank would be agitated with slurry pumps and pumped out of the tank. This process has been demonstrated on Tanks 16 (which has not been closed) and 17 (which has been closed). The amount of waste left after spray washing was estimated at about 3,500 gallons in Tank 16 and about 4,000 gallons in Tank 17. If modeling evaluations showed that performance objectives could not be met after an initial spray water washing, additional spray water washes would be used prior to employing other cleaning techniques.

After spray water washing is complete, DOE could use oxalic acid cleaning. Hot oxalic acid would be sprayed through the spray nozzles that were used for spray water washing.

Oxalic acid has been demonstrated in Tank 16 only and shown to provide cleaning that is about twice as effective as spray water washing for removal of radioactivity (See Table S-1). Use of oxalic acid in an HLW tank would require successfully demonstrating that dissolution of HLW sludge solids by the acid would not create a potential for a nuclear criticality.

On the basis of performance and historical data, DOE believes that waste removal meets the Criteria 2 and 3 requirements of the evaluation process for determining that waste can be considered "waste incidental to reprocessing" (see text box). In addition, waste removal followed by spray water washing, meets the Criterion 1 requirement for removal of key radionuclides to the extent "technically and economically practical" (DOE Order 435.1). If Criteria 2 or 3 could not be met, enhanced cleaning methods such as additional water washes or oxalic acid cleaning could be employed. However, DOE considers that oxalic acid cleaning beyond the extent needed to meet performance objectives is not "technically and economically practical" within the meaning of DOE Order 435.1, for reasons discussed below.

In general, the economic costs of oxalic acid cleaning are quite high. DOE estimates that oxalic acid cleaning (including disposal costs) per tank would cost approximately $1,050,000.

DOE considers that performance of bulk waste removal and spray washing, which together result in removal of 98% to 99% of the total curies and over 99% of the volume of waste, constitutes the limit of what is economically and technically practicable for waste removal (DOE Response to U.S. Nuclear Regulatory Commission Additional Questions on SRS HLW Cover Tank Closure, April 1999). However, DOE recognizes that enhanced waste removal operations may be required for some tanks and is committed to performing the actions necessary to meet "incidental waste" determination and performance objectives. DOE further recognizes that, if it could not clean the tank components sufficiently to meet the waste incidental to reprocessing criteria, it would need to examine alternative disposition strategies. Alternatives could include disposal in place as high-level waste (which is not contemplated in DOE Order 435.1), development of new cleaning technologies, or packaging the cleaned tank pieces and storing them until DOE could ship them to a geologic repository for disposal. A geologic

[2] The Natural Resources Defense Council (NRDC) has filed a Petition in the Court of Appeals for the Ninth Circuit asking the Court to review DOE Order 435.1 and claiming that the Order is "arbitrary, capricious, and contrary to law." The Nuclear Regulatory Commission, in responding recently to a separate petition from the NRDC, has concluded that DOE's commitments to (1) clean up the maximum extent technically and economically practical, and (2) meet performance objectives consistent with those required for disposal of low level waste, if satisfied, should serve to provide adequate protection of public health and safety (65 FR 62377, October 18, 2000).

Table S-1. Tank 16 waste removal process and curies removed with each sequential step.

Sequential Waste Removal Step	Curies Removed	% of Curies Removed	Cumulative Curies Removed	Cumulative Percent Curies Removed
Bulk Waste Removal	2.74×10^{6}	97%	2.74×10^{-6}	97
Spray Water Washing	2.78×10^{4}	0.98%	2.77×10^{-6}	97.98
Oxalic Acid Wash & Rinse	5.82×10^{4}	2%	2.83×10^{-6}	99.98

repository has not yet been approved and waste acceptance criteria have not yet been finalized.

The potential for nuclear criticality is one significant technical constraint on the practicality of oxalic acid cleaning. Also, extensive use of oxalic acid cleaning could affect downstream waste processing activities (DWPF and salt disposition). The presence of oxalates in the waste feed to DWPF that would result from oxalic acid cleaning would adversely affect the quality of the glass, and special batches of the salt disposition process could be required to control the sodium oxalate concentration.

Nine HLW tanks have leaked measurable amounts of waste from primary containment to secondary containment with only one leaking to the soil surrounding the tanks. For these tanks, the waste would be removed from the secondary containment using water and/or steam. Such cleaning has been attempted at SRS on only one tank (Tank 16), and the operation was only about 70 percent completed, because salts mixed with sand (from sandblasting of tank welds) made salt removal more difficult. Cleaning of the secondary containment is not a demonstrated technology and new techniques may need to be developed. The amount of waste in secondary containment is small, so the environmental risk of this waste is minimal compared to the amount of residual waste that would be contained inside the tanks after bulk waste removal and cleaning.

S.3 NEPA Process

NEPA provides Federal decisionmakers with a process to use when considering the potential environmental impacts of proposed actions and alternatives. This process also provides several ways the public can be informed about and influence the selection of an alternative.

In 1995, DOE began preparations for closure of the HLW tanks. DOE prepared the *Industrial Wastewater Closure Plan for F- and H-Area High-Level Waste Tank Systems*. At the same time, DOE prepared the *Environmental Assessment for the Closure of the High-Level Waste Tanks in F- and H-Areas at the Savannah River Site*. In a Finding of No Significant Impact signed on July 31, 1996, DOE concluded that closure of the HLW tanks in accordance with the General Closure Plan would not result in significant environmental impacts. Since that time DOE has closed Tanks 17 and 20.

DOE re-examined the 1996 Tank Closure Environmental Assessment and has decided to prepare an EIS before any additional HLW tanks are closed at SRS. This decision was based on several factors, including a desire to explore the environmental impacts from closure and to open a new round of information sharing and dialogue with stakeholders. In the December 29, 1998, Federal Register, DOE published a Notice of Intent (NOI) to prepare an EIS on closure of the HLW tanks. Publication of the NOI began a 45-day public scoping period. DOE held public scoping meetings on January 14, 1999, in North Augusta, South Carolina, and on January 19, 1999, in Columbia, South Carolina. DOE considered comments received during the scoping period in preparing this Draft EIS. The comments, along with DOE's responses, are given in Appendix D of this EIS and briefly summarized here.

DOE received three comment letters, one E-mail, seven oral comments at the public scoping meetings, and one Recommendation from the

SRS Citizens Advisory Board. DOE identified 36 separate comments in these submittals and presentations.

Several comments related to the alternatives for closing the HLW tanks and suggested additional alternatives. One expressed the opinion that any alternative premised on "reclassification" of the residual waste in the tanks as waste incidental to reprocessing violated the Nuclear Waste Policy Act of 1982. DOE believes that the alternatives suggested by the commentors were substantially the same as the alternatives DOE proposed to evaluate. In regard to the waste incidental to reprocessing comment, it is within the scope of DOE's authority and responsibilities under the AEA to establish and carry out a procedure for determining if residual waste may be managed as transuranic or low-level waste. DOE's procedure is found in DOE Order 435.1 and the accompanying Manual 435.1-1.

Commentors suggested that certain data be included in the EIS, including the total volume of waste and the total amount of each chemical and radionuclide that DOE expected to remain in the tanks as residual waste. DOE has included this information in the EIS.

Several comments suggested evaluations to be performed. DOE has provided reasons for not using certain evaluation methods suggested by commentors (see Appendix D of the EIS).

Commentors were also concerned with the application of certain laws, regulations, and criteria, particularly the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), RCRA, the Nuclear Waste Policy Act, and South Carolina's regulations. DOE has provided responses to each of the comments in Appendix D of the EIS. In addition, Chapter 7 of the EIS provides a review of laws, regulations, and DOE Orders that apply to the closure of the HLW tanks.

Commentors were concerned about the EIS schedule and process as it relates to closure of the HLW tanks. DOE will complete the EIS process before closing any additional waste tanks at SRS. In addition, preparation of the EIS will not interfere with the established schedule for closure of the HLW tanks.

One commentor wanted to know if the tanks being considered for closure were the same tanks that have leaked in the past. All tanks that have leaked are inactive, meaning they do not receive fresh waste, and none of them are continuing to leak. Most of these tanks currently store sludge, salt, or both. In cases where liquid high-level waste is stored, the waste level is below the known leak sites. In accordance with the SRS Federal Facility Agreement, DOE is obligated to close all of these tanks by 2022. One of the tanks that already leaked, Tank 20, has already been closed.

One commentor was concerned about the process for removing sludges from the HLW tanks. The EIS describes the processes that were used for cleaning Tanks 17 and 20 and those that will be used in the future. DOE also acknowledges that new technologies may be useful in the future for removing sludges from the HLW tanks.

One commentor observed that new missions would add to the amount of HLW and prolong the closure process. DOE has recently selected SRS as the site for several new missions. The Pit Disassembly and Conversion Facility, Mixed Oxide Fuel Facility, Immobilization Facility, and the Tritium Extraction Facility will not add HLW to the current SRS inventory. Stabilizing plutonium residues from the Rocky Flats Environmental Technology Site at SRS is expected to result in the equivalent of five DWPF canisters. The melt and dilute facility for management of spent nuclear fuel would add the equivalent of 17 DWPF canisters. These canisters are in addition to the approximately 6,000 canisters DOE expects to produce absent the new missions.

S.4 Purpose and Need

DOE needs to reduce human health and safety risks at and near the HLW tanks, and to reduce the eventual introduction of contaminants into the environment. If DOE does not take action after bulk waste removal, the tanks would fail and contaminants would be released to the environment. Failed tanks would present the risk of accidents to individuals. Release of contaminants to the environment would present human health risks, particularly to individuals who might use contaminated water, in addition to adverse impacts to the environment.

S.5 Decisions to be Based on This EIS

This EIS provides an evaluation of the environmental impacts of several alternatives for closure of the HLW tanks at SRS. The closure process will take place over a period of up to 30 years. The EIS provides the decisionmaker with an assessment of the environmental, health and safety effects of each alternative. The selection of a tank closure alternative, following completion of this EIS, will guide the selection and implementation of a closure method for each HLW tank at SRS. Within the framework of the selected alternative, and the environmental impact of closure described in the EIS, DOE will select and implement a specific closure method for each tank.

In addition to the closure methods and impacts described in this EIS, the tank closure program will operate under a number of laws, regulations, and regulatory agreements described in Chapter 7 of this EIS. In addition to the General Closure Plan (a document prepared by DOE based on responsibilities under the AEA and other laws and regulations and approved by SCDHEC), the closure of individual tanks will be performed in accordance with a tank-specific Closure Module. Each Closure Module will incorporate a specific plan for tank closure and modeling of impacts based on that plan. Through the process of preparing and approving each Closure Module, DOE will select a closure method that is consistent with the closure alternative selected after completion of this EIS. The selected closure method for each tank will result in the closure of all tanks with impact on the environment equal to or less than those described in this EIS. If a tank closure that meets the performance objectives of the closure module cannot be accomplished using the selected alternative, DOE would prepare the appropriate additional NEPA review prior to implementing closure of the tank.

During the expected 30-year period of tank closure activities, new technologies for tank cleaning or other aspects of the closure process may become available. DOE would conduct the appropriate NEPA review for any proposal to use a new technology.

S.6 Proposed Action and Alternatives

DOE proposes to close the HLW tanks at SRS in accordance with applicable laws and regulations, DOE Orders, and the *Industrial Wastewater Closure Plan for F- and H-Area High-Level Waste Tank Systems* approved by SCDHEC, which specifies the management of residuals as waste incidental to reprocessing. The proposed action evaluated in this EIS would begin when bulk waste removal has been completed. Under each alternative except No Action, DOE would close 49 HLW tanks and associated waste handling equipment including evaporators, pumps, diversion boxes, and transfer lines.

DOE is evaluating three alternatives in this EIS.

Tank Closure Alternatives

Implementation of each alternative would start following bulk waste removal and SCDHEC approval of a tank-specific Closure Module that is protective of human health and the environment.

- Clean with water and fill the tanks with grout (Preferred Alternative). If necessary to meet the performance objectives, oxalic acid cleaning could be used. The use of sand or saltstone as fill material would also be considered.
- Clean and remove the tanks for disposal in the SRS waste management facilities
- No Action. Leave the tank systems in place without cleaning or stabilizing, following bulk waste removal.

S.6.1 CLEAN AND STABILIZE TANKS ALTERNATIVE

Following bulk waste removal, DOE would clean the tanks to remove as much additional waste as can reasonably be removed and fill the tanks with a material that would bind up remaining residual waste and prevent future collapse of the tanks. DOE considers three options for tank stabilization under this alternative:

- Fill with Grout (Preferred Alternative)
- Fill with Sand
- Fill with Saltstone

In the evaluation and cleaning phase of tank closure each tank system or group of tank systems would be evaluated to determine the inventory of radiological and nonradiological contaminants remaining after bulk waste removal and spray water washing. This information would be used to conduct a performance evaluation as part of the preparation of a Closure Module. In the evaluation DOE would consider: (1) the types of contamination in the tank and the configuration of the tank system, and (2) the hydrogeologic conditions at and near the tank location, such as distance from the water table and distance to nearby streams. The performance evaluation would include modeling the projected contamination pathways for selected closure methods, and comparing the modeling results with the performance objectives developed in the General Closure Plan. If the modeling shows that performance objectives would be met, the Closure Module would be submitted to SCDHEC for approval.

If the modeling shows that the performance objectives would not be met, additional cleaning steps (such as additional water spray washing, oxalic acid cleaning, or other cleaning techniques) would be taken until enough waste had been removed that the performance objectives could be met. DOE estimates that oxalic acid cleaning could be required on as many as three-quarters of the tanks to meet performance objectives.

Tank Stabilization

After DOE would clean a tank and demonstrate that the performance objectives could be met, SCDHEC would approve a Closure Module. The tank stabilization process would then begin. Each tank system (including the secondary containment, for those that have one) would be filled with a pumpable, self-leveling backfill material. DOE's preferred option is to use grout, a concrete-like material, as backfill. The grout would be trucked to an area near the tank farm, batched if necessary, and pumped to the tank. The fill material would be high enough in pH to be compatible with the carbon steel walls of the waste tank. The grout would be formulated with chemical properties that would retard the movement of radionuclides in the residual waste in the closed tank. Therefore, the closure configuration for each tank or group of tanks would be determined on a case-by-case basis through development of the Closure Module.

Using the preferred option of grout as fill material, the grout would be poured in three distinct layers as illustrated in Figure S-6. The bottom-most layer would be a specially formulated reducing grout to retard the migration of important contaminants. The middle layer would be a low-strength material designed to fill most of the volume of the tank interior. The final layer would be a high-strength grout to deter inadvertent intrusion from drilling.

If DOE were to choose another fill material (sand or saltstone) for a tank system, all other aspects of the closure process would remain the same, as described above.

Sand is readily available and inexpensive. Its emplacement is more difficult than grout because it does not flow readily into voids. Any equipment or piping left on or inside the tank that might require filling (to eliminate voids inside the device) might not be adequately filled. Over time, the sand would tend to settle in the tank, creating additional void spaces. The dome of the tank would then become unsupported and would sag and crack. The sand would tend to

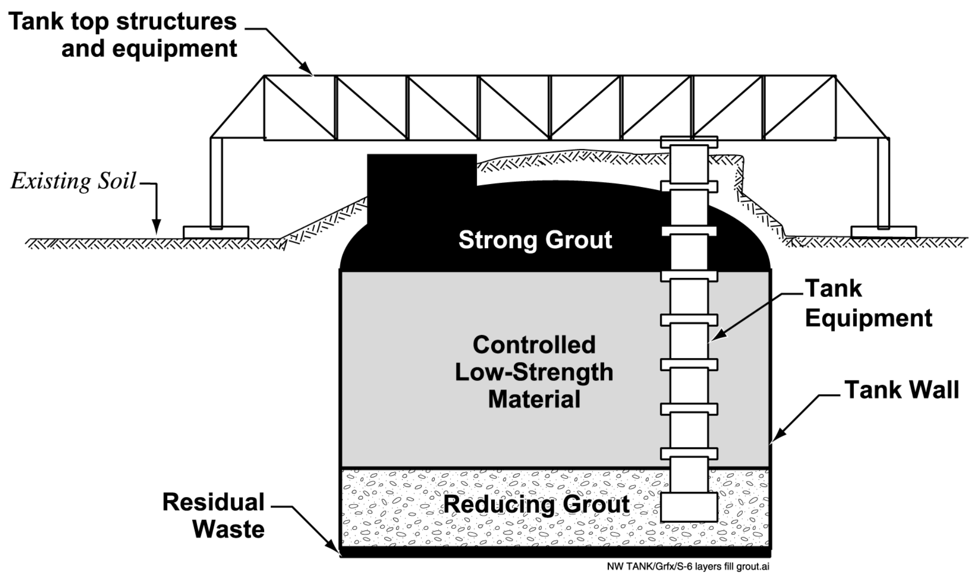


Figure S-6. Typical layers of the fill with grout option.

isolate the contamination from the environment to some extent, limit the amount of settling of the tank top after failure, and prevent wind from spreading the contaminants. Nevertheless, water would flow readily through the sand. Sand is relatively inert and could not be formulated to retard the migration of radionuclides. Thus, expected contamination levels in groundwater and surface water streams resulting from migration of residual contaminants would be higher than the levels for the preferred option.

Saltstone could also be used as fill material. Saltstone is the low-radioactivity fraction of HLW mixed with cement, flyash, and slag to form a concrete-like mixture. Saltstone is normally disposed of as low-level waste in the SRS Saltstone Disposal Facility. This alternative would have the advantage of reducing the amount of Saltstone Disposal Facility area that would be required. Filling the tank with a grout mixture that is contaminated with radionuclides, like saltstone, would considerably complicate the project and increase worker radiation exposure, which would increase risk to workers and add to the cost of closure. In addition, the saltstone would contain large quantities of nitrate that would not be present in the tank residual. Because nitrates are very mobile in the environment, these large quantities of nitrate would adversely impact the groundwater near the tank farms over the long term.

Following the use of any of the stabilization options described above, four tanks in F-Area and four tanks in H-Area would require backfill soil to be placed over the top of the tanks. The backfill soil would bring the ground surface at these tanks up to the surrounding surface elevations to prevent water from collecting in the surface depressions. This action would prevent ponding conditions over the tanks that could facilitate degradation of the tank structure.

S.6.2 CLEAN AND REMOVE TANKS ALTERNATIVE

The Clean and Remove Tanks Alternative would include cleaning the tanks, cutting them up in situ, removing them from the ground, and transporting tank components for disposal in an engineered disposal facility at another location on SRS. This alternative has not been demonstrated on HLW tanks.

For the Clean and Remove Tanks Alternative, DOE would have to perform enhanced cleaning beyond that contemplated for the other action alternatives, until tanks were clean enough to be safely removed and could meet waste acceptance criteria at SRS Low-Level Waste Disposal Facilities. Worker exposure would have to be As Low As Reasonably Achievable to ensure protection of the individuals required to perform the tank removal operations. This might require the use of cleaning technologies such as oxalic acid cleaning, mechanical cleaning, and additional steps as yet undefined on most of the tanks. DOE considers that these additional actions on so many tanks are not "technically and economically practical" within the meaning of DOE Order 435.1 because of criticality safety concerns associated with acidic cleaning solutions, potential interference with downstream waste processing activities, and high cost.

Following bulk waste removal and cleaning, the steel components of the tank would be cut up, removed, placed in radioactive waste transport containers (approximately 3,900 SRS low-level waste disposal boxes per tank), and transported to SRS radioactive waste disposal facilities for disposal. During cutting and removal operations, steps would be taken and technologies employed to limit both emissions and exposure of workers to radiation. This alternative would require the construction of approximately 16 new low-activity waste vaults at SRS for disposal of the tank components. This alternative has the advantage of allowing disposal of the contaminated tank system in a waste management facility that is already approved for receiving low-level waste.

With removal of the tanks, backfilling of the excavations left after the removal would be required. The backfill material would consist of a soil type similar to the soils currently surrounding the tanks.

S.6.3 NO ACTION ALTERNATIVE

For HLW tanks, the No Action Alternative would involve leaving the tank systems in place after bulk waste removal has taken place. Even after bulk waste removal, each tank would contain residual waste and, in those tanks that reside in the water table, ballast water. The tanks would not be backfilled.

After some period of time (probably hundreds of years), the reinforcing bar in the roof of the tank would rust and the roof would fail, causing the structural integrity to degrade. Similarly, the floor and walls of the tank would degrade over time. Rainwater would pour into the exposed tank, flushing contaminants from the residual waste in the tanks and eventually carrying these contaminants into the groundwater. Contamination of the groundwater would occur much more quickly than it would if the tank were backfilled and the residual waste bound with the backfill material.

S.7 Alternatives Considered, But Not Analyzed

S.7.1 MANAGEMENT OF TANK RESIDUALS AS HIGH-LEVEL WASTE

The alternative of managing the tank residuals as HLW is not preferred, in light of the requirements embodied in the State-approved General Closure Plan for a regulatory approach based on the designation of the residuals as waste incidental to reprocessing.

The waste incidental to reprocessing designation does not create a new radioactive waste type. The terms "incidental waste" or "waste incidental to reprocessing" refer to a process for identifying waste streams that might otherwise be considered HLW due to their origin, but are actually low-level or transuranic waste, if the waste incidental to reprocessing requirements contained in DOE Manual 435.1-1 are met. The goal of the waste incidental to reprocessing determination process is to safely manage a limited number of reprocessing waste streams that do not warrant geologic repository disposal because of their low threat to human health or the environment. Although the technical alternatives of managing tank residuals under the General Closure Plan would likely be the same as those that would apply to managing residuals as HLW, the application of regulatory requirements would be different.

As described in the General Closure Plan, DOE will meet the waste incidental to reprocessing requirements of DOE Manual 435.1-1, which entail a step for removing key radionuclides to the extent that is technically and economically practical, a step for incorporating the residues into a solid form, and a process for demonstrating that appropriate disposal performance objectives are met. The technical alternatives evaluated in the EIS represent a range of tank cleaning and stabilization techniques. The radionuclides in residual waste would be the same whether the material is HLW, low-level waste, or transuranic waste; however, the regulatory regime would be different.

DOE must demonstrate its ability to meet certain performance objectives before SCDHEC will approve a Closure Module. Appendix C of the General Closure Plan describes the process DOE used to determine the performance objectives (dose limits and concentrations established to be protective of human health) incorporated in the General Closure Plan. As described in Chapter 7 of this EIS, DOE will establish performance standards for the closure of each HLW tank. In the General Closure Plan, DOE considered dose limits and concentrations found in current (40 CFR 191, 10 CFR 60) and proposed (40 CFR 197, 10 CFR 63) HLW management requirements in defining the performance standards. DOE considered the HLW management dose limits and concentrations as performance indicators of the ability to protect human health and the environment, even though the residual would not be considered HLW. That evaluation (described in Appendix C of the General Closure Plan) identified numerical performance standards (concentrations or dose limits for specific radiological or chemical constituents released to the environment) based on the requirements and guidance. Those numerical standards apply to all exposure pathways and to specific media (air, groundwater, and surface water), at different points of compliance, and over various periods during and after closure.

If DOE determines through the waste incidental to reprocessing process that the tank residues cannot be managed as LLW, as expected, or alternatives as TRU waste, the residues would be managed as HLW. The technical alternatives for managing the residues as HLW, however, would be the same as those for managing the residues under the LLW requirements. Thus, DOE expects that the potential environmental impacts that could result from managing the residues under the LLW requirements would be representative of the impacts if the HLW standards were applicable. For these reasons, this EIS does not present the management of tank residues as HLW as a separate alternative.

S.7.2 OTHER ALTERNATIVES CONSIDERED, BUT NOT ANALYZED

DOE considered the alternative of delaying closure of additional tanks, pending the results of research. For the period of delay, the impacts of this approach would be the same as the No Action Alternative. DOE continues to conduct research and development efforts aimed at improving closure techniques. DOE has evaluated the No Action Alternative, thereby evaluating the impacts of delaying closure.

DOE considered an alternative that would represent grouting of certain tanks and removal of others. DOE has examined the impacts of both tank removal and grouting. Depending on the ability of cleaning to meet performance requirements for a given tank, the decisionmakers may elect to remove a tank if it is not possible to meet the performance requirements by using another method. This EIS captures the environmental and health and safety impacts of both options.

S.8 Comparison of Environmental Impacts among Alternatives

Closure of the HLW tanks would affect the environment, as well as human health and safety, during the period of time when work is being done to close the tanks and after the tanks have been closed. For this EIS, DOE has defined the period of short-term impacts to be from the year 2000 through about 2030, or the period during which the HLW tanks would be closed. Long-term impacts would be those resulting from the eventual release of residual waste contaminants from the stabilized tanks to the environment. In this EIS, DOE has estimated these impacts over a period of 10,000 years.

S.8.1 SHORT-TERM IMPACTS

DOE evaluated short-term impacts of the tank closure alternatives (Note – the preferred alternative is one of the options) on a number of environmental media. DOE also characterized the employment required for each alternative and estimated the cost to close an HLW tank using each alternative and option.

DOE compared impacts in the following areas:

- Geologic and Water Resources
- Nonradiological Air Quality
- Radiological Air Quality
- Ecological Resources
- Land use
- Socioeconomics
- Cultural Resources
- Worker and Public Health Impacts
- Environmental Justice
- Transportation
- Waste Generation
- Utilities and Energy Consumption
- Accidents

In general, the No Action alternative has the least impact on the environment over the short term, the Clean and Remove Tanks alternative has the greatest, and the impacts of the Clean and Stabilize Tanks alternative fall in between. Table S-2 shows those areas in which there are notable differences in impacts among the alternatives.

For the short term, No Action means continuing normal tank farm operations, including waste transfers, but not closing any tanks. The impacts, in terms of radiological and nonradiological air and water emissions and human health and safety, are the least of the three alternatives and in all cases are very small.

> The primary health effect of radiation is the increased incidence of cancer. Radiation impacts on workers, and public health are expressed in terms of latent cancer fatalities. A radiation dose to a population is estimated to result in cancer fatalities at a certain rate, expressed as a dose-to-risk conversion factor. The EPA has established dose-to-risk conversion factors of 0.0005 per person-rem for the general population and 0.0004 per person-rem for workers. The difference is due to the presence of children, who are believed to be more susceptible to radiation, in the general population.
>
> DOE estimates the doses to the population and uses the conversion factor to estimate the number of cancer fatalities that might result from those doses. In most cases, the result is a small fraction of one. For these cases, DOE concludes that the action would very likely result in no additional cancer in the exposed population.

Over the short term, the Clean and Remove Tanks alternative has significantly greater impacts than the other alternatives. This is particularly notable in worker exposure to radiation and the resultant cancer fatalities, and in the numbers of on-the-job injuries. DOE's analysis estimates that implementation of the Clean and Remove Tanks alternative would result in about five cancer fatalities in the worker population, while the estimate for the Clean and Stabilize Tanks alternative is less than one, and the estimate for No Action is essentially zero. The Clean and Remove Tanks alternative would result in the generation of twice as much liquid radioactive waste and about 15 times as much low-level waste as the Clean and Stabilize Tanks alternative. The waste generation would be the result of the cleaning activities required to clean the tanks so they could be removed from the ground, and from disposal of the tanks as low-level waste at another location on the Savannah River Site.

The labor and waste disposal requirements of the Clean and Remove Tanks alternative would result in a cost of more than $100 million per tank, compared to about $6.3 million for the most costly option (Clean and Fill with Saltstone) of the Clean and Stabilize Tanks alternative. While the Clean and Remove Tanks Alternative would

Table S-2. Comparison of short-term impacts by tank closure alternative.

Parameter	No Action Alternative	Clean and Stabilize Tanks Alternative: Clean and Fill with Grout Option	Clean and Stabilize Tanks Alternative: Clean and Fill with Sand Option	Clean and Stabilize Tanks Alternative: Clean and Fill with Saltstone Option	Clean and Remove Tanks Alternative
Geologic Resources Soil backfill (m^3)	None	170,000	170,000	170,000	356,000
Air Resources					
Nonradiological air emissions (tons/yr.):					
Particulate matter	None	4.5	3.1	3.6	None
Carbon monoxide	None	5.6	5.6	16.0	None
Benzene	None	0.02	0.02	0.43	None
Air pollutants at the SRS boundary (maximum concentrations-μg/m^3)[a]:					
Carbon monoxide – 1 hr.	None	1.2	1.2	3.4	None
Volatile organic compounds – 1 hr.	None	0.5	0.5	2.0	None
Annual radionuclide emissions (curies/year):					
Saltstone mixing facility	Not used	Not used	Not used	0.46	Not used
Socioeconomics (employment – full time equivalents)					
Annual employment	40	85	85	131	284
Life of project employment	980	2,078	2,078	3,210	6,963
Radiological dose and health impacts to involved workers:					
Closure collective dose (total person-rem)	29.4[b]	1,600	1,600	1,800	12,000
Closure latent cancer fatalities	0.012	0.65	0.65	0.72	4.9
Occupational Health and Safety:					
Recordable injuries-closure	110[c]	120	120	190	400
Lost workday cases-closure	60[c]	62	62	96	210

Table S-2. (Continued).

Parameter	No Action Alternative	Clean and Stabilize Tanks Alternative: Clean and Fill with Grout Option	Clean and Stabilize Tanks Alternative: Clean and Fill with Sand Option	Clean and Stabilize Tanks Alternative: Clean and Fill with Saltstone Option	Clean and Remove Tanks Alternative
Transportation (offsite round-trip truckloads per tank)	0	654	653	19	5
Waste Generation					
Maximum annual waste generation:					
Radioactive liquid waste (gallons)	0	600,000	600,000	600,000	1,200,000
Nonradioactive liquid waste (gallons)	0	20,000	20,000	20,000	0
Low-level waste (m^3)	0	60	60	60	900
Total estimated waste generation					
Radioactive liquid waste (gallons)	0	12,840,000	12,840,000	12,840,000	25,680,000
Nonradioactive liquid waste (gallons)	0	428,000	428,000	428,000	0
Low-level waste (m^3)	0	1,284	1,284	1,284	19,260
Mixed low-level waste (m^3)	0	257	257	257	428
Utility and Energy Usage:					
Water (total gallons)	7,120,000	48,930,000	12,840,000	12,840,000	25,680,000
Steam (total pounds)	NA	8,560,000	8,560,000	8,560,000	17,120,000
Fossil fuel (total gallons)	NA	214,000	214,000	214,000	428,000
Utility cost (total)	NA	$4,280,000	$4,280,000	$4,280,000	$12,840,000

a. No exceedances of air quality standards are expected.
b. Collective dose for the No Action Alternative is for the period of closure activities for the other alternatives. This dose would continue indefinitely at a rate of approximately 1.2 person-rem per year.
c. For the No Action Alternative, recordable injuries and lost workday cases are for the period of closure activities for the other alternatives. These values would continue indefinitely.
NA = Not available.

effectively eliminate the future radiation dose at the seepline, under the Preferred Alternative this seepline dose would be within the 4 millirem per year drinking water standard, which would equate to 0.000002 latent cancer fatality. Thus, DOE would spend $4.9 billion (for all 49 HLW tanks) to reduce a projected dose that already would be less than 4 millirem. This alternative would result in about 12,000 person-rem (4.9 latent cancer fatalities) within the population of SRS workers performing these activities. DOE believes that the incremental benefits of oxalic acid cleaning do not warrant the high costs associated with using this cleaning method on all tanks.

There are some differences in impacts among the three options of the Clean and Stabilize Tanks alternative in the short term, but none are significant. The Clean and Fill with Grout option would use about four times as much water (from groundwater sources) than the other options. The Clean and Fill with Saltstone option would employ the most workers and result in more occupational injuries and a very slightly increased risk of cancer fatalities for workers. It would also be the most costly of the three options.

DOE evaluated the impacts of potential accidents related to each alternative. The highest consequence accidents would be transfer errors (spills) and seismic events during cleaning. Both of these accidents could happen during cleaning under the Clean and Stabilize Tanks Alternative and the Clean and Remove Tanks Alternative, and there is no difference in the consequences.

S.8.2 LONG-TERM IMPACTS

In the long term, the important impact to consider is the effect on the environment and human health of residual waste contaminants that will eventually find their way to the accessible environment. DOE estimated long-term impacts by completing a performance evaluation that includes fate and transport modeling over a period of 10,000 years to determine when certain impacts (e.g., radiation dose and the associated health effects) would reach their peak value. Table S-3 shows those areas in which there are notable differences in impacts among the alternatives.

Any waste that migrates through the groundwater and outcrops at a stream location (called a "seepline" in the EIS) would result in radiological doses and possible consequent health effects to individuals exposed to water containing the contaminants. For H-Area, the seepline along Upper Three Runs and Fourmile Branch is about 1,200 meters downgradient from the center of the tank farm while, for F-Area, the seepline is about 1,800 meters downgradient from the tank farm (see Figure S-1). Because of the long travel time from the closed and stabilized tank to the groundwater outcrop, the impacts would be substantially reduced compared to what they might have been if the contaminants came into the accessible environment more quickly. This can be seen clearly by comparing the long-term impacts of the No Action Alternative to the impacts of the Clean and Fill with Grout Option of the Clean and Stabilize Tanks Alternative. Figure S-7 graphically illustrates this.

If the Clean and Remove Tanks Alternative were chosen, residual waste would be removed from the tanks and the tank systems themselves would be removed and transported to SRS radioactive waste disposal facilities. Long-term impacts at these facilities are evaluated in the Savannah River Site Waste Management EIS (DOE/EIS-0217).

The long-term impacts of low-level waste disposal in low-activity vaults presented in the SRS Waste Management EIS are about one-one thousandth of the long-term tank closure impacts presented in this EIS for water resources and public health. Under this alternative, some land in E-Area would be permanently committed to disposal and would therefore be unavailable for other uses or for ecological habitat. After removal of the tanks and subsequent CERCLA actions, some land and habitats could become available for other uses or habitat.

Table S-3. Comparison of long-term impacts by tank closure alternative.[a]

		Clean and Stabilize Tanks Alternative		
Parameter	No Action Alternative	Clean and Fill with Grout Option	Clean and Fill with Sand Option	Clean and Fill with Saltstone Option
Surface Water	Limited movement of residual contaminants in closed tanks to down-gradient surface waters	Almost no movement of residual contaminants in closed tanks to down-gradient surface waters	Almost no movement of residual contaminants in closed tanks to down-gradient surface waters	Almost no movement of residual contaminants in closed tanks to down-gradient surface waters
Maximum dose from beta-gamma emitting radionuclides in surface water (millirem/year)				
Upper Three Runs	0.45	(b)	4.3×10^{-3}	9.6×10^{-3}
Fourmile Branch	2.3	9.8×10^{-3}	0.019	0.130
Groundwater				
Groundwater concentrations from contaminant transport – F-Area Tank Farm:				
Drinking water dose (mrem/yr.)				
1-meter well	35,000	130	420	790
100-meter well	14,000	51	190	510
Seepline, Fourmile Branch (1,800 meters downgradient)	430	1.9	3.5	25
Groundwater concentrations from contaminant transport – H-Area Tank Farm:				
Drinking water dose (mrem/yr.)				
1-meter well	9.3×10^{6}	1×10^{5}	1.3×10^{5}	1×10^{5}
100-meter well	9.0×10^{4}	300	920	870
Seepline (1,200 meters downgradient): North of Groundwater Divide	2,500	2.5	25	46
South of Groundwater Divide	200	0.95	1.4	16
Maximum Groundwater Concentrations of Nitrates[c]				
1-meter well	270	21	22	440,000
100-meter well	69	4.7	4.9	180,000
Seepline	3.4	0.1	0.2	3,300

Table S-3. (Continued).

Parameter	No Action Alternative	Clean and Stabilize Tanks Alternative: Clean and Fill with Grout Option	Clean and Stabilize Tanks Alternative: Clean and Fill with Sand Option	Clean and Stabilize Tanks Alternative: Clean and Fill with Saltstone Option
Ecological Resources				
Maximum absorbed dose to aquatic and terrestrial organisms (in millirad per year):				
Sunfish dose	0.89	0.0038	0.0072	0.053
Shrew dose	24,450	24.8	244.5	460.5
Mink dose	2,560	3.3	25.6	265
Public Health				
Radiological contaminant transport from F-Area Tank Farm:				
Adult resident latent cancer fatality risk	2.2×10^{-4}	9.5×10^{-7}	1.8×10^{-6}	1.3×10^{-5}
Child resident latent cancer fatality risk	2.0×10^{-4}	8.5×10^{-7}	1.7×10^{-6}	1.2×10^{-5}
Seepline worker latent cancer fatality risk	2.2×10^{-7}	8.0×10^{-10}	1.6×10^{-9}	1.2×10^{-8}
Intruder latent cancer fatality risk	1.1×10^{-7}	4.0×10^{-10}	8.0×10^{-10}	8.0×10^{-9}
Adult resident maximum lifetime dose (millirem)[d]	430	1.9	3.6	26
Child resident maximum lifetime dose (millirem)[d]	400	1.7	3.3	24
Seepline worker maximum lifetime dose (millirem)[d]	0.54	0.002	0.004	0.03
Intruder maximum lifetime dose (millirem)[d]	0.27	0.001	0.002	0.02
Radiological contaminant transport from H-Area Tank Farm:				
Adult resident latent cancer fatality risk	8.5×10^{-5}	3.9×10^{-7}	5.5×10^{-7}	6.5×10^{-6}
Child resident latent cancer fatality risk	7.5×10^{-5}	3.3×10^{-7}	5.5×10^{-7}	6.5×10^{-7}
Seepline worker latent cancer fatality risk	8.4×10^{-8}	(e)	4.0×10^{-10}	6.8×10^{-9}
Intruder latent cancer fatality risk	4.4×10^{-8}	(e)	(e)	3.2×10^{-9}
Adult resident maximum lifetime dose (millirem)[d]	170	0.7	1.1	13
Child resident maximum lifetime dose (millirem)[d]	150	0.65	1.1	1.3
Seepline worker maximum lifetime dose (millirem)[d]	0.21	(b)	0.001	0.017
Intruder maximum lifetime dose (millirem)[d]	0.11	(b)	(b)	0.008

a. The Clean and Remove Tanks Alternative is not presented in this table because the residual waste (and tank components) would be removed from the tank farm areas and transported to SRS radioactive waste disposal facilities; impacts of this facility are evaluated in the SRS Waste Management EIS (DOE/EIS-0217).
b. The radiation dose for this alternative is less than 1×10^{-3} millirem.
c. Given in percent of EPA Primary Drinking Water Maximum Contaminant Levels (MCL). A value of 100 is equivalent to the MCL concentration.
d. Calculated based on an assumed 70-year lifetime.
e. The risk for this alternative is less than 4.0×10^{-10}.

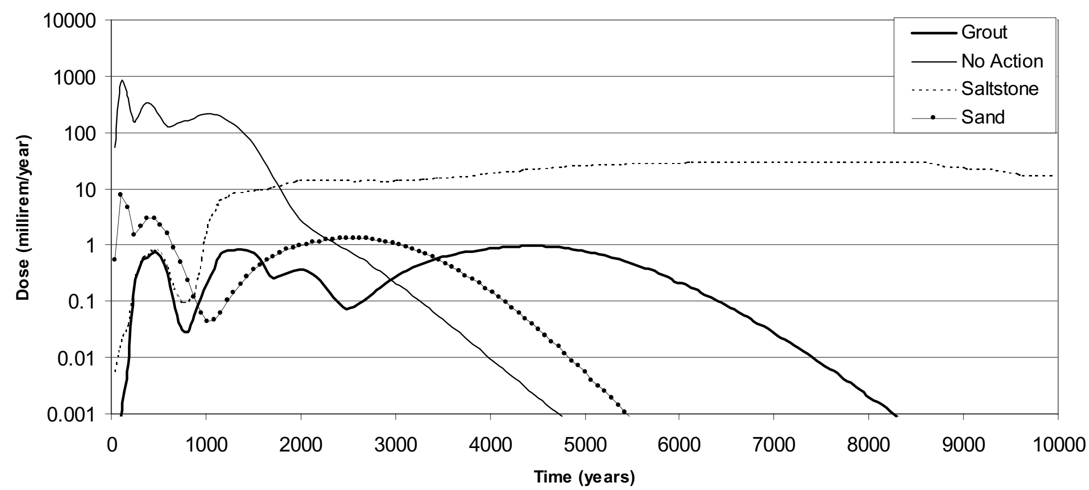


Figure S-7. Predicted Drinking Water Dose Over Time at the H-Area Seepline North of the Groundwater Divide in the Barnwell-McBean and Water Table Aquifers.

There are always uncertainties associated with the results of analyses, especially if the analyses attempt to predict impacts over a long period of time. These uncertainties could result from assumptions used, the complexity and variability of the process(es) being analyzed, the use of incomplete information, or lack of information.

The uncertainties involved in estimating impacts over the 10,000-year period analyzed in this EIS are described in Chapter 4 and Appendix C of the EIS. Over the long term, there would be limited movement of residual contaminants from the closed tanks to surface waters downgradient from the tanks under the No Action Alternative, and almost no such movement under the Clean and Fill with Grout Option under the Clean and Stabilize Tanks Alternative and an intermediate amount under the Clean and Fill with Sand and Clean and Fill with Saltstone Options. The use of a stabilizing agent to retard the movement of residual contaminants under the Clean and Stabilize Alternative results in considerably lower long-term environmental impacts than the No Action Alternative, as described below.

Conservative modeling which exaggerates concentrations at wells close to the tank farms estimates that doses from groundwater at wells 1 meter and 100 meters distant from the tank farms, and at the seepline in Fourmile Branch, would be very large under the No Action Alternative. Under the Clean and Stabilize Tanks Alternative, doses would be much smaller, but incremental doses at the 100 meter well would still exceed the average annual dose a person living in South Carolina receives from natural and man-made sources. The same is true under all three options in the H-Area Tank Farm at the 100-meter well. The doses decrease substantially with distance from the tank farm.

The greatest long-term impacts occur under the No Action Alternative. For this alternative, the Maximum Contaminant Level for beta-gamma radionuclides is exceeded at all points of exposure. On the other hand, the Clean and Fill with Grout Option shows the lowest long-term impacts at all exposure points, and the Maximum Contaminant Level for beta-gamma radionuclides is met at the seepline for this alternative. Impacts for the Clean and Fill with Grout Option would occur later than under the No Action Alternative or the Clean and Fill with Sand Option. The Clean and Fill with Saltstone Option would delay the impacts at the seepline, but would. result in a higher peak dose than either the Clean and Fill with Grout or Clean and Fill with Sand Options

If, in the future, people were unaware of the presence of the closed waste tanks and chose to live in homes built over the tanks, they would have essentially no external radiation exposure under the Clean and Fill with Grout Option or the Clean and Fill with Sand Option. Residents could be exposed to external radiation under the Clean and Fill with Saltstone Option, due to the presence of radioactive saltstone near the ground surface. If it is conservatively assumed that all shielding material over the saltstone would be removed by erosion or excavation, at 1000 years after tank closure a resident living on top of a closed tank would be exposed to an effective dose equivalent of 390 mrem/year, resulting in an estimated 1 percent increase in risk of latent cancer fatality from a 70-year lifetime of exposure. For the No Action Alternative, external exposures to onsite residents would be expected to be unacceptably high, due to the potential for contact with residual waste.

The risk of incurring a fatal cancer as a result of radiation doses is also greater under the No Action Alternative than under any of the Options of the Clean and Stabilize Tanks Alternative. The preferred Option, Clean and Fill with Grout, would result in the least risk of a fatal cancer of all the Options under the Clean and Stabilize Tanks Alternative.

Effects on aquatic and terrestrial organisms are very large under the No Action Alternative, and two or three orders of magnitude less under the options of the Clean and Stabilize Tanks Alternative.

SRS personnel have prepared a report, referred to as the *Composite Analysis*, that calculated the potential cumulative impact to a hypothetical member of the public over a period of 1,000 years from releases to the environment from all sources of residual radioactive material expected to remain in the SRS General Separations Area which contains all of the SRS waste disposal facilities, chemical separations facilities, HLW tank farms, and numerous other sources of radioactive material. The impact of primary concern was the increased probability of fatal cancers. The *Composite Analysis* also included contamination in the soil in and around the HLW tank farms resulting from previous surface spills, pipeline leaks, and Tank 16 leaks as sources of residual radioactive material. The *Composite Analysis* considered 114 potential sources of radioactive material containing 115 radionuclides.

From a land use perspective, the F- and H- Area Tank Farms are zoned Heavy Industrial and are within existing heavily industrialized areas. The alternatives evaluated in this EIS are limited to closure of the tanks and associated equipment. They do not address other potential sources of contamination co-located with the tank systems, such as soil or groundwater contamination from past releases or other facilities. Consequently, future land use of the Tank Farms areas is not solely determined by the alternatives for closure of the tank systems. For example, the Environmental Restoration program may determine that the tank farms areas should be capped to control the spread of contaminants through the groundwater. Such decisions would constrain future use of the tank farms areas. Any of these options under the Clean and Stabilize Tanks Alternative would render the tank farms areas least suitable for other uses, as the closed filled tanks would remain in the ground. The Clean and Remove Tanks Alternative would have somewhat less impact on future land use since the tank systems would be removed. However, DOE does not expect the General Separations Area, which surrounds the F- and H-Area Tank Farms, to be available for other uses.