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Rev. 3

INDUSTRIAL WASTEWATER GENERAL CLOSURE PLAN FOR F-AREA WASTE TANK SYSTEMS

Industrial Wastewater Construction Permit #17,424-IW

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REVISION SUMMARY

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ACRONYMS

ARP/MCU	Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CM	Closure Module
CMCOCs	Contaminant Migration Constituents of Concern
CTS	Concentrate Transfer System
DB	diversion box
DOE	U.S Department of Energy
DWPF	Defense Waste Processing Facility
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESD	Explanation of Significant Difference
FDB	FTF Diversion Box
FFA	SRS Federal Facility Agreement
FTF	F-Area Tank Farm
GCP	General Closure Plan
GWMP	Groundwater Monitoring Plan
GSA	General Separations Area
HSWA	Hazardous and Solid Waste Amendments of 1984
HTF	H-Area Tank Farm
IAPP	Interim Action Proposed Plan
IASB	Interim Action Statement of Basis
IROD	Interim ROD
IWW	Industrial Wastewater
LDB	Leak Detection Box
LWTRSAPP	Liquid Waste Tank Residuals Sampling and Analysis Program Plan
MCL	Maximum Contaminant Level
MLDB	Modified Leak Detection Box
mrem	millirem
OU	Operable Unit
OUO	Official Use Only
PA	Performance Assessment
PCA	South Carolina Pollution Control Act
PP	pump pit
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SA	Special Analysis
SARA	Superfund Amendments and Reauthorization Act
SCDHEC	South Carolina Department of Health and Environmental Control
SDF	Saltstone Disposal Facility
SPF	Saltstone Production Facility
SRS	Savannah River Site
SWMU	Solid Waste Management Unit
SWPF	Salt Waste Processing Facility
UTR	Upper Three Runs

EXECUTIVE SUMMARY

This General Closure Plan (GCP) has been prepared to support the removal from service of the F-Area Tank Farm (FTF) underground radioactive waste tanks and ancillary equipment at the Savannah River Site (SRS). The SRS is one of the facilities in the U.S. Department of Energy (DOE) complex constructed to produce nuclear materials. Since beginning operations in the early 1950s, uranium and plutonium recovery processes have generated liquid radioactive waste, which is currently stored in underground tanks in the F and H Areas at the site. The DOE intends to remove from service the waste tanks that do not meet the standards established in Appendix B of the SRS Federal Facility Agreement (FFA), entered into agreement pursuant to Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Sections 3008(h) and 6001 of the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA) (hereinafter jointly referred to as RCRA) and the Atomic Energy Act of 1954. [WSRC-OS-94-42] Removal of these tanks from service will reduce the risk of a leak to the environment and provide a stable form that is protective of human health and environment.

Although the waste tank system removal effort plans for the removal or decontamination of all residues, contaminated containment system components (liners, etc.), and structures and equipment contaminated with hazardous and/or radioactive substances, it is recognized that DOE cannot practicably remove or decontaminate all structures and equipment. Therefore, after the South Carolina Department of Health and Environmental Control (SCDHEC), Environmental Protection Agency (EPA), and DOE mutually agree that waste removal may cease, any residual contaminants will be stabilized and the waste tanks shall be removed from service in accordance with the Pollution Control Act (PCA), S.C. Code Ann., Section 48-1-10, et seq. (1985) and all applicable regulations promulgated pursuant to the PCA. Applicable regulations include SCDHEC Regulation 61-67, *Standards for Wastewater Facility Construction* and SCDHEC Regulation 61-82, *Proper Closeout of Wastewater Treatment Facilities*. Removal from service includes operational closure of the waste tank system under, and then removal from the industrial wastewater permit that regulates their operation, the *F and H Area High Level Radioactive Waste Tank Farms Construction Permit No. 17424-IW* (hereinafter referred to as IWW Construction Permit #17,424-IW) and the SRS FFA which will control the subsequent remediation of the FTF. [DHEC_03-03-1993, WSRC-OS-94-42]

The DOE has identified environmental requirements and guidance considered pertinent to the F-Area waste tank system's removal from service and has derived performance objectives to be met for the protection of human health and the environment, and to provide information for use in a potential RCRA/CERCLA response action in the closed FTF. The performance objectives used are the SCDHEC R.61-58, *State Primary Drinking Water Regulations* for radionuclides and the SCDHEC maximum contaminant levels (MCLs) for nonradiological constituents. A performance assessment (PA) has been developed to assess the long-term fate and transport of any residual contamination in the environment resulting from the removal from service of the waste tanks and ancillary equipment and to provide reasonable assurance that groundwater concentrations derived from residual contamination in the tanks and ancillary structures will be within those performance objectives.

The DOE will prepare a detailed tank-specific closure module (CM), which will be submitted to SCDHEC and EPA for review. The CM will provide details of any residual contamination content based on sampling and analysis and/or process knowledge. After SCDHEC approves the module and EPA concurs, all agencies are in agreement that waste removal activities can cease and DOE will stabilize the residual contaminants as the final step of the SCDHEC approved removal from service of each tank and associated ancillary equipment. Following stabilization, DOE will submit a final configuration report to SCDHEC with certification that the closure activities have been performed in accordance with the GCP and the CM. Each CM will represent an incremental removal from service related to IWW Construction Permit #17,424-IW.

1.0 INTRODUCTION

Since the early 1950s, the primary mission of SRS had been to produce nuclear materials for national defense and deep space missions. The processes used to recover these nuclear materials from production reactor fuel and target assemblies in the chemical separations areas at SRS generated significant volumes of liquid radioactive waste. This waste is currently stored in underground storage tanks in F and H Areas near the center of the site. Today, the primary focus at SRS is environmental restoration with the highest priority being removal, treatment and disposal of the liquid waste in the FTF and H-Area Tank Farm (HTF).

In support of environmental restoration activities at SRS, DOE, the EPA and SCDHEC signed a FFA pursuant to Section 120 of CERCLA and Sections 3008(h) and 6001 of RCRA. The agreement became effective in August 1993. As part of this comprehensive agreement, DOE has committed to remove from service those liquid radioactive waste tank systems that do not meet the standards set forth in Appendix B of the FFA. Appendix B of the FFA also defines the specific radioactive waste tank systems that are subject to the agreement. [WSRC-OS-94-42]

The FFA identifies the approved plan and schedule for this work. This approved plan is attached and incorporated into this GCP (Attachment 1). Should the schedule be amended pursuant to the process set forth in the FFA, with the agreement of SCDHEC (agreement not to be unreasonably withheld), DOE will provide a revised Attachment 1 to SCDHEC and it will be a modification to the GCP. [WSRC-OS-94-42]

After wastes are removed from individual waste tank systems and the systems are stabilized, the waste tank systems will be operationally closed under, and then removed from, the industrial wastewater permit that regulates their operation. SCDHEC will regulate the waste tank system removal from service via the IWW Construction Permit #17,424-IW, applicable South Carolina law and regulation, and the SRS FFA. [DHEC_03-03-1993, WSRC-OS-94-42] This FTF GCP describes the process by which DOE will document the removal from service of individual waste tank systems in FTF.

1.1 Purpose and Objectives

The purpose of this document is to set forth the general protocol by which DOE intends to remove from service the waste tanks and ancillary equipment at the FTF at SRS to protect human health and the environment in accordance with SCDHEC R.61-82, *Proper Closeout of Wastewater Treatment Facilities*, and R.61-67, *Standards for Wastewater Facility Construction*. [SCDHEC R.61-82; SCDHEC R.61-67] For the purposes of this document, FTF includes the radioactive waste tank systems located in F Area described in Appendix B of the FFA. The term "waste tank system" is intended to include individual waste tanks and associated ancillary equipment used to support operations in FTF. This plan implements the applicable environmental regulatory standards and guidelines pertinent to removal from service of the waste tank systems and describes the process for evaluating the stabilized tank configuration. This plan also describes the method of stabilizing the waste tank systems and residual contamination associated with these systems. Additionally, the plan describes the integration of the waste tank system closure activities with existing commitments to remove waste from the tank systems before removal from service, and ultimately to investigate, assess, and to take appropriate response action (if needed) concerning the FTF under the FFA.

The specific objectives of this plan are as follows:

- Identify the State environmental requirements and guidance that apply to the removal from service of the FTF individual waste tanks systems, and describe how DOE will comply with these requirements.
- Describe the process DOE will follow in selecting waste removal and stabilization methods for individual waste tank systems as they are removed from service.
- Describe the process for characterization and quantification of residues remaining in the waste tank systems following waste removal activities.
- Describe the methodology for determining impacts of individual removal actions such that the final closure of all FTF systems will comply with environmental standards.
- Describe the specific documentation that will be required to detail waste removal activities, stabilization and facility status and the process that will be used to review and approve this documentation and authorize removal from service.

The process outlined in this plan is intended to comply with the requirements of SCDHEC R.61-82 and R.61-67 and be consistent with the requirements of the FFA, under which the FTF will eventually be assessed for any appropriate response action. This document is not intended to satisfy or to replace the requirements of the DOE Manual 435.1-1, Tier 2 Closure Plan. The GCP will not be updated on a standard, predetermined schedule but, instead, will be revised when either DOE or SCDHEC believes the process described in this document needs to be updated.

1.2 F-Area Waste Tank System General Closure Plan Structure

Section 2 provides an abbreviated description of the waste tank types and ancillary equipment included in the FTF. A detailed description can be found in the FTF PA that has been prepared to provide the input to this document and to other regulatory documents required for closure activities in FTF. [SRS-REG-2007-00002]

Section 3 identifies the applicable regulatory framework to remove the waste tank systems from service.

Section 4 describes the process for selecting waste removal technologies appropriate to the waste tank system and determining the appropriate extent of removal activities. Although removal of the bulk waste from an individual waste tank or from associated ancillary equipment is an operational activity (i.e., not specifically part of waste tank system closure), it is an essential precursor to removal from service of the waste tanks.

Section 5 identifies the performance objectives applicable to removal from service of the waste tank systems and describes the methodology for using fate and transport modeling to assess the long-term impact of any residual contamination. Although high-level summary results from the FTF PA are presented here, the specific details of the modeling and associated results are provided in the FTF PA document.

Section 6 of this document describes the process that will be used to develop, review, and approve CMs for individual waste tank systems and ultimately to receive approval to remove the waste tank system from the governance of IWW Construction Permit #17,424-IW. The anticipated durations for the activities in this process are also described.

Section 7 describes the stabilization processes for the waste tank systems.

Finally, Section 8 describes the maintenance and monitoring plans for the interim period from the time the tank system is removed from service until the final closure of the FTF Operable Unit (OU).

2.0 FACILITY DESCRIPTION

A legacy of the SRS mission was the generation of liquid waste from chemical separations processes in both F and H Areas. Since the beginning of SRS operations, an integrated waste management system consisting of several facilities designed for the overall processing of liquid waste has evolved. Two of the major components of this system are the FTF and HTF located in F and H Area respectively, which are near the center of the site (Figure 2.0-1). F Area is where plutonium, uranium, and other radionuclides were separated from irradiated fuel and target assemblies using chemical separations processes. The tank farms, which store and process waste from the chemical separations process, include tanks, evaporators, transfer line systems, and other ancillary equipment.

The FTF site was chosen because of its favorable terrain and its proximity to the F-Canyon Separations Facility (the major waste generation source), which was located near the center of the Site, away from the SRS boundaries. Figure 2.0-2 shows the setting of F Area and FTF within the General Separations Area (GSA).

The FTF is a 22 acre site consisting of 22 liquid waste storage tanks, two evaporator systems, transfer pipelines, six diversion boxes (DBs), one catch tank, a concentrate transfer system (CTS) tank, and three pump pits (PPs). Figure 2.0-3 shows the general layout of FTF. There are three major waste tank types in FTF that range in size from 750,000 gallons (Type I tanks) to 1.3 million gallons (Type III and Type IV tanks) and have varying degrees of secondary containment and intra-tank interference, such as cooling coils and columns. The FTF was constructed to receive waste generated by various SRS production, processing, and laboratory facilities. The use of FTF isolated these wastes from the environment, SRS workers, and the public. With FTF and HTF, facilities are in place to pretreat the accumulated sludge and salt solutions (supernate) to enable the management of these wastes within other SRS facilities (i.e., Defense Waste Processing Facility (DWPF) and Saltstone Production Facility (SPF)). These treatment facilities convert the sludge and supernate to more stable forms suitable for permanent disposal in a federal repository or the Saltstone Disposal Facility (SDF), as appropriate. Extensive descriptions of the FTF and waste processing facilities are provided in the FTF PA. [SRS-REG-2007-00002]

Figure 2.0-1: SRS Operational Area Location Map

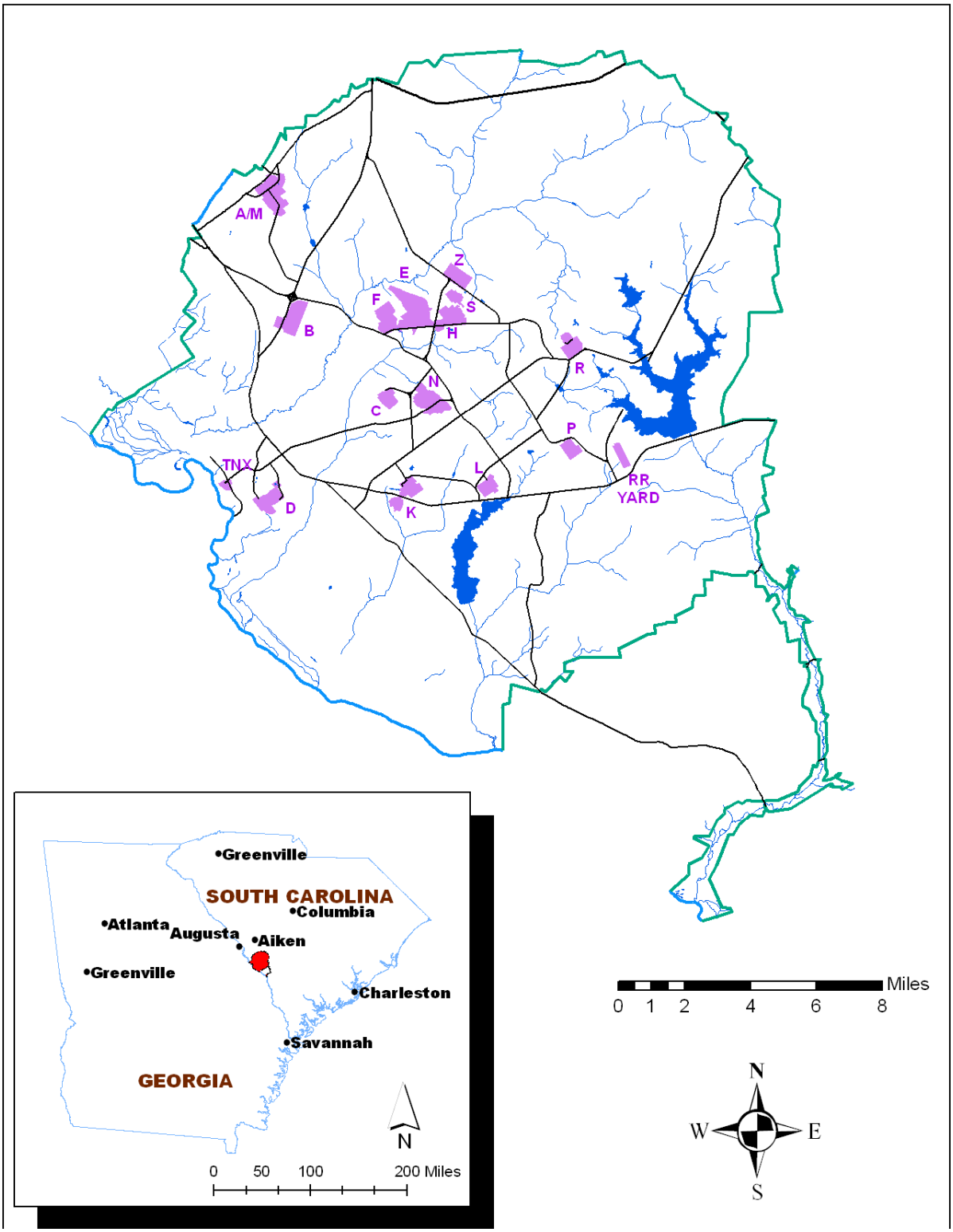


Figure 2.0-2: Layout of the General Separations Area

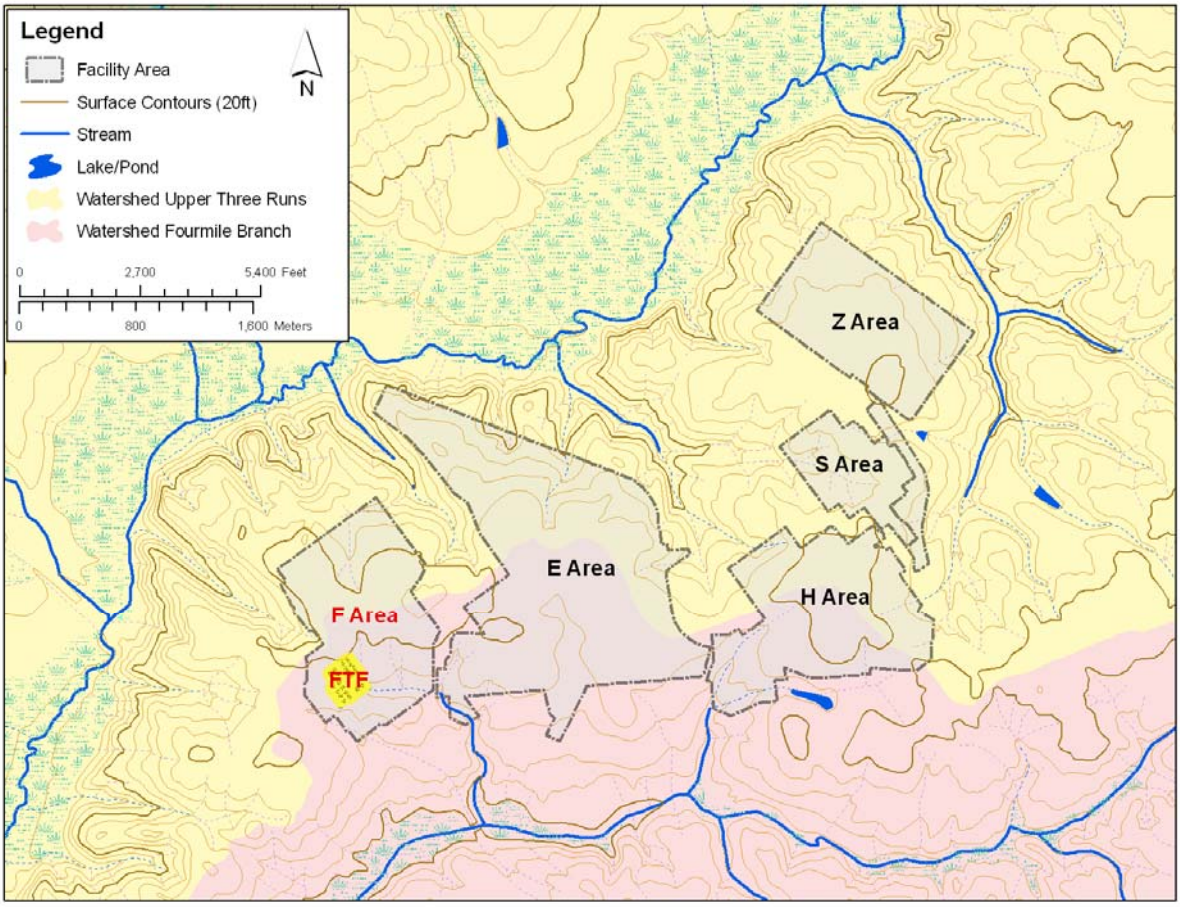
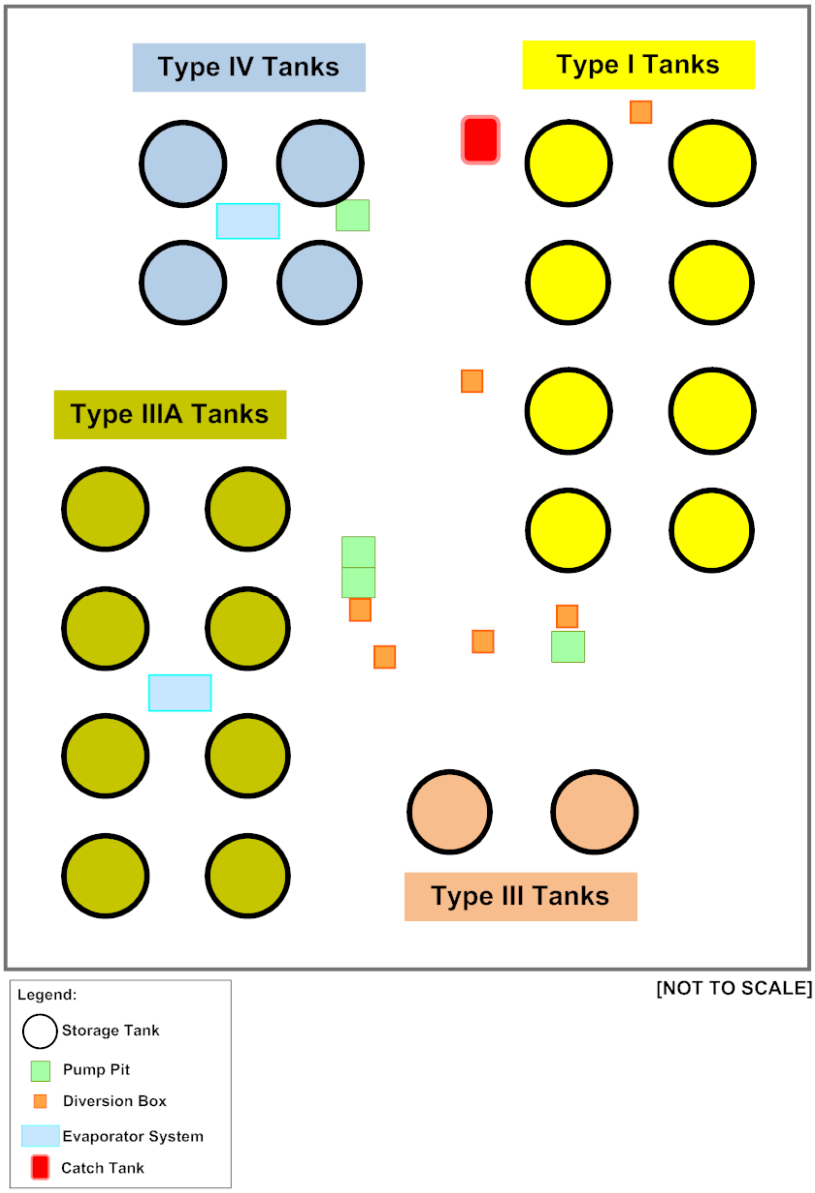


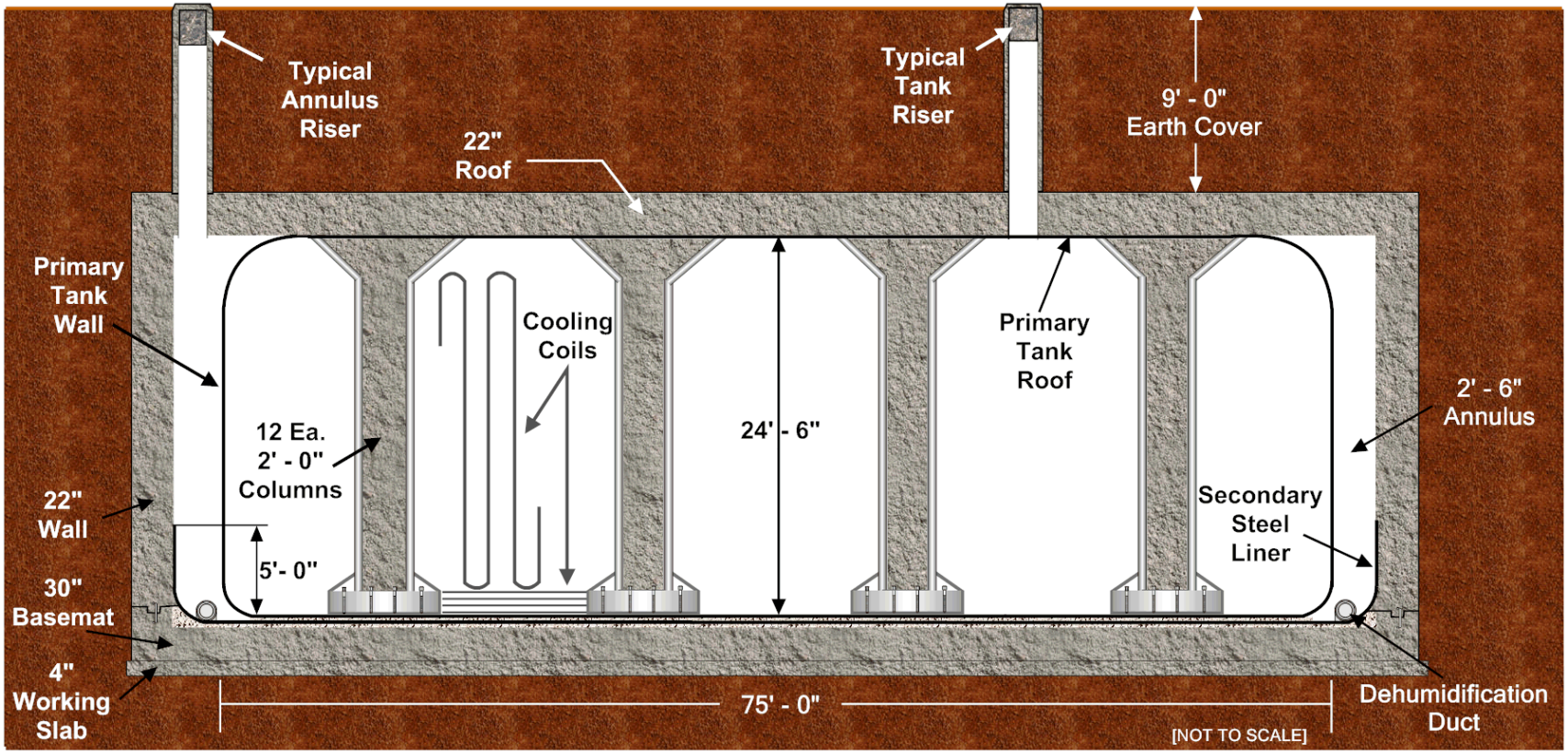
Figure 2.0-3: General Layout of F-Area Tank Farm



2.1 Type I Waste Tanks

The F Area waste tanks are comprised of three different designs, Type I, Type III/IIIA, and Type IV, all constructed of carbon steel. The Type I waste tanks have 5-foot high secondary annulus pans and forced cooling (Figure 2.1-1). The Type I waste tanks (Tanks 1 through 8) were constructed in the early 1950s and first received waste from F Canyon in 1954. A typical Type I waste tank is shown in Figure 2.1-1. These waste tanks are 75 feet in diameter and 24.5 feet high, with a nominal operating capacity of 750,000 gallons. The waste tank tops are approximately 9 feet below grade. Additional details of the Type I waste tanks are provided in Section 3 of the FTF PA. [SRS-REG-2007-00002]

Figure 2.1-1: Sketch of Typical Type I Waste Tank



2.2 Type III/IIIA Waste Tanks

There are two Type III and eight Type IIIA waste tanks in the FTF. The FTF Type III waste tanks were completed in 1969 (Tank 33) and 1972 (Tank 34) and the FTF Type IIIA waste tanks were completed in 1978 (Tanks 25 through 28) and 1980 (Tanks 44 through 47). Typical Type III and IIIA waste tanks are shown in Figures 2.2-1 and 2.2-2, respectively. These waste tanks are 85 feet in diameter and 33 feet high, with a nominal operating capacity of 1,300,000 gallons. Additional details of the Type III and IIIA waste tanks are provided in Section 3 of the FTF PA. [SRS-REG-2007-00002]

Figure 2.2-1: Sketch of Typical Type III Waste Tank

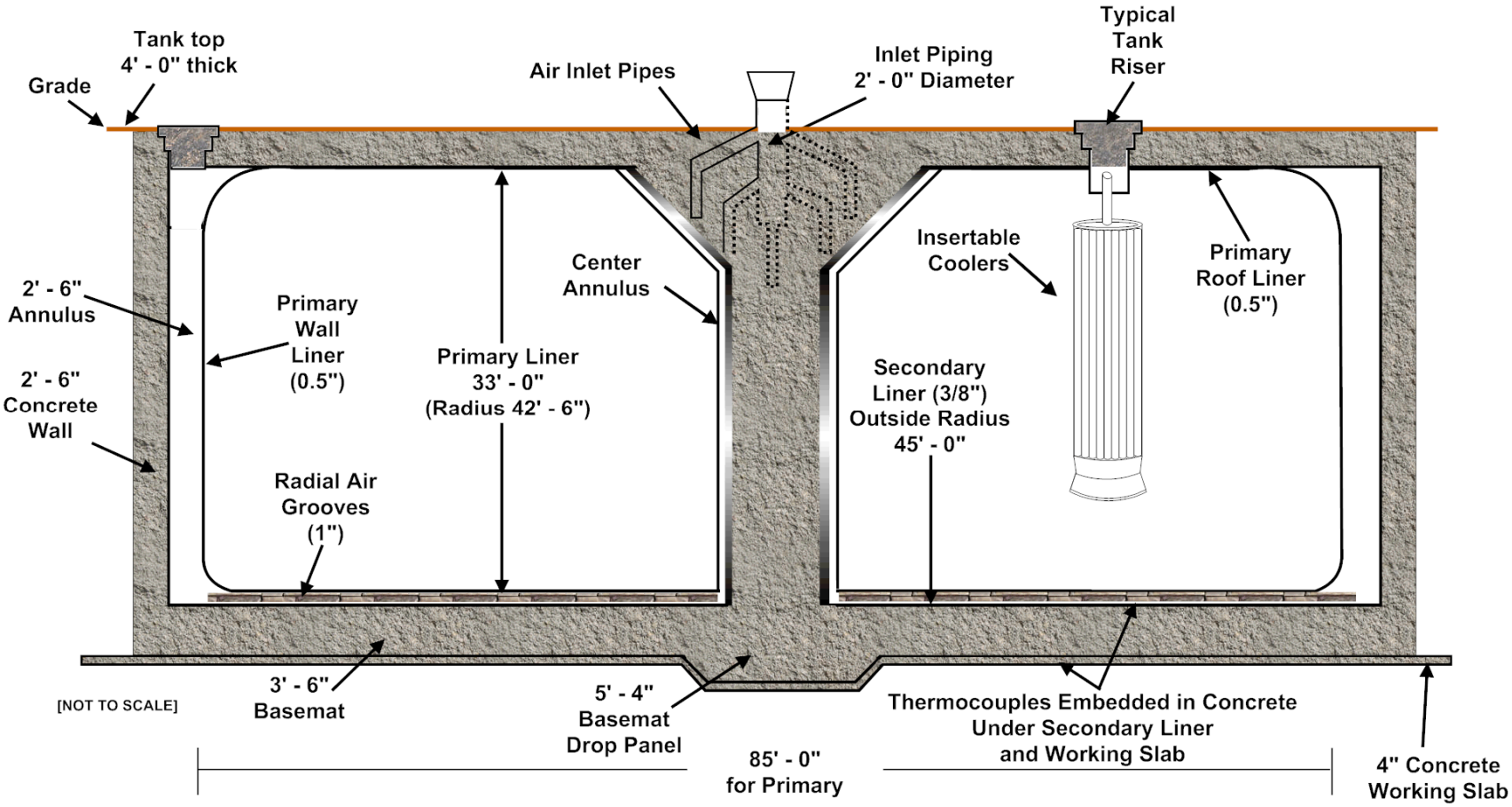
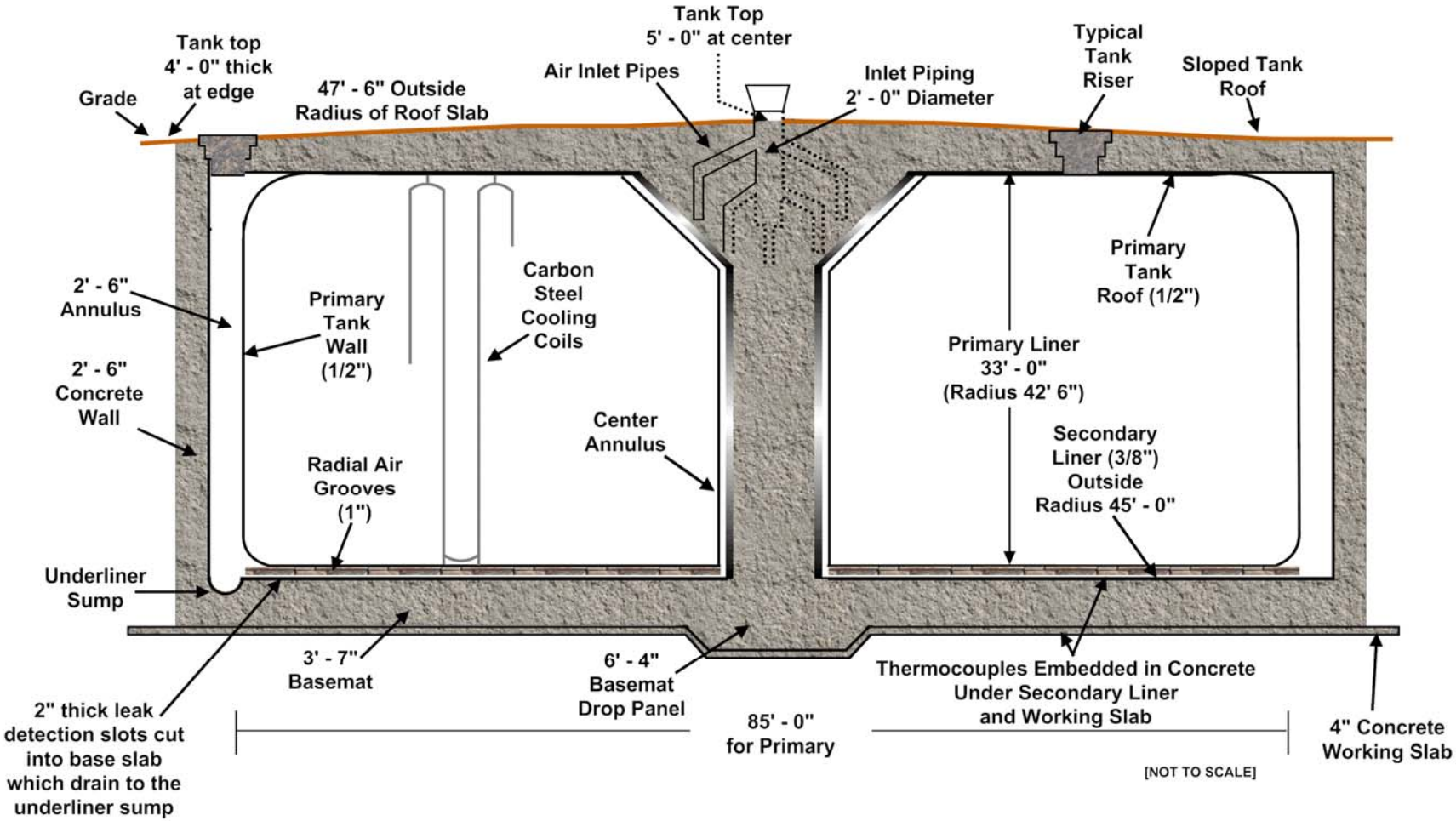


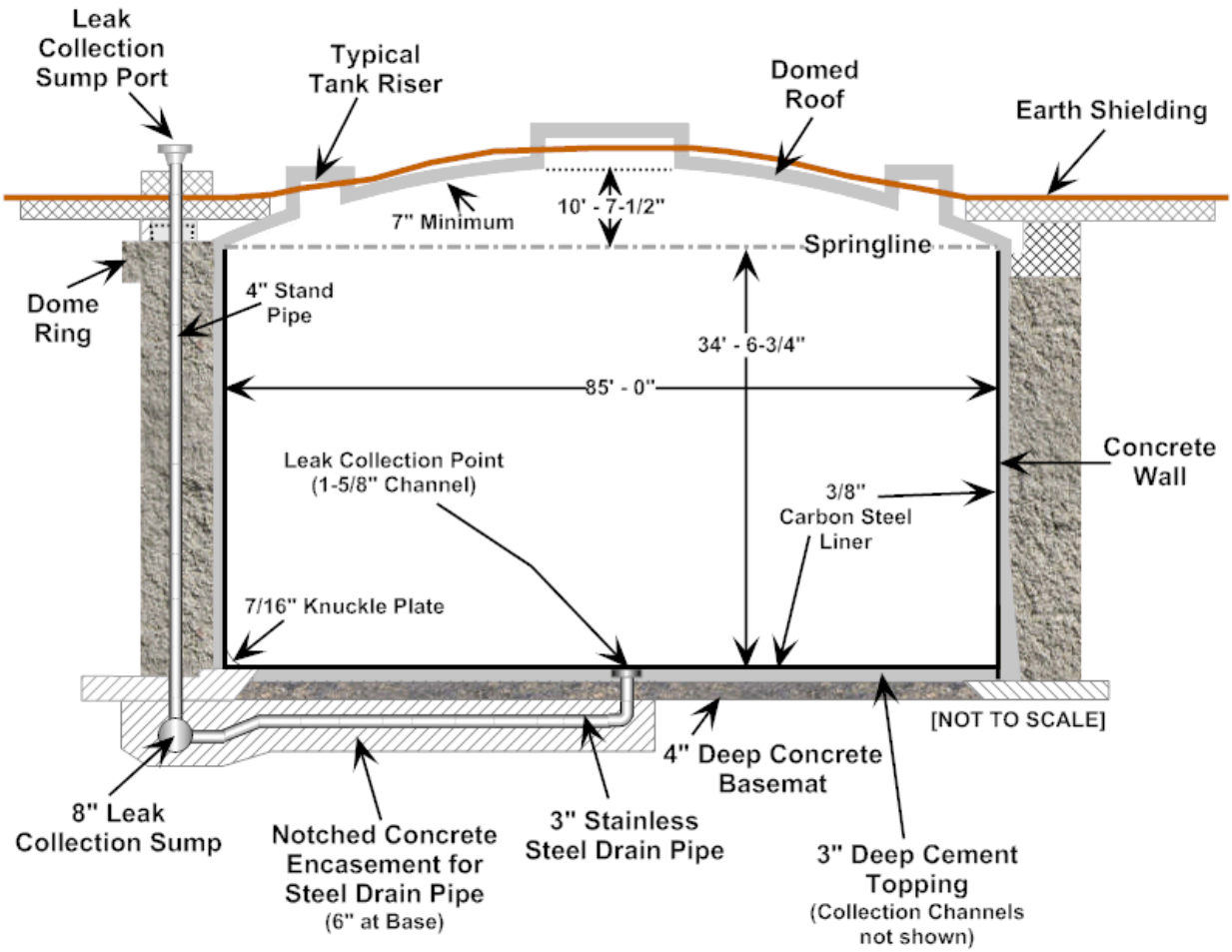
Figure 2.2-2: Sketch of Typical Type IIIA Waste Tank



2.3 Type IV Waste Tanks

There are four Type IV waste tanks in the FTF (Tanks 17 through 20). The FTF Type IV waste tanks were constructed in the late 1950s. A typical Type IV waste tank is shown in Figure 2.3-1. These waste tanks have a single carbon steel liner with a spherical reinforced concrete domed roof that is self-supporting. Type IV waste tanks are 85 feet in diameter and approximately 34 feet high at the side wall, with a nominal operating capacity of 1,300,000 gallons. Tanks 17 and 20 were operationally closed in 1997 under SDCHEC approved CMs. [PIT-MISC-0002, PIT-MISC-0004] Additional details of the Type IV waste tanks are provided in Section 3 of the FTF PA. [SRS-REG-2007-00002]

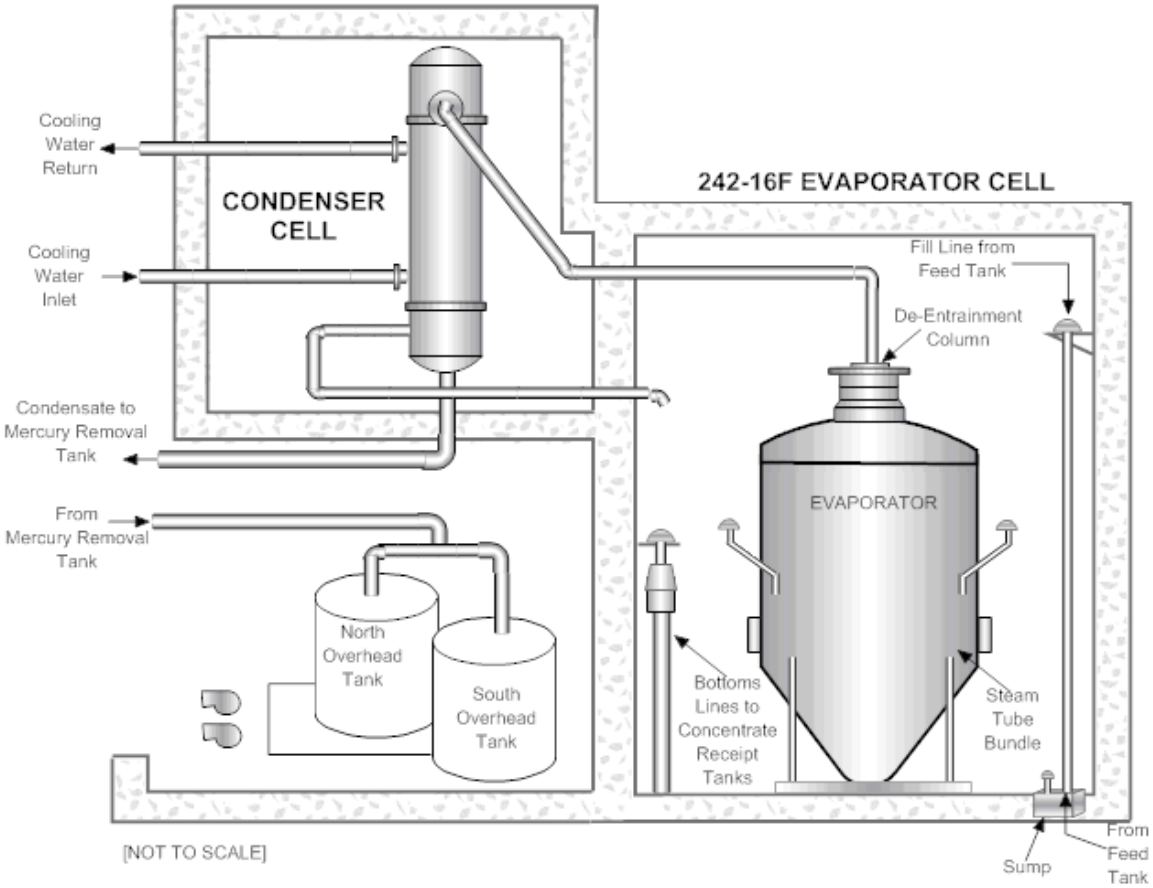
Figure 2.3-1: Sketch of Typical Type IV Waste Tank



2.4 Evaporator Systems

There are two evaporator systems in the FTF, the 242-F Evaporator System and the 242-16F Evaporator System (Figure 2.4-1). The evaporators are used to reduce the amount of liquid volume of radioactive waste resulting from past and present chemical separation processes, and from ongoing pretreatment processes and waste tank system cleaning operations. The evaporator systems are principally comprised of the evaporator, the overheads system, and the condenser. The 242-F Evaporator System also includes the 242-3F CTS which was used to distribute evaporator bottoms to tanks throughout FTF. The 242-F Evaporator Facility (which is similar to the 242-16F Evaporator) was constructed and placed into service in 1960 and was removed from service in 1988. The 242-16F Evaporator Facility was constructed in 1980 and continues to operate. Additional details of the evaporator systems are provided in Section 3 of the FTF PA. [SRS-REG-2007-00002]

Figure 2.4-1: 242-16F Evaporator System Schematic

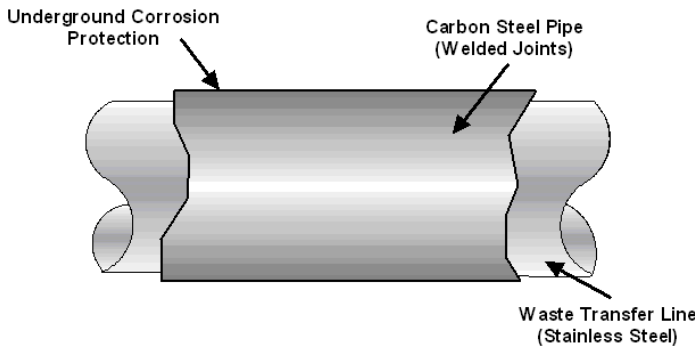


Note: Jumpers from the evaporator pot to the receipt tanks and from the feed tank to the condenser were not included to minimize the complexity of the figure

2.5 Transfer Line System

There are over 45,000 linear feet of transfer line piping in FTF, with the line segments ranging from a few feet, to over 4,000 feet in length. The FTF waste transfer lines are typically constructed of a stainless steel primary core pipe and are normally located below ground. Most primary transfer lines have secondary containments of some type. The majority of primary transfer lines are surrounded by another pipe (jacket) constructed of carbon steel, stainless steel, or cement-asbestos. These jackets typically drain to Leak Detection Boxes (LDB), Modified Leak Detection Boxes (MLDB), or to another primary or secondary containment (e.g., a waste tank). A few primary transfer lines are located inside a covered, concrete encasement. A typical transfer line is depicted in Figure 2.5-1. Additional details of the transfer line system are provided in Section 3 of the FTF PA. [SRS-REG-2007-00002]

Figure 2.5-1: Typical Transfer Line Design



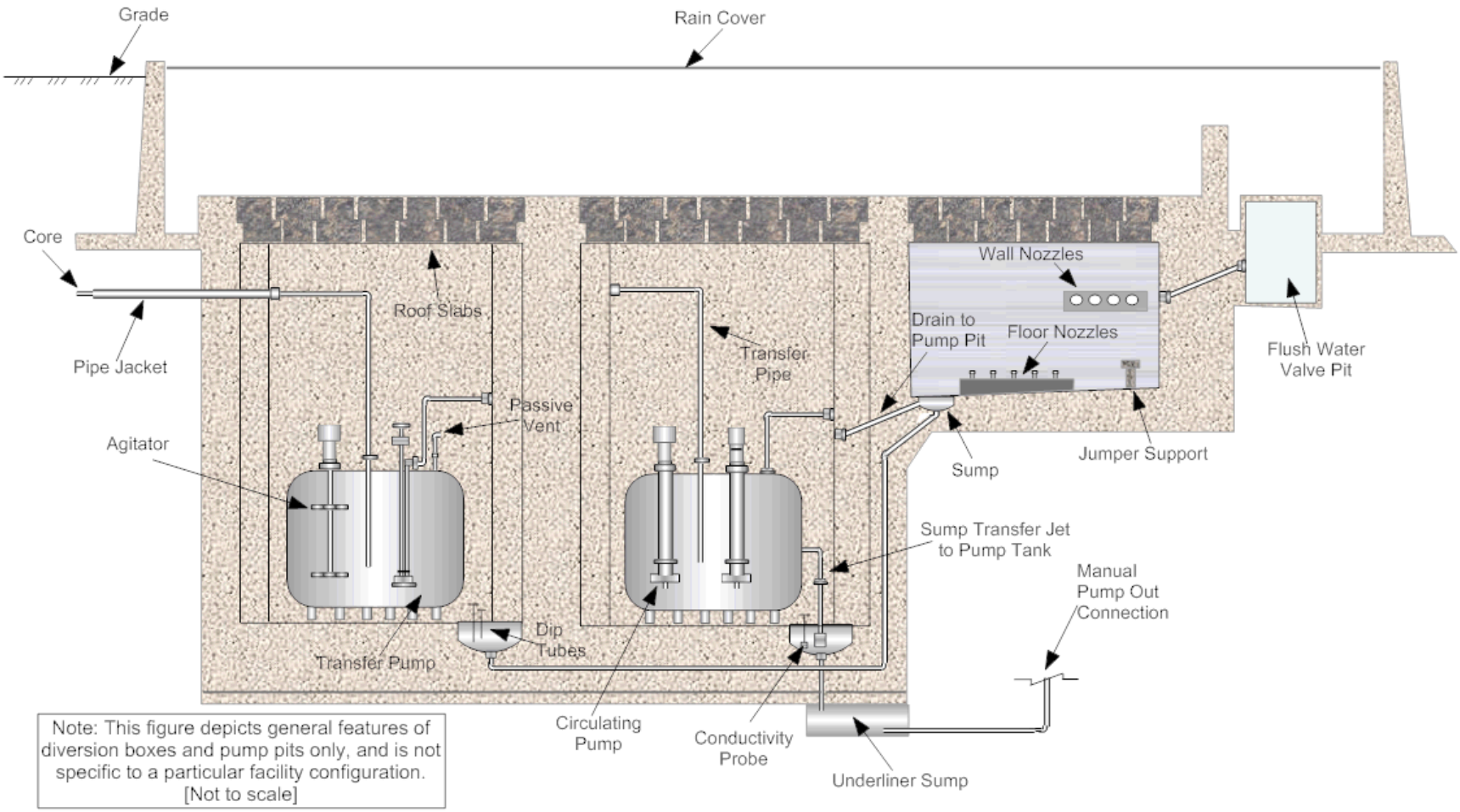
2.6 Pump Pits and Pump Tanks

The PPs are shielded reinforced concrete structures located below grade at the low points of transfer lines and are usually lined with stainless steel (see figure in Section 2.7). The PP walls are approximately 2 to 3 feet thick (2 feet – 1 inch minimum), with sloped floors that are approximately 3 feet thick (2 feet – 9 inch minimum), and cell covers that are concrete slabs approximately 2 to 3 feet thick. All PPs house a pump tank with the PPs providing secondary containment. See Figure 2.0-3 for locations of the PPs relative to other tank farm components. Additional details of the PPs and pump tanks are provided in Section 3 of the FTF PA. [SRS-REG-2007-00002]

2.7 Diversion Boxes and Valve Boxes

The DBs are shielded reinforced concrete structures containing transfer line nozzles to which jumpers are connected in order to direct waste transfers to the desired location. The DBs are often constructed in conjunction with a PP (Figure 2.7-1). Transfer valve boxes facilitate specific waste transfers that are conducted frequently. The valves are generally manual ball valves in removable jumpers with flush water connections on the transfer lines. Leakage collects in the valve box and drains back to the associated waste tank, DB, LDB, or LDB drain cell. Valve boxes are generally located adjacent to the waste tanks they serve and are designated accordingly. Additional details of the DBs and valve boxes are provided in Section 3 of the FTF PA. [SRS-REG-2007-00002]

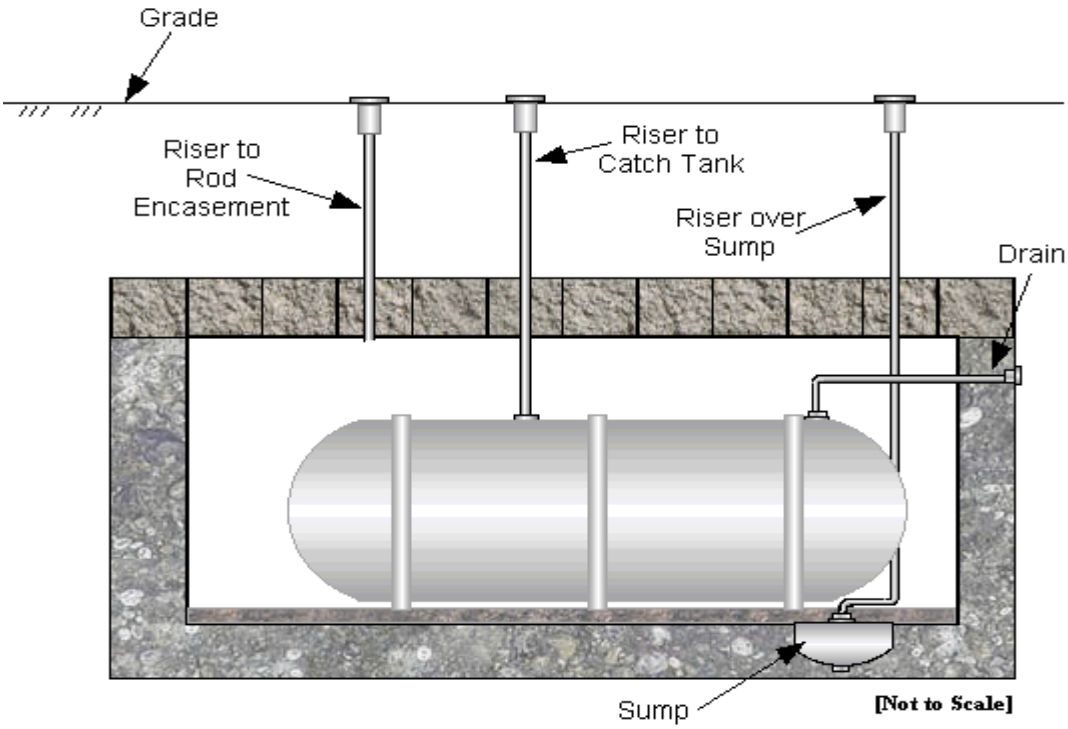
Figure 2.7-1: Typical Diversion Box and Pump Pit Design



2.8 Catch Tank

There is a single catch tank in FTF (Figure 2.8-1) designed to collect drainage from FTF Diversion Box-1 (FDB-1) and the Type I waste tank transfer line encasements. The stainless steel catch tank capacity is approximately 11,700 gallons and is located in an underground reinforced concrete cell. The catch tank encasement has walls over 3 feet thick and is built on a 4-inch thick concrete pad. Additional details of the catch tank are provided in Section 3 of the FTF PA. [SRS-REG-2007-00002]

Figure 2.8-1: Catch Tank Cross Section



2.9 Other Ancillary Equipment

The LDBs provide for the collection and detection of leakage from the transfer line. Drain piping can be run from a transfer line jacket to an LDB. The LDBs have conductivity probe leak detection and drain and overflow plugs. Drain piping for the LDBs is provided so that leaks are diverted to the evaporator cell sump, or to a DB, PP, or drain cell.

The MLDBs serve the same purpose as the LDBs but are larger and are installed at low points that cannot be gravity drained to a collection point. In addition to a conductivity probe, MLDBs also include a vent line to a DB or PP, an above ground pressure gage to monitor for potential over-pressurization, and a smear/cleanout pipe for measuring level and manual pump-out of leakage into the box.

Additional descriptions of the FTF ancillary equipment are presented in Section 3 of the FTF PA. [SRS-REG-2007-00002]

3.0 REGULATORY FRAMEWORK

3.1 Waste Tank Systems Removal From Service

FTF waste storage and removal operations are governed by IWW Construction Permit #17,424-IW issued by SCDHEC on March 3, 1993. The permit covers both FTF and HTF. The permit was issued under the authority of the PCA and all regulations implementing that Act. The State of South Carolina has authority for approval of wastewater treatment facility operational closure under Chapter 61, Articles 67 and 82 of the SCDHEC Regulations.

Removal from service of the waste tank systems is preceded by bulk waste removal, tank cleaning and stabilization with grout. Before any waste tank system is removed from service, DOE must present the general plan under which all the waste tank systems will be closed. Whereas this GCP provides the framework and methodologies to be used in demonstrating compliance with regulatory requirements, each subsequent individual CM will implement those methodologies documenting the effectiveness of the specific technologies used in waste removal activities and characterizing the actual residuals remaining in each waste tank system. Each CM will represent an incremental removal from service related to IWW Construction Permit #17,424-IW.

In accordance with CERCLA 42 U.S.C. §9620(e)(1) and RCRA 42 U.S.C §§6829(h) and 6961, the DOE, EPA, and the SCDHEC entered into a FFA, effective August 16, 1993. [WSRC-OS-94-42, www.epa.gov/superfund/policy/cercla.htm] This agreement provides for a comprehensive remediation of SRS, governs the corrective/remedial action process from site investigation through site remediation, and describes procedures for that process. The FFA, in conjunction with applicable South Carolina law and regulation, establish the framework for the operation, new construction, removal from service (operational closure), and any appropriate RCRA/CERCLA response action related to the liquid waste tank systems. The FFA provides timetables for the operational closure (removal from service) of waste tanks that do not meet the secondary containment standards of FFA Section IX.C, or that leak or have leaked, as well as provisions for new construction and prevention and mitigation of releases or potential releases from the waste tank systems.

The FFA, Section IX.E, addresses the eventual removal of tanks and ancillary equipment from service and any appropriate RCRA/CERCLA response action relating to the waste tank systems. The waste tanks must be removed from service in accordance with the PCA and regulations implementing that Act as cited in the paragraph above. The DOE is satisfying that requirement by submitting and implementing this GCP and the individual CMs for the waste tank systems. [WSRC-OS-94-42] Subsequent RCRA/CERCLA response action will evaluate an engineered closure cap to be installed over the FTF after all of the waste tanks and ancillary equipment have been removed from service to provide physical stabilization of the closed site and to minimize infiltration of surface water. Details of a potential closure cap that would be placed over the FTF can be found in Section 3 of the FTF PA. [SRS-REG-2007-00002]

3.2 Integration of Removal from Service with Final FFA Corrective/Remedial Actions

The FFA, Section IX.E.2., addresses the interface between removal from service of the waste tanks and ancillary equipment, and any subsequent RCRA/CERCLA response action for any contaminated soils, structures, and equipment that DOE cannot practicably remove or decontaminate. Soils, structures and equipment associated with the waste tank systems within

FTF that remain after completion of operational closure activities, that DOE cannot practicably remove or decontaminate, will be addressed in accordance with the response action provision (Sections XI through XVI) of the FFA. The FFA provides that SCDHEC is the designated oversight agency for review and approval of all response action documents leading up to the proposed plan. Furthermore, DOE must obtain written concurrence from both EPA and SCDHEC prior to publication of proposed plans and Record of Decisions (RODs). The SCDHEC will be the designated oversight agency for review/approval of "RD/CM and CA/RA documents" for the high-level waste tanks identified in Appendix B to the FFA and oversight of all associated response action field activities. [WSRC-OS-94-42, Section IX.E.2.]

The DOE has determined that there are historical spill sites in FTF not covered by IWW Construction Permit #17,424-IW that may require response actions under the FFA. [WSRC-OS-94-42] These spill sites were previously listed on the FFA Appendix G (Site Evaluation Areas) by DOE at the time of the FFA approval and have subsequently been placed on Appendix C RCRA/CERCLA Units List) as part of the FTF OU for evaluation and possible remediation. The DOE, with the approval of EPA and SCDHEC, has determined that a formal site evaluation is unnecessary. Instead, OUs were created to address the FTF. The FTF OU comprises the FTF waste tank systems and associated soils. The other OU that is relevant to FTF is the GSA Western Groundwater OU as shown in Figure 3.2-1. [WSRC-RP-2003-4147]

Figure 3.2-1: General Separations Area Groundwater Operable Units

The GSA Western Groundwater OU addresses groundwater underneath the operating area that includes the FTF. The DOE is monitoring the groundwater from the GSA Western Groundwater OU under formal FFA-approved plans and submitting annual reports on groundwater quality until closure of the groundwater OU. [ERD-EN-2005-0127] In the *RCRA Facility*

Investigation/Remedial Investigation (RFI/RI) Phase 1 Work Plan for the General Separations Area (GSA) Western Groundwater Operable Unit (WSRC-RP-2003-4147), DOE, EPA, and SCDHEC have concluded that the most appropriate action is to continue to monitor the groundwater to ensure that surface water resources are adequately protected and to ensure that possible sources of contamination are appropriately remediated prior to approving a ROD on these groundwater units. Investigations of the GSA Western Groundwater OU are ongoing. Final remedial decisions regarding this groundwater OU will be timed with the clean up of potential sources of contamination to the GSA Western Groundwater OU.

The FFA is currently based on a strategy that relies on an industrial area-by-area closure to fulfill its requirements. Once closure of the waste tank systems is complete, a decision for the final area closure of the FTF OU under the FFA can be established through a proposed plan and ROD. All proposed plans under the FFA are subject to review and comment by the EPA, SCDHEC, stakeholders and the public and approval by both the EPA and SCDHEC. A formal dispute resolution process is set forth in the FFA in case of disagreement on any actions to be taken.

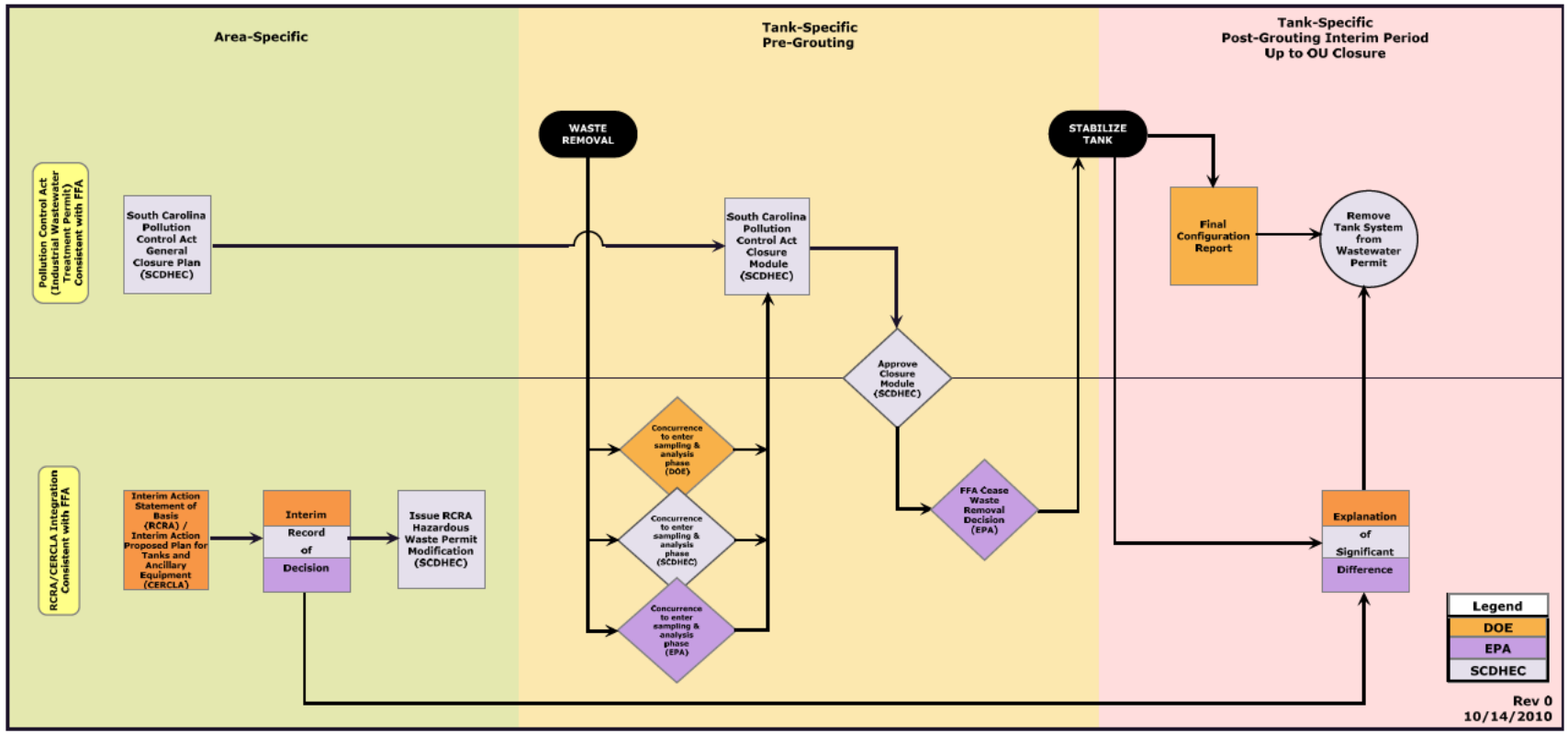
The FFA requires a review of the selected remedy every 5 years, consistent with 42 U.S.C 9621(c), to ensure that human health and the environment are being protected by the selected remedy. Should the DOE, EPA, and SCDHEC conclude that additional action or modification of the remedy is appropriate; the DOE will implement any additional response.

The FFA was designed and is being implemented in a manner that integrates multiple regulatory programs and facility activities into a cohesive and protective strategy. There are no identified regulatory gaps in the operation, closure and long-term monitoring of FTF.

3.3 Regulatory Documentation Pathway to Closure

Figure 3.3-1 depicts the integration of the documentation required for the IWW Construction Permit #17,424-IW and the RCRA/CERCLA integrated documentation required by the FFA. The documentation for removal from service of the individual waste tank systems in FTF involves multiple agencies, each with specified criteria required to be demonstrated prior to taking removal from service actions. The analytical results documented in the FTF PA provide the foundation for future decision making actions by all affected regulatory agencies. The PA was developed to generate results needed to demonstrate that all of the performance objectives have been met. Some of the documents will provide closure information that is applicable to the entire FTF (i.e., area-specific documentation) and some will be specific to individual waste tank system closure activities.

Figure 3.3-1: Regulatory Documentation Path to Closure of the F-Area Tank Farm



After all waste tanks and ancillary equipment in the FTF have been removed from service a final ROD will be issued for the FTF OU in accordance with the FFA.

3.3.1 South Carolina Pollution Control Act General Closure Plan

The SCDHEC has the authority to approve the PCA GCP via IWW Construction Permit #17,424-IW. This GCP documents the process that will be employed for evaluating each waste tank system or group of waste tank systems within the FTF to determine if the cleaning and stabilization is protective of human health and the environment. It also describes the process by which waste removal technologies are chosen, the process to determine when all practicable waste removal is complete, and the process to determine that the closure activities are consistent with the performance objectives described in Section 5.1.

The FFA, Section IX.E, addresses the eventual removal of waste tanks and ancillary equipment from service and the final closure of the FTF. The FFA states that removal of tanks from service must be performed in accordance with the PCA and all applicable regulations implementing that Act. The DOE is accepting the requirement by submittal of this GCP and the individual CMs for the removal from service of the waste tank systems.

3.3.2 Interim Action Statement of Basis/Interim Action Proposed Plan

The SCDHEC, EPA and the DOE have agreed in the FFA to integrate RCRA/CERCLA documentation for waste removal and waste tank closure activities being performed under the PCA and the FFA. An interim action statement of basis/interim action proposed plan (IASB/IAPP) will be developed for interim maintenance and monitoring controls for waste tanks that have been removed from service under the IWW Construction Permit #17,424-IW until a final remedy for the FTF OU is determined and a final ROD is issued, as depicted in Figure 3.3-1. The initial plan will be developed for Tanks 17 and 20, which have already been removed from service, and are subject to public review and comment. Upon approval, SCDHEC, EPA and DOE will issue an Interim ROD (IROD). As other waste tank systems are removed from service, an Explanation of Significant Difference (ESD) will be issued to modify the IROD and apply the maintenance and monitoring controls to those waste tank systems.

3.3.3 Modification to the RCRA Hazardous Waste Permit

The SRS RCRA Hazardous Waste Permit Module VIII, Corrective Actions for Solid Waste Management Unit (SWMU) will be modified to implement maintenance and monitoring interim measures documented in the IASB/IAPP and the IROD, as modified by the ESDs.

3.3.4 Concurrence to Enter Residual Sampling and Analysis Phase

When DOE considers that it is appropriate to cease waste removal operations in specific waste tanks, preliminary data and other information will be presented in a briefing to EPA and SCDHEC to obtain agreement that there is reasonable assurance that further waste removal efforts are not technically practicable from an engineering perspective and it is appropriate to transition to the sampling and analysis phase of the waste tank system removal from service process. If EPA and SCDHEC agree, they will independently provide letters of agreement to DOE. This agreement to proceed to the sample and analysis phase is a non-binding preliminary decision and does not satisfy the requirements of FFA, Appendix L. 9.b as described in Section 4.3.

3.3.5 Closure Module

A waste tank system-specific CM detailing the inventory and removal from service configuration of an individual waste tank system will be submitted to SCDHEC for review and approval. This CM will demonstrate that further waste removal efforts are not technically practicable from an engineering perspective and will consider such things as technology capabilities, schedule impacts and a quantified cost, risks and benefit analysis. In addition, the CM will be provided to EPA Region 4 project managers for review to ensure consistency with the FFA requirements for overall remediation of the FTF.

Following waste removal activities, the actual inventory information will replace the initial estimated inventory that was used in the FTF PA and an Special Analysis (SA) will be developed to validate that the performance objectives will continue to be met for the overall FTF closure. The CM will document the revised estimates for the peak groundwater concentrations and peak dose using actual data from all waste tank systems that have been removed from service and the estimated closure inventory of those waste tank systems that have not yet been removed from service. Knowledge gained as systems are removed from service will be factored into the inventory estimates for those systems pending cleaning.

Approval of the CM by SCDHEC constitutes authorization to initiate final, irreversible removal from service activities (e.g., grouting of waste tank structures). Approval of the CM by SCDHEC and a letter of agreement by EPA also constitute approval that FFA Appendix L, Requirement 9b has been satisfied for the specified waste tank system addressed in the CM (see Section 4.3).

Section 6 of this Closure Plan provides a detailed description of the elements contained in a CM.

3.3.6 Completion of Tank Stabilization

When the waste tanks have been stabilized with grout, as authorized by the approved CM and EPA cease waste removal decision, DOE has met the FFA commitment for operational closure (i.e., removal from service).

3.3.7 Explanation of Significant Difference

The DOE will submit an ESD to EPA and SCDHEC to modify the IROD to include each of the waste tank systems as they are removed from service. This action will subject the waste tanks systems to the maintenance and monitoring controls listed in the IROD.

3.3.8 Final Configuration Report

Following completion of stabilization of the individual waste tank system, DOE will provide a Final Configuration Report to SCDHEC describing the final configuration of that system. The report will include certification by a South Carolina professional engineer that all work has been completed in accordance with the approved GCP and CM.

3.3.9 Waste Tank Removal from Wastewater Permit

Sufficient evidence will be presented to SCDHEC to allow verification that the closure activities have been satisfactorily achieved in accordance with the approved CM. This evidence may include, but not be limited to, video, photographs, work packages, and signed off procedures, as appropriate. Following successful inspection and evaluation of the

documentation, SCDHEC will then provide written verification that the waste tank systems have been removed from the conditions of IWW Construction Permit #17,424-IW. After all waste tanks and ancillary equipment in the FTF have been removed from service, a series of documents required by the FFA will lead to a final ROD for the FTF OU.

4.0 WASTE REMOVAL

Although the waste tank system removal effort plans for the removal or decontamination of all residues, contaminated containment system components (liners, etc.), and structures and equipment contaminated with hazardous and/or radioactive substances, it is recognized that DOE cannot practicably remove or decontaminate all structures and equipment. [WSRC-OS-94-42 Section IX.E.2.] Consequently, the general strategy for waste tank systems closure, which begins with prioritization of waste tanks to be removed from service, appropriately includes focus on the general methods for selection of decontamination technology and implementation of those methods.

The order of removal from service of the waste tank systems is driven by a series of priorities and operating constraints that includes, but is not limited to, the following:

- maintaining contingency waste tank space within the entire liquid waste system (i.e., space available in waste tanks in both FTF and HTF),
- controlling waste tank chemistry in order to maintain the integrity of the carbon steel primary waste tanks,
- requirements to remove waste from waste tanks with a leakage history and waste tanks that do not meet secondary containment and leak detection requirements on a schedule specified in the FFA Appendix L,
- restrictions imposed by state-approved permits (IWW Construction Permit #17,424-IW, SRS Z-Area SDF Class 3 Landfill Permit #025500-1603)
- commitments in the (current update) SRS Approved Site Treatment Plan (SRNS-TR-2008-00101),
- preparing waste for downstream waste treatment facilities (e.g., DWPF, Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit (ARP/MCU), Salt Waste Processing Facility (SWPF), SPF, etc.), and
- meeting nuclear safety basis requirements.

The complex interdependency of safety and process requirements of the various waste pretreatment facilities, as well as the limited available space within the liquid waste system, influences the sequencing of the waste tanks undergoing waste removal and cleaning. The ancillary equipment such as evaporator systems and CTS may be closed as part of the closure of an individual waste tank or a group of waste tanks or may be closed independent of waste tank closures. The DOE will determine the most efficient and cost-effective schedule for the removal from service of these ancillary facilities, and will continue to communicate the plans and schedules for these closure activities with SCDHEC. The ancillary equipment will be tracked via the system-specific CMs as described in Section 6.1.

The DOE's anticipated schedule for removal of the waste tank systems from service was developed in accordance with federal and state agreements. The FFA provides dates for bulk waste removal efforts and removal from service of Type I and Type IV waste tanks (i.e., waste tanks that do not meet the standards set forth in Appendix B of the FFA). [WSRC-OS-94-42] Type III and Type IIIA waste tanks will remain in service until there is no longer a need for them to support waste treatment, as described in the *Savannah River Site Approved Site Treatment Plan, 2009 Update*. [SRNS-TR-2008-00101]

4.1 Process for Technology Selection

The actual process utilized for waste removal can vary depending on the past service history of the waste tank system, the physical characteristics of the waste remaining, the physical configuration of the waste tank system, and the timing of the waste removal actions.

In the waste removal technology selection process, DOE uses a structured approach (e.g., Alternative Studies method) for identification and comparison of viable alternatives that meet the defined functions and requirements for waste removal in the specific application. The Alternative Studies method is an example of a technology selection process that has been used successfully at SRS. [WSRC-IM-98-00033] The Alternatives Studies method uses formal analysis and is based on a set of weighted decision criteria. A sensitivity analysis may be included to aid in proper selection of a preferred alternative.

The DOE's technology selection process generally follows the Alternative Studies methodology (with modifications where appropriate) and typically includes activities similar to the following steps:

1. Identification and selection of a group of individuals with the necessary skills and experience in waste tank system operations to effectively identify and assess viability of waste removal options.
2. Identification of the function(s) to be met and the defined project requirements - Criteria for technology include a reasonable likelihood of achieving estimated removal results.
3. Identification of alternatives which perform the function(s) - A wide range of current technologies are considered (e.g., sluicing, mixing, chemical, vacuum, manipulators, and robotics) from DOE, commercial, and international sources. Alternatives include volume reduction and chemical extraction technologies.
4. Determination of viability of the alternatives to satisfy requirements - Selection of viable alternatives that have a reasonable likelihood of success based on similar applications within DOE and/or industry are considered. Proof-of-principle demonstrations and laboratory or pilot-scale tests may be used to aid in the determination of viability.
5. Establishment and weighting of criteria against which to evaluate alternatives - Criteria may include likelihood to effectively meet desired waste removal results (functions and requirements), maturity, cost, complexity, reusability, radiological control requirements, and system-wide impacts (effects on downstream systems, generation of secondary waste, etc.).
6. Evaluation of alternatives against the selected criteria - Each alternative is evaluated against each criterion and assigned a comparative ranking.
7. Selection of a preferred alternative - A scoring method is used for selecting a preferred alternative. In the scoring method, the merit of each alternative is determined by summing the contributions to that alternative from each identified criterion. In this method, weighted criteria must be used if the criteria have varying degrees of importance. In the scoring method of alternative selection, defined and weighted criteria are used to select the optimum from among a set of alternatives that meet the defined function.

The DOE will continue to evaluate new technologies as they are developed for potential use in waste removal applications. In addition they will also evaluate, on a case-by-case basis, any special conditions that may occur during waste removal activities that may require application of

additional or alternative technologies. The DOE will share these evaluations on a waste tank-specific basis with SCDHEC at the earliest practical quarterly meeting.

4.2 Potential Future Waste Tank Cleaning Technology

The DOE's process for considering technological developments relevant to waste tank system cleaning that occur after issuance of this GCP will include the evaluation of techniques of comparable, or greater, effectiveness than the technologies currently in use. A range of potential technologies for evaluation will include technologies developed and/or used at other DOE sites, in domestic commercial industry, and in international applications. Waste tank system cleaning technologies that will potentially be evaluated include, but are not necessarily limited to, sluicing, mixing, chemical cleaning, vacuum retrieval techniques, mechanical manipulators, robotic devices, and processes that target removal (chemical extraction) of certain material from the residuals that may remain in the waste tank.

The FFA Appendix L, Requirement 9.b states:

> *9.b "The parties agree to the following process concerning waste removal. For each tank, DOE shall involve SCDHEC and EPA throughout each stage in the bulk waste and heel removal processes to explain the activities undertaken, results of removal operations, challenges, and DOE's next steps. DOE shall consider and openly discuss any feedback from participants prior to proceeding to the next stage. These interactions are anticipated to be frequent and informal meetings or conference calls, as agreed to by the participating parties, but shall occur no less than quarterly. When DOE considers waste removal to be complete, DOE shall notify EPA and SCDHEC and provide supporting documentation to SCDHEC and EPA for review. DOE, SCDHEC, and EPA shall mutually agree that waste removal activities may cease."*
> [WSRC-OS-94-42, Appendix L]

The DOE will provide annual updates on new waste removal and characterization technologies to SCDHEC in a dedicated meeting as information becomes available. Materials presented in these annual meetings will be provided to SCDHEC in a manner that can be referenced. The first annual update will include the technologies that were considered and the evaluation process in a written format. Updates will include sharing of information and lessons learned between DOE sites and recent and regular reports published under DOE's technology development program.

4.3 Cessation of Waste Removal Activities

A dispute resolution was reached between DOE, EPA and SCDHEC in November 2007 concerning the extension of removal from service dates for Tanks 18 and 19 in the FFA. This dispute resolution has been incorporated into the FFA in Appendix L. [WSRC-OS-94-42] One of the conditions in the FFA, Appendix L requirements, as stated above, is that all three parties agree that waste removal activities may cease. In addition, FFA Appendix L, Requirement 1 is specifically directed at waste removal activities associated with Tank 18 and Tank 19 and states, in part:

> *"DOE has initiated additional waste removal efforts from Tanks 19 and 18 and will continue waste removal efforts until DOE, SCDHEC and Environmental Protection Agency (EPA) agree that waste removal may cease."*

This decision process will occur in two phases. Once DOE has reached the conclusion that there is reasonable assurance that waste removal activities for a particular waste tank system can cease, DOE will provide preliminary data and other information that waste has been adequately removed using the selected technology and that there is reasonable assurance that compliance with performance objectives can be demonstrated. The preliminary data that will be provided to SCDHEC and EPA may vary depending on the waste tank and its history. Examples of this information include evidence of diminished effectiveness of technology used on waste removal demonstrated by charts, graphs, photographs, videos, available process sample analysis, and technical papers. The ultimate outcome will be mutual agreement between DOE, SCDHEC, and EPA that it is not technically practicable, from an engineering perspective, to continue waste removal activities and that DOE should proceed to the sampling and analyses phase of the waste tank system removal from service process. [WSRC-OS-94-42]

This tentative agreement to cease waste removal activities will be documented in letters of agreement to DOE from SCDHEC and from EPA. This preliminary decision to move on to the sampling and analysis phase is non-binding and does not satisfy Appendix L, Requirement 9.b.

Subsequently, a full review of the final residues and configuration will be available in the CM which must be approved by SCDHEC before stabilization can be initiated. The DOE will make no irrevocable configuration changes to the waste tanks until the CM has been submitted and approved by SCDHEC. After SCDHEC's formal approval of the CM, EPA will provide a final letter of agreement that waste removal activities may cease. The SCDHEC's approval of the CM and EPA's agreement letter will satisfy Appendix L, Requirement 9.b. The approval process is depicted in a Section 6.2 figure.

5.0 PERFORMANCE EVALUATION

The SRS has completed a comprehensive PA to provide reasonable assurance that the FTF systems will comply with applicable performance objectives as described in Section 5.1 below after they are removed from service. [SRS-REG-2007-00002] The performance objectives described in Section 5.1 below were selected on the basis that, although all media and pathways have been evaluated, the groundwater concentrations are by far the most limiting pathway, contributing approximately 92% of the all-pathways dose to a member of the public. A major component of the decision process involves fate and transport groundwater modeling to evaluate compliance with those performance objectives. As each waste tank system completes the waste removal process and the residuals are characterized, an SA will document that the performance standards will continue to be met for the overall closure of FTF.

The process described in the PA has been developed to allow removal from service of individual waste tanks to proceed, while recognizing and considering the uncertainty of the source terms of the waste tanks that are yet to undergo final waste removal operations. The FTF PA will be maintained per the requirements of DOE M 435.1-1 and updated over time, as needed when new information becomes available.

5.1 Constituents Included in Modeling

5.1.1 Radiological Constituent Screening

An initial radionuclide screening process was developed and performed to support characterization efforts and was applicable for FTF PA modeling. CBU-PIT-2005-00228 identifies how SRS performed a screening of radionuclides by initially evaluating 849 radionuclides. Of the original 849 radionuclides, 159 remained on the list and 690 were excluded from further consideration. Screening criteria used in this initial evaluation are described in CBU-PIT-2005-00228 and in the FTF PA. [SRS-REG-2007-00002]

Additional screening was performed for the remaining 159 isotopes based on short half-life, the presence/absence of parent radionuclides and the expectation of waste tank inventory. The result of these two screening processes yielded a list of 54 radionuclides that would be included in the characterization. The screening processes and the resulting list of radionuclides are detailed in the FTF PA. [SRS-REG-2007-00002]

5.1.2 Non-Radiological Constituent Screening

The list of non-radiological constituents that were included in the PA modeling was derived from the State Primary Drinking Water Regulations for inorganic contaminants specified in SCDHEC R.61-58. Asbestos, beryllium, cyanide, and thallium were removed from the list because of lack of inventory in the waste tanks. This list was compared to the list of inorganic characteristic hazards specified in 40 CFR 261 and silver and lead were added to the list. Secondary contaminants copper, manganese, iron, and zinc were also included due to the process knowledge that they were potentially present in the waste. Specific controls exist that preclude the introduction of organic constituents to the waste tank systems and were therefore not considered for establishing inventory or for PA modeling.

5.2 Applicable Performance Objectives for Predictive Modeling

Performance objectives for groundwater applicable to FTF waste tank system removal from service are as follows:

1. The SCDHEC State Primary Drinking Water Regulations for radionuclides (i.e., 4 mrem/yr beta-gamma dose and 15 pCi/L total alpha concentration, and 5 pCi/L total Ra-228 + Ra-226)
2. The SCDHEC State Primary Drinking Water Regulations for nonradiological inorganic constituents.

These performance objectives are used only in the PA process to provide reasonable assurance that at the time of final FFA corrective/remedial actions, it can be concluded that groundwater concentrations derived from residual contamination in the tanks and ancillary structures will be within the MCLs in the groundwater. The SCDHEC State Primary Drinking Water Regulations and associated MCLs are listed in Table 5.2-1. [SCDHEC R.61-58]

Table 5.2-1: Constituents Modeled in the PA with SCDHEC Primary and Secondary Drinking Water Standards and MCLs

Constituent	Units	MCLs
Radiological		
Beta-gamma dose [c]	mrem/yr	4.0
Alpha concentration [c]	pCi/L	15
Total Ra-228 +Ra-226 [c]	pCi/L	5.0
Nonradiological		
Antimony	µg/L	6.0
Arsenic	µg/L	10
Barium	µg/L	2,000
Cadmium [c]	µg/L	5.0
Chromium[a]	µg/L	100
Copper[b]	µg/L	1,300
Fluoride	µg/L	4,000
Iron[b]	µg/L	300
Lead	µg/L	15
Manganese[b; c]	µg/L	50
Mercury	µg/L	2.0
Nickel	µg/L	100
$NO_2 + NO_3$ (as N)	µg/L	10,000
Selenium	µg/L	50
Silver[b]	µg/L	100
Uranium	µg/L	30
Zinc[b]	µg/L	5,000

[a] Total chromium (chromium III and VI)
[b] Secondary MCLs
[c] Constituents identified in Section 5.7 of SRS-REG-2007-00002; significant beta-gamma constituents include I-129, K-40, and Tc-99; significant alpha constituents include Np-237, Pa-231, Pu-239, Pu-240, and Th-229 (total alpha in the Primary Drinking Water Regulations does not include uranium isotopes)

5.3 Contaminant Migration Constituents of Concern

In the FTF PA, Contaminant Migration Constituents of Concern (CMCOCs) were identified through a system that is consistent with both the Area Closure Project protocols and the FTF PA. The CMCOCs were identified by modeling the release of contaminants and their travel through the vadose zone. Any contaminants that were modeled to reach the water table were compared to MCLs or Regional Screening Levels (RSL). Any constituents that are predicted to exceed

these standards in the groundwater directly beneath FTF were identified as CMCOCs. The PA shows that the only two nonradiological constituents that were identified as CMCOCs were cadmium and manganese and the radiological CMCOCs included I-129, K-40, Np-237, Pa-231, Pu-239, Pu-240, Ra-226 + Ra-228, Tc-99, Th-229, U-233, U-234, U-236. [SRS-REG-2007-00002, Sections 4.8 and 5.7]

5.4 Assessment Evaluation

As described in Sections 2.4.2 and 2.4.3 of the FTF PA, the *SRS Long Range Comprehensive Plan* is founded on the following assumptions:

- SRS will be owned and controlled by the federal government in perpetuity,
- the property will be used only for industrial purposes,
- site boundaries will remain unchanged, and
- residential use will not be allowed onsite.

[SRS-REG-2007-00002]

Therefore, a scenario in which a future hypothetical member of the public (MOP) establishes a residence directly on the FTF and obtains drinking water from the water table below is highly unlikely. A more probable, although still unlikely, location for the future member of the public to be exposed to the groundwater below the FTF would be at the Upper Three Runs (UTR) seepline or the Fourmile Branch seepline located at least 1 mile from the FTF. The PA has shown that there is reasonable assurance that human health and the environment will continue to be protected after waste tank systems have been removed from service. For each waste tank system that is removed from service, a SA will be performed to validate and document that the assumptions made in the PA remain protective using updated waste tank system inventories. [SRS-REG-2007-00002]

5.5 Process to Characterize Waste Tank Residue

The residual material that remains in the waste tanks upon removal from service must be representatively sampled and characterized to verify that the assessment of performance remains valid. To support waste tank residue characterization, the SRS Liquid Waste Tank Residuals Sampling and Analysis Program Plan (LWTRSAPP) will provide a defensible basis for characterizing the residual material remaining in the system at the time of removal from service. Waste tank residue characterization will include representative sampling of the material remaining in the specific waste tank. In some cases, process knowledge and historical sampling will be used to support characterization of residuals. Successful characterization of the residual material will minimize uncertainty in the concentration and volume values. The LWTRSAPP will require approval prior to approval of any subsequent CM associated with the FTF GCP. The SRS LWTRSAPP will be submitted within 120 days of approval of the FTF GCP.

5.5.1 Sampling

The sampling plan for the waste storage tanks will include the number of samples collected, the chosen sample locations, the volume of samples collected, and the sampling techniques. Sample methods will be planned to provide the capability to collect and analyze samples from residual solid material as well as from liquids if present.

If sampling is required for ancillary equipment (e.g., the residuals remaining in the FTF CTS tank), a similar approach will be taken as described above for waste storage tanks and a

sampling plan will be developed to demonstrate that the sample volumes, locations, and sampling technique result in representative samples.

5.5.2 Inspections

Visual inspections (video footage and/or photographs) of the waste storage tanks during cleaning operations will be planned and conducted, where possible, to support identification of residual material unique from the rest of the waste tank residuals. Utilizing landmarks within the waste tanks and any equipment within the waste tank, the visual inspections will also be used to support residual volume estimates within waste tank systems, as appropriate. If not possible, an alternate technique will be identified and be used to support the characterization process.

Sample collection may be filmed and/or photographed in a manner that records the location of each sample and the sampling technique. The chain-of-custody process for transferring samples to the laboratory will demonstrate samples are genuine.

5.5.3 Analysis

The LWTRSAPP will define the list of analytes. As validation of process knowledge is achieved, this knowledge will be used to select analytes that validate the assessment of performance. Justification for selection will be included in the respective CM.

5.6 Modeling to Predict Groundwater Impacts

The FTF PA modeling has predicted the expected groundwater concentrations of radiological and nonradiological constituents at various locations around the perimeter of the FTF and has shown that, based on expected inventory at the time of final FFA corrective/remedial actions, there is reasonable assurance that the groundwater concentrations derived from residual contamination in the tanks and ancillary structures will be within the MCLs (SRS-REG-2007-00002, Section 4.8 and Section 5.7). The referenced sections of the PA describe the application of human health and ecological risk assessment protocols, typically used for area closures, to the waste tanks systems. This risk assessment evaluates groundwater concentrations of contaminants that are expected to be present in the waste tank residues. Prior to removal of a waste tank system, each CM will determine the peak groundwater concentrations and peak dose, using actual data from all waste tank systems that have been removed from service and the estimated inventory of those waste tank systems that have not yet been cleaned. This analysis will be documented in a SA, and will provide reasonable assurance that performance objectives, as described above in Section 5.1, will be met.

To predict the contribution of the waste tank residues to the groundwater, as it relates to the State Primary Drinking Water Regulation, R.61-58, the concentrations of the significant alpha-emitting radionuclides (excluding radon and uranium) are added together for any given year and the highest summed concentration occurring during an extended period of time (i.e. 10,000 years) following closure of the FTF (also known as the peak year concentration) is compared to the alpha MCL of 15 pCi/L. (Note that the FTF Performance Assessment determined annual concentrations in two-year increments. [SRS-REG-2007-00002] This is also the method to predict the contribution to the MCL of 5 pCi/L for total Ra-226 and Ra-228. For total uranium, the predicted concentration each year is compared to the MCL value of 30 µg/L.

The prediction of the contribution to the beta-gamma dose MCL is performed in the same manner. The dose contribution of the significant beta-gamma dose contributors is determined by comparing the concentration of each significant beta-gamma emitter in the groundwater throughout the evaluation period with the EPA-calculated derived concentration for each radionuclide that would provide a beta-gamma dose of 4 mrem/yr. The fractions (i.e., groundwater concentration divided by derived concentration) for each beta-gamma emitter are then summed to determine the peak year values during an extended period of time (i.e., 10,000 years) following closure of FTF. The highest sum of fractions for any year is determined and verified to be less than one. To determine the peak beta-gamma dose, the fraction can be multiplied by the 4 mrem/yr MCL value.

(Note: Derived MCL concentrations for beta and photon emitters can be found at http://www.epa.gov/ogwdw/radionuclides/pdfs/guide_radionuclides_table-betaphotonemitters.pdf)

Subsequent maintenance and monitoring, as described in Section 8.0 will demonstrate that the performance objectives are met. Each CM will include a review of the current applicable waste tank closure regulations to ensure that closure objectives are up to date and based on the regulations in effect when the CM is developed.

6.0 CLOSURE MODULE PREPARATION AND APPROVAL

6.1 Closure Module Preparation

As waste removal activities in waste tank systems are completed and these systems are prepared for removal from service activities, waste tank system-specific CMs are prepared to document the unique aspects associated with the removal from service of that individual system of waste tank(s) and associated ancillary equipment. Because it is anticipated that the waste tank systems in FTF will be removed from service over decades, the system-specific modules provide the opportunity to address and evaluate evolving technologies for waste removal and waste tank stabilization, and potential changes to regulations. The CMs also provide a mechanism for SCDHEC to review and approve each individual removal from service activity.

When SCDHEC, EPA, and DOE have mutually agreed that current waste removal technology activities may cease and there is reasonable assurance that performance objectives can be met, each waste tank system will be visually inspected and sampled, as appropriate, to determine the characterization of contaminants in the residuals. The actual inventory information will replace the initial estimated inventory that was used in the FTF PA and an SA will be developed to provide reasonable assurance that the performance objectives will continue to be met for the FTF closure. The CM will document the revised estimates for the peak groundwater concentrations and peak dose using actual data from all waste tank systems that have been removed from service or cleaned and the estimated closure inventory of those waste tank systems that have not yet been cleaned. Knowledge gained as systems are removed from service will be factored into the inventory estimates for those systems pending cleaning. If the analysis demonstrates that there is not reasonable assurance that performance objectives can be met, additional waste removal steps will be taken or alternative engineered barriers will be evaluated to ensure compliance with the performance objectives. The FTF PA will be periodically revisited to verify that performance objectives can be met with the revised inventory.

A waste tank system-specific CM detailing the inventory and removal from service configuration of an individual waste tank system will be submitted to SCDHEC for review and approval. In addition, the CM will be provided to EPA Region 4 project managers for review to ensure consistency with the FFA requirements for overall remediation of the FTF. The CM may also be provided to the public by SCDHEC for their review and comment prior to SCDHEC approval.

If necessary, additional individual modules will be written for the evaporators, DBs, PPs, and transfer lines that were not included in a given CM of a group of waste tank systems. These CMs will also be provided to EPA Region 4 for review. A decision on additional CMs will be made with input from SCDHEC and will generally follow removal from service of a grouping of waste tank systems. For example, it is planned that a CM will be developed for the 242-F Evaporator System some time after removal from service of waste tank systems that include Tanks 17 through 20. Each module will be a stand-alone document and will be based on the process outlined in this FTF GCP. The individual module will provide the actual details for removal from service of an individual waste tank system or group of systems. The ancillary equipment will be tracked via the system-specific CMs and construction permit modifications. The construction permit will be modified to remove ancillary equipment as it is removed from service. In addition, a table listing the FTF ancillary equipment will be included in each CM with the document number of the CM in which it was included and the date of removal from service. Table 6.1-1 illustrates a typical tracking method to be utilized in the CMs.

Table 6.1-1: Typical F-Area Tank Farm System Removal From Service Tracking

Waste tank System	Closure Module Document Number	Date of Removal from Service
242-F Evaporator Pot		
Mercury Collection Tank		
Cesium Removal Column Pump Tank		
Overheads Tank, North		
Overheads Tank, South		
242-3F Concentrate Transfer System		
242-16F Evaporator Pot		
Mercury Collection Tank		
Cesium Removal Column Pump Tank		
Overheads Tank, North		
Overheads Tank, South		
FPT-1, Pump Tank 1 and FPP-1		
FPT-2, Pump Tank 2 and FPP-2		
FPT-3, Pump Tank 3 and FPP-3		
FDB-1		
FDB-2		
FDB-3		
FDB-4		
FDB-5		
FDB-6		
F-Area Catch Tank		

In general, the purpose of the module will be to present a cogent analysis to demonstrate that the proposed removal from service configuration is protective of human health and the environment and that the individual closure actions will continue to be supportive of meeting the applicable performance objectives for the closure of the entire FTF.

A CM will contain the following elements:

Introduction – Defines the purpose and scope of the CM. States the objectives to be met based on the most current applicable regulations.

Facility Description – Describes the waste tanks and ancillary equipment that are uniquely included in the scope of the CM. Also provides a history of the waste tank system(s) and the waste type(s) that have been managed in the system, as applicable.

Waste Removal and Closure Configuration – Describes the process used to remove waste from the waste tank system(s), as applicable, and describes the proposed end state of the system being removed from service. This section will focus on these sub-elements:

- Summary description of the selection process for waste removal (with associated references containing the detail descriptions)
- Details of the waste removal process
- Characterization of residual material and quantification of remaining inventory including sampling and analysis details
- Waste tank system isolation process and final configuration of the waste tank system

- Description of structures and equipment that are part of this removal from service activity including any equipment that will remain in a waste tank at the time of removal from service
- Stabilization strategy including type and characteristics of fill material, as appropriate

Performance Evaluation – Using the baseline fate and transport model from the PA, the peak groundwater concentrations and peak dose will be determined using actual inventory data from all waste tank systems (i.e., waste tanks and associated ancillary equipment) that have been removed from service and the estimated inventory of those systems that have not yet been removed from service. The inventories from each waste tank system will be provided and will be annotated whether they are actual final inventories or estimated inventories based on process knowledge. An analysis will be provided to demonstrate that it is not technically practicable from an engineering perspective to continue with active waste removal activities. This analysis will include, but not be limited to, such things as technology capabilities, schedule impacts and a quantified cost, risks and benefit analysis.

The peak groundwater concentration will be provided for applicable radiological and nonradiological components to demonstrate reasonable assurance that human health and the environment will continue to be protected, as described in Section 5.2 and 5.4. [SCDHEC-R.61-58]

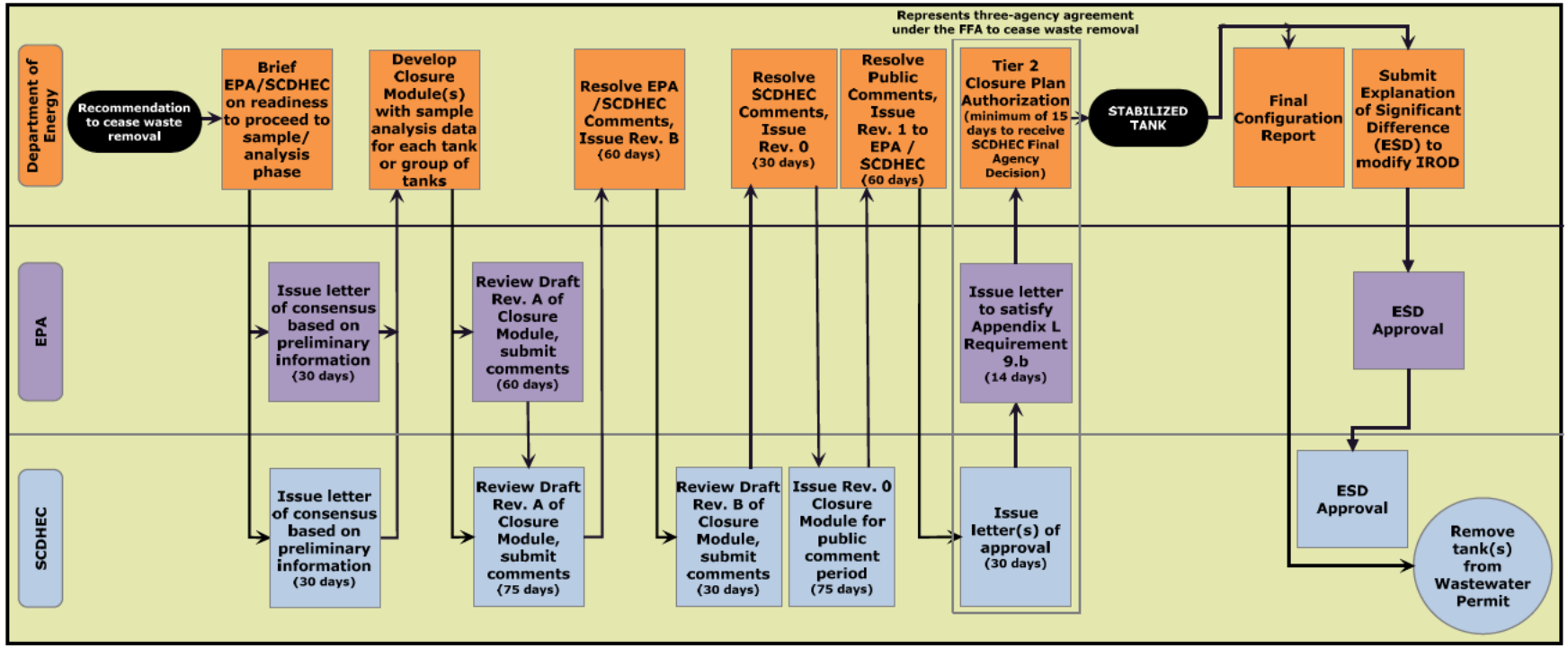
6.2 Closure Module Approval Process

The process depicted in Figure 6.2-1 and described below provides roles, products, and anticipated schedule durations for the transitioning from waste tank system cleaning, through the state approval process to take the permanent actions of emplacing fill material, as applicable, and finally through removal of the system from IWW Construction Permit #17,424-IW. This process will meet the requirements of the industrial wastewater permit issued by the SCDHEC, the requirements of the FFA (including FFA Appendix L, requirement 9.b), and the mutual agreement that waste removal activities may cease. These durations may be shortened in the future as more experience is obtained in the preparation of the documents. [WSRC-OS-94-42]

The process includes the following steps.

1. DOE will determine the best technologies for waste removal and will conduct waste removal activities until reasonably assured that compliance with removal from service criteria can be demonstrated after completion of the deployed technology. DOE will keep SCDHEC and EPA apprised of the technology selection process for each waste tank system and of the progress of waste removal, at a minimum, through regular quarterly meetings.
2. When DOE is satisfied that waste removal activities are sufficiently complete to provide reasonable assurance that proceeding to the sampling and analysis phase will demonstrate that removal from service criteria are met, a briefing will be provided to EPA and SCDHEC to present the preliminary data available at that point.

Figure 6.2-1: Closure Module Development and Review Process



3. Following the briefing, if SCDHEC and EPA agree with DOE that the preliminary information indicates that further waste removal is not technically practicable from an engineering perspective, SCDHEC and EPA will each provide a concurrence letter to DOE, within 30 days of the briefing that, based on the information provided, it is appropriate to discontinue active waste removal activities and to proceed to the sampling and analyses phase of the waste tank system removal from service process.
4. After sample results are finalized, a draft CM for the waste tank system or group of systems will be prepared and submitted to SCDHEC and to EPA for review. The EPA will provide its comments to SCDHEC and the final SCDHEC comments will be returned to DOE within 75 days of receipt of the CM.
5. Within 60 days, DOE will disposition comments received from SCDHEC on the CM, will revise the draft CM as appropriate, and revised draft CM will be resubmitted to SCDHEC for a second review. In addition to the draft revision of the CM, DOE will also provide a matrix indicating how each comment was dispositioned. SCDHEC will return comments to DOE on the revised draft CM and the associated matrix within 30 days of receipt.
6. Within 30 days of receipt of the comments from SCDHEC, the comments on draft revision will be incorporated and the final CM Revision 0 will be submitted to SCDHEC. Within 15 days, SCDHEC plans to initiate a 45-day public review and comment period. Within 15 days after the public comment period, SCDHEC will provide feedback to DOE on changes desired as a result of public comments.
7. Within 60 days following the receipt of feedback from public comments, DOE will make changes and issue the CM Revision 1 to SCDHEC for approval.
8. Following a review that determines that the CM is adequate, a letter will be issued by SCDHEC to DOE within 30 days providing approval of the CM and final agreement that all waste removal activities can cease. Within 14 days after SCDHEC approval, EPA will also provide concurrence to DOE, via a letter, that waste removal can cease. These letters will document completion of FFA Appendix L requirement 9.b.The final CM approval is a prerequisite to approval and issuance of the DOE Tier 2 Closure Authorization. A 15-day “hold” period is required before any irreversible closure actions can be taken by DOE to account for the required waiting period between the SCDHEC staff decision and the SCDHEC final agency decision. Once the final agency decision is received, DOE will authorize the removal from service action through approval of the DOE Tier 2 Closure Authorization..
9. Following waste tank stabilization, the FFA commitment for operational closure (i.e., removal from service) has been met. The DOE will submit an ESD to modify the IROD and apply the maintenance and monitoring controls to the waste tank(s) as they are removed from service.
10. In parallel, DOE will provide SCDHEC with a final closure configuration report for the individual waste tank system, certifying that work has been completed in accordance with the approved GCP and CM. Then, SCDHEC will provide a letter to DOE removing the closed waste tank system from IWW Construction Permit #17,424-IW.

7.0 STABILIZATION

In May 2002, DOE issued an Environmental Impact Statement (EIS) on waste tank cleaning and stabilization alternatives. [DOE-EIS-0303] The DOE studied five alternatives, 1) empty, clean and fill with grout, 2) empty, clean and fill waste tank with sand, 3) empty, clean and fill waste tank with saltstone, 4) clean and remove waste tanks, and 5) no action.

Evaluations described in the EIS showed the "Empty, clean and fill with grout" alternative to be the best approach to minimize human health and safety risks associated with closure of the waste tanks. [DOE-EIS-0303]

Filling a cleaned waste tank with grout provides stability to the walls and ceiling. The grout fill also helps to reduce water intrusion into the waste tank over time. Reducing the amount of water allowed to enter a closed waste tank retards the migration of residual material from the waste tank to the environment. The DOE issued a ROD selecting the "Empty, clean and fill with grout" alternative for SRS waste tank closure in August 2002. [DOE-EIS-0303 ROD]

Each of the waste tank systems has a unique operating history, as well as various hydrogeologic characteristics, such as the distance from the water table and the distance to nearby streams. The DOE will determine the removal from service configuration for each waste tank system on a case-by-case basis, although all removal from service actions will have common features. Common features include 1) isolation by eliminating mechanical and electrical services and removing or isolating accessible piping and conduits, and 2) ensuring the long-term stability of the structure or equipment which includes filling with grout. Failed equipment, or equipment that is no longer needed, may be encapsulated in the fill material when removing a waste tank system from service. This equipment may be associated with the waste tank that is undergoing removal from service or another waste tank system that is undergoing removal from service in FTF. The CM for the waste tank system(s) will provide details of the all of the equipment and structures that will remain in a waste tank system.

Fill material is typically composed of a combination of pumpable, self-leveling backfill materials for waste tank system removal from service. It is anticipated that fill material technologies will be enhanced during the course of FTF removal from service. The DOE plans to take advantage of improvements, as appropriate, and to discuss them in subsequent CMs.

This removal from service configuration for each waste tank system will promote long-term stability of the system. Those components of the systems where fill material will be utilized will reduce the migration of residuals remaining, fill voids to the extent practicable, and prevent future subsidence of the structures. Also, the configuration discourages inadvertent intrusion. Additional information on the waste tank system stabilization can be found in Section 3.2.3 of the FTF PA. [SRS-REG-2007-00002] This configuration is the current baseline case in the FTF PA. Alternative configurations may be evaluated in the future and, if found to be suitable, may be implemented with approval of SCDHEC.

Ancillary equipment associated with each waste tank system may be filled with grout contingent on the specific characteristics of that equipment and will be fully documented in the applicable CM. There are no current plans to add fill material to the FTF transfer lines. Flushing of the transfer lines after use has long been practiced for waste transfers to prevent material build up within the systems. Transfer line core pipe flushing has been part of operations of the waste tank

farms from at least the mid-1970s, and there is also indication that some level of flushing has always been a part of transfer system operations. The rigor to which flushing has been applied has increased over the years and has been a requirement from the safety basis documents in the recent past. In addition to operational practices of flushing, specific design practices have contributed to removing the waste from waste transfer line piping systems. The installation of stainless steel for the waste transfer core piping, the transfer piping sloping toward a waste tank with minimal valves and the layout of turn radii are specific design features that prevent waste accumulation in the piping systems. The waste transfer lines were modeled in the FTF PA with no grout and the result was in compliance with the required performance objectives. Since any residual radioactive waste would be on the interior wall of the transfer lines and the leach rate would not be significantly influenced by grout, then there is no environmental benefit to grouting these small diameter transfer lines. [SRS-REG-2007-00002]

Stabilization options will continue to be evaluated throughout the FTF removal from service process.

8.0 MAINTENANCE AND MONITORING

The FFA directs the comprehensive remediation of SRS. It contains requirements for site investigation and remediation of releases and potential releases of hazardous substances and expands the site investigation process begun at SRS to address releases of hazardous or radioactive substances. The agreement also establishes requirements for the prevention and mitigation of releases or potential releases at or from the FTF and the remediation of soils and groundwater when all FTF waste tanks have been removed from service. Because not all waste tank systems will be closed at the same time, there will be an interim period where some systems remain operational, while others are closed. [WSRC-OS-94-42]

Following waste tank or group of waste tanks and/or ancillary equipment removal from service, that waste tank(s) or equipment will be removed from the IWW Construction Permit #17,424-IW via an ESD to the IROD. Maintenance and monitoring of the waste tanks after removal from service until final FFA corrective/remedial actions will be governed by the basis of the IROD and the RCRA permit. The interim institutional controls are provided in an interim action statement of basis/interim action proposed plan for FTF waste tanks and ancillary equipment and the associated IROD. Groundwater monitoring will be conducted during the interim period from the time the individual waste tanks and ancillary equipment are removed from service and the final closure of the FTF Area OU in accordance with a FTF groundwater monitoring plan (GWMP). This plan requires approval prior to approval of any CM associated with the FTF GCP. The FTF GWMP will be submitted within 120 days of approval of the FTF GCP. This plan will include such elements as a groundwater monitoring network, sampling frequency, constituents and associated detection limits, reporting frequency, and triggers for evaluation of corrective action. For the interim period from the time the waste tanks are grouted until the IROD is modified via an ESD, the waste tanks will be subject to the following maintenance and monitoring requirements. [WSRC-OS-94-42]

- Continue groundwater monitoring as requested by SCDHEC in support of IWW Construction Permit #17,424-IW. The analysis of groundwater samples will be performed by a laboratory certified for applicable parameters in accordance with SCDHEC R.61-81, *State Environmental Laboratory Certification Program*.
- Conduct annual visual inspections of the area surrounding the waste tank(s) and perform maintenance actions as appropriate. Conditions that will be inspected will include, at a minimum, water accumulation in surrounding areas and physical integrity of visible installed barriers.
- Provide access controls for on-site workers via the Site Use Program, Site Clearance Program, work control, worker training, worker briefing of health and safety requirements and identification signs located at the waste unit boundaries.
- Notify the EPA and SCDHEC in advance of any changes in land use.
- Provide access controls against trespassers as consistent with the 2000 RCRA Part B Permit Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, control entry systems, and warning signs in place at the SRS boundary. [WSRC-IM-98-30]

Once removal from service of all waste tanks and ancillary equipment is complete, a decision for the final area closure under the FFA can be established by a final ROD/permit modification as provided for in the FFA. The maintenance and monitoring requirements listed above will be addressed in a formal post-closure monitoring plan that will be developed in concert with SCDHEC and EPA at that time. In developing this plan, consideration will be given to inclusion of such elements as a groundwater monitoring network, sampling frequency, constituents and associated detection limits, reporting frequency, and triggers for evaluation of corrective action.

9.0 REFERENCES

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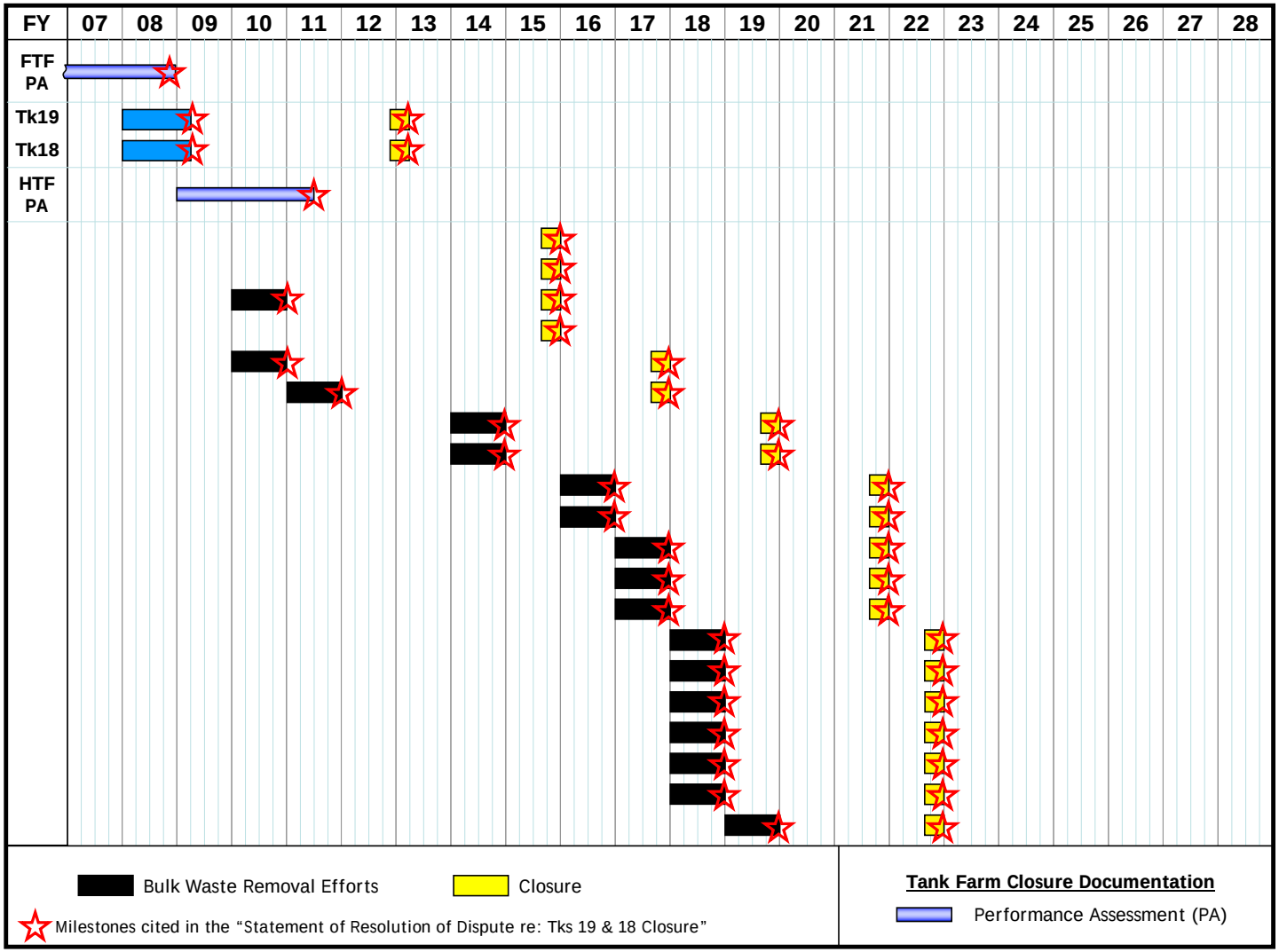
ATTACHMENT 1: SRS FEDERAL FACILITY AGREEMENT APPROVED WASTE REMOVAL PLAN AND SCHEDULE

Attachment 1: FFA Waste Removal Plan & Schedule (Approved 11/19/2007)