SRR-CWDA-2020-00011
Revision 0

INDUSTRIAL WASTEWATER CLOSURE MODULE FOR F-AREA DIVERSION BOXES 5 AND 6 F-AREA TANK FARM, SAVANNAH RIVER SITE

February 2021

Industrial Wastewater Construction Permit No. 17,424-IW

Prepared by: Savannah River Remediation LLC
Waste Disposal Authority
Aiken, SC 29808

Prepared for U.S. Department of Energy Under Contract No. DE-AC09-09SR22505

This page intentionally left blank

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

AEA	Atomic Energy Act
ALARA	As Low As Reasonably Achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGCP	Consolidated General Closure Plan
CLSM	Controlled Low-Strength Material
CM	Closure Module
CMCOC	Contaminant Migration Constituents of Concern
COC	Constituents of Concern
CTS	Concentrate Transfer System
DB	Diversion Box
DOE	U. S. Department of Energy
EIS	Environmental Impact Statement
EPA	U. S. Environmental Protection Agency
FCR	Final Configuration Report
FDB	F-Area Diversion Box
FFA	Federal Facilities Agreement
FPP	F-Area Pump Pit
FTF	F-Area Tank Farm
GSA	General Separations Area
HEPA	High Efficiency Particulate Air
HTF	H-Area Tank Farm
I.D.	Inside Diameter
IROD	Interim Record of Decision
LDB	Leak Detection Box
LTAD	Low Temperature Aluminum Dissolution
LWTRSAPP	Liquid Waste Tank Residuals Sampling and Analysis Program Plan
LZ	Lower Zone
MCL	Maximum Contaminant Level
MOP	Member of the Public
N/A	Not Applicable
OA	Oxalic Acid
OU	Operable Unit
P&ID	Piping and Instrumentation Diagrams
PA	Performance Assessment
PP	Pump Pit
PRG	Preliminary Remediation Goal
PS	Production Support
RCRA	Resource Conservation and Recovery Act
RFS	Removal from Service
ROD	Record of Decision
RSL	Regional Screening Level
SA	Special Analysis
SCDHEC	South Carolina Department of Health and Environmental Control
SLDR	Sample Location Determination Report

SRS	Savannah River Site
SRR	Savannah River Remediation LLC
TSR	Technical Safety Requirements
UTR	Upper Three Runs
UTRA	Upper Three Runs Aquifer
UZ	Upper Zone
WCS	Waste Characterization System
WTS	Waste Transfer System

EXECUTIVE SUMMARY

The *Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems* (CGCP) (SRR-CWDA-2017-00015) was prepared to support the future removal from service (RFS) of the F-Area Tank Farm (FTF) and H-Area Tank Farm (HTF) underground radioactive waste tanks and ancillary structures at the Savannah River Site (SRS) that are regulated under the *F and H Area High Level Radioactive Waste Tank Farms Construction Permit No. 17,424-IW* (hereinafter referred to as Construction Permit #17,424-IW), and the SRS Federal Facility Agreement (FFA) which will control the subsequent remediation of the FTF and HTF. [DHEC_01-25-1993, WSRC-OS-94-42]

The CGCP establishes the protocol by which the U. S. Department of Energy (DOE) intends to close waste tank systems and ancillary structures at SRS and receive approval from the South Carolina Department of Health and Environmental Control (SCDHEC) following public comment. Specifically, CGCP Section 11, *Closure Module Preparation and Approval*, outlines the requirements for Closure Module (CM) content, development, and approval. This CM supports the RFS of F-Area Diversion Boxes 5 and 6 (FDB-5, FDB-6) in the FTF under Construction Permit #17,424-IW. [DHEC_01-25-1993]

The SRS is a Federal facility owned by DOE. Since beginning operations in the early 1950s, uranium and plutonium recovery processes have generated liquid radioactive waste, which is currently stored in underground waste tanks and contacted ancillary structures in the F and H Areas at the site. The DOE intends to remove from service all of the ancillary structures and waste tanks with priority being given to the old-style waste tanks that do not meet the standards established in Appendix B of the SRS FFA. [WSRC-OS-94-42] The FFA has been entered into pursuant to Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Sections 3008(h) and 6001 of the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984 (hereinafter jointly referred to as RCRA) and the Atomic Energy Act of 1954 (AEA), as amended, 42 U.S.C. § 2011.[1] [WSRC-OS-94-42] Once SCDHEC, the U. S. Environmental Protection Agency (EPA), and DOE mutually agree that waste removal from FDB-5 and FDB-6 may cease, any residual contaminants will be stabilized through operational closure, and then these ancillary structures will be removed from service under Construction Permit #17,424-IW. [DHEC_01-25-1993] Subsequently, the stabilized structures will be monitored and maintained in accordance with the requirements of an Interim Record of Decision (IROD) and the SRS RCRA Hazardous Waste Permit, Module VIII, as solid waste management units.

The DOE intends to remove FDB-5 and FDB-6 from service in accordance with SCDHEC Regulation 61-82, *Proper Closeout of Wastewater Treatment Facilities*, and SCDHEC Regulation 61-67, *Standards for Wastewater Facility Construction*. In addition, the FDB-5 and FDB-6 RFS by this process is intended to be consistent with the applicable requirements of RCRA and CERCLA described in the FFA, which will govern the subsequent remediation of the FTF operable unit (OU). These regulations were reviewed at the time of development of this CM and have been verified not to have changed since the CGCP was issued. [SCDHEC R.61-82, SCDHEC R.61-67, WSRC-OS-94-42, SRR-CWDA-2017-00015]

[1] DOE's submittal of this plan does not waive any DOE claim of jurisdiction over matters reserved to it under the Atomic Energy Act of 1954.

A performance assessment (PA) has been developed for FTF to assess the long-term fate and transport of residual contaminants in the environment resulting from the RFS of the FTF waste tanks and ancillary structures. [SRS-REG-2007-00002] Considering the layout of the FTF and the presumed footprint of a potential closure cap (if deemed necessary and appropriate when a final remedy is selected for the FTF OU), it is expected that monitoring wells will be located approximately 100 meters from the FTF boundary (i.e., line of demarcation enclosing the FTF waste tanks). In accordance with DOE M 435.1-1, the FTF PA used 100 meters as a point of assessment to predict long-term performance. [DOE M 435.1-1]

This CM describes the method by which DOE developed the assigned inventories for residual materials possibly remaining in FDB-5 and FDB-6, and the plans to isolate these ancillary structures from the FTF facilities that remain operable. This CM was developed using the assigned inventories for FDB-5 and for FDB-6. The assigned inventories are based on identified waste composition and properties from data in the SRS Waste Characterization System (WCS) (the WCS tracks waste data including projected radionuclide and non-radiological inventories based on sample analyses, process histories, compositional studies, and theoretical relationships.) The total radiological and chemical inventories assigned to FDB-5 and FDB-6 were calculated based on these concentrations multiplied by the total affected surface area of the respective ancillary structure. [SRR-CWDA-2020-00029] A Special Analysis (SA) was then performed using the FDB-5 and FDB-6 assigned inventories. DOE has confirmed that regulatory performance objectives will be met and that the stabilized FDB-5 and FDB-6 configurations would be protective of human health and the environment.

Based on the information provided in this CM and supporting documents, it may be concluded that (1) there is reasonable assurance that, at the time of final FFA corrective/remedial actions, groundwater concentrations derived from residual contamination in the waste tanks and ancillary structures will meet the regulatory performance objectives and (2) further waste removal is not technically practicable from an engineering perspective.

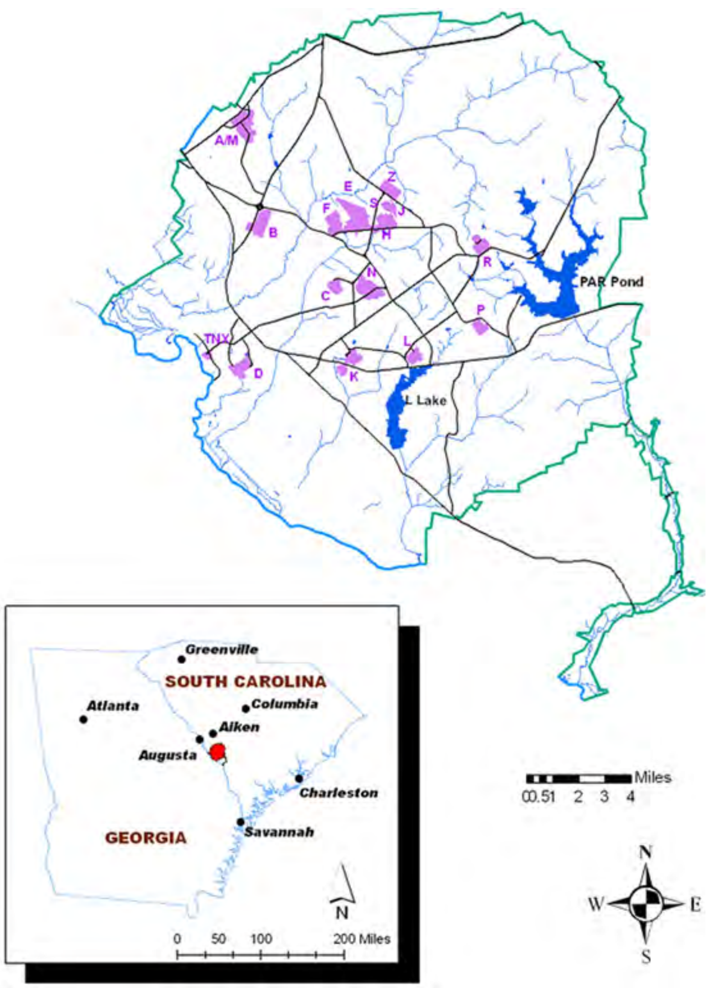
Through completion of this CM, DOE will have determined that all CGCP requirements have been met to proceed with removing FDB-5 and FDB-6 from service and that DOE is ready to complete the process by stabilizing these ancillary structures with grout. Through approval of this CM, SCDHEC is agreeing that waste removal activities for FDB-5 and FDB-6 can cease and authorizes stabilization of these ancillary structures and the residual contaminants under Construction Permit #17,424 IW. [DHEC_01-25-1993] Following operational closure, DOE will submit separate Final Configuration Reports (FCRs) for FDB-5 and FDB-6 to SCDHEC (as described in the CGCP) with certification that the RFS activities have been performed in accordance with the CGCP and this CM.

1.0 INTRODUCTION

Since the early 1950s, the primary SRS mission had been to produce nuclear materials primarily for national defense and deep space missions. A legacy of the SRS mission was the liquid waste generated from chemical separations processes in both F and H Areas. Since the beginning of SRS operations, an integrated Liquid Waste System consisting of several facilities designed for the overall processing of liquid waste has evolved. Two of the major system facilities are the FTF and HTF located in F Area and H Area, respectively, which are near the center of the site (Figure 1.0-1). In F Area, plutonium, uranium, and other radionuclides were extracted from target assemblies using chemical separation processes with the resultant waste being sent to the underground tanks in the FTF. The tank farms, which store and process the chemical separations waste, include waste tanks and ancillary structures such as evaporators, transfer line systems, pump tanks and pump pits, and diversion boxes.

In this document the term "ancillary structure" will refer to structures, systems, and equipment within the FTF, other than the underground waste storage tanks, that may contain a residual chemical and radioactive material inventory and must be accounted for as part of the FTF closure.

Figure 1.0-1: SRS Operational Area Location Map



In support of environmental remediation activities at SRS; DOE, EPA, and SCDHEC signed the SRS 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 committed to submit and comply with a schedule 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 describes the specific radioactive waste tank systems that are subject to the agreement. [WSRC-OS-94-42]

The CGCP establishes the general protocols for the RFS of the FTF and HTF waste tanks and ancillary structures in accordance with SCDHEC R.61-82 and SCDHEC R.61-67. This CM provides specific information on the FDB-5 and FDB-6 RFS in the FTF and demonstrates activities have been performed in accordance with requirements set forth in CGCP Section 11.0, *Closure Module Preparation and Approval*. [SRR-CWDA-2017-00015]

This CM supports the FDB-5 and FDB-6 RFS in the FTF under Construction Permit #17,424-IW. [DHEC_01-25-1993]

This CM contains the following elements:

Introduction (Section 1.0) – Defines this CM purpose and scope.

Facility Description (Section 2.0) – Describes FDB-5 and FDB-6 and provides a history of each ancillary structure.

Waste Removal (Section 3.0) – Describes the process used to document the absence of waste in FDB-5 and confirm the amount of waste remaining in FDB-6.

Residual Material Characterization (Section 4.0) – Details the development of the FDB-5 and FDB-6 assigned inventories.

Performance Evaluation (Section 5.0) – Presents the FDB-5 and FDB-6 SA results for the predicted groundwater concentrations using the assigned inventories and the FTF baseline fate and transport modeling.

Waste Removal Analysis (Section 6.0) – Discusses that it is not technically practicable from an engineering perspective to conduct additional waste removal activities in either FDB-5 or FDB-6. This analysis considers technology capabilities, and relative benefit.

System Isolation and Stabilization (Section 7.0) – Describes the plans to isolate and grout FDB-5 and FDB-6, and the fill material type and characteristics.

Maintenance and Monitoring (Section 8.0) – Describes the FTF maintenance and monitoring plans that will be used for the interim period from the FDB-5 and FDB-6 RFS until the FTF OU final closure.

Conclusion (Section 9.0) – Provides the conclusion that DOE has demonstrated that the proposed RFS configurations are protective of human health and the environment and that the closure actions will continue to be supportive of meeting the applicable performance standards for the FTF OU closure.

Waste Tank Systems Tracking (Appendix A) – This section tracks the FTF waste tanks and ancillary structures listed in the CGCP to ensure that all required FTF waste system components will be addressed in a CM. This table will be updated in each subsequent CM with the RFS date and the CM document number that addresses each FTF waste tank and ancillary structure.

2.0 FACILITY DESCRIPTION

The FTF is a 22-acre site containing 22 underground liquid waste storage tanks and associated ancillary structures, including two evaporator systems, a concentrate transfer system (CTS), six diversion boxes (DBs), one catch tank, three pump pits (PPs), and waste transfer pipelines. Figure 2.0-1 shows the general layout of FTF and the locations of FDB-5 and FDB-6. The FTF was constructed to receive waste generated by various SRS production, processing, and laboratory facilities. Detailed descriptions of the FTF facilities are provided in the FTF PA. [SRS-REG-2007-00002]

The FTF site was originally chosen because of its favorable terrain, proximity to the F-Canyon Separations Facility (the major waste generation source), and isolation distance (at least 5.5 miles) from the SRS boundaries. Figure 2.0-2 shows the setting of F Area and FTF within the SRS General Separations Area (GSA).

Figure 2.0-1: Layout of the F-Area Tank Farm and Locations of FDB-5 and FDB-6

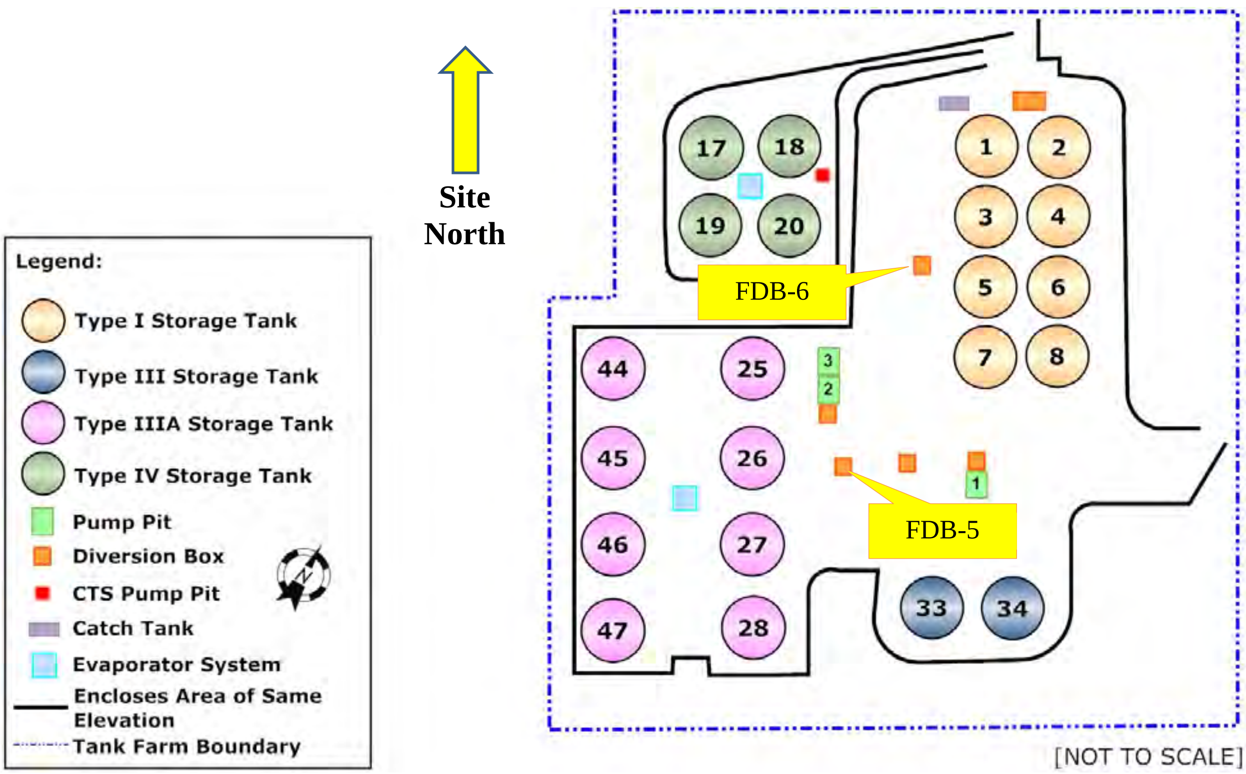
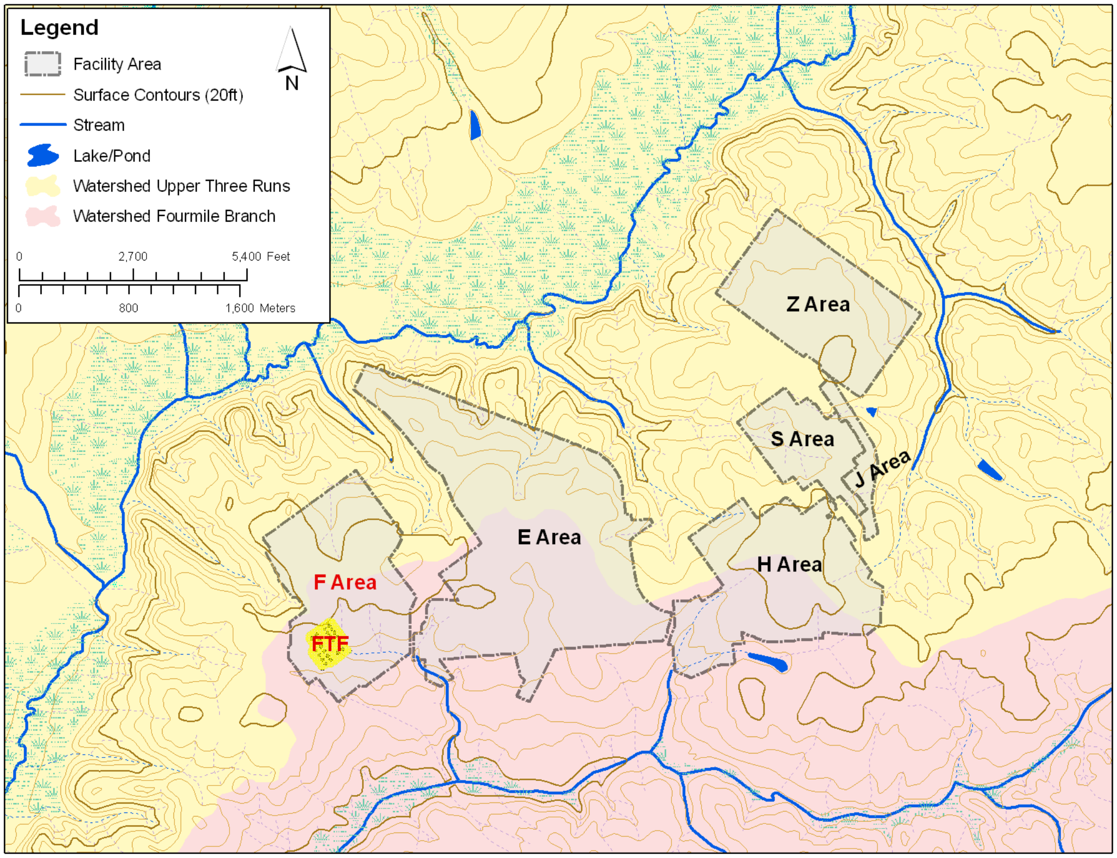


Figure 2.0-2: Layout of the GSA Showing F Area and the FTF



Diversion boxes are junction chambers used to interconnect dedicated waste transfer lines. Most dedicated transfer lines are routed to a wall-mounted nozzle inside a DB. The transfer lines can be interconnected by installing "jumpers" between nozzles to complete the desired transfer path. Transfer paths can be redirected by switching jumpers inside a DB rather than installing new transfer lines. Jumpers are stainless-steel pipe segments specifically fabricated to an exact length and balance. They have special end connections (Hanford connectors) designed to seal against the DB wall nozzles to complete a transfer path.

A Hanford connector is a specially designed clamp with a gasketed seal affixed to each end of a jumper. When tightened, the jaws of the clamp close and seat the jumper end-gasket securely onto a wall nozzle. The seal prevents leakage during a waste transfer. The clamp portion is tightened remotely using an impact wrench suspended from a crane. The wall nozzles in FDB-6 also have a separate inlet line so that flush water can be added directly into the transfer line following a transfer. Any leakage from a jumper connection would be contained inside the DB and would gravity drain into a floor sump and leak detection box (LDB) system. The sump can be drained independently to a PP for transfer to a waste tank.

Pump pits are intermediate pumping stations in the FTF and HTF waste transfer systems and are located at the low point of a transfer line. Pump pits contain a pump tank and hydraulic pumps and/or jet pumps to transfer wastes and associated transfer line water flushes.

FDB-5 and FDB-6 were part of the FTF waste transfer system. FDB-5 was built in the mid-to-late 1970s to make waste transfers from the 242-3F CTS to Tanks 25F through 28F, 33F, and 34F. FDB-6 was built in the late 1970s for feed material transfers to the 242-1F Evaporator from Tanks 26F and 7F.

2.1 FDB-5 Design and Construction

Figures 2.1-1 and 2.1-2 show a plan view, cross-sections, and various design features of FDB-5. The DB is a rectangular concrete structure 13-feet long, 11.25-feet wide, and 17.17-feet high (inside dimensions) with the long axis oriented north-south.[2] It has walls 2.5-feet thick and a base slab approximately 4.7-feet thick. The vault floor is approximately 16 feet below grade. The vault extends approximately 4 feet above grade and has three, 3-foot thick interlocking concrete cell covers oriented east-west. [W702452] The interior vault walls and floor are lined with welded stainless-steel sheets. The wall sheets are approximately 0.125-inches thick. The exterior vault walls were coated with a damp-proofing compound during construction. A west-to-east sloping, sheet metal rain cover has been placed over the vault top. A north-to-south series of supporting I-beams on the underside of the cover create a gap between the top of the cell covers and underside of the rain cover. The gap decreases in height from approximately 10 inches on the west side to approximately 5.5-inches on the east side. The rain cover has one sealable case in the northeast corner covering a single 5-inch inside diameter (I.D.) Schedule 40 pipe riser that penetrates the concrete cell cover above the sump in the vault floor.

The vault has a stainless-steel lined sump in the northeast corner of the floor that is 3-feet long, 2-feet wide, and 1.6-feet deep (Figure 2.1-1). The stainless-steel sheets lining the vault floor and sump are 0.375-inches thick. The vault floor slopes towards a gutter along the east wall that drains to the sump. [W703321] A low, stainless-steel screen is present on the south and west sides of the sump and in the gutter notch (Figure 2.1-2).

The sump can be gravity drained to F-Area Pump Pit (FPP)-2. Sump drainage is controlled by a plug on the end of a fixed rod actuated through the 5-inch riser in the cell cover. A sump overflow line exits the north vault wall at an elevation just below the top of the sump screen. Waste drain lines from clean-outs enter FDB-5 through the transfer line jackets at Nozzles 3 and 4 and Nozzles 9 and 10. There is also a capped drain line entering FDB-5 through the transfer line jacket at Nozzles 7 and 8. The drain lines exit the vault through an opening sealed in the north vault wall approximately 3 feet above the sump bottom and join the sump drain line to FPP-2 (Figure 2.1-2).

A system of underliner leak detection slots was formed into the concrete floor surface underneath the stainless-steel vault floor liner. The underliner leak detection system is piped to an LDB outside the northeast corner of the vault (Figure 2.1-1).

There is a flush water valve box at grade on the northeast vault corner. It was used to activate a spray water nozzle system to rinse the DB interior if needed. The valve box is 3-feet long, 1.5-feet wide, and 2.7-feet deep and has a 1-foot thick concrete cover, but no rain cover. The flush water piping enters the vault through an 8-inch wide by 10-inch high open slot on the north wall approximately 14 feet above the vault floor. [W702452]

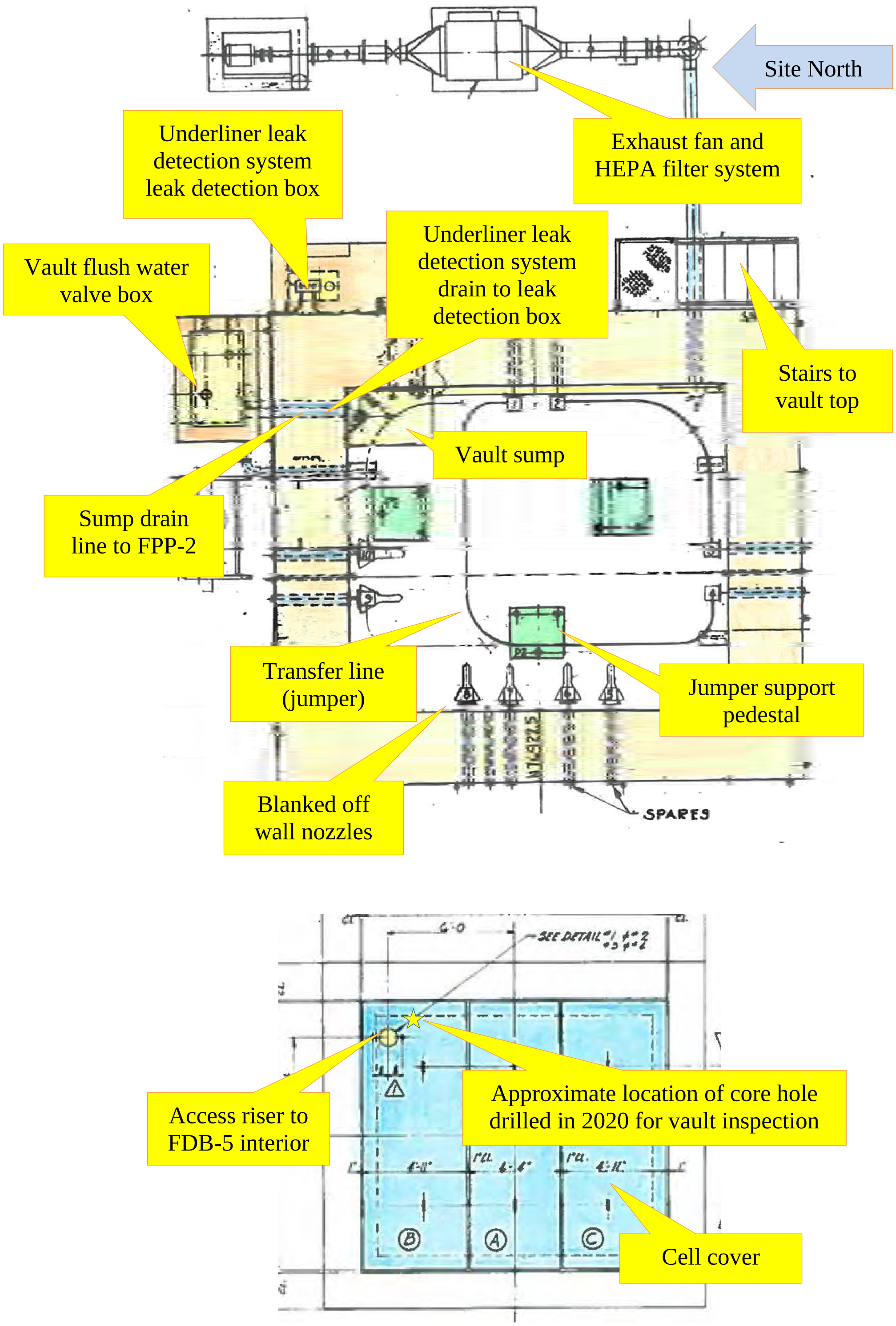
[2] All compass directions given are based on site north which is approximately 36º 22' west of true north.

A set of metal stairs on the southeast corner of FDB-5 provides access to the top of the vault. FDB-5 has a High Efficiency Particulate Air (HEPA) ventilation system at grade on the east side of the vault (Figure 2.1-1).

There are 10 wall nozzles in FDB-5. The north, south, and east vault walls each have two wall-mounted nozzles for waste transfer line (jumper) connections using Hanford connectors. The west wall has four nozzles (Figure 2.1-2). Spare wall Nozzles 5, 6, 7, and 8, that were installed for future transfer line connections, are blanked off using dummy Hanford connectors. Several metal "pedestals" on the vault floor support the installed jumpers. There are two abandoned jumpers on the vault floor.

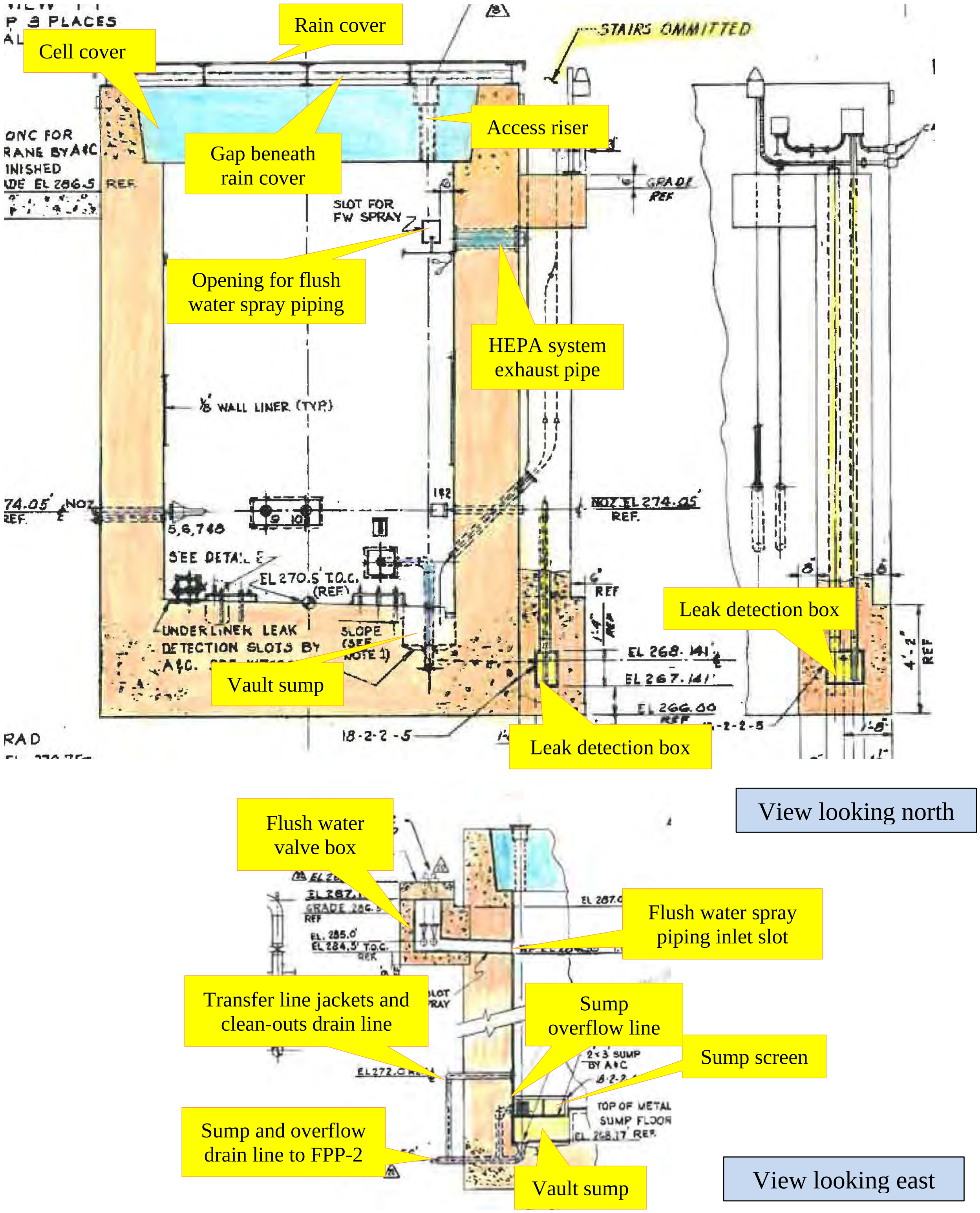
Figure 2.1-3 is a photograph of the northeast corner of FDB-5 showing the flush water valve box and sealable case covering the vault access riser above the sump.

Figure 2.1-1: Plan View of FDB-5 and Cell Covers



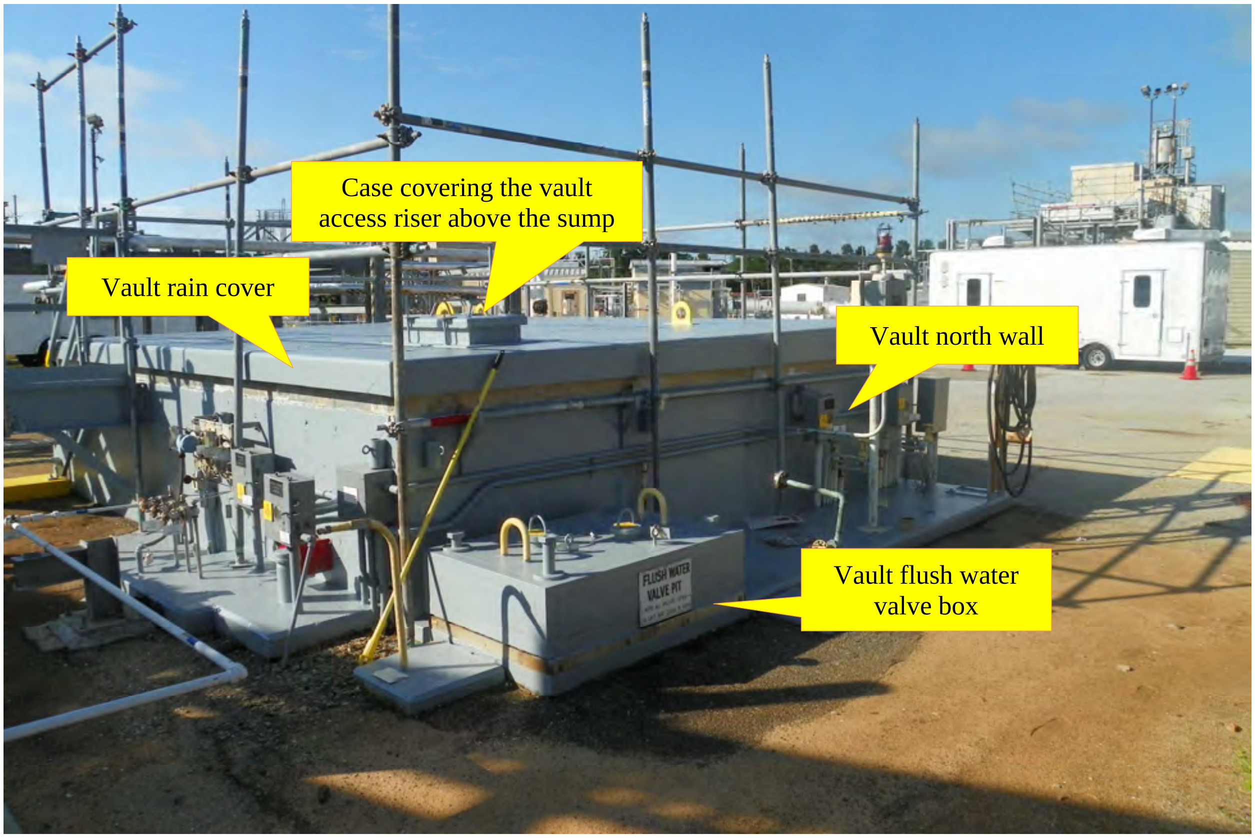
[W703320]

Figure 2.1-2: Cross-Sections of FDB-5 Showing the Sump, Leak Detection Box, and Vault Flush Water Valve Box and Piping Inlet



[W702452]

Figure 2.1-3: View of the FDB-5 Northeast Corner, Flush Water Valve Box, and Vault Access Riser Area. View to Southwest, May 2018.

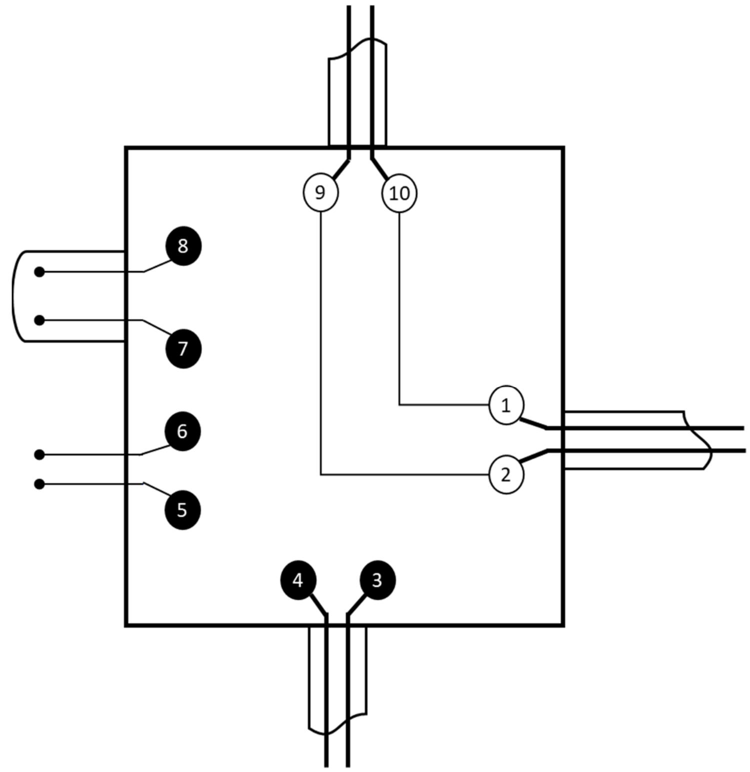


2.2 FDB-5 Vault Piping

There are several piping penetrations through the FDB-5 vault walls for the waste system transfer lines while others are for drainage, leak monitoring, instrument air supply, and vault ventilation.

Figure 2.2-1 is a schematic of the internal FDB-5 waste transfer piping. The 10 waste transfer lines are all 2-inch I.D., Schedule 40 stainless-steel. All waste transfer lines are inside secondary containment jackets that drain to leak detection boxes. Because multiple lines may be inside one jacket, the jackets range from 6 to 10 inches in diameter. The vault flush water lines are 0.75-inches I.D. The current line status is summarized in Table 2.2-1. Details on the additional lines inside the vault are summarized in Table 2.2-2.

Figure 2.2-1: FDB-5 Waste Transfer Piping System Diagram



[M-M6-F-3123]

Table 2.2-1: Current Status of FDB-5 Waste Transfer Piping System

Nozzle Number	Purpose	Nozzle status in FDB-5	Transfer Line Termination Status
1	From 242-3F CTS Pump Tank	Jumpered to Nozzle 10	Dummy Hanford connector in 242-3F CTS Pump Pit
2	To 242-3F CTS Pump Tank	Jumpered to Nozzle 9	Dummy Hanford connector in 242-3F CTS Pump Pit
3	From Tank 33F	Dummy Hanford Connector	Tank 33F Riser C2
4	To Tank 34F	Dummy Hanford Connector	Tank 34F Riser C2
5	Spare	Dummy Hanford Connector	Capped at FDB-5
6	Spare	Dummy Hanford Connector	Capped at FDB-5
7	Spare	Dummy Hanford Connector	Capped at FDB-5
8	Spare	Dummy Hanford Connector	Capped at FDB-5
9	From Tank 28F	Jumpered to Nozzle 2	Tank 28F Riser C2
10	To Tank 25F	Jumpered to Nozzle 1	Tank 25F Riser C2

[after M-M6-F-3123]

Table 2.2-2: Additional FDB-5 Vault Piping System Lines

Pipe Size (I.D. Inches)	Purpose
6	Ventilation Duct for the HEPA system
1	To LDB-1
1	To LDB-2
1	To LDB-3
1.5	Transfer line jackets and clean-out drains to sump drain line
3	Sump drain system to FPP-2
1	Sump overflow line
1	Instrument air (3 lines)
0.75	Flush water supply line to vault spray nozzles

[after M-M6-F-3123]

2.3 FDB-5 Operational History

FDB-5 was constructed in the mid-to-late 1970's and used between March 1980 and September 1985. FDB-5 was used to transfer waste between the 242-3F CTS, Tanks 25F through 28F, and Tanks 33F and 34F. The transfers through FDB-5 were only concentrated evaporator discharge (supernate). No "fresh canyon waste" or "sludge slurry" were sent through FDB-5.

FDB-5 is currently inactive.

2.3.1 FDB-5 Decontamination History

FDB-5 had a history of jumper plugging caused by the concentrated, high-salt CTS waste crystallizing inside the transfer lines during cold weather. When a line became plugged, the jumper was disconnected and lifted near the top of the vault. A "skill-of-the-craft catheterization procedure" was used to dissolve the internal salt and flush the line. The procedure involved inserting a polyethylene tube fed with water into the disconnected jumper to dissolve and flush out the very soluble salt waste. After the salt dissolution was complete, the FDB-5 interior walls and floor were washed using the jumper flushing apparatus. The waste and wash water would collect in the sump and then be gravity-drained to FPP-2. [SRR-CWDA-2018-00059]

Aside from the jumper cleanings, FDB-5 has no known waste leakage or spillage events. [SRR-CWDA-2018-00059]

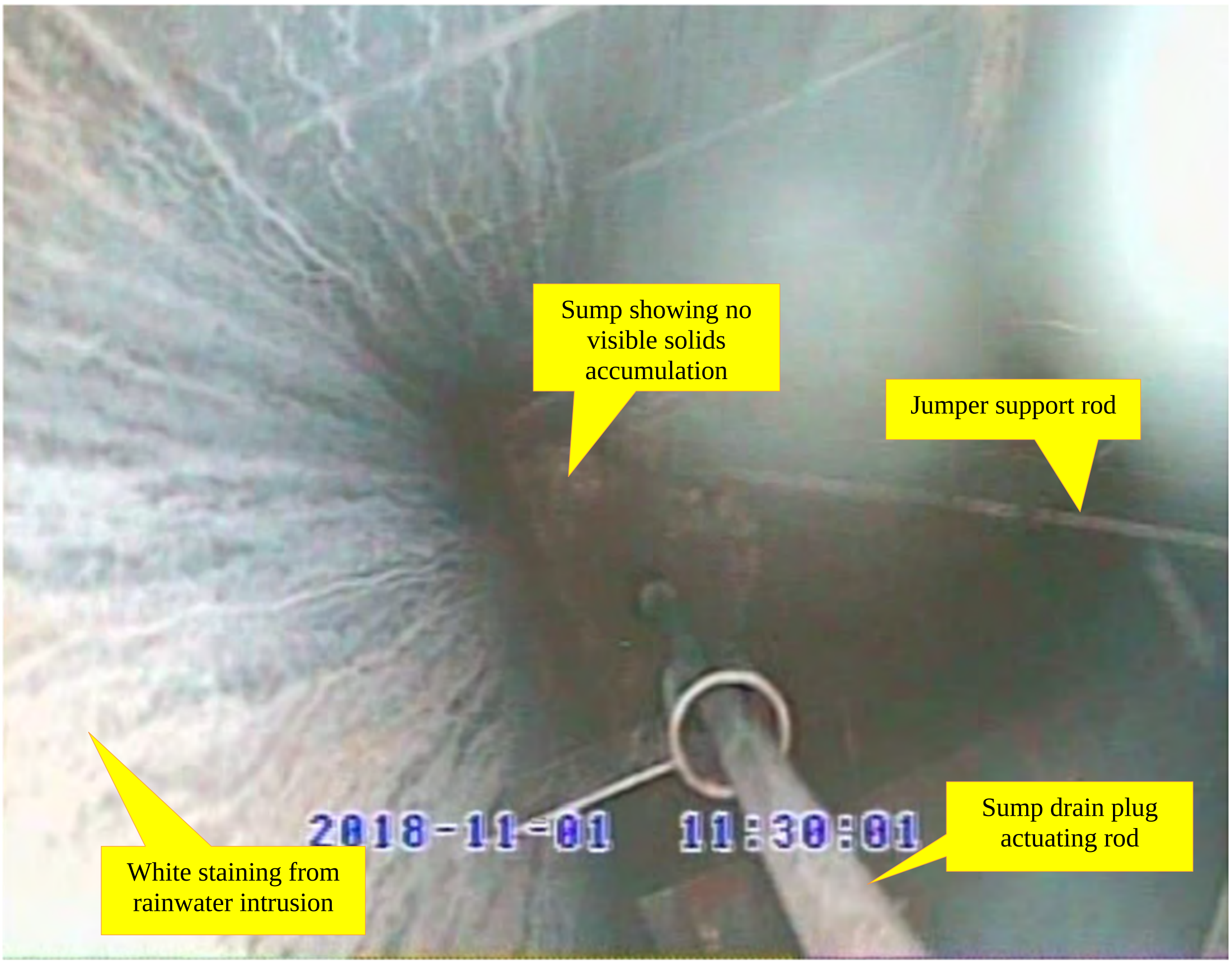
2.4 FDB-5 Inspections

Two video camera inspections were performed on FDB-5. The first was in November 2018 and the second in February 2020. The February 2020 inspection required coring a 6-inch diameter hole through a cell cover so a wider vault area could be inspected using a larger camera. The location of the cored hole is shown in Figure 2.1-1.

November 1, 2018

In November 2018, the FDB-5 vault interior was inspected using a small "lipstick" camera. The larger, full-size inspection camera normally used could not be inserted into the vault because the area below the access riser was partially blocked by the sump drain plug actuating rod. [V-18-0791] During the inspection, no solids were seen on the vault floor or in the sump within the limited viewing area (Figure 2.4-1). White staining on the vault walls appeared to be associated with rainwater intrusion around the edges of the cell covers prior to the rain cover installation.

Figure 2.4-1: View Looking Down at the FDB-5 Sump (November 2018)



February 5, 2020 Inspection

In February 2020, a 6-inch diameter hole was cored through the cell cover approximately 32 inches southeast of the access riser (Figure 2.1-1) and the vault interior was inspected. This second inspection confirmed the jumper and wall nozzle status and that there was no obvious solid waste on the cell walls and floor (Figures 2.4-2 through 2.4-4). [V-20-0140] During the inspection and smear sampling of the floor, the sump screen became dislodged and came to rest across the sump (Figure 2.4-4).

Radiation monitoring using portable, direct reading, ion chamber survey instruments during the coring and inspection, measured a 1 mrem/hr extremity dose and no skin, or whole-body dose over the open core hole. [TKFM-M-20200205-28]

Figure 2.4-2: Views of the FDB-5 Vault Interior

Figure 2.4-3: Close-up View of FDB-5 Northwest floor Area (February 5, 2020)

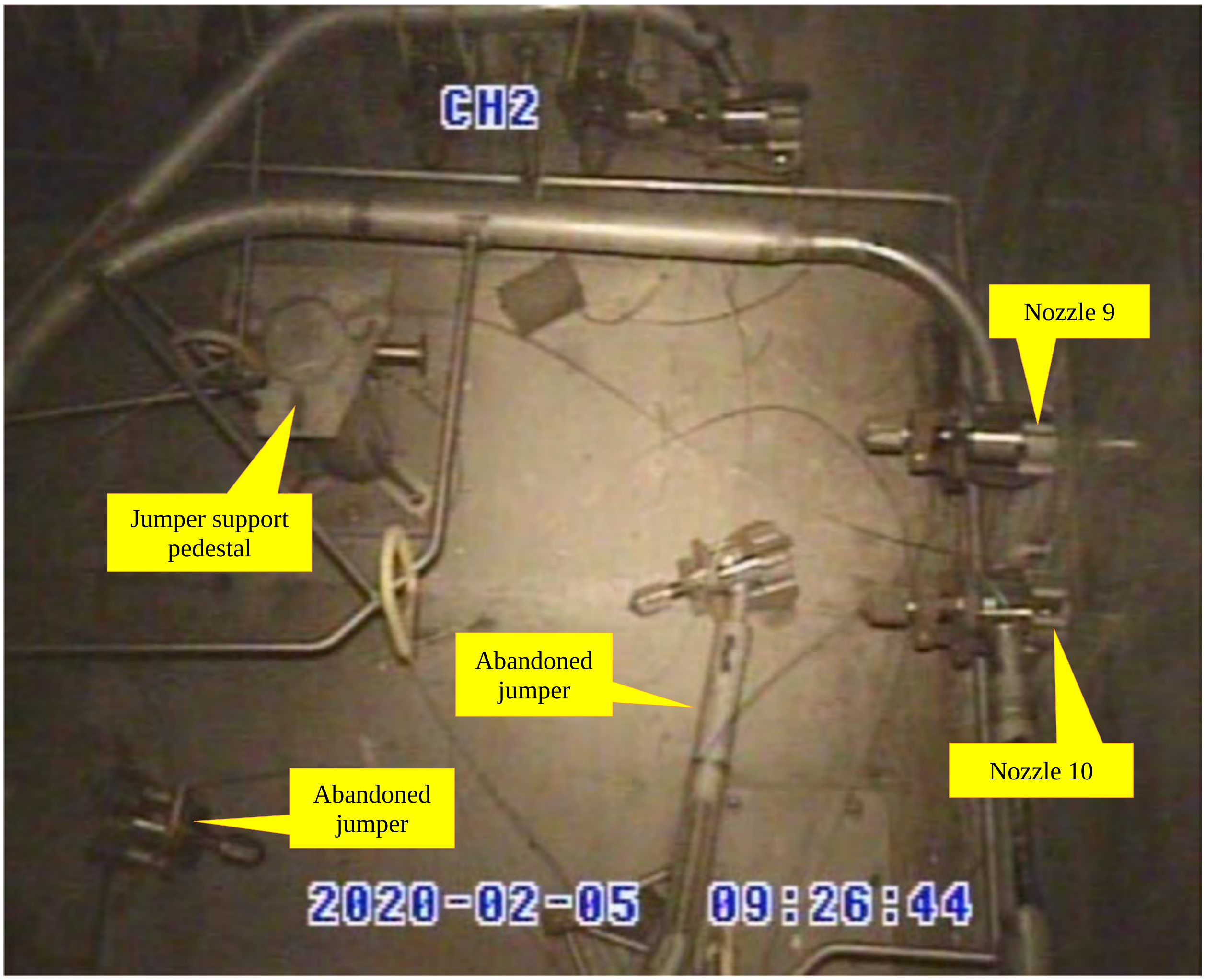
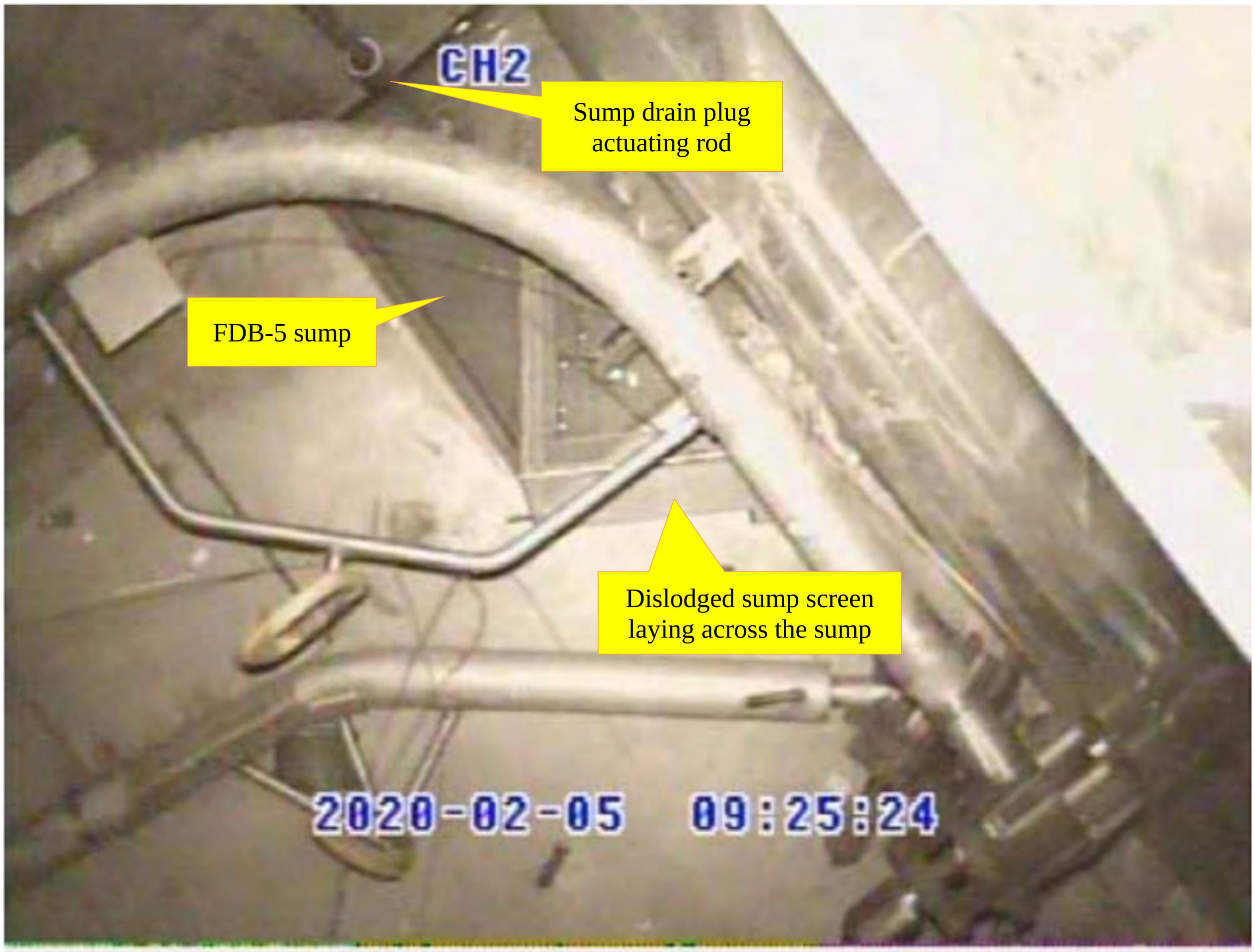


Figure 2.4-4: Close-up View of FDB-5 Sump Area (February 5, 2020)



2.5 FDB-6 Design and Construction

Figures 2.5-1 through 2.5-3 show a plan view, cross-sections, and various design features of FDB-6. The DB is a rectangular concrete structure 15-feet long, 11-feet wide, and 18-feet high (inside dimensions) with the long axis oriented east-west. It has walls 2.5-feet thick and a base slab approximately 4.7-feet thick. The vault floor is approximately 16.6 feet below grade. The vault extends approximately 4 feet above grade and has five, 3-foot thick interlocking concrete cell covers oriented north-south (Figure 2.5-3). The interior vault walls and floor are lined with welded stainless-steel sheets. The wall sheets are approximately 0.125-inches thick. The exterior vault walls were coated with a damp-proofing compound during construction. [W702275] A north-to-south sloping sheet metal rain cover has been placed over the vault top. An east-west series of supporting I-beams on the underside of the cover create a gap between the top of the cell covers and underside of the rain cover. The gap decreases in height from approximately 10 inches on the north side to 5.5 inches on the south side. The rain cover has four individual sealable cases covering the four, 5-inch I.D. Schedule 40 pipe risers penetrating the concrete cell covers (Figures 2.5-1 and 2.5-4).

The vault has a stainless-steel lined sump in the southwest corner of the floor that is 3-feet long, 2-feet wide, and 1.6-feet deep. The stainless-steel sheets lining the vault floor and sump are 0.375-inches thick. The vault floor slopes towards a gutter along the west wall that drains to the sump. [W702275] A low, stainless-steel screen is present on the north and east sides of the sump and in the gutter notch (Figure 2.5-1).

The sump can be gravity drained to FPP-3. Sump drainage is controlled by a plug on the end of a fixed rod actuated through the 5-inch riser in the southwest corner of the western cell cover. A sump overflow line exits the west vault wall at an elevation just below the top of the sump screen. A clean-out drain line enters the vault via the Nozzle 5 jacket and exits the vault through an opening sealed in the south vault wall approximately 3 feet above the sump bottom and joins the sump drain line going to FPP-3 (Figure 2.5-1).

A system of underliner leak detection slots was formed into the concrete floor surface underneath the stainless-steel vault floor liner. The underliner leak detection system drains to an LDB outside the southwest corner of the vault (Figure 2.5-1).

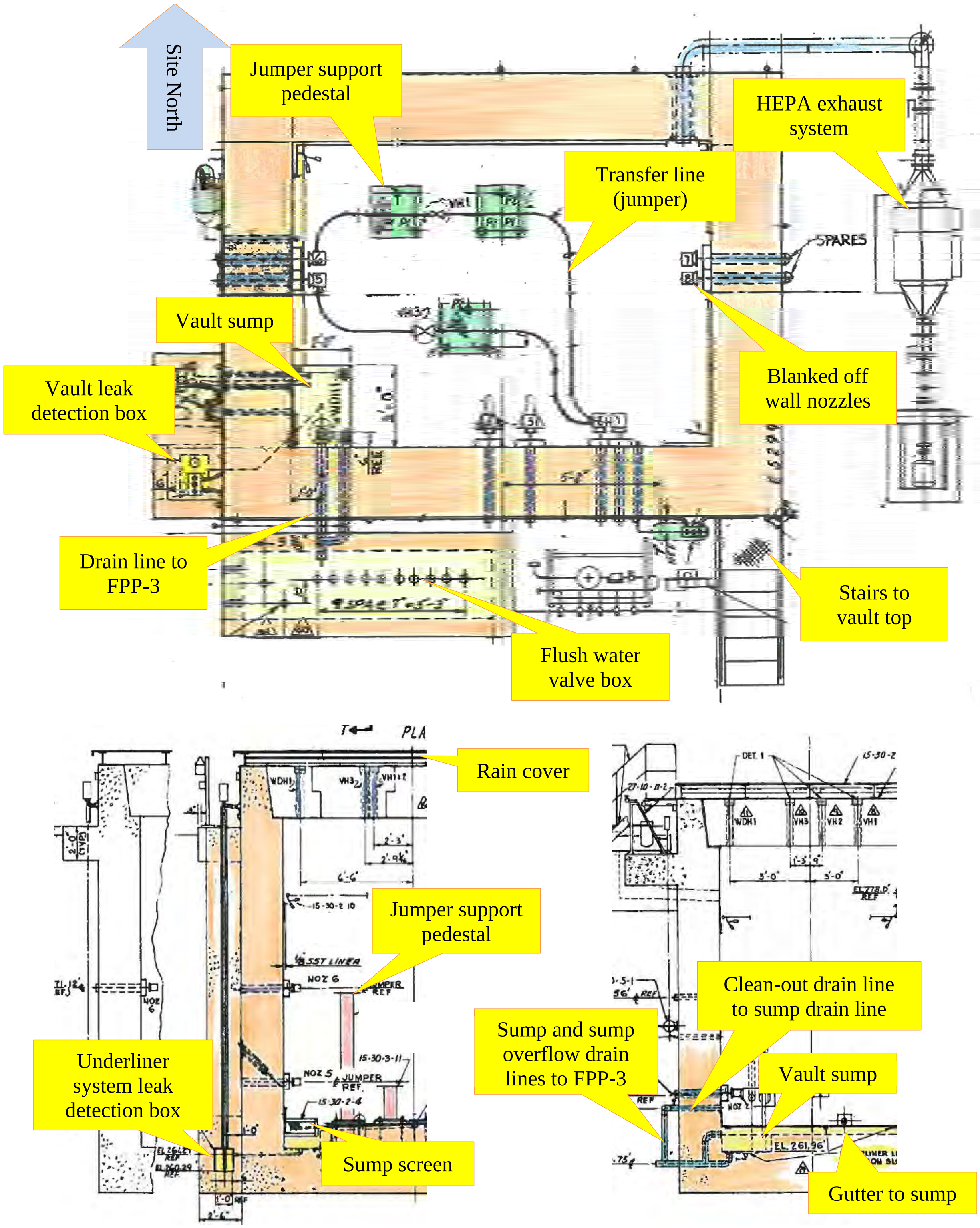
There is a flush water valve box at grade on the southwest vault corner. The wall nozzles in FDB-6 have a special inlet for water addition that allowed the transfer lines used to be flushed following a waste transfer. One valve could also activate a spray water nozzle system to rinse the diversion box interior if needed. The valve box is 9-feet long, 2.5-feet wide, and 2.9-feet high (inside dimensions) and has a 1-foot-thick concrete cover, but no rain cover. The flush water piping enters the vault through a 6-foot wide and 8-inch high open slot in the south vault wall approximately 12 feet above the vault floor (Figure 2.5-2). [W702358]

A set of metal stairs on the southeast corner of FDB-6 provides access to the top of the vault. FDB-6 has a HEPA ventilation system at grade on the east side of the vault (Figure 2.5-1).

There are eight wall nozzles in FDB-6. The west, south, and east vault walls each contain wall-mounted nozzles for waste transfer line (jumper) connections. The south wall has four nozzles while the west and east walls each have two nozzles (Figure 2.5-1). Spare wall Nozzles 7 and 8, that were installed for future transfer line connections, are blanked off using dummy Hanford connectors. Several metal "pedestals" on the vault floor support the installed jumpers. There are two abandoned jumpers on the vault floor.

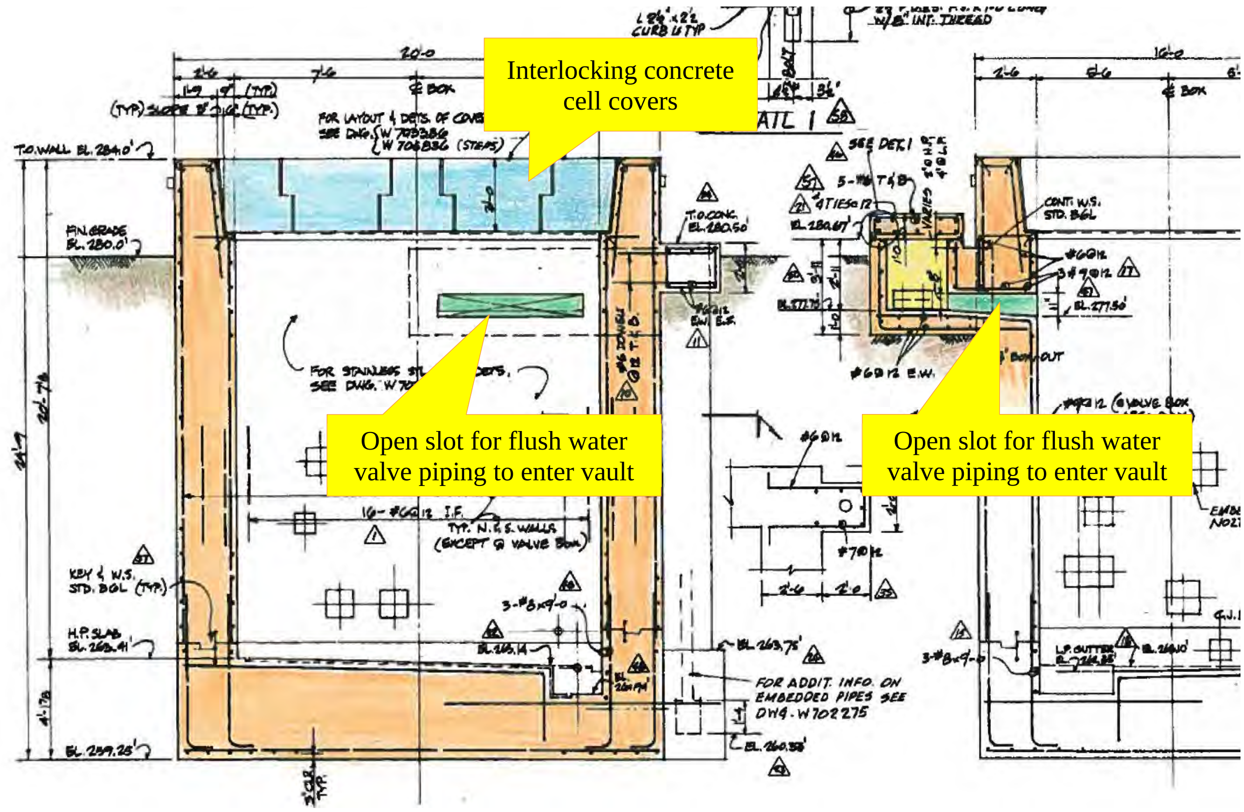
Figure 2.5-4 is a photograph of FDB-6 showing the flush water valve box, sealable cases covering the vault access risers, HEPA system, and stairs to the vault top. Figure 2.5-5 is a close-up of the FDB-6 vault top.

Figure 2.5-1: Plan View of FDB-6 and Cross-Sections of the Vault Sump and Underliner Drain System



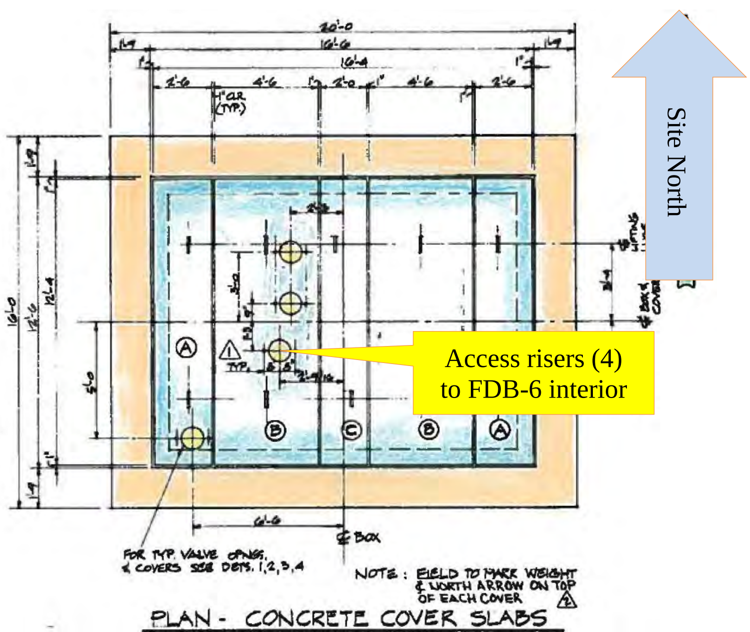
[W702275]

Figure 2.5-2: Cross-Section of FDB-6 Showing the Flush Water Valve Box Detail



[W703384]

Figure 2.5-3: Plan View of the FDB-6 Cell Cover Slabs and Vault Access Risers



[W703386]

Figure 2.5-4: Aerial View of FDB-6 Showing Rain Cover, Cases Covering Vault Access Risers, Stairs to Vault Top, and HEPA System. View to West.

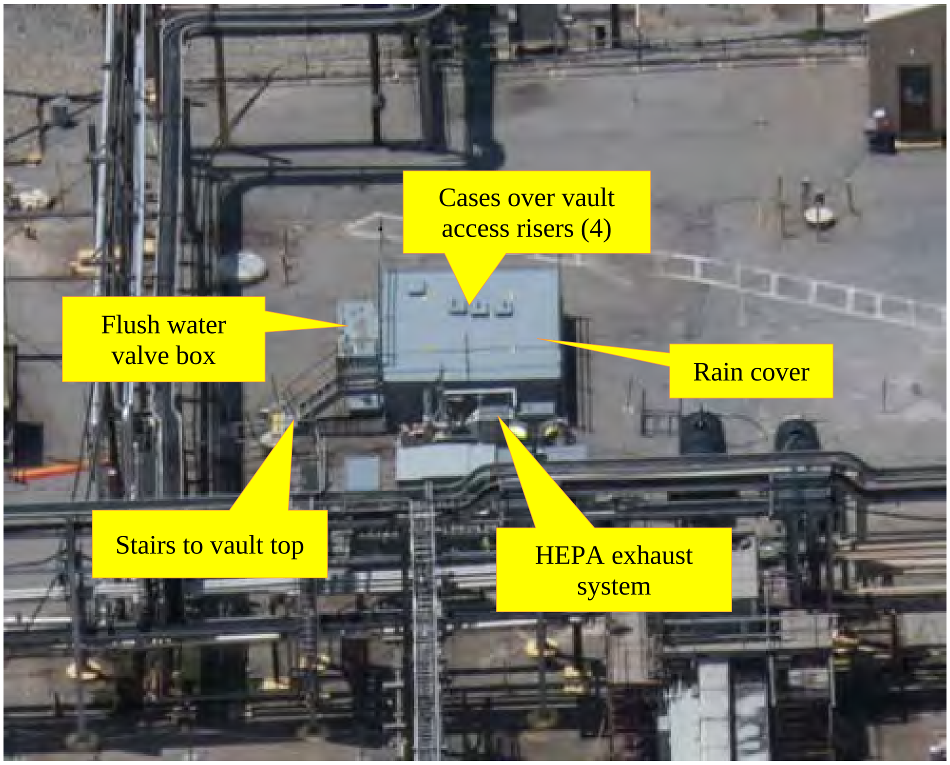
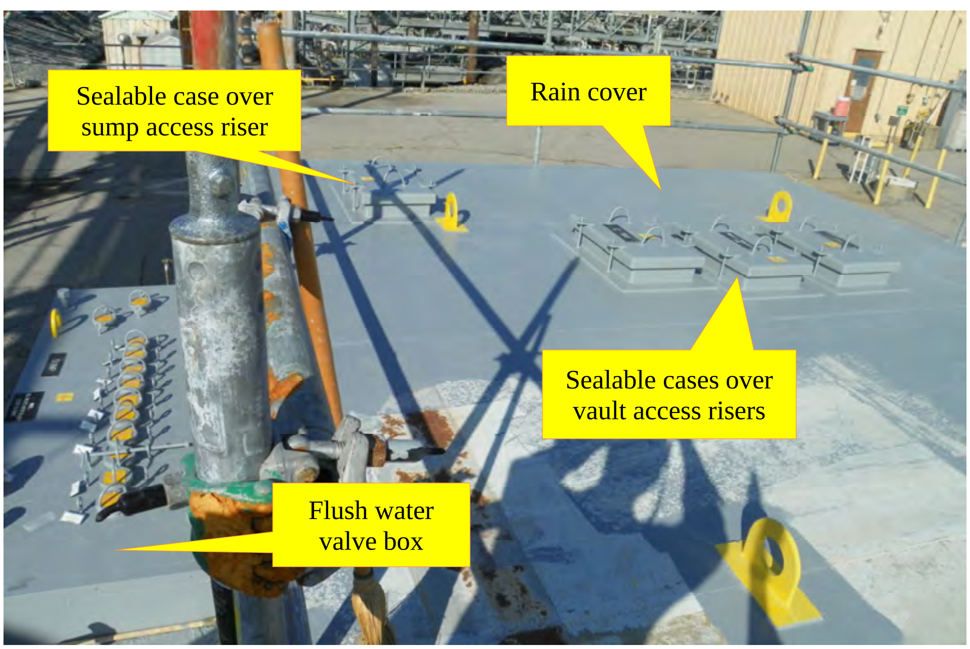


Figure 2.5-5: Close-up View of the FDB-6 Vault Top, Cases Covering Vault Access Risers and Flush Water Valve Box. View to West.



2.6 FDB-6 Vault Piping

There are numerous piping penetrations through the FDB-6 vault walls. Eight are for the waste system transfer lines while the others are for drainage, leak monitoring, instrument air supply, and vault ventilation.

Figure 2.6-1 is a schematic of the FDB-6 internal waste transfer piping. The eight waste transfer lines are all 3-inch I.D., Schedule 40 stainless-steel. All waste transfer lines are inside 4-inch secondary containment jackets that drain to leak detection boxes. The current line status is summarized in Table 2.6-1. Additional lines and their purpose are summarized in Table 2.6-2.

There are four access ports through the cell covers that have removable lead plugs (Figures 2.5-3 and 2.5-4).

Figure 2.6-1: FDB-6 Transfer Piping System Diagram

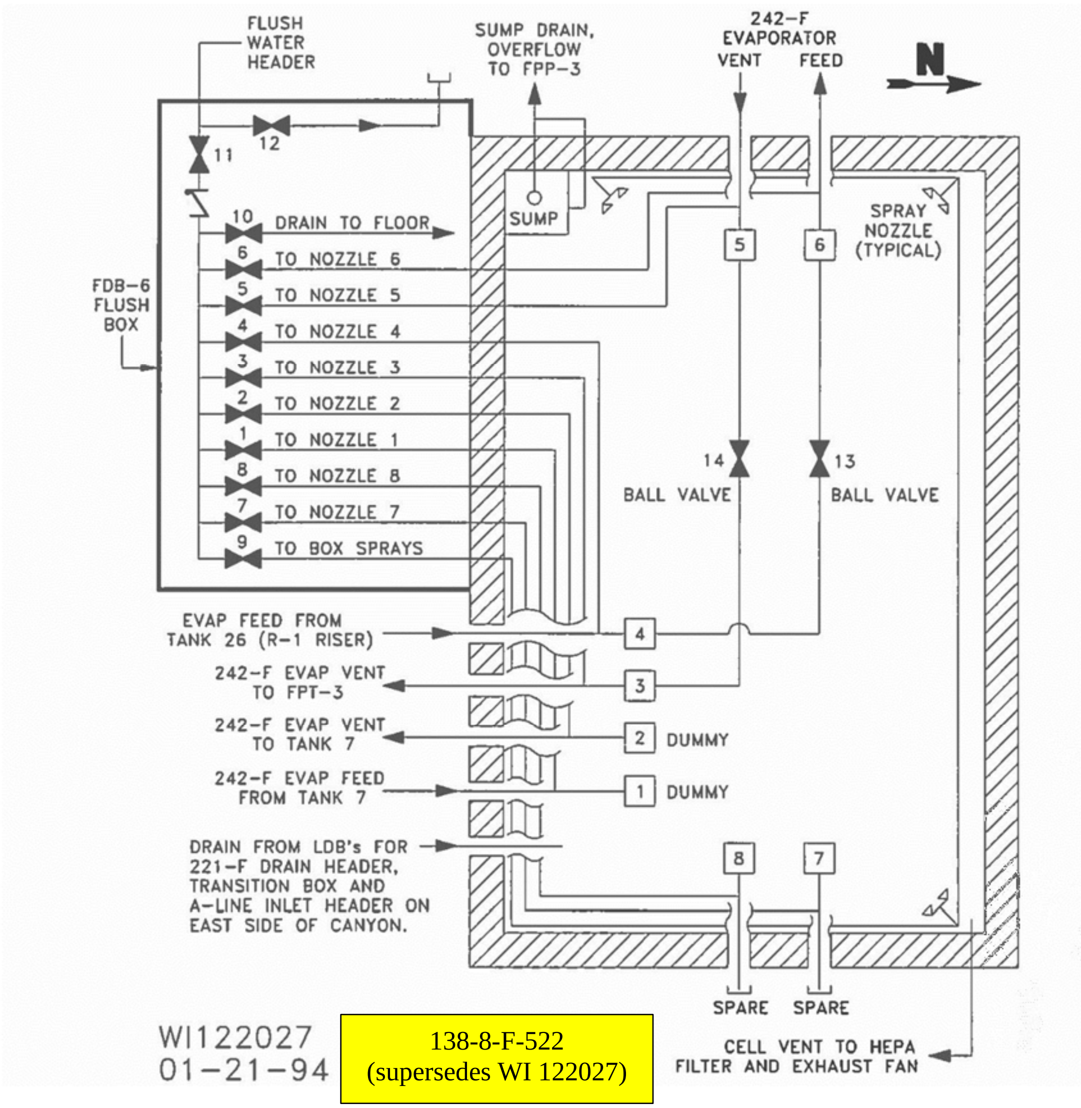


Table 2.6-1: Current Status of FDB-6 Waste Transfer Piping System

Nozzle Number	Purpose	Nozzle Status in FDB-6	Transfer Line Termination Status
1	Evaporator feed from Tank 7F, Riser 1	Dummy Hanford Connector	Tank 7F Riser 1
2	242-1F Evaporator vent line to Tank 7F	Dummy Hanford Connector	Tank 7F wall penetration
3	242-1F Evaporator vent line to FPT-3	Jumpered to Nozzle 5	Connected to FPP-3, Nozzle 3
4	Evaporator feed from Tank 26F	Jumpered to Nozzle 6	Tank 26F Riser 1
5	242-1F Evaporator vent line	Jumpered to Nozzle 3	Capped in 242-1F Evaporator cell
6	Feed to 242-1F Evaporator	Jumpered to Nozzle 4	Capped in 242-1F Evaporator cell
7	Spare	Dummy Hanford connector	Capped at FDB-6
8	Spare	Dummy Hanford connector	Capped at FDB-6

[after M-M6-F-3357]

Table 2.6-2: Additional FDB-6 Vault Piping System Lines

Pipe Size (I.D. Inches)	Purpose
6	Ventilation Duct
1	From LDB-1
1	From LDB-2
1	Clean-out drain line to sump drain line
4	Sump drain system to FPP-3
1	Sump overflow line
1	Instrument air (3 lines)
1	Drain from LDBs at 221-1F header, transition box, and A-Line inlet header at F-Canyon
0.75	Flush water supply lines

[after M-M6-F-3357]

2.7 FDB-6 Operational History

FDB-6 was constructed in the mid-to-late 1970s to transfer feed material to the 242-1F Evaporator from Tanks 26F and 7F. The transfers through FDB-6 were only supernate (evaporator feed). No “fresh canyon waste” or “sludge slurry” were sent through FDB-6. FDB-6 usage stopped when the 242-1F evaporator went out of service in 1988.

Cracking of the asphalt surrounding FDB-6 along with a process air line failure indicated poor soil compaction around the FDB-6 vault that was confirmed by testing. From September 15 to October 17, 1981, the soil surrounding FDB-6 was excavated and then returned with controlled compaction. [DPSP 81-21-10]

FDB-6 is currently inactive.

2.7.1 FDB-6 Leakage and Decontamination History

In March 1979, after hydrotesting of the feed line from FDB-6 to the 242-1F Evaporator, contaminated water (1,236 d/m/ml beta-gamma) was found in the FDB-6 sump. Smearable contamination on the walls was <500 d/m alpha and <1,000 c/m beta-gamma. The source appeared to be leakage from a dummy Hanford connector inside the vault. Decontamination of the vault reduced the transferable contamination to <10 c/m beta-gamma. [DPSP 79-21-3] The installed FDB-6 leak detection system performed as designed and there was no indication by the system of any liquid getting beyond the stainless-steel liner. Therefore, there would have been no reason to believe any material reached the surrounding soil.

In December 1979, 10 inches of water were drained from the FDB-6 sump. Samples measured <4,000 d/m/ml, and the source was suspected to be rainwater. The sump level was monitored to determine if water level increases correlated with tank farm conditions and activities. [DPSP 79-21-12]

No other leakage events inside FDB-6 have been reported. [SRR-CWDA-2018-00059] However, as described below, a small amount of unknown material was observed on the vault floor by Nozzle 3 during the July 13, 2018, camera inspection.

2.8 FDB-6 Inspections

Three video camera inspections have been performed on FDB-6. The most thorough inspection occurred on July 13, 2018. The second inspection, on August 31, 2019, focused on the valve box to verify that the opening for the flush water piping into FDB-6 was an open slot. The third inspection, on December 7, 2019, was to confirm that Nozzles 7 and 8 were sealed with dummy Hanford connectors.

July 13, 2018 Inspection

A video camera was inserted through the most northerly riser on the vault top. This inspection focused on the vault walls, floor area, and sump. Figure 2.8-1 shows various views of the FDB-6 interior.

The floor appears to be free of residual material except for two areas where anomalous material was found. Figure 2.8-2 shows the sump area with a small globule of shiny, black material near the southeast edge of the sump screen. The physical appearance of the material suggests that it might possibly be a glue-like material or mastic used to attach a gasket sealing the perimeter space between the vault and the cell covers and on the horizontal, interlocking surfaces running the length of the cell covers. It does not appear to be residual sludge material. [V-18-0439] The appearance is also not consistent with the waste (i.e., supernate) transferred through the diversion box. [U-ESR-F-00092]

A small deposit of material resembling crystallized salt (supernate) was seen on the vault floor near Nozzle 3 (Figure 2.8-3). It is most likely from a leak at Nozzle 4. [U-ESR-F-00092]

Figures 2.8-4 and 2.8-5 show an object laying beneath a Hanford connector on a disconnected jumper in the northern region of the vault. A close-up shows it resembles a degraded piece of plastic, most likely a "Rad bag" fragment (plastic bag used to hold potentially contaminated equipment).

The July 2018 survey also confirmed two discarded jumpers on the vault floor. [V-18-0439]

No additional residual material was seen on the vault walls, floor, or sump during the July 2018 inspection.

<u>*August 31, 2019 Inspection*</u>

A video camera was inserted into the flush water valve box. This inspection confirmed that the opening for the flush water piping to enter the vault was not blocked or sealed off. [V-19-0946]

<u>*December 7, 2019 Inspection*</u>

A video camera was inserted into the diversion box through the riser used for the July 2018 inspection. This inspection confirmed that Nozzles 7 and 8 were capped with dummy Hanford connectors. [V-19-1125]

Figure 2.8-1: Views of the FDB-6 Vault Interior

Figure 2.8-2: View of the FDB-6 Vault Southwest Corner and Sump (July 2018)

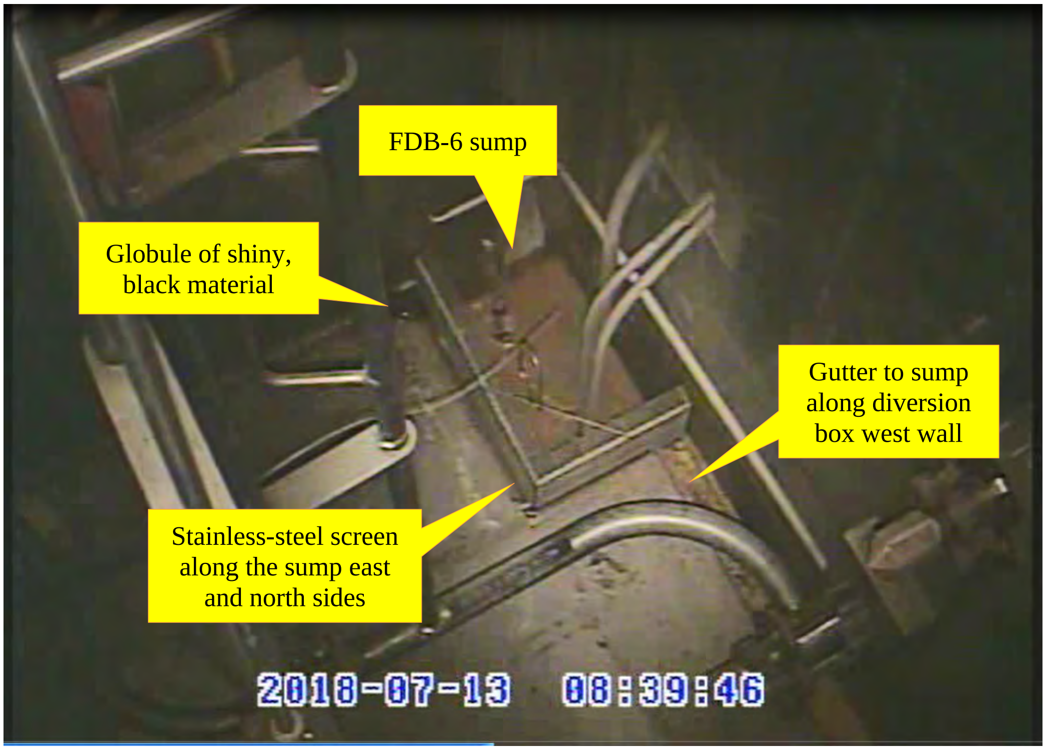


Figure 2.8-3: The Material (Salt) Deposit below Nozzle 4 in the Southeast Vault Region (July 2018)

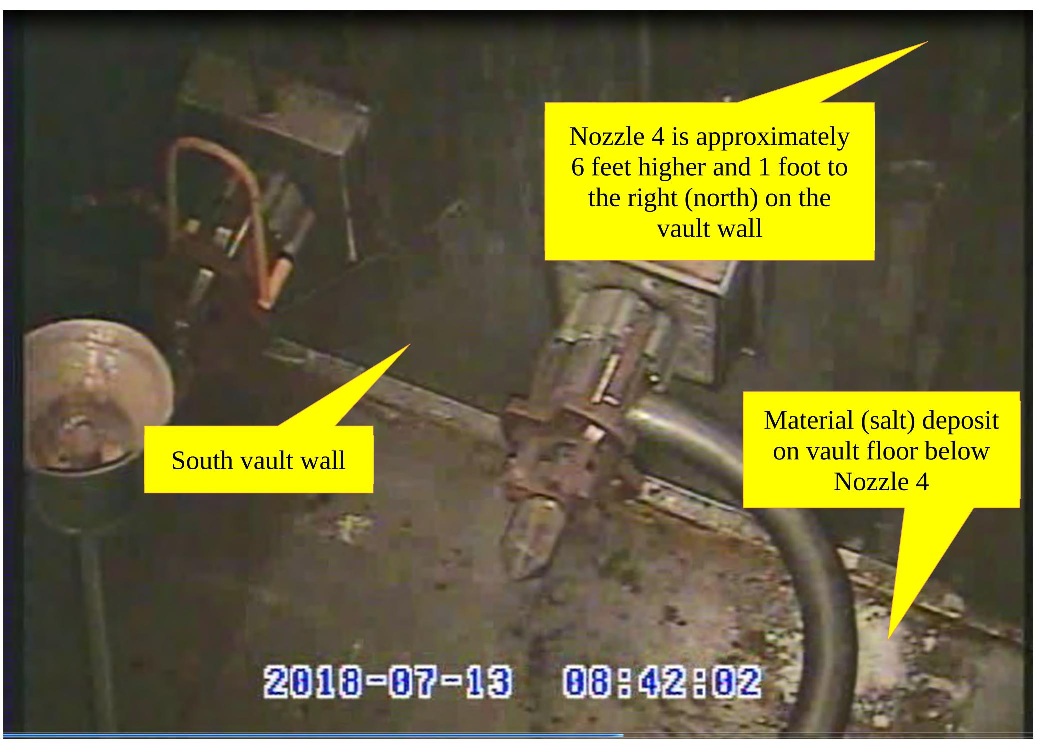


Figure 2.8-4: View of FDB-6 North Region Floor Showing Discarded Plastic beneath a Disconnected Hanford Connector (July 2018)

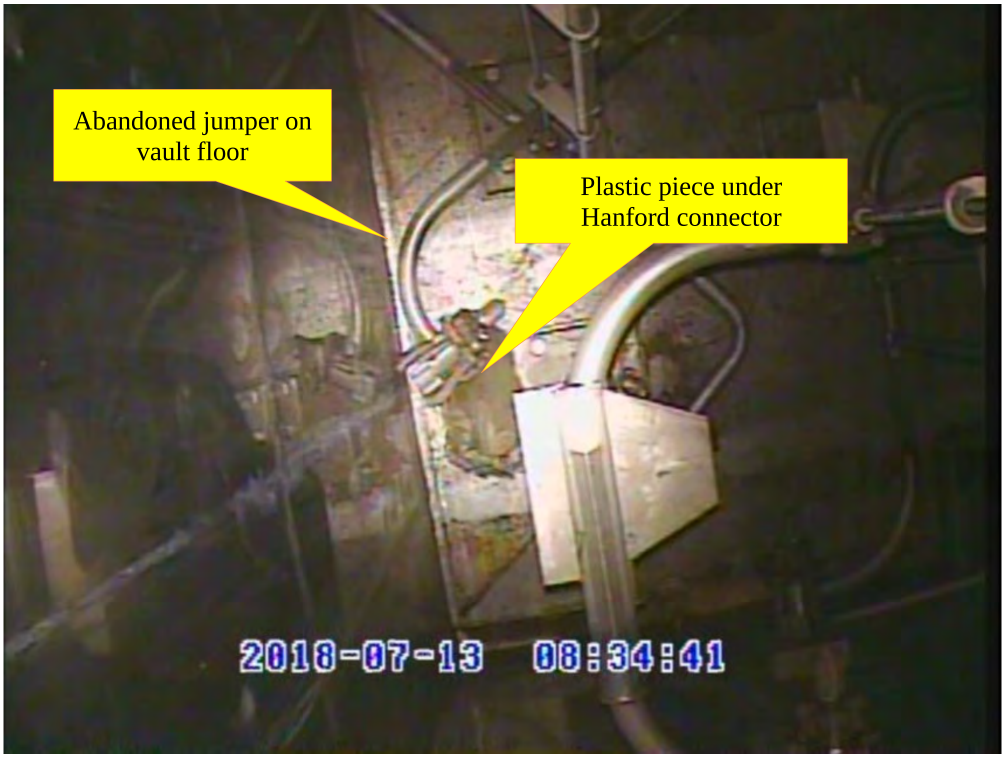
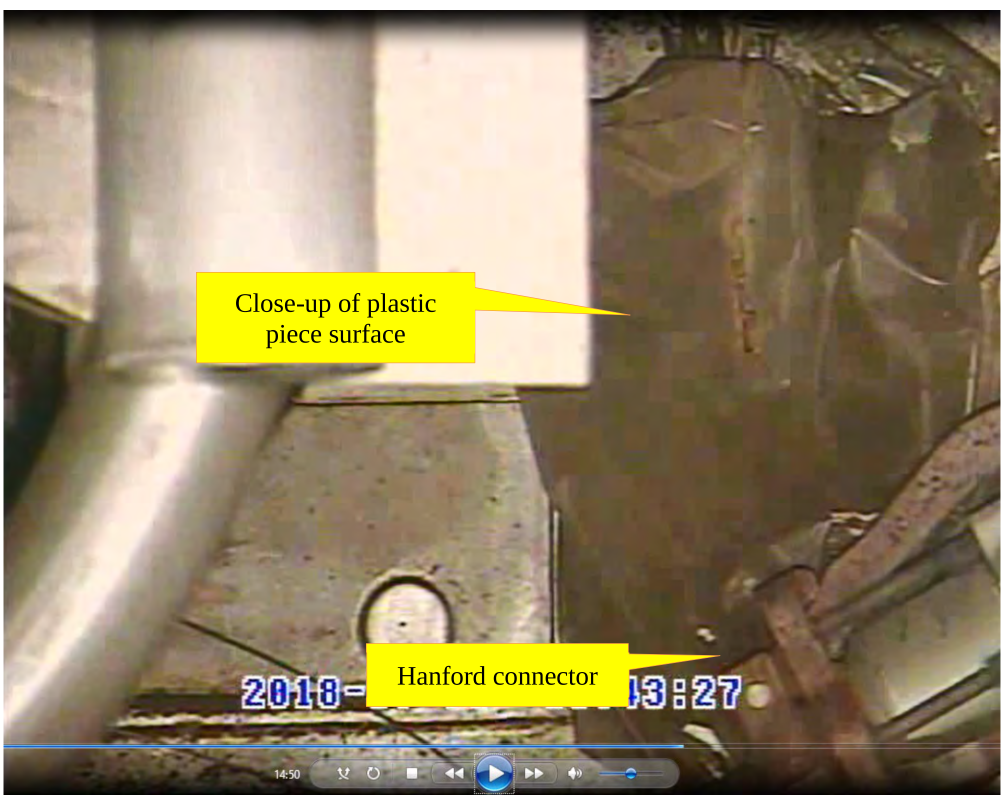


Figure 2.8-5: Close-up of Plastic Piece on FDB-6 Vault Floor (July 2018)



3.0 FDB-5 AND FDB-6 WASTE REMOVAL

As shown by the individual camera inspections, with the exception of a potential small salt deposit in FDB-6, there are no accumulated solids in either FDB-5 or FDB-6.

Because the FDB-5 transfer lines were typically flushed several times with clean water after each transfer, only minimal, if any, waste might be present inside the jumpers. [SRR-CWDA-2020-00029] The only residual material possibly inside the FDB-5 vault would have resulted from jumper cleaning. Because the waste was highly-soluble salt, and the vault was washed down after jumper cleanings, only minimal residual material might remain on the interior vault surfaces, and inside the sump drain line piping.

Because the FDB-6 transfer lines were also typically flushed several times with clean water after each transfer, only minimal, if any, waste might be present inside the jumpers. The only residual materials inside the FDB-6 vault is the minimal residual material remaining on the interior vault surfaces, inside the sump drain line piping, and the small deposit below Nozzle 4.

3.1 FDB-5 Waste Removal

Aside from the jumper cleanings, FDB-5 has had no known waste leakage or spillage events. [SRR-CWDA-2018-00059]

The waste generated during the jumper flushings and vault wash down activities, and any subsequent wall and floor washing, was drained to FPP-2 via the sump. No additional vault cleaning has been performed since FDB-5 use was discontinued in September 1985.

3.2 FDB-6 Waste Removal

Following the March 1979 detection of contaminated water in FDB-6, the vault was decontaminated. [DPSP 79-21-3] The report does not mention the decontamination method used, but the waste water was probably drained via the sump to FPP-3. Similarly, the water detected in December 1979 was also drained via the sump to FPP-3. [DPSP 79-21-12] No other waste leakage or water intrusion records or reports have been located.

No additional vault cleaning has been performed since FDB-6 use was discontinued in 1988.

As explained in Section 6.0, there are no plans to remove the globule of material by the sump or the small material deposit on the vault floor below Nozzle 4.

3.3 Residual Material Volume Estimate

Camera inspections of the two DBs are summarized in Section 2.0. The FDB-5 inspection determined there was no visible residual material inside the vault. [U-ESR-F-00094] Trained personnel from SRR Engineering performed a volume determination using the processes described in *Tank Mapping Methodology* (SRR-LWE-2010-00240) for the small deposit of material on the vault floor below Nozzle 4 and estimated it had a volume of 0.3 gallons (with an uncertainty range of 0.1 to 0.6 gallons). [U-ESR-F-00092]

3.4 Basis to Proceed to Sampling and Analysis Phase in FDB-5 and FDB-6

As described in the FDB-5 and FDB-6 Sample Location Determination Reports (SLDRs), except for the approximately 0.3 gallons of what is assumed to be crystallized salt in FDB-6, no other waste was observed in either DB. [SRR-CWDA-2020-00024, SRR-CWDA-2020-00033] Any potentially remaining residual materials on the interior vault and jumper surfaces that have contacted waste, would be extremely difficult to remove or sample and would not justify a characterization effort and cost. Any anticipated SA and PA modeling impacts can be addressed without sampling by assigning a conservative and bounding inventory to the DBs as explained in the *Inventory Assignment at Closure for FDB-5 and FDB-6* (SRR-CWDA-2020-00029).

On July 13, 2020, Savannah River Remediation (SRR) presented the *Proposal to Cease Waste Removal Activities in F-Area Diversion Boxes 5 and 6* (SRR-CWDA-2020-00059) to DOE, SCDHEC, and EPA. The proposal focused on the inspections and visual evidence showing there is no significant amount of residual material remaining inside either FDB-5 or FDB-6.

SRR also proposed developing assigned radiological and chemical constituent inventories for FDB-5 and FDB-6 as allowed by the *Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems* (SRR-CWDA-2017-00015). The assigned inventories would then be used in the SA and other modeling efforts.

3.5 Agreement to Proceed to Sampling and Analysis Phase

Following the cease waste removal presentation, DOE sent the formal *Request for Concurrence to Proceed to Sample and Analysis Phase of the Closure Process for F-Area Diversion Boxes (FDB) 5 and 6 (SEMS Number: 23)* to SCDHEC and EPA. [WDPD-20-37] In response, SCDHEC and EPA sent concurrence letters approving the request to enter the sampling and analysis phase of the closure process for FDB-5 and FDB-6. [SRR-OS-2020-00309, SRR-OS-2020-00331]

4.0 RESIDUAL MATERIAL CHARACTERIZATION

The FTF PA did not assign a residual material inventory to either FDB-5 or FDB-6 because neither DB served as a primary waste containment structure. The PA also assumed the DBs contained a negligible inventory relative to other nearby significant inventory sources such as the waste tanks. [SRS-REG-2007-00002]

Because of their operating and leakage history, residual materials inside FDB-5 and FDB-6 could be present as a visible deposit and as a residue on the jumper interiors and vault interior surfaces such as the floor, sump, and walls. The surface residues, and any visible residual materials, would be the contributors to the total DB inventory.

The *Liquid Waste Tank Residuals Sampling and Analysis Program Plan* (LWTRSAPP) (SRR-CWDA-2011-00050) commits to characterizing residual materials remaining in a waste tank or ancillary structure being removed from service. However, as allowed in some instances by the LWTRSAPP and CGCP, and in consultation with the regulatory authorities, alternative actions, such as using process knowledge, can be used to determine an inventory for a waste tank or ancillary structure. [SRR-CWDA-2011-00050, SRR-CWDA-2017-00015]

4.1 FDB-5 and FDB-6 Inventory Determination Methodology

Details for the inventory assignment approach used for these DBs are presented in the *Inventory Assignment at Closure for FDB-5 and FDB-6* (SRR-CWDA-2020-00029). The approach used the same general methodology as the FTF PA to estimate the residual material inventory in the FTF transfer piping system. [SRR-REG-2020-00029, SRS-REG-2007-00002]

The FTF PA methodology assumed the transfer line internal surface contains residual material in three forms:

- Diffused into the metal,
- An oxide film coating, and
- Residue film remaining after a transfer and flush. [CBU-PIT-2005-00120]

The residual inventory was determined analytically and is considered to be reasonably bounding by assuming that residual material inside the jumpers accumulated in the same manner as residual material accumulated in the FTF transfer lines. While not directly analogous, the approach would also include (bound) the small globule of shiny black material, and the small deposit of material seen near Nozzle 3 on the FDB-6 floor during the visual inspection by assuming the vault floor and sump floor have the same residue. The approach would also ignore the inventory accumulated via diffusion into the metal or oxide film formed on steel surfaces since they are <1% compared to the residual inventory in the film remaining after flushing. [SRR-CWDA-2020-00029]

The FTF PA (Section 3.3) determined the surface concentrations (in curies and kilograms per square foot) for each of these three contributors based on representative dry sludge waste concentrations. Greater than 99% of the transfer line inventory contribution came from the residue film remaining after flushing. [SRS-REG-2007-00002]

The representative dry sludge concentration was determined by reviewing the waste transfers within FTF and between FTF and HTF using tank-specific transfer information and applying a weighted average to each contaminant in the individual FTF waste tanks. Each tank's dry sludge concentrations were used in this determination. The final waste tank inventory values were based on data from the Waste Characterization System (WCS). WCS is an electronic information system that tracks waste tank data, including projected radionuclide and chemical inventories, based on sample analyses, process histories, composition studies, and theoretical relationships. [B-UG-H-00058]

The chemical and radionuclide Constituents of Concern (COCs) used for the inventory determination and in the SA were the same ones used in the FTF PA for ancillary equipment inventory estimation. [SRS-REG-2007-00002]

4.1.1 Inventory Calculation

Camera inspections confirmed that the vault and sump walls are clean, and except for the small material deposit in FDB-6, there are no visible material accumulations on the floor. Since the waste was highly soluble salt, after flushing there would only be minimal material possibly remaining on the vault floor, sump floor, and sump drain piping. Therefore, the vault and sump walls contribution to the inventory are assumed to be insignificant.

The total radiological and chemical inventory assigned to each diversion box was determined by multiplying the FTF PA calculated transfer line residue concentrations by the total affected diversion box surface area. A 4-inch I.D. transfer line surface concentration was chosen as the most conservative for the surface area calculation. Because the FTF transfer lines are predominantly 2-inch I.D., the use of a 4-inch I.D. line surface concentration increases the inventory. [SRR-CWDA-2020-00029] The affected area calculated used the internal surface area of the four transfer lines in each diversion box (two attached and two abandoned on the floor) and the diversion box floor area (neglecting the vault, sump, and gutter walls). The four jumpers in FDB-5 total 60.4 linear feet of pipe. The four jumpers in FDB-6 total 75 linear feet of pipe.

The formulas used for the concentration calculations are:

<u>*Radionuclides*</u>

Concentration (Ci) = (Affected surface area in ft^2) x (Isotope concentration in Ci/ft^2)

<u>*Chemicals*</u>

Concentration (kg) = (Affected surface area in ft^2) x (Chemical concentration in kg/ft^2)

The total affected surface area for FDB-5 is 182 ft^2 and for FDB-6 is 209 ft^2.

[SRS-CWDA-2020-00029]

4.1.2 Dry Sludge Concentrations Used for Inventory Calculation

The weighted "dry sludge" radionuclide and chemical constituent concentrations used for the FDB-5 and FDB-6 inventory calculation are presented in *Inventory Assignment at Closure for FDB-5 and FDB-6* (SRR-CWDA-2020-00029).

As previously discussed, no "fresh canyon waste" or "sludge slurry" were sent through either FDB-5 or FDB-6. Therefore, using the dry sludge concentrations provides a conservative representation of the actinides and long-lived isotopes that are important to the FTF PA. The short-lived isotopes that are more concentrated in supernate than sludge will decay quicker and would not be significant dose contributors for the long-term impacts hundreds to thousands of years in the future.

In addition, the concentrations are decayed only to September 30, 2020, consistent with the FTF closure date assumed in the FTF PA. The date of FTF closure will be later causing some of the radionuclides of interest (e.g., Cs-137, Sr-90) to be overrepresented in the FDB-5 and FDB-6 inventory because additional decay between 2020 and the date of actual FTF closure is not accounted for.

The conservative nature of this inventory approach is also indicated by the fact that the assigned inventory for FDB-5 contains significantly more radioactivity than would be indicated by the two surveys of FDB-5 performed in 2020. The maximum radioactivity detected during the two surveys correlated to 5.0E-04 Ci/ft^2 beta-gamma and 2.5E-08 Ci/ft^2 alpha. For comparison, the FDB-5 inventory assignment based on the transfer line concentrations calculated in the FTF PA (Table 3.3-11) had 4.07E-02 Ci/ft^2 for Sr-90 (the primary beta-gamma source) and 2.38E-04 Ci/ft^2 for Pu-238 (the primary alpha source). [SRS-REG-2007-00002] The survey readings would be much higher if the assigned inventory were actually present.

4.2 FDB-5 Assigned Inventory

As mentioned earlier, the *F Area Diversion Box #5 Final Volume Determination and Uncertainty Estimate* (U-ESR-F-00094) determined there were no residual materials visible inside FDB-5.

The methodology used to calculate the FDB-5 inventory is presented in Section 4.1. The final FDB-5 assigned inventory is presented in Tables 4.2-1 and 4.2-2.

Table 4.2-1: FDB-5 Assigned Radionuclide Inventory (Decayed to September 30, 2020)

Radionuclide	Inventory (Ci)	Radionuclide	Inventory (Ci)	Radionuclide	Inventory (Ci)
Ac-227	1.81E-10	Eu-152	1.57E-03	Rh-106	3.51E-08
Al-26	1.76E-06	Eu-154	1.71E-02	Ru-106	3.51E-08
Am-241	1.38E-01	Eu-155	1.52E-02	Sb-125	9.66E-04
Am-242m	1.98E-04	H-3	1.93E-04	Sb-126	5.28E-05
Am-243	2.26E-05	I-129	1.68E-08	Sb-126m	3.77E-04
Ba-137m	1.29E+00	Na-22	2.77E-06	Se-79	2.00E-04
Bk-249	5.21E-31	Nb-94	8.92E-06	Sm-151	5.84E-01
C-14	1.01E-05	Ni-59	3.97E-04	Sn-126	3.77E-04
Ce-144	4.51E-10	Ni-63	3.29E-02	Sr-90	7.41E+00
Cf-249	1.91E-22	Np-237	1.87E-05	Tc-99	3.55E-03
Cm-242	5.70E-22	Pa-231	7.39E-09	Te-125m	2.37E-04
Cm-243	3.33E-06	Pm-147	1.48E-02	Th-229	1.19E-05
Cm-244	6.39E-03	Pr-144	4.51E-10	Th-230	3.39E-05
Cm-245	8.19E-08	Pu-238	4.33E-02	U-232	1.76E-07
Cm-247	3.06E-20	Pu-239	1.70E-02	U-233	8.81E-05
Cm-248	7.04E-21	Pu-240	6.26E-03	U-234	5.66E-05
Co-60	5.51E-03	Pu-241	2.95E-02	U-235	6.70E-07
Cs-134	3.06E-06	Pu-242	5.15E-05	U-236	1.08E-06
Cs-135	3.88E-06	Pu-244	2.42E-08	U-238	3.31E-05
Cs-137	1.38E+00	Ra-226	3.40E-05	Y-90	7.41E+00

[SRS-CWDA-2020-00029]

Table 4.2-2: FDB-5 Assigned Chemical Inventory

Chemical	Concentration (kg)	Concentration (g)
Ag	1.93E-03	1.93
As	6.52E-05	0.0652
Ba	2.38E-03	2.38
Cd	6.77E-03	6.77
Cr	2.53E-03	2.53
Cu	1.29E-03	1.29
F	1.75E-03	1.75
Fe	2.75E-01	275
Hg	1.84E-03	1.84
Mn	4.97E-02	49.7
Ni	2.00E-01	200
$NO_2 + NO_3$	2.29E-01	229
Pb	1.41E-02	14.1
Sb	1.56E-03	1.56
Se	2.00E-04	0.20
U	1.08E-01	108
Zn	2.40E-03	2.40

[SRS-CWDA-2020-00029]

4.3 FDB-6 Assigned Inventory

As mentioned earlier, the *F Area Diversion Box #6 Final Volume Determination and Uncertainty Estimate* (U-ESR-F-00092) estimated there were 0.3 gallons of what appeared to be salt waste under the area of Nozzle 4 inside the vault.

The methodology used to calculate the FDB-6 inventory is presented in Section 4.1. The dry sludge volume calculated for the affected FDB-6 area is assumed to conservatively bound the 0.3 gallons of visible waste on the floor beneath Nozzle 4 and the small globule of shiny black material near the sump screen. The final FDB-6 assigned inventory is presented in Tables 4.3-1 and 4.3-2.

Table 4.3-1: FDB-6 Assigned Radionuclide Inventory (Decayed to September 30, 2020)

Radionuclide	Inventory (Ci)	Radionuclide	Inventory (Ci)	Radionuclide	Inventory (Ci)
Ac-227	2.08E-10	Eu-152	1.80E-03	Rh-106	4.03E-08
Al-26	2.03E-06	Eu-154	1.96E-02	Ru-106	4.03E-08
Am-241	1.59E-01	Eu-155	1.75E-02	Sb-125	1.11E-03
Am-242m	2.28E-04	H-3	2.22E-04	Sb-126	6.06E-05
Am-243	2.59E-05	I-129	1.93E-08	Sb-126m	4.33E-04
Ba-137m	1.48E+00	Na-22	3.18E-06	Se-79	2.30E-04
Bk-249	5.98E-31	Nb-94	1.02E-05	Sm-151	6.71E-01
C-14	1.16E-05	Ni-59	4.56E-04	Sn-126	4.33E-04
Ce-144	5.18E-10	Ni-63	3.78E-02	Sr-90	8.51E+00
Cf-249	2.19E-22	Np-237	2.15E-05	Tc-99	4.08E-03
Cm-242	6.54E-22	Pa-231	8.49E-09	Te-125m	2.72E-04
Cm-243	3.82E-06	Pm-147	1.69E-02	Th-229	1.36E-05
Cm-244	7.34E-03	Pr-144	5.18E-10	Th-230	3.89E-05
Cm-245	9.41E-08	Pu-238	4.97E-02	U-232	2.02E-07
Cm-247	3.51E-20	Pu-239	1.96E-02	U-233	1.01E-04
Cm-248	8.09E-21	Pu-240	7.19E-03	U-234	6.50E-05
Co-60	6.33E-03	Pu-241	3.39E-02	U-235	7.69E-07
Cs-134	3.51E-06	Pu-242	5.91E-05	U-236	1.24E-06
Cs-135	4.45E-06	Pu-244	2.78E-08	U-238	3.80E-05
Cs-137	1.59E+00	Ra-226	3.91E-05	Y-90	8.51E+00

[SRS-CWDA-2020-00029]

Table 4.3-2: FDB-6 Assigned Chemical Inventory

Chemical	Concentration (kg)	Concentration (g)
Ag	2.22E-03	2.22
As	7.48E-05	0.075
Ba	2.74E-03	2.74
Cd	7.77E-03	7.77
Cr	2.91E-03	2.91
Cu	1.48E-03	1.48
F	2.01E-03	2.01
Fe	3.16E-01	316
Hg	2.11E-03	2.11
Mn	5.71E-02	57.1
Ni	2.30E-01	230
$NO_2 + NO_3$	2.63E-01	263
Pb	1.62E-02	16.2
Sb	1.79E-03	1.79
Se	2.30E-04	0.23
U	1.24E-01	124
Zn	2.76E-03	2.76

[SRS-CWDA-2020-00029]

4.4 Assigned Inventory Conservatisms

Using an approach like the one used for the transfer line inventory estimation in the FTF PA results in several conservatisms for the inventories assigned to FDB-5 and FDB-6:

- The radiologic and chemical inventories assigned to FDB-5 and FDB-6 conservatively assume material presence on the DB surfaces (jumper internals and vault floors) equivalent to approximately five gallons of residual material. [SRR-CWDA-2020-00029] Camera inspections confirmed that the vault and sump walls are clean with no residual material visible in FDB-5 and only an estimated 0.3 gallons of material on the FDB-6 floor. [U-ESR-F-00092, U-ESR-F-00094]
- The calculated concentrations used in the inventory assignment are decayed only to September 30, 2020, consistent with the closure date assumed in the FTF PA. The actual closure date will be later resulting in some of the radionuclides of interest (Cs-137, Sr-90) being overrepresented in the inventories because additional decay before the actual FTF closure is not accounted for.
- The transfers through FDB-5 and FDB-6 were only supernate (evaporator feed and concentrated supernate), not sludge slurry. If the calculated concentrations used dried salt, the inventories would contain significantly less long-lived transuranic radionuclides of concern.

- The assigned inventory for FDB-5 contains significantly more radioactivity than would be indicated by the two surveys performed in 2020. The maximum radioactivity detected during the two surveys was 5.0E-04 Ci/ft^2 beta-gamma and 2.5E-08 Ci/ft^2 alpha. For comparison, the FDB-5 inventory assignment based on the transfer line concentrations calculated in the FTF PA (Table 3.3-11) had 4.07E-02 Ci/ft^2 for Sr-90 (the primary beta-gamma source) and 2.38E-04 Ci/ft^2 for Pu-238 (the primary alpha source). [SRS-REG-2007-00002] The survey readings would be much higher if the assigned inventory were actually present.

5.0 PERFORMANCE EVALUATION

Background

The FTF PA was prepared to support closure of the FTF underground radioactive waste tanks and ancillary structures. The FTF PA purpose is to evaluate the potential impact on human health and the environment by modeling the residual contaminant release from waste tanks and ancillary structures that have been stabilized with grout. Therefore, the assumed inventory of contaminants is the starting point for modeling the contaminant release.

A methodical approach was used to construct projections of FTF waste tank system closure inventories to be used in the PA modeling. This approach considered current tank inventories, uncertainties in the effectiveness of tank cleaning technologies, laboratory detection limits, decay products, and radionuclide half-lives. The current FTF inventory projection is provided in *F-Tank Farm Closure Inventory for Use in Performance Assessment Modeling*. [SRR-CWDA-2009-00045]

As mentioned previously, no inventory was assigned to FDB-5 or FDB-6 in the FTF PA because neither diversion box served as a primary waste containment structure. Their assumed inventory was considered negligible relative to other nearby significant inventory sources like the waste tanks. [SRS-REG-2007-00002] However, the FDB-5 and FDB-6 assigned inventories represent an increase relative to the FTF PA and supporting Special Analyses.

5.1 FDB-5 and FDB-6 Special Analysis

The purpose of the FDB-5 and FDB-6 Special Analysis (SA) is to evaluate the information regarding the final residual inventories that are planned to be grouted in-place in FDB-5 and FDB-6. This new inventory information was used to update select portions of the FTF fate and transport modeling performed in the FTF PA and its supporting Special Analyses (i.e., the Tank 18/19 SA [SRR-CWDA-2010-00124] and the Tank 5/6 SA [SRR-CWDA-2012-00106]). The potential impacts of the new inventory information on the assumptions from the FTF PA and supporting Special Analyses were also considered.

The FTF PORFLOW flow and transport model was not changed for the modeling runs performed for the SA except to add the FDB-5 and FDB-6 inventories. The FTF PORFLOW model was rerun with the assigned FDB-5 and FDB-6 inventories to provide 1-meter and 100-meter radiological concentrations. No PORFLOW deterministic sensitivity runs were performed.

As a result of the small residual inventories and associated low doses, no FTF probabilistic GoldSim modeling was performed for this SA.

The SA results are summarized below. Full details are presented in the *FDB-5 and FDB-6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site* (SRR-CWDA-2020-00055).

5.2 Assessment Evaluation

The potential impacts of the new inventory information on the assumptions in the FTF PA and supporting SAs were evaluated and many were found to be unchanged. A summary of those other impacts evaluated using the estimated FDB-5 and FDB-6 inventories are:

- The SRS site characteristics information is not affected.
- The FTF facility design information is not affected.
- The FTF waste tank inventories are not affected.
- The FTF analysis of performance (overview of analysis, source term release) is not affected.
- The closure system modeling information is not affected.
- The biotic pathways calculations are not affected.
- The airborne and radon pathway conceptual model and analysis approach is not affected.
- The bioaccumulation factors and human health exposure parameters are not affected.
- The dose analysis information is not affected.
- The "As Low As Reasonably Achievable" (ALARA) information is not affected.
- The FTF Contaminant Migration Constituents of Concern (CMCOCs) identified in the Tank 5/6 SA are not impacted.
- The uncertainty analyses and sensitivity analyses information presented in the FTF PA and its supporting SA are not affected.
- Because the peak flows release rates (fluxes) are waste tank fluxes (which are not affected by the new FDB-5 and FDB-6 information and did not change) the FTF PA peak flux information has not been updated.
- The Member of the Public (MOP) peak dose analysis information is not affected.

Additional information on these individual evaluations is in the *FDB-5 and FDB-6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site* (SRR-CWDA-2020-00055).

5.3 Groundwater Evaluation

Section 4.3 of FTF PA contains a discussion of the modeling codes. The FTF PA Base Case (i.e., deterministic) modeling was performed using the same flow and transport model that was used in the FTF PA, Rev. 1 and its supporting SAs. The FTF PORFLOW flow and transport model was not changed for this SA except to add the FDB-5 and FDB-6 inventories. The FTF PORFLOW model was rerun with the new FDB-5 and FDB-6 inventories to provide 1-meter and 100-meter radiological concentrations. No PORFLOW deterministic sensitivity runs were performed.

The FTF GoldSim flow and transport model was not changed for the SA modeling runs except to add the FDB-5 and FDB-6 inventories to provide radiological concentrations. As a result of the small residual inventories and associated low doses, no FTF probabilistic GoldSim modeling was performed for this SA.

Maximum groundwater concentrations were generated for the exposure points:

1) 100-meters from the FTF, and
2) The Upper Three Runs (UTR) and Fourmile Branch (FMB) seeplines.

The 100-meter groundwater concentrations were calculated for the FTF PA Base Case using only the revised FDB-5 and FDB-6 inventories to see their impact. Calculations were performed using both the GoldSim FTF and PORFLOW FTF models. [SRR-CWDA-2020-00055]

5.3.1 Groundwater Concentrations at the Seeplines

Because the peak seepline concentrations are dominated by waste tank releases and are unchanged by the new FDB-5 and FDB-6 information, the seepline groundwater concentrations did not require updating. The UTR and FMB seepline groundwater concentrations calculated in the Tank 5/6 SA remain the peak seepline groundwater concentrations. [SRR-CWDA-2012-00106]

5.3.2 MOP Exposure Dose Analysis

Peak doses have been recalculated using only the FDB-5 and FDB-6 peak groundwater concentrations identified in Section 6.3.2 of the SA using the PORFLOW FTF model for the FTF PA Base Case. [SRR-CWDA-2020-00055]

Table 5.3-1 shows a comparison of the 100-meter peak groundwater pathway doses (recalculated using the FDB-5 and FDB-6 FTF inventories) for the different 100-meter sectors (Figure 5.3-1) within 1,000 and 10,000 years. Table 5.4-1 also shows the 100-meter peak groundwater pathway doses from the *Tanks 5 and 6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site* (SRR-CWDA-2012-00106) calculated using all the FTF inventories. In calculating the peak groundwater pathway dose, the highest radionuclide concentration within each sector's vertical computational mesh from the Upper Three Runs Aquifer (UTRA)-Upper Zone (UZ), UTRA-Lower Zone (LZ), and the Gordon Aquifer aquifers was used.

Figure 5.3-1 FTF 1-meter and 100-meter PORFLOW Model Evaluation Sectors

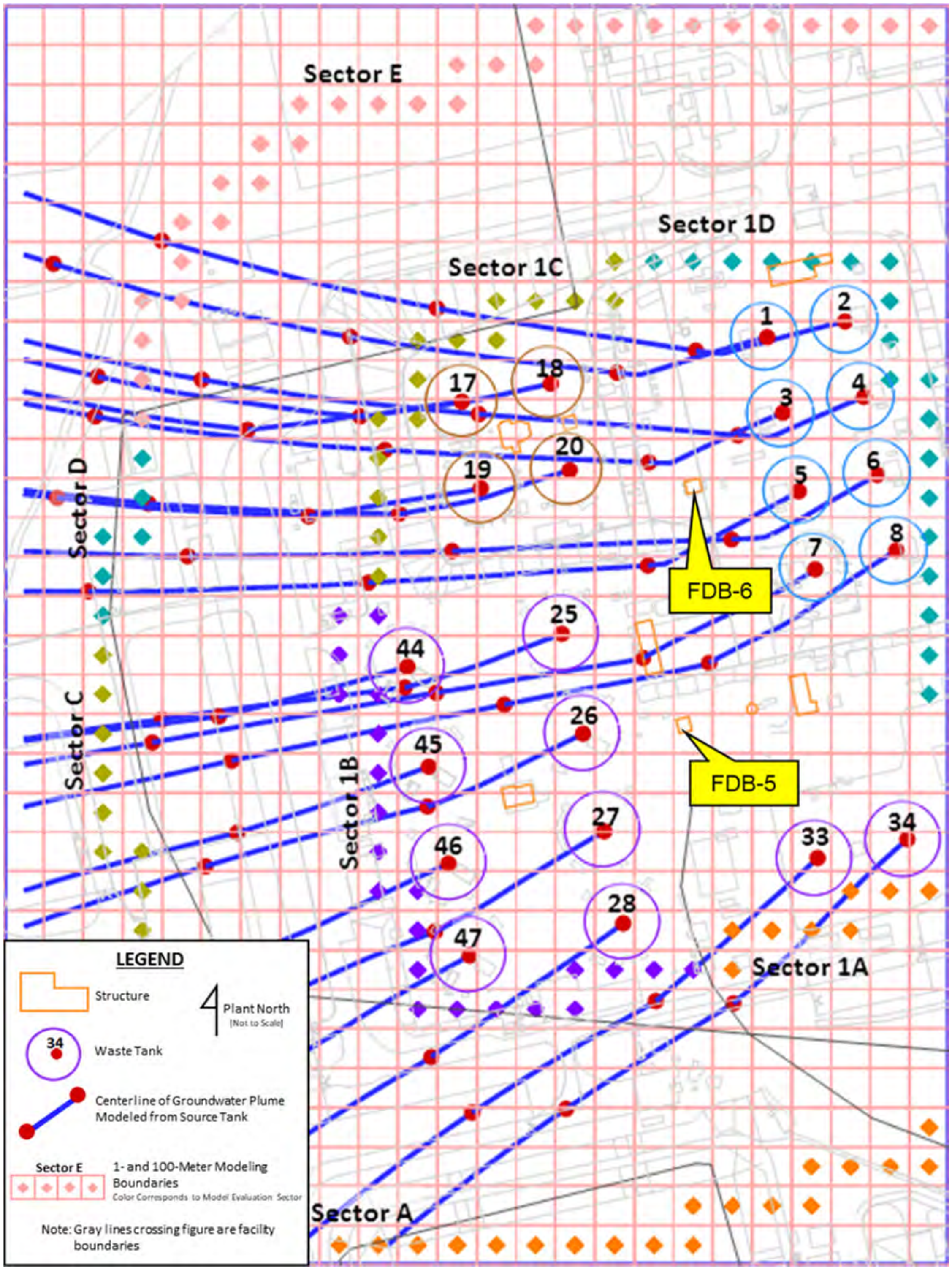


Table 5.3-1: 100-Meter MOP Peak Groundwater Pathways Dose by Modeling Sector

Sector	FTF Highest Peak Dose in 1,000 Years	FDB-5 Highest Peak Dose in 1,000 Years	FDB-6 Highest Peak Dose in 1,000 Years	FTF Highest Peak Dose in 10,000 Years	FDB-5 Highest Peak Dose in 10,000 Years	FDB-6 Highest Peak Dose in 10,000 Years
A	0.1 mrem/yr (year 752)	0.001 mrem/yr (year 724)	<0.001 mrem/yr	0.1 mrem/yr (year 752)	0.001 mrem/yr (year 724)	<0.001 mrem/yr
B	0.1 mrem/yr (year 754)	0.006 mrem/yr (year 722)	<0.001 mrem/yr	0.1 mrem/yr (year 754)	0.006 mrem/yr (year 722)	<0.001 mrem/yr
C	0.1 mrem/yr (year 740)	0.006 mrem/yr (year 720)	0.005 mrem/yr (year 724)	0.2 mrem/yr (year 4,306)	0.006 mrem/yr (year 720)	0.005 mrem/yr (year 724)
D	0.3 mrem/yr (year 704)	<0.001 mrem/yr	0.01 mrem/yr (year 720)	1.8 mrem/yr (year 6,056)	<0.001 mrem/yr	0.01 mrem/yr (year 720)
E	0.4 mrem/yr (year 704)	<0.001 mrem/yr	0.004 mrem/yr (year 720)	3.3 mrem/yr (year 10,000)	<0.001 mrem/yr	0.004 mrem/yr (year 720)

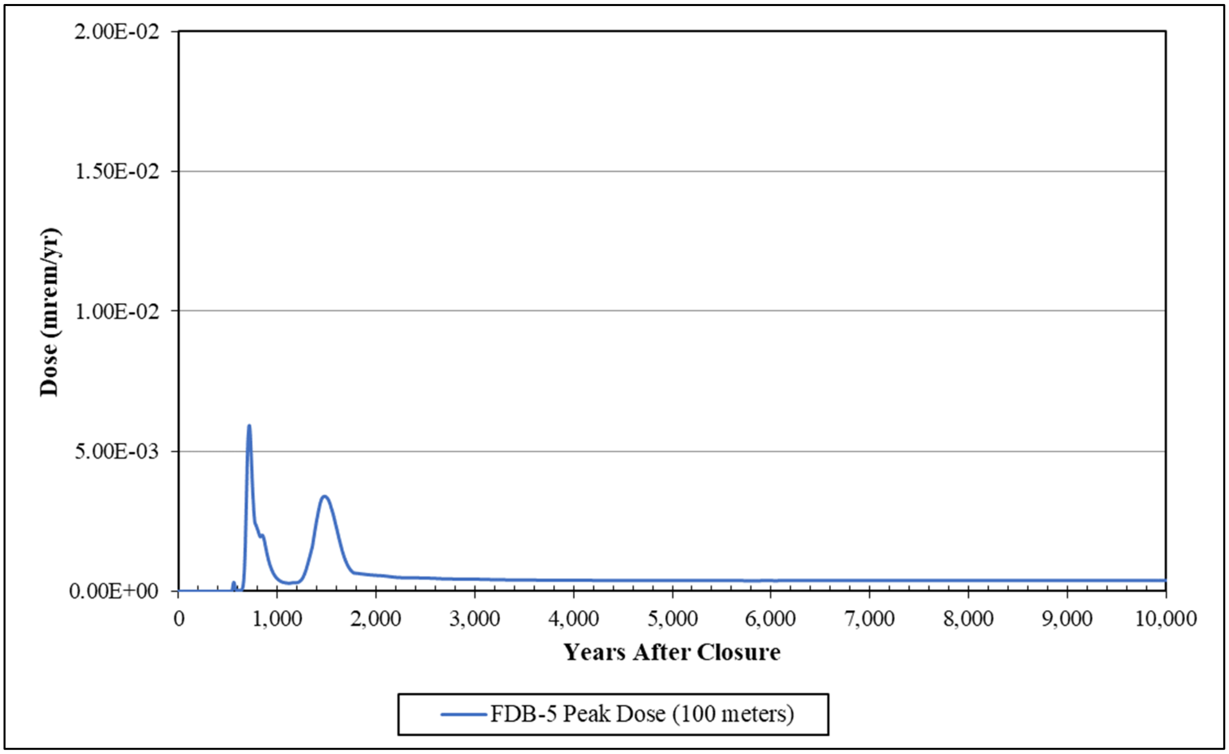
Note: Dose values are shown to two significant figures to illustrate changes/trends. The use of two significant figures is not meant to imply this level of precision for these dose projections.

The highest FDB-5 and FDB-6 related peak-groundwater pathway dose for both 1,000 and 10,000 years is 0.01 mrem/yr in Sector D and is associated with FDB-6 (Tc-99 contributes 50% of this peak). The 0.01 mrem/yr peak is significantly less than 100-meter peak groundwater pathway doses calculated for the entire FTF in 1,000 years (0.4 mrem/yr) and 10,000 years (3.3 mrem/yr). The FTF peak doses in 1,000 and 10,000 years are unchanged from the updated Base Case results previously reported in *Tanks 5 and 6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site* (SRR-CWDA-2012-00106).

The highest FDB-5 associated peak-groundwater pathway dose within 1,000 years is approximately 0.006 mrem/yr in Sector C at year 720 and Sector B at year 722 (Table 5.3-1). Figure 5.3-2 shows the FDB-5 100-meter MOP receptor peak dose and doses within 10,000 years for the five 100-meter sectors.

The highest FDB-6 associated peak-groundwater pathway dose within 1,000 years is approximately 0.01 mrem/yr in Sector D at year 720 (Table 5.3-1). Figure 5.3-3 shows the FDB-6 100-meter MOP receptor peak dose and doses within 10,000 years for the five 100-meter sectors.

Figure 5.3-2: FDB-5 100-Meter MOP Peak Groundwater Pathway Dose within 10,000 Years for the Five 100-Meter Modeling Sectors



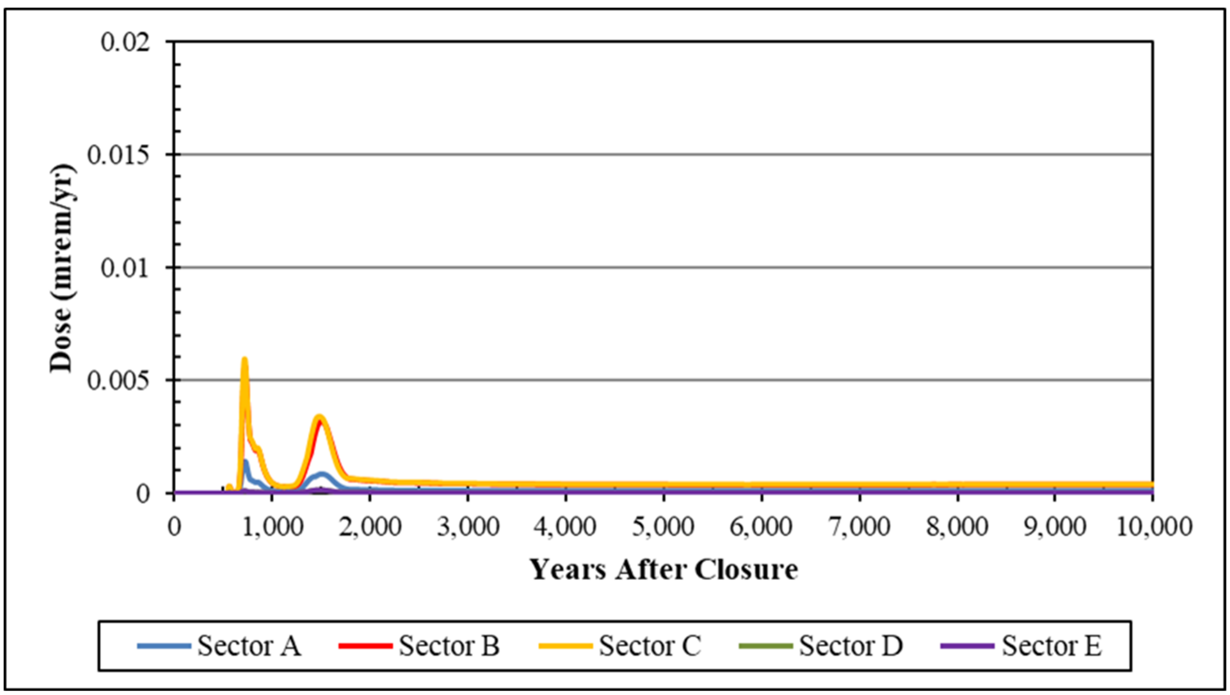
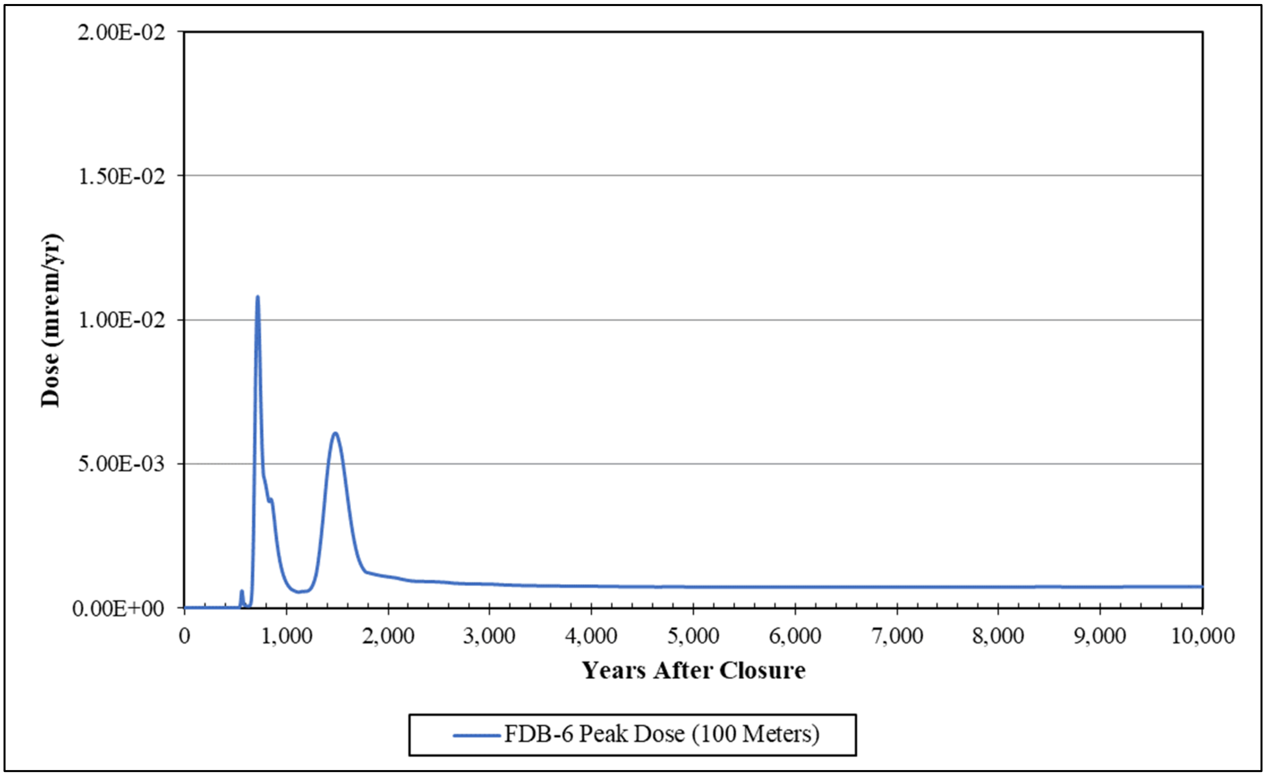
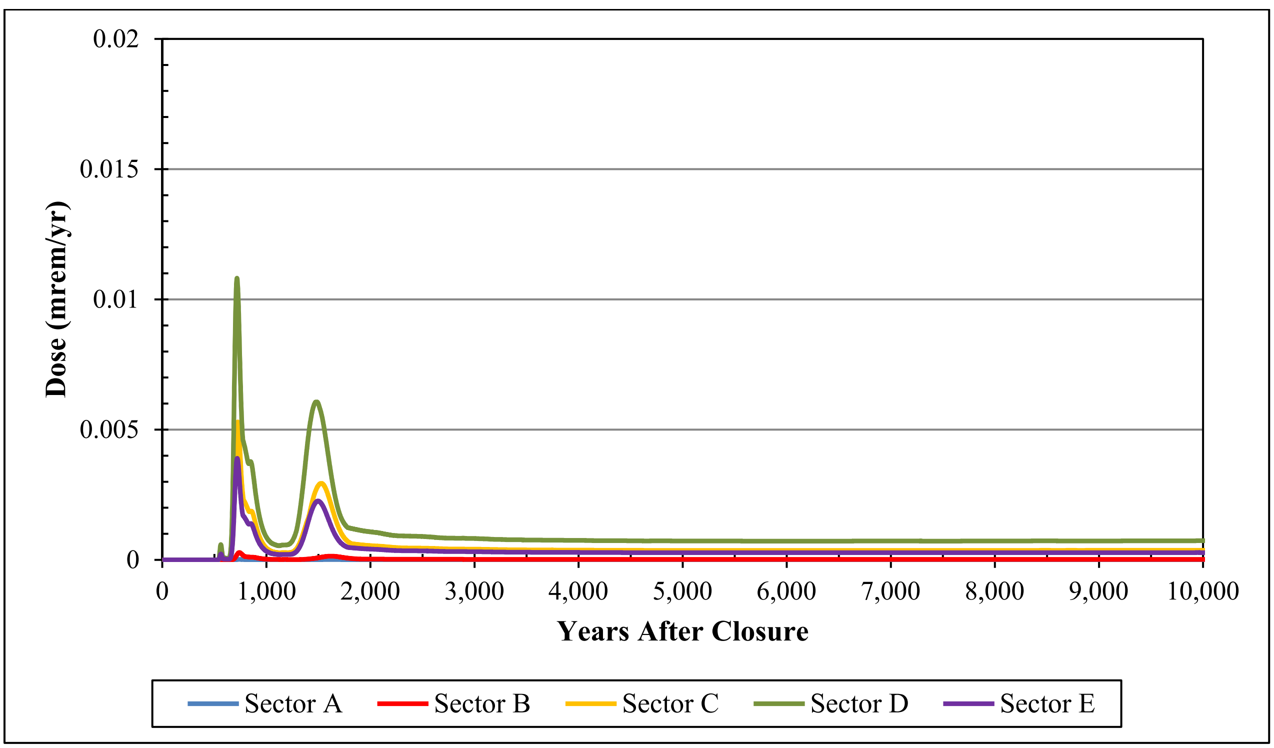


Figure 5.3-3: FDB-6 100-Meter MOP Peak Groundwater Pathway Dose within 10,000 Years for the Five 100-Meter Modeling Sectors





5.3.3 MOP Peak Groundwater and All-Pathways Dose at the Stream

The peak groundwater-pathway doses for the FMB and UTR seeplines were not recalculated for the updated FDB-5 and FDB-6 inventories based on the low 100-meter MOP doses in 1,000 years.

The peak all-pathways annual dose for the MOP at the stream is not impacted by the updated FDB-5 and FDB-6 inventories. The peak all-pathways annual dose for the MOP remains 3.3 mrem/yr as calculated in the *Tanks 5 and 6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site* (SRR-CWDA-2012-00106) and is associated with Sector E.

5.4 RCRA/CERCLA Risk Analysis

The RCRA/CERCLA risk assessment for the FTF final facility closure follows the current SRS Area Completion Project protocols for human health and ecological risk assessments. The Tank 5/6 SA identified Np-237 and Tc-99 as CMCOCs based on the 1,000-year concentration curves and using the Savannah River Nuclear Solutions Area Completion Project protocols for human health and ecological risk assessments. These CMCOCs are not impacted by the assigned radiological inventories in either FDB-5 or FDB-6. [SRR-CWDA-2012-00106, SRR-CWDA-2020-00055]

The peak groundwater concentrations calculated using only the FDB-5 and FDB-6 radiological inventories are insignificant. The overall FTF peak radiological groundwater concentrations and CMCOCs identified in the Tank 5/6 SA remain overriding. [SRR-CWDA-2020-00055]

The Groundwater Chemical Concentrations at 1-meter from FTF were not revised to incorporate FDB-5 and FDB-6 because those chemical inventories were insignificant in comparison to individual waste tank inventories. No individual FDB-5 or FDB-6 chemical inventory was even 0.5% of the Tank 5F or Tank 6F chemical inventory, with most being less than 0.1%. Because the peak groundwater chemical contributions resulting only from the FDB-5 and FDB-6 chemical inventories are insignificant, the overall FTF peak chemical groundwater concentrations and CMCOCs identified in the Tank 5/6 SA remaining overriding. [SRR-CWDA-2020-00055] Accordingly, the groundwater radiological and chemical concentrations at 1-meter from the FTF remain accurate and did not need to be revised to incorporate the FDB-5 and FDB-6 inventories. [SRR-CWDA-2020-00055]

5.5 F-Tank Farm Interpretation of Results

Section 7.0 of FTF PA summarizes the conservatisms used in modeling and provides a summary and interpretation of the results presented in Section 5.0 and Section 6.0 of the FTF PA. The FTF PA conservatisms information are not affected by the new FDB-5 and FDB-6 assigned inventories. The individual dose results provided in the Section 7.1.2 of FTF PA and its supporting Special Analyses remain valid.

5.6 Conclusions

The FTF PA provides groundwater radionuclide concentrations at 1-meter, 100-meters, and at the two seepline exposure points approximately 1,600-meters from FTF. The groundwater concentrations are provided for each of the three aquifers as applicable as a part of the FTF groundwater modeling. The FTF PA also provides groundwater concentrations for chemical contaminants at 1-meter and 100-meters. In addition, FTF PA provides intruder doses as well as analyses for the air pathways and radon ground surface flux. The FTF PA results can be used in subsequent documents to demonstrate compliance with the pertinent requirements identified below for final FTF facility closure as indicated in Table 5.6-1.

Table 5.6-1: Key Limits from Regulatory Requirements

Requirement	**All-Pathways Dose**	**Intruder Dose**	**Air Pathway Dose**	**Radon Flux**	**Groundwater Protection**
NDAA Section 3116: 10 CFR 61.41 and 61.42	25 mrem/yr	500 mrem/yr	N/A	N/A	N/A
DOE M 435.1-1	25 mrem/yr	500 mrem – acute 100 mrem/yr – chronic	10 mrem/yr	20 pCi/m^2/s at ground surface	< MCL
SCDHEC Primary Drinking Water Regulations (SCDHEC R.61-58)	N/A	N/A	N/A	N/A	< MCL

N/A = Not Applicable
MCL = Maximum Contaminant Level

The key radiological results from the FTF PA and supporting SAs remain valid and are shown in Table 5.6-2. These results were not changed by the new FDB-5 and FDB-6 assigned inventories.

Table 5.6-2: Summary Radiological Results for F-Tank Farm

Location	**Peak Within 10,000 Years (from the FTF PA and supporting SAs)**		
	All-Pathways Dose (mrem/yr)	**Groundwater Pathway Dose (mrem/yr)**	**Air Pathway Dose (mrem/yr)**
100 meters from FTF	3.3 at ~ year 10,000	3.3 at ~ year 10,000	4.6E-06
At Seepline(s)	0.10 at ~ year 5,550	0.10 at ~ year 5,550	8.3E-07

Note Dose values are shown to two significant figures to illustrate changes/trends. The use of two significant figures is not meant to imply this level of precision for these dose projections.
Note The FTF PA, Rev.1 peak intruder dose is 73 mrem/yr at year 101 from a chronic scenario, drilling through a transfer line and using groundwater concentrations at the maximum 1-meter FTF location. This value is not changed in this Special Analysis.
Note The FTF PA peak radon flux at the ground surface is 3.6E-08 pCi/m^2/s.

As reported previously in the *Tanks 5 and 6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site* (SRR-CWDA-2012-00106), the peak groundwater radionuclide concentrations for Np-237 and Tc-99 were above the respective Preliminary Remediation Goal (PRG) or Maximum Contaminant Level (MCL) values at 1-meter; no PRG or MCL values were exceeded at 100-meters or at the seeplines. The peak concentrations for the chemicals of concern were also calculated, and all were less than the MCL or Regional Screening Level (RSL) at 1-meter from FTF.

The groundwater acute and chronic exposure scenario information presented in the FTF PA are not significantly affected by the new FDB-5 and FDB-6 information.

The FTF peak groundwater radionuclide concentrations were not changed by the new FDB-5 and FDB-6 residual waste information. The groundwater chemical concentrations at 1-meter from the FTF were not revised to incorporate the FDB-5 and FDB-6 chemical inventories because they are insignificant in comparison to individual waste tank inventories.

The SA results provide reasonable assurance that compliance is maintained with the specific requirements of NDAA Section 3116, DOE M 435.1-1, and the MCLs. The results presented in the FTF PA and supporting SAs are not significantly impacted by the estimated residual inventories that will remain in FDB-5 and FDB-6 when they are filled with grout and removed from service. [SRR-CWDA-2020-00055]

6.0 ASSESSMENT OF THE IMPACT OF DEPLOYING ADDITIONAL WASTE REMOVAL TECHNOLOGY

The FDB-5 and FDB-6 structures served as secondary containment for the transfer lines (jumpers) that passed through them. As such, the DB's were not designed to serve as primary waste storage structures and therefore did not hold or store waste. As described in Sections 2.0 and 3.0, the only contact with waste was incidental as part of jumper cleaning in FDB-5, and inleakage of contaminated water from a hydrotest into FDB-6. Following these incidents, the DB's were decontaminated by washing down the interiors with clean water.

As expected, based on their operational histories, and as verified by video inspection, the structures do not contain accumulated solids on their interior surfaces. The only exception is the approximately 0.3 gallons of material on the FDB-6 floor which likely resulted from a small leak at a nozzle. Because only supernate was transferred through these DBs, it is presumed to be crystalized supernate. [U-ESR-F-00092, U-ESR-F-00094] Because the transfer lines were flushed with clean water after each transfer, only minimal, if any, waste might be present inside the jumpers. [SRR-CWDA-2020-00029]

As discussed in Section 5.0, to bound the impact of the assumed waste residue potentially present on the interior surface of the DBs or jumpers, a conservative inventory was assigned to each of the structures. Using the assigned inventory, an SA was performed to evaluate the potential risk to a future hypothetical member of the public (MOP). The SA estimated the maximum dose to a future hypothetical MOP resulting from the waste potentially in FDB-5 at 0.006 mrem/yr and from FDB-6 at 0.01 mrem/year. [SRR-CWDA-2020-00055]

This section presents an evaluation of the potential benefits resulting from further waste removal efforts in FDB-5 and FDB-6.

6.1 Analysis of Potential Cleaning Technologies

As required by the CGCP, DOE continues to provide an annual cleaning technology briefing to SCDHEC in a dedicated meeting. Meeting materials are provided to SCDHEC in a manner that can be referenced. These annual updates include information shared and lessons learned between DOE sites and recent and regular reports published under DOE's technology development program. The last briefing held was in November 2020. [SRR-LWE-2020-00095]

As discussed in the CGCP, there are three categories of cleaning technologies that could be deployed for additional waste removal in FDB-5 and FDB-6. These include:

- Mechanical cleaning,
- Chemical cleaning, and
- Vacuum removal technologies.

To be effective, any technology deployed would need to effectively remove the film coating potentially present on the vault floor and inside the abandoned and in-place jumpers that are assumed to contain the remaining residual material. [SRR-CWDA-2020-00029]

6.1.1 Mechanical Cleaning Technologies

Typical mechanical cleaning technologies used in waste removal within the waste tanks at SRS involve the addition of water or supernate to the waste tank and subsequent use of mixing devices and transfer pumps to agitate and/or recirculate the tank contents. The mixing/recirculating dissolves the soluble fraction of the waste and suspends accumulated solids so that they can be transferred out of the tank.

Because the DBs were cleaned by being sprayed down with water, it is uncertain if any additional benefit would be gained by mechanically mixing any added solution, except for potentially dissolving and removing the approximately 0.3 gallons of crystalized supernate in FDB-6.

To possibly improve waste removal efficiency over water washing, a mechanical cleaning approach would also need to incorporate a mechanical abrasion process such as brushing, scraping, or sandblasting the surfaces to remove any potential film. This approach would require development and testing for deployment of the technology, as well as removal of cell covers or core drilling a new, large access port for equipment deployment.

The effectiveness of deploying additional mechanical cleaning technology for potential waste residue removal on the DB's interior surfaces is uncertain. Deploying any mechanical cleaning technology with a mechanical abrasion process capable of cleaning the jumper interior surfaces would be very difficult and would require removing the DB cell covers to disconnect the in-place jumpers and access their, and the abandoned jumpers, internal surfaces.

6.1.2 Chemical Cleaning Technologies

Chemical cleaning using oxalic acid (OA) and/or Low Temperature Dissolution (LTAD) has been utilized for waste tank cleaning at SRS. The LTAD process is a cleaning technique applicable to sludge waste that is high in aluminum content. As discussed in Section 2.0, FDB-5 or FDB-6 were not used for any sludge slurry transfers and there would be no practical reason to use the LTAD process on them. The OA cleaning process would require adding OA into the DBs to a level that would fully submerge the abandoned jumpers on the floor. Typically, OA cleaning also incorporates agitation to facilitate acid contact so OA cleaning would also require development of a mixing device to agitate and /or recirculate the cleaning solution.

The effectiveness of using a chemical cleaning technology to remove any potential waste residue on the DB interior surfaces is uncertain. Chemical cleaning could potentially remove some waste residue from inside the abandoned jumpers, but without opening the DB and removing the in-place jumpers, chemical cleaning would not remove any potential residue within the in-place jumpers. Because the small deposit remaining in FDB-6 is assumed to be soluble salt material, it is possible that chemical cleaning would be effective at removing that material.

6.1.3 Vacuum Cleaning Technologies

With the exception of the small deposit in FDB-6, the DBs do not have any accumulated solids, so the benefit of deploying a vacuum technology is uncertain. The vacuum technology previously used to remove waste from Tanks 18F and 19F, was a mechanical crawler called a

Mantis. It was designed to remove sludge solids using a high-pressure hydro-lance to break up waste mounds while an educator aspirated the mobilized waste from the floor.

It would not be practical to deploy the Mantis technology in either FDB-5 or FDB-6. The Mantis' 8-foot length and approximate 3-foot width would make maneuvering inside a DB very difficult and the Mantis probably would not be able to maneuver over discarded jumpers or around the jumper support pedestals to reach all areas of the floor. Additionally, the Mantis would not be able to clean either the in-place or abandoned jumper interiors.

Deployment of vacuum technology in FDB-5 and FDB-6 would require development of a smaller robotic platform with vacuum capability that could maneuver within a congested diversion box. Given that easy entry into the DBs is limited to the existing 5-inch or 6-inch I.D. access ports, deployment of this technology would likely require removal of the cell covers and/or core drilling of larger access ports.

The effectiveness of a vacuum technology on removing any potential waste residue on the DB interior surfaces is uncertain. A vacuum technology would not be effective at removing any residue potentially remaining inside the installed or abandoned jumpers.

6.1.4 Technology Deployment Issues in FDB-5 and FDB-6

Deployment of any mechanical, chemical, or vacuum cleaning technology to perform additional waste removal within FDB-5 or FDB-6 would have costs associated not only with development, testing, and deployment of the technology, but also the costs associated with erection of a containment structure and installation of portable ventilation to control the spread of contamination. Work packages and procedures to support deployment would have to be developed. Deployment of any technology would also need to be evaluated against the existing Documented Safety Analysis to ensure safety of the workers and the public.

In addition, the activities involved with removing cell covers or coring larger access ports, cleaning the interior vault surfaces and removing jumpers for interior cleaning, as well as any chemical addition (e.g., OA) to the vault or potential use of high pressure sprays, would come with the additional risk of potentially contaminating the work area and require additional financial costs and worker exposure for clean-up.

6.2 Estimated Dose Reduction

The FDB-5 and FDB-6 SA results using the assigned inventories were compared to the results in the FTF PA to confirm that this updated information did not adversely impact the FTF PA results. The FDB-5 and FDB-6 SA provides reasonable assurance that, without any additional waste removal in FDB-5 or FDB-6, the groundwater contaminant concentrations derived from the assumed residual contamination in these ancillary structures following removal from service will be below the performance objectives.

Based on the SA, the maximum estimated dose to a future hypothetical MOP resulting from any potential waste residue within FDB-5 is 0.006 mrem/yr and from FDB-6 is 0.01 mrem/year. [SRR-CWDA-2020-00055] Therefore, even if any additional cleaning technology was capable of removing all the residual waste that may remain within the DBs, the maximum potential dose reduction to a hypothetical future MOP would only be 0.01 mrem/yr.

6.3 Assessment Conclusion

The cleaning technologies currently available are not feasible for deployment in FDB-5 and FDB-6.

Nevertheless, even if a technology could be identified and deployed, the essentially zero benefit associated with further residual material removal from FDB-5 and FDB-6 would not justify the associated additional costs, would likely increase worker dose, and risk the potential spread of contamination. Therefore, it may be concluded that further residual removal is not technically practicable from an engineering perspective.

7.0 ANCILLARY STRUCTURE ISOLATION PROCESS AND STABILIZATION STRATEGY

This section summarizes the planned FDB-5 and FDB-6 isolation process and subsequent stabilization strategy to be implemented. Additional isolation details are presented in the *F-Tank Farm Diversion Box 5&6 Isolation Strategy* (SRR-LWE-2020-00045). Additional stabilization details are presented in the *F-Tank Farm Diversion Box 5&6 Grout Strategy* (SRR-LWE-2020-00005).

7.1 FDB-5 and FDB-6 Isolation Process

The isolation process will disconnect FDB-5 and FDB-6 from the FTF Waste Transfer System (WTS) and the FTF support systems. The strategy for isolating both diversion boxes is to ensure there is no ability to add material (waste, water, steam, air, etc.) or energy to the diversion boxes via the site infrastructure.

Isolation is complete when all process lines relevant to FDB-5 and FDB-6 are isolated either via physical obstruction (blank, blind flange, cap, closed valve, etc.), air gap, and/or facility approved Manual 2S administrative controls in addition to Manual E7 compliant designs. [2S Manual, E7 Manual] All electrical sources will be isolated (i.e., physically separated) from equipment and instrumentation. As a result of isolation, there will be no ability to add material (waste, water, steam, air, etc.) or energy to the diversion boxes via the site infrastructure.

Mechanical and electrical isolation matrices will be developed (and maintained in SRS Document Control), that identify the technical baseline drawings and means of isolation. These matrices will serve as the configuration management documents for system isolation points. System isolation points are identified, including the code compliant supply system isolation point, on Piping and Instrumentation Diagrams (P&ID) and Electrical Wiring Diagrams/Schematic drawings as deemed appropriate. Details of the isolation strategy for FDB-5 and FDB-6 are included in Attachment A of the isolation strategy. [SRR-LWE-2020-00045]

As part of the closure of FDB-5 and FDB-6, the above grade portion of the diversion boxes will be entombed in concrete after the interiors are filled with grout. If additional isolation points are identified during the design development for final structure entombment, they will be added to the appropriate mechanical and electrical isolation matrices.

The current strategy is to fully isolate FDB-5 and FDB-6 prior to grout introduction to ensure there is no ability to add material (waste, water, steam, air, etc.) or energy to the diversion boxes via the site infrastructure.

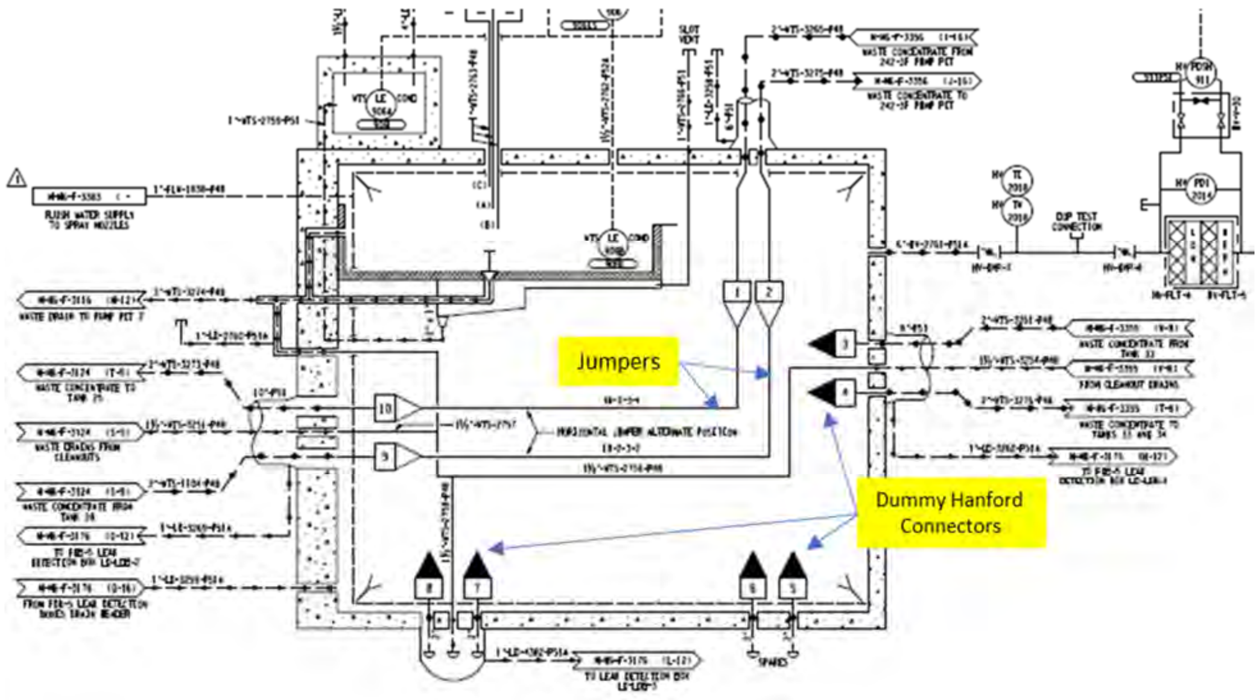
The grout strategy is summarized in Section 7.3.

7.1.1 FDB-5 System Isolation

FDB-5 is connected to six transfer lines which are associated with Nozzles 1, 2, 3, 4, 9, and 10. In addition, there are four other nozzles (Nozzles 5, 6, 7, and 8) with lines that are capped just outside of the diversion box (Figure 7.1-1).

FDB-5 received concentrated supernate from the 242-3F CTS pump tank and then diverted it to either the Tanks 33F and 34F CTS loop line using Nozzles 3 and 4, or the Tanks 25F-28F CTS loop line using Nozzles 9 and 10, then returned any remaining concentrated supernate back to the CTS pump tank. Since the 242-1F Evaporator has not been operated since 1988, these transfer lines are considered inactive and have been downgraded to Production Support (PS) status. Nozzles 3 through 8 are blanked with dummy Hanford connectors inside the diversion box and do not require modification for isolation.

Figure 7.1-1: FDB-5 Transfer Lines



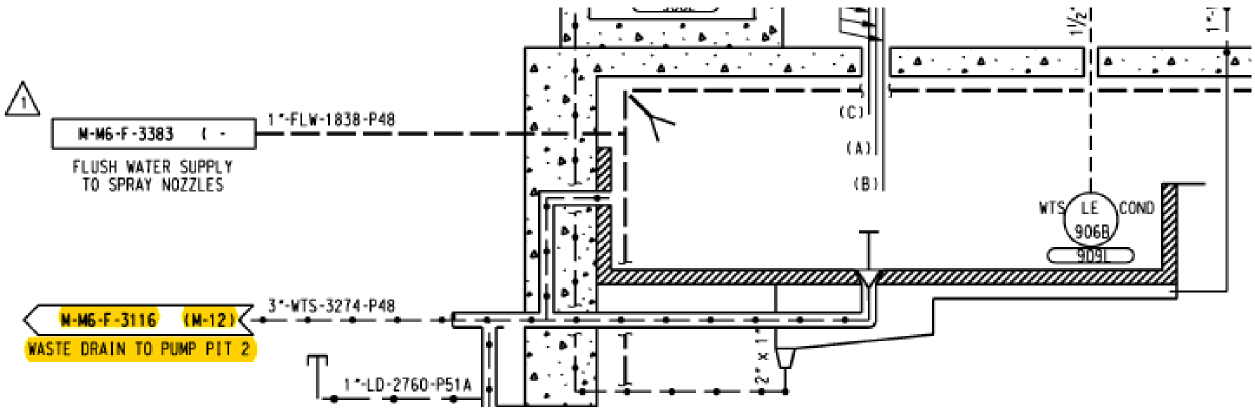
[M-M6-F-3123]

Two jumpers remain connected inside the diversion box. One jumper connects Nozzles 1 and 10, and the other connects Nozzles 2 and 9. The transfer lines connected to Nozzles 1 and 2 are both isolated with dummy Hanford connectors at the 242-3F pump pit and no further action is necessary.

The transfer lines connected to Nozzles 9 and 10 form the Tank 25F-28F CTS loop line which is a transfer path from FDB-5 Nozzle 10 to Tank 25F. The loop continues from Tank 25F to Tank 26F, then from Tank 26F to Tank 27F, then from Tank 27F to Tank 28F, and then returns to FDB-5 Nozzle 9 to complete the loop. The transfer line segments are interconnected with piping between nozzles located within the Riser C2 box at each of the tanks. In Tanks 25F, 27F, and 28F, the piping has a drop valve installed which allowed the concentrated supernate to be released into the tank. In Tank 26F, the piping does not have a drop valve. There is no installed equipment associated with the loop line that has the motive force to transfer waste material into either of the connected FDB-5 jumpers. In addition, facility Technical Safety Requirements (TSRs) prohibit the addition of waste into, or through, FDB-5. [S-TSR-G-00001] No further action is necessary to isolate the transfer lines associated with Nozzles 9 and 10.

FDB-5 has a sump floor drain with a line that leads to F-Pump Pit 2 (FPP-2) and subsequently to F-Pump Tank 2 (FPT-2) (Figure 7.1-2). The sump has an overflow drain line that connects outside of FDB-5 to the drain line to FPT-2. Enough low-slump concrete will be placed into the diversion box and allowed to set, so that the height of the concrete in the sump is above the overflow drain line in the wall. This will prevent grout with higher flowability from entering the drain line and reaching FPT-2.

Figure 7.1-2: FDB-5 Sump and Overflow Drain Lines



[M-M6-F-3123]

There are three leak detection boxes associated with FDB-5 (LD-LDB-1, LD-LDB-2, LD-LDB-3) that connect to a common 1-inch diameter pipe which penetrates the wall of FDB-5 and is open to the interior of the diversion box. The LDB system was designed to collect any material that might leak into the transfer line jackets for FDB-5. Any material collected in these LDBs would drain into the FDB-5 vault and flow to the sump. Because there is no equipment associated with the transfer lines that has the motive force to transfer waste material into the transfer lines, there is little chance for leakage into the transfer line jackets and into the LDB system. No further action is necessary to isolate the LDB network for FDB-5. Details of the LDB system are presented in the isolation plan. [SRR-LWE-2020-00045]

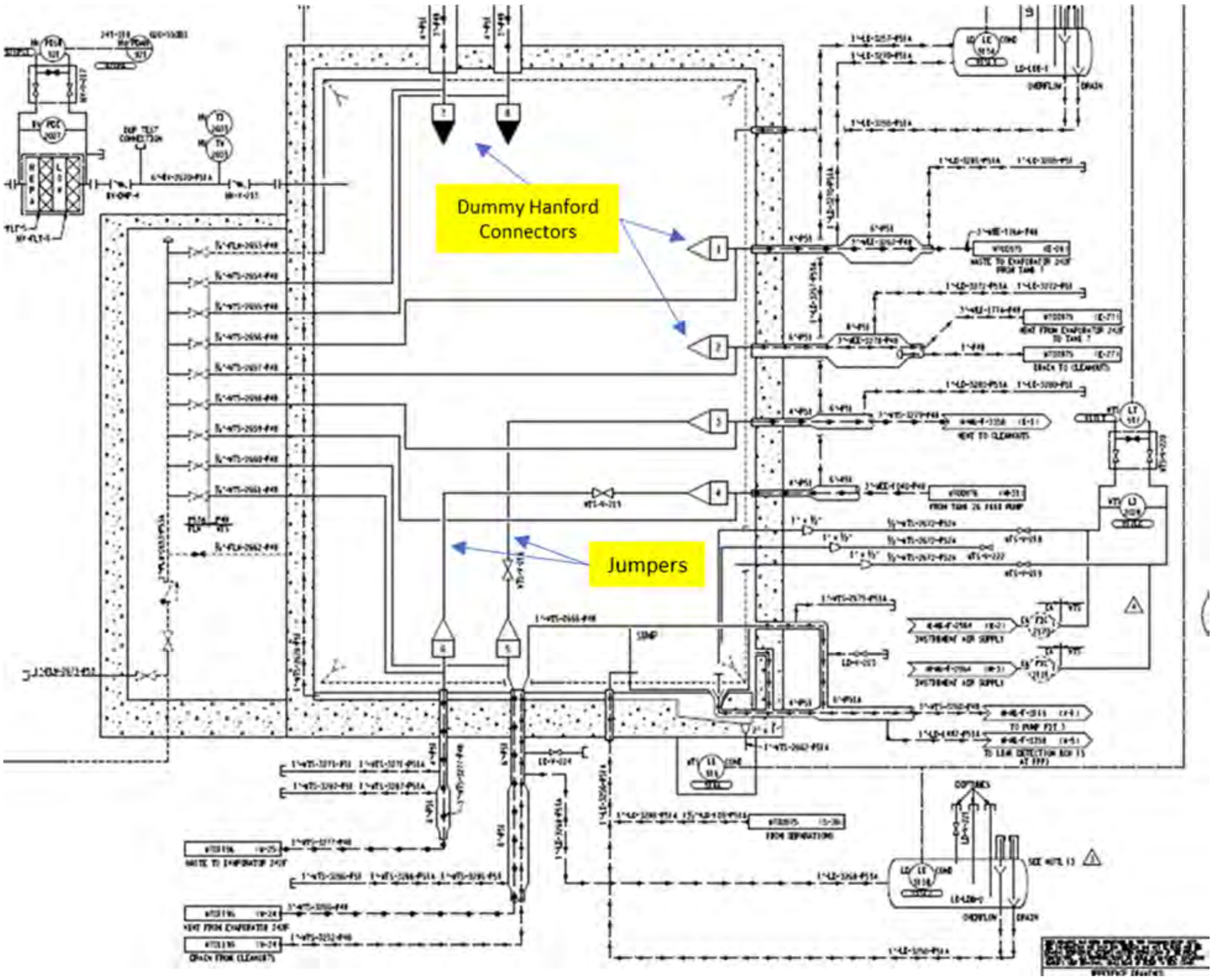
When FDB-5 is stabilized, grout will flow, to some extent, into the drain line coming from the LDBs effectively sealing off that pathway for any material to enter FDB-5.

7.1.2 FDB-6 System Isolation

FDB-6 is connected to six transfer lines associated with Nozzles 1 through 6. Two additional nozzles, Nozzles 7 and 8, are capped just outside of the diversion box (Figure 7.1-3). FDB-6 was used to direct supernate to the 242-1F Evaporator System for volume reduction from either Tank 7F using Nozzle 1, or Tank 26F using Nozzle 4. Because the 242-1F Evaporator has not been operated since 1988, these transfer lines are considered inactive and have been downgraded to PS status. Nozzles 1, 2, 7, and 8 are blanked with dummy Hanford connectors inside the diversion box and do not require modification for isolation.

Two jumpers remain connected inside the diversion box. One jumper connects Nozzles 3 and 5, and the other connects Nozzles 4 and 6. The transfer lines connected to Nozzles 5 and 6 are both isolated at the 242-1F Evaporator with installed blanks, and no further action is necessary to isolate them. The transfer line connected to Nozzle 3 was used as a vent line for the 242-1F Evaporator and is currently connected to FPT-3 Nozzle 11. FPT-3 Nozzle 11 is open to the headspace in FPT-3 and there is no installed equipment associated with the nozzle that has the motive force to transfer waste material into this jumper. In addition, facility TSRs prohibit the addition of waste into or through FDB-6. Therefore, no further action is necessary to isolate the transfer line associated with FDB-6 Nozzle 3.

Figure 7.1-3: FDB-6 Transfer Lines

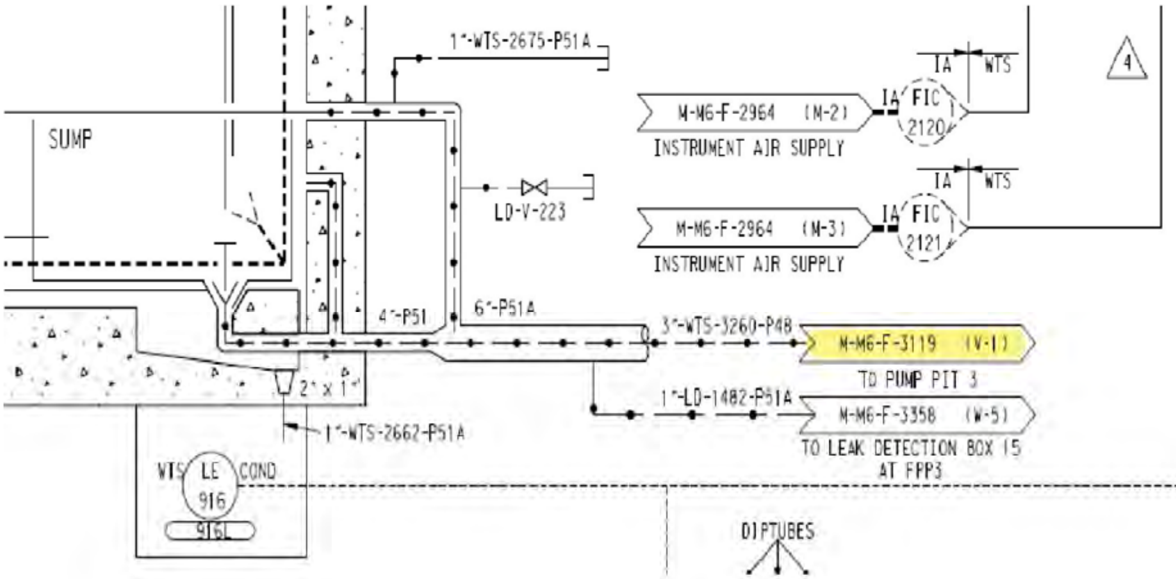


[M-M6-F-3357]

The transfer line connected to Nozzle 4 was used to transfer waste from Tank 26F to the 242-1F Evaporator and is currently connected to a transfer pump in Tank 26F Riser 1. The transfer pump has since been removed from the riser, therefore no motive force exists to transfer waste material into the FDB-6 jumper. In addition, facility TSRs prohibit the addition of waste into or through FDB-6. No further action is necessary to isolate the transfer line associated with Nozzle 4.

FBD-6 has a sump drain line that leads to FPP-3 (Figure 7.1-4). The sump has an overflow drain line that connects outside of FDB-6 to the drain line to FPP-3. Enough low-slump concrete will be placed into the diversion box and allowed to set, so that the height of the concrete in the sump is above the overflow drain line in the wall. This will prevent grout with higher flowability from entering the drain line and reaching FPP-3.

Figure 7.1-4: FDB-6 Sump and Overflow Drain Lines



[M-M6-F-3357]

There are two LDBs associated with FDB-6 (LD-LDB-1, LD-LDB-2) that each have a 1-inch diameter pipe which penetrates the wall of FDB-6 and is open to the interior of the diversion box. Any material collected in these LDBs would drain into FDB-6 and flow to the sump. Because there is no equipment associated with the transfer lines that has the motive force to transfer waste material into the transfer lines, there is little chance for leakage into the transfer line jackets and into the LDB system. No further action is necessary to isolate the LDB network for FDB-6. Details of the LDB system are presented in the isolation plan. [SRR-LWE-2020-00045]

When FDB-6 is stabilized, grout will flow, to some extent, into the drain line coming from the LDBs effectively sealing off that pathway for any material to enter FDB-6.

7.2 Additional Diversion Box Systems Requiring Isolation

Flush Water Systems

FDB-5 has two flush water supply lines. To isolate one supply line, valve FLW-V-113 will be locked out to prevent flow into the diversion box.

The second FDB-5 flush water supply line has already been isolated. This same isolation point also isolates the one, and only flush water supply line into FDB-6.

Heating and Ventilation (H&V) Systems

FDB-5 has one ventilation line that is vented out to a HEPA filter and fan. The line will be closed at an in-line valve. This will isolate the temperature indicators, the radiation monitoring system, HEPA filter and fan that are connected down the line behind the valve.

FDB-6 has one ventilation line that is vented out to a HEPA filter and fan. The line will be closed at an in-line valve. This will isolate the temperature indicators, the radiation monitoring system, and HEPA filter, and the fan that are connected down the line behind the valve.

Dip Tubes

FDB-5 has three dip tubes that reach into the sump. They will be isolated by closing a valve at the surface.

FDB-6 has three dip tubes that reach into the sump. They will be isolated by closing a valve at the surface.

Conductivity Probes

The FDB-5 leak detection sump conductivity probe and sump conductivity probe will be electrically isolated to ensure there is no energized circuit inside FDB-5.

The FDB-6 leak detection sump conductivity probe will be electrically isolated to ensure there is no energized circuit inside FDB-6. The sump conductivity probe has been previously isolated.

Additional details of the isolation strategy planned for each diversion box are presented in Attachment A of the *F-Tank Farm Diversion Box 5&6 Isolation Strategy* (SRR-LWE-2020-00045).

7.3 FDB-5 and FDB-6 Stabilization Strategy

7.3.1 Grout Option Selection

In May 2002, DOE issued an Environmental Impact Statement (EIS) on waste tank cleaning and stabilization alternatives. [DOE/EIS-0303] The EIS concluded the Fill-with-Grout alternative was preferred. The DOE also issued a Record of Decision (ROD) selecting the Fill-with-Grout alternative for SRS waste tank closure. [DOE/EIS-0303 ROD] As explained in the *Regulatory Strategy for Closure of F-Area and H-Area Tank Farms Ancillary Structures* (SRR-CWDA-2018-00064), meeting the requirements regarding isolation and stabilization contained in the CGCP for ancillary structures will satisfy the criteria of the 2002 EIS and associated ROD.

Evaluations described in the EIS showed the Fill-with-Grout alternative was the best approach to minimize human health and safety risks associated with closure of the waste tanks and ancillary structures. [DOE/EIS-0303]

Because FDB-5 and FDB-6 do not contain an appreciable amount of waste, using grout with reducing properties to chemically treat infiltrating water is not necessary. The primary purpose of the grout required for the operational closure of FDB-5 and FDB-6 is structure stabilization to prevent future subsidence of the FTF closure cap. In the case of FDB-5 and FDB-6, the 3-foot thick, rebar reinforced concrete cell covers serve as an adequate intruder barrier; therefore, grout with a compressive strength greater than 2,000 psi is not required.

7.3.2 Grout Functions, Requirements, and Formulation

The grout proposed for filling FDB-5 and FDB-6 is a zero-bleed variant of Controlled Low-Strength Material (CLSM). CLSM has been widely used in applications across SRS for various fill applications and its properties are well understood and documented. CLSM was one of three grout formulations used in the stabilization of Tanks 17F and 20F when these tanks were operationally closed in the late 1990s.

The advantages of using CLSM for stabilizing FDB-5 and FDB-6 are ease of use and low bleedwater. CLSM is highly flowable prior to gelling which allows it to flow and completely fill the enclosing space with little chance of leaving voids. CLSM is self-consolidating and self-leveling and does not require mechanical assistance to become level. The zero-bleed CLSM has admixtures to reduce bleedwater which limits the amount of liquid accumulating on the grout surface during placement. However, the low viscosity of CLSM requires sealing any openings to locations where it is not desired.

As described below, a low-slump concrete will be used to fill and seal the DB sumps and sump overflow drain lines prior to filling the vaults with CLSM. Because a mound is desired to reach and effectively seal the drain and sump overflow line openings, no mechanical vibration will be used unless it becomes necessary for desired concrete placement.

SCDHEC approval for CLSM and low-slump concrete use was necessary because they are not currently listed in the CGCP as approved grout formulations for waste tank or ancillary structure stabilization. CLSM and low-slump concrete use was approved by SCDHEC on February 25, 2021. [SRR-OS-2021-00046]

The supplier selected to provide grout for the diversion box fillings will be required to demonstrate the ability to batch and deliver the flowable, structural fill material to FTF. Samples of material batched at full-scale will be tested to qualify the ability of the grout subcontractor to produce and deliver the mix.

7.4 Diversion Box Grouting Plan

Grout will be supplied by an off-site vendor. The vendor will deliver the grout using unmodified concrete mixer trucks to a grout distribution and placement station in FTF that will be installed and operated by SRR.

The first cement mixer truck will be tested prior to use to ensure the correct mix is being used to grout the diversion boxes. A chute will be used to deliver the grout to the diversion box interior through one of the access ports. The chute will ensure the truck’s hopper will not be contaminated and also provided some adjustability for grout pouring and placement.

A portable ventilation system and in-stream radiation monitoring will be used during the grouting to ensure any contamination within the diversion box does not escape into the surroundings.

7.4.1 FDB-5 Grouting

FDB-5 will be filled using the existing access ports and the 6-inch core hole drilled through the cell cover in 2020. If necessary, a layer of absorbent material (AquaSorbe-HP) will first be placed into the sump to congeal (gel) any free liquid. Enough low-slump concrete will then be placed inside the vault to block the sump drain and sump overflow line to ensure that no CLSM can flow out and reach FPP-2. The low-slump concrete will be allowed to sufficiently set before the rest of the diversion box is filled with the zero-bleed CLSM.

The CLSM will be poured into the diversion box via one of the access ports in the cell covers. A video camera will be placed inside the diversion box through another cell cover access port.

The ventilation will be installed at the same access port as the camera, or if determined to be necessary, a new access port will be core drilled in the cell covers. While the grout is being poured, SRR Engineering will visually monitor the grout configuration inside the diversion box for void space formation and to confirm the CLSM is self-leveling in a satisfactory manner. If unsatisfactory mounding or other irregularities are seen, SRR Engineering will evaluate the conditions to determine alternate pour methods to minimize void spaces.

The camera will remain inside the diversion box interior until it needs to be removed to prevent being entombed within the grout. When it is removed from the vault interior, it will then be positioned to view down the access port to monitor the grout level as it rises into the access port.

As the grout level rises, CLSM will flow into, and seal the open piping penetrations. Prior line isolation will prevent CLSM flowing into undesired locations. The grout will also flow into the abandoned jumpers on the vault floor and fill them to the extent possible. The grout will also encase any other equipment remaining in the vault including the installed jumpers.

The flush water valve box will partially fill as the grout level rises above the piping slot into the vault. After the vault is filled and the grout has set, the valve box risers will be opened and the remainder of the valve box filled with CLSM. The valve box risers will be re-inserted and the valve box sealed.

The rain cover will be cut into pieces and placed into a container for disposal. The portable ventilation system used during grouting will also be removed and properly dispositioned.

Once the internal diversion box grouting process is complete and cured, formwork and rebar for a monolithic pour will be erected around the footprint of the diversion box, including the valve box and the pads containing the sump leak detection box risers, the diversion box sump risers, and the diptubes. A high-strength concrete will then be poured inside the formwork to fully entomb the diversion box.

It will not be necessary to fill the LDB because it is outside the footprint of the vault and does not represent a future fast-flow path for infiltrating groundwater. It will also be effectively isolated as a result of the sump filling, and subsequent entombment of the diversion box.

If the ventilation duct for FDB-5 is not filled with grout to grade level during the diversion box filling, any portion of the duct remaining above grade will also need to be entombed within the high-strength concrete monolith.

7.4.2 FDB-6 Grouting

FDB-6 shall be filled using the four existing ports in the diversion box cell covers. The grout filling process will be the same as described for the FDB-5 grouting above.

7.4.3 Equipment Abandoned in the Diversion Boxes

Both diversion boxes have internal equipment that will be abandoned, including thermocouples, jumpers, dummy nozzles, and plastic pieces. As discussed above, the abandoned equipment will be entombed in-place and internal void spaces filled to the extent practicable as the grout level rises.

Typically, the goal of equipment fill grouting is to eliminate, to the extent practicable, possible vertical fast flow paths through the grout that could allow infiltrating water to reach the residual waste on the floor sooner and/or without being conditioned by the reducing properties of the grout. In the case of FDB-5 and FDB-6, there is no vertical equipment with internal void space running from the top to the bottom of the diversion boxes. There is also little, to no waste on the floor of the two diversion boxes, so potential fast flow paths to the residual waste are not of concern.

As mentioned, the consistency of the CLSM will allow it to flow into the abandoned jumpers on the diversion box floors as much as allowable before curing occurs. The two jumpers in FDB-5 and the two in FDB-6 which are currently connected to wall nozzles will remain in their current configuration. [SRR-LWE-2020-00045]

7.4.4 Transfer Line Grouting

As described in the isolation strategy, the two jumpers in FDB-5 and the two in FDB-6 which are still connected to nozzles will remain in their current configuration. The jumpers are considered part of the FTF transfer line system and, as discussed in the CGCP, there are no plans to add fill material to the FTF transfer lines.

8.0 MAINTENANCE AND MONITORING PLANS

The FFA establishes requirements for the prevention and mitigation of releases or threats of releases at, or from, the FTF and any needed soil and groundwater remediation when all FTF waste tanks and ancillary structures have been removed from service. Because not all waste tank systems will be removed from service at the same time, there will be an interim period where some systems remain operational, while others are removed from service. [WSRC-OS-94-42]

Following stabilization, FDB-5 and FDB-6 will become subject to the maintenance and monitoring requirements of an IROD/RCRA Permit Modification. These ancillary structures will then be removed from Construction Permit #17,424-IW. In the interim period following RFS until application of the IROD/RCRA Permit Modification and any subsequent needed final FFA corrective/remedial actions, FDB-5 and FDB-6 will be subject to the following maintenance and monitoring requirements:

- Historically, groundwater monitoring has been performed in accordance with the current SRS programs that have been conducted inside and around FTF since the 1970's, as requested by SCDHEC in support of Construction Permit #17,424-IW (DHEC_01-25-1993). The *F-Area Tank Farm Groundwater Monitoring Plan* (SRNS-RP-2011-00995) provides the requirements for groundwater monitoring. The groundwater sample analyses are performed by a laboratory certified for applicable parameters in accordance with SCDHEC Regulation 61-81, *State Environmental Laboratory Certification Program*. Results have been and will continue to be reported annually to SCDHEC and EPA.
- Annual visual inspections of the area surrounding FDB-5 and FDB-6 will be conducted and maintenance actions will be performed as appropriate. Where visible, the grout and entombing concrete will be inspected for significant cracking. The area stormwater system will be maintained to ensure that any possible water infiltration through the grout and concrete is minimized. Inspections will commence within one year of grout stabilization, because the final concrete entombment may be later, and will be performed annually. Deficiencies will be corrected as soon as practical and will be documented by procedure. Within 30 days of detection, DOE will notify SCDHEC of any significant cracking of the grout or concrete or degradation of the stormwater system and will establish a schedule to complete necessary maintenance activities. Inspection records will be maintained until all tanks and ancillary structures have been removed from service and the FTF OU is closed.
- Access controls for on-site workers will be provided via the Site Use Program, Site Clearance Program, work control, worker training, worker briefing on health and safety requirements, and identification signs located at the waste unit boundaries.
- EPA and SCDHEC will be notified in advance of changes in land use in accordance with the *Savannah River Site Land Use Plan* (SRNS-RP-2013-00162).
- Access controls against trespassers will be provided as consistent with the 2000 RCRA Part B Permit Renewal Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, entry control systems, and warning signs in place at the SRS boundary. [WSRC-IM-98-30]

9.0 CONCLUSIONS

As determined by the individual camera inspections, except for the estimated 0.3-gallon salt deposit in FDB-6, there are no obvious solids accumulations in either FDB-5 or FDB-6.

Based on the information presented in this CM, DOE has determined that further waste removal efforts are not technically practicable from an engineering perspective for FDB-5 and FDB-6. This determination is based on the approach followed and defined in the CGCP.

- Visual Observations Inside the FDB-5 Vault – The determination that no residual materials are present was based on visual observations using remotely operated cameras inserted through the inspection port and a hole cored through a vault cell cover. Figure 9.0-1 shows various views of the FDB-5 interior. Radiation monitoring and smear sampling results during the inspections did not indicate the presence of obvious residual material inside the vault but were indicative of surface contamination.

Figure 9.0-1: Views of the FDB-5 Vault Interior

- Visual Observations Inside the FDB-6 Vault – Visual inspections determined that with the exception of an estimated 0.3 gallons of residual material in one area of the vault floor, FDB-6 is free of any accumulated solids. The material is thought to be crystallized supernate. [U-ESR-F-00092] The visual inspections inside the vault were performed using remotely operated cameras inserted through the inspection ports in the vault cell covers. Figure 9.0-2 shows various views of the FDB-6 interior. Radiation monitoring during the inspections did not indicate the presence of a significant amount of residual material inside the vault.

Figure 9.0-2: Views of the FDB-6 Vault Interior

- Analysis of Deploying an Additional Waste Removal Technology – An analysis of deploying another cleaning technology concluded that it was not technically practicable from an engineering perspective to perform additional waste removal activities. The analysis included such factors as technology capabilities and effectiveness (Section 6.0). The evaluation concluded that:
  - No existing technology has been identified that is suitable for deployment to effectively remove additional residual material that might be present on the FDB-5 and FDB-6 vault floor and jumper interior surfaces.

  - The very small benefit that would be realized by further residual material removal from FDB-5 and FDB-6 does not justify the anticipated costs associated with developing and deploying a new technology.
  - The worker dose for performing additional waste removal does not justify the minimal future risk reduction potentially realized.
- Human Health and Environment Impacts – As allowed by the CGCP and LWTRSAPP for low-volume conditions; radiological and chemical inventories were assigned to FDB-5 and FDB-6. Based on the FDB-5 and FDB-6 SA groundwater modeling results using the assigned inventories (Section 5.0), there is reasonable assurance that groundwater concentrations derived from residual contamination in the FTF waste tanks and ancillary structures will meet the performance objectives. These modeling results provide assurance that human health and the environment will continue to be protected after the FTF waste tank systems have been stabilized with grout and removed from service. [SRR-CWDA-2020-00055]
- Isolation Strategy – The isolation strategy ensures that FDB-5 and FDB-6 will be isolated from the remainder of the FTF WTS and the FTF support systems, preventing their use for any future waste processing activities (Section 7.1).
- Stabilization – DOE evaluated stabilization alternatives in the EIS (DOE/EIS-0303) and determined that the “Fill with Grout” alternative is the best approach to minimize human health and safety risks associated with the RFS of waste tanks and ancillary structures (Section 7.3).
- Maintenance and Monitoring – DOE will monitor groundwater, conduct annual surface visual inspections, and control access to the FTF during the interim period between the FDB-5 and FDB-6 RFS until final closure of the FTF OU (Section 8.0).

DOE has determined that after completion of this CM, all CGCP requirements will have been met to proceed with the FDB-5 and FDB-6 RFS and DOE will be ready to stabilize these ancillary structures with grout. Approval of this CM by SCDHEC signifies State acceptance of the proposed DOE closure activities for FDB-5 and FDB-6 and State concurrence that waste removal activities for FDB-5 and FDB-6 can cease. In accordance with the FFA, EPA will also provide concurrence that waste removal activities may cease. Following stabilization, DOE will submit separate Final Configuration Reports (FCRs) for FDB-5 and FDB-6 to SCDHEC with certification that the RFS activities have been performed in accordance with the CGCP and this CM.

DOE has determined that any remaining residual material in FDB-5 and FDB-6 has been removed to the extent technically practicable from an engineering perspective and DOE is ready to proceed to isolation and stabilization activities summarized in Section 7.0.

Based on the information provided in this CM and supporting documents, it may be concluded that:

1) There is reasonable assurance that, at the time of final FFA corrective/remedial actions, groundwater concentrations derived from residual contamination in the waste tanks and ancillary structures will be less than the South Carolina state drinking water standards and,
2) Further residual removal is not technically practicable from an engineering perspective.

10.0 REFERENCES

2S Manual, *Conduct of Operations Manual,* Savannah River Site, Aiken, SC, Rev.1, February 14, 2013 (Table of Contents)

10 CFR 61.41, *Licensing Requirements for Land Disposal of Radioactive Waste*, U.S. Nuclear Regulatory Commission, Washington, D.C., July 27, 2020.

10 CFR 61.42, *Protection of Individuals from Inadvertent Intrusion*, U.S. Nuclear Regulatory Commission, Washington, D.C., July 27, 2020.

138-8-F-522, *Diversion Box FDB-6*, Manual SW1.10, Savannah River Site, Aiken, SC, Rev. 7, February 28, 1992. (Cancelled)

B-UG-H-00058, *Waste Characterization System Online Software User Guide,* Savannah River Site, Aiken, SC, Rev. 4, July 5, 2018.

CBU-PIT-2005-00120, *Ancillary Equipment Residual Radioactivity Estimate To Support Tank Closure Activities For F-Tank Farm,* Westinghouse Savannah River Company, Savannah River Site, Aiken, SC, Rev. 0, June 16, 2005.

DHEC_01-25-1993, Sadler, M.F., *Construction Permit #17,424-IW, SRS F/H-Area, Aiken and Barnwell County,* South Carolina Department of Health and Environmental Control, Columbia, SC, January 25, 1993.

DOE/EIS-0303, *Savannah River Site High-Level Waste Tank Closure Final Environmental Impact Statement*, U.S. Department of Energy – Savannah River, Savannah River Site, Aiken, SC, May 2002.

DOE/EIS-0303 ROD, *Savannah River Site High Level Tank Closure Final Environmental Impact Statement Record of Decision*, U.S. Department of Energy, Washington DC, August 19, 2002.

DOE M 435.1-1 Change 2, *Radioactive Waste Management Manual*, U.S Department of Energy, Washington, DC, June 2011.

DPSP 79-21-3, *Waste Management Programs Report for March 1979*, E.I. DuPont De Nemours & Company, Atomic Energy Division Savannah River Plant, Aiken, SC, March 1979.

DPSP 79-21-12, *Waste Management Programs Report for December 1979*, E.I. DuPont De Nemours & Company, Atomic Energy Division Savannah River Plant, Aiken, SC, December 1979.

DPSP 81-21-10, *Waste Management Programs Report for October 1981*, E.I. DuPont De Nemours & Company, Atomic Energy Division Savannah River Plant, Aiken, SC, October 1981.

E7 Manual, *Conduct of Engineering*, Savannah River Site, Aiken, SC, (Table of Contents).

M-M6-F-3123, *F Area New Hill Diversion Box 5 Heating and Ventilation Waste Transfer System Piping and Instrumentation Drawing*, Savannah River Site, Aiken, SC, Rev. 4, June 2012.

M-M6-F-3357, *F Area Old Hill Diversion Box 6 Waste Transfer System Piping and Instrument Drawing*, Savannah River Site, Aiken, SC, Rev. 6, July 24, 2013.

NDAA Section 3116, *Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA),* Defense Site Acceleration Completion, October 2004.

S-TSR-G-00001, *Concentration, Storage and Transfer Facilities Technical Safety Requirements*, Savannah River Site, Aiken, SC, Rev. 60, March 2020.

SCDHEC R.61-58, *State Primary Drinking Water Regulation*, http://www.scdhec.gov/Agency/RegulationsAndUpdates/LawsAndRegulations/Water/, South Carolina Department of Health and Environmental Control, Columbia, SC, September 2014.

SCDHEC R.61-67, *Standards for Wastewater Facility Construction*, http://www.scdhec.gov/Agency/RegulationsAndUpdates/LawsAndRegulations/Water/, South Carolina Department of Health and Environmental Control, Columbia, SC, June 2015.

SCDHEC R.61-82, *Proper Closeout of Wastewater Treatment Facilities*, http://www.scdhec.gov/Agency/RegulationsAndUpdates/LawsAndRegulations/Water/, South Carolina Department of Health and Environmental Control, Columbia, SC, April 11, 1980.

SRNS-RP-2011-00995, *F-Area Tank Farm Groundwater Monitoring Plan*, Savannah River Site, Aiken, SC, Rev. 1, February 2012.

SRNS-RP-2013-00162, *Savannah River Site Land Use Plan*, Savannah River Site, Aiken, SC, May 2013.

SRR-CWDA-2009-00045, *F-Tank Farm Waste Tank Closure Inventory for Use in Performance Assessment Modeling*, Savannah River Site, Aiken, SC, Rev. 2, October 2012.

SRR-CWDA-2010-00124, *Tank 18/Tank 19 Special Analysis for the Performance Assessment for the F-Area Tank Farm at the Savannah River Site*, Savannah River Site, Aiken, SC, Rev. 0, February 2012.

SRR-CWDA-2011-00050, *Liquid Waste Tank Residuals Sampling and Analysis Program Plan*, Savannah River Site, Aiken, SC, Rev. 4, June 2017.

SRR-CWDA-2012-00106, *Tanks 5 and 6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site*, Savannah River Site, Aiken SC, Rev. 1, January 2013.

SRR-CWDA-2017-00015, *Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems*, Savannah River Site, Aiken, SC, Rev. 1, April 2017.

SRR-CWDA-2018-00059, *Email (August 23, 2018) Between Malcolm Smith and Keith Harp of FDB-5/6 Operational Events Interview Summary*, Savannah River Site, Aiken, SC, August 23, 2018.

SRR-CWDA-2018-00064, *Regulatory Strategy for Closure of F-Area and H-Area Tank Farms Ancillary Structures*, Savannah River Site, Aiken, SC, Rev. 1, December 2018.

SRR-CWDA-2020-00024, *F-Area Diversion Box 5 Sample Location Determination Report*, Savannah River Site, Aiken, SC, Rev. 0, December 2020.

SRR-CWDA-2020-00029, *Inventory Assignment at Closure for FDB-5 and FDB-6*, Savannah River Site, Aiken, SC, Rev. 1, February 23, 2021.

SRR-CWDA-2020-00033, *F-Area Diversion Box 6 Sample Location Determination Report*, Savannah River Site, Aiken, SC, Rev. 0, December 2020.

SRR-CWDA-2020-00055, *FDB-5 and FDB-6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site,* Savannah River Site, Aiken, SC, Rev. 1, February 2021.

SRR-CWDA-2020-00059, *Proposal to Cease Waste Removal Activities in F-Area Diversion Boxes 5 and 6*, Savannah River Site, Aiken, SC, Rev. 0, July 13, 2020.

SRR-LWE-2010-00240, *Tank Mapping Methodology*, Savannah River Site, Aiken, SC, Rev. 1, November 28, 2012.

SRR-LWE-2020-00005, *F-Tank Farm Diversion Box 5&6 Grout Strategy,* Savannah River Site, Aiken, SC, Rev. 0, August 2020.

SRR-LWE-2020-00045, *F-Tank Farm Diversion Box 5&6 Isolation Strategy,* Savannah River Site, Aiken, SC, Rev. 0, August 2020.

SRR-LWE-2020-00095, *Annual SCDHEC Technology Briefing*, Savannah River Site, Aiken, SC, Rev. 0, November 18, 2020.

SRR-OS-2020-00309, *Request for Concurrence to Proceed to Sample and Analysis Phase of the Closure Process for F-Area Diversion Boxes (FDB) 5 and 6 (SEMS Number 23) dated July 28, 2020 and received electronically July 28, 2020*, South Carolina Department of Health and Environmental Control, Columbia, SC, July 29, 2020.

SRR-OS-2020-00331, *Request for Concurrence to Proceed to Sample and Analysis Phase of the Closure Process for F Area Diversion Boxes (FDB) 5 and 6 (SEMS Number: 23) dated July 28, 2020*, U.S. Environmental Protection Agency, Washington DC, August 11, 2020.

SRR-OS-2021-00046, *Request for Approval to Use Alternate Fill Materials for Operational Closure of Tank Farm Ancillary Structures at Savannah River Site, Aiken, SC, dated February 3, 2021 (SRR-CWDA-2021-0010),* South Carolina Department of Health and Environmental Control, Columbia, SC, February 25, 2021.

SRS-REG-2007-00002, *Performance Assessment for the F-Tank Farm at the Savannah River Site*, Savannah River Site, Aiken, SC, Rev. 1, March 31, 2010.

TKFM-M-20200205-28, *FDB-5 Smear Survey of Cell Floo*r, Savannah River Site, Aiken, SC, Rev. 0, February 5, 2020.

U-ESR-F-00092, *F Area Diversion Box #6 Final Volume Determination and Uncertainty Estimate*, Savannah River Site, Aiken, SC, Rev. 1, February 22, 2021.

U-ESR-F-00094, *F Area Diversion Box #5 Final Volume Determination and Uncertainty Estimate*, Savannah River Site, Aiken, SC, Rev. 1, February 22, 2021.

V-18-0439, *Video inspection for FDB-6 July 13, 2018*, Savannah River Site, Aiken, SC, July 13, 2018, *Maintained in the Structural Authority and Inspection database*.

V-18-0791, Video for *FDB-5 Valve Cup Adjustment and Camera Inspection*, Savannah River Site, Aiken, SC, November 1, 2018, *Maintained in the Structural Authority and Inspection database*.

V-19-1125, Video for *Performed Annual Inspection and Monitoring*, Savannah River Site, Aiken, SC, December 7, 2019, *Maintained in the Structural Authority and Inspection database*.

V-19-0946, Video for *Observe the Conditions Within the Flush Water Box at FDB-6*, Savannah River Site, Aiken, SC, August 31, 2019, *Maintained in the Structural Authority and Inspection database*.

V-20-0140, Video for *FDB-5 Camera Inspection*, Savannah River Site, Aiken, SC, February 5, 2020, *Maintained in the Structural Authority and Inspection database*.

W702275, *Savannah River Plant Bldg 241F Waste Storage FAC FY 76 FDB6 Equi Arrgt Sheet 1 Process and Instruments,* Savannah River Site, Aiken, SC, Rev. 47, August 3, 1979.

W702358, *Savannah River Plant Bldg 241F Waste Storage Fac FY'76 FDB-6 Ppg Arrgt Sht 1 Process*, E.I. DuPont De Nemours & Company, Wilmington, Delaware, Rev. 31, September 1994.

W702452, *Savannah River Plant Bldg 241F Waste Storage Facilities FY'76 FDB5 Equip. Arrgt. Process & Instruments*, E.I. DuPont De Nemours & Company, Wilmington, Delaware, Rev. 57, August 1996.

W703320, *Savannah River Plant Bldg 241F Diversion Box #5 Plans Sections & Details Sheet 2 Concrete & Steel*, E.I. DuPont De Nemours & Company, Wilmington, Delaware, Rev. 82, August 28, 1978.

W703321, *Savannah River Plant Building 241-31F Diversion Box #5 S/S Liner Details Steel*, Savannah River Site, Aiken, SC, Rev. 57, March 1978.

W703384, *Savannah River Plant Building 241-32F Diversion Box #6 Plans, Sections, and Details – Sheet #1*, Savannah River Site, Aiken, SC, Rev. 61, November 29, 1977.

W703386, *Savannah River Plant Building 241-32F Diversion Box #6 Plans, Sections, and Details Sheet #2 Concrete & Steel*, Savannah River Site, Aiken, SC, Rev. 95, September 13, 1994.

WDPD-20-37, *Request for Concurrence to Proceed to Sample and Analysis Phase of the Closure Process for F Area Diversion Boxes (FDB) 5 and 6 (SEMS Number: 23)*, U.S. Department of Energy, Washington, DC, July 29, 2020.

WSRC-IM-98-30, *2000 RCRA Part B Permit Application*, Volume I, Section F.1, Savannah River Site, Aiken, SC, Rev. 1, January 2002.

WSRC-OS-94-42, *Federal Facility Agreement for the Savannah River Site*, Savannah River Site, Aiken, SC, August 9, 2016.

APPENDIX A: FTF WASTE TANK SYSTEMS CLOSURE TRACKING

Future closure of the waste tanks and ancillary structures will be conducted in such a way that structures will be included in CMs when determined that it is practical to remove the structures from service simultaneously with the waste tanks and there is no longer a need for the ancillary structures to manage waste in tanks that are still in service. The ancillary structures to be closed as part of the HTF are listed in Table A-1. As CMs are developed and approved, Table A-1 will be updated to include the document number and date of RFS for each of the ancillary structures listed in Permit #17,424-IW (DHEC_01-25-1993) to ensure that all waste tanks and ancillary structures have been addressed.

Table A-1: FTF Waste Tank Systems Removal from Service Tracking Table

Waste Tank System Listed in SCDHEC Construction Permit #17,424-IW	Closure Module / Addendum Document Number	Removal from Service Date[a]
Tank 1		
Tank 2		
Tank 3		
Tank 4		
Tank 5	SRR-CWDA-2012-00071	December 2013
Tank 6	SRR-CWDA-2012-00071	December 2013
Tank 7		
Tank 8		
Tank 17	PIT-MISC-0004	December 1997
Tank 18	SRR-CWDA-2010-00003	September 2012
Tank 19	SRR-CWDA-2010-00003	September 2012
Tank 20	PIT-MISC-0002	July 1997
Tank 25		
Tank 26		
Tank 27		
Tank 28		
Tank 33		
Tank 34		
Tank 44		
Tank 45		
Tank 46		
Tank 47		
242-F (1F) Evaporator Pot		
Condenser		
Cesium Removal Column Pump Tank		
Overheads Tank South		
Overheads Tank North		
Overheads Diverting Tank		

Table A-1: FTF Waste Tank Systems Removal from Service Tracking Table (continued)

Waste Tank System Listed in SCDHEC Construction Permit #17,424-IW	Closure Module / Addendum Document Number	Removal from Service Date[a]
242-3F Concentrate Transfer System		
242-16F (2F) Evaporator Pot		
Condenser		
Mercury Collection Tank		
Cesium Removal Column Pump Tank		
Overheads Tank #1, South		
Overheads Tank #2, North		
FPP-1 and FPT-1		
FPP-2 and FPT-2		
FPP-3 and FPT-3		
FDB-1		
FDB-2		
FDB-3		
FDB-4		
FDB-5	SRR-CWDA-2020-00011	
FDB-6	SRR-CWDA-2020-00011	
F-Area Catch Tank		
Tanks 17-20 Underliner Sump Drains[b]		

a As used here, the *Removal From Service Date* is the DOE letter date documenting operational closure to SCDHEC and EPA.

b Not specifically listed in the Permit, but closure committed to in the *Tanks 18 and 19 Final Configuration Report* (SRR-CWDA-2012-00170).